Capital Structure Part 1:
MM, Taxes, Static Tradeoff Theory, and Conflicts between Claimholders

Professor Kathleen Kahle
University of Arizona
Finance 601
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This Week's Readings

- Copeland, Weston, Shastri, Chapters 12 & 15
- Modigliani, Franco, and Merton H. Miller (1958, 1963), "The Cost of Capital, Corporation Finance, and the Theory of Investment," American Economic Review, 48, 261-297.
- Miller, Merton H. (1977), "Debt and Taxes", The Journal of Finance, 32, 261-275.
- DeAngelo, H. and R. Masulis (1980), "Optimal Capital Structure under Corporate and Personal Taxation," Journal of Financial Economics 8, 3-30.
- Myers (1977), "Determinants of Corporate Borrowing" Journal of Financial Economics, 5, 147-175.

What Is Corporate Finance?

- Microeconomics of decision-making in firms; three main questions
  - Capital budgeting ("investment")
    - How should firms optimally make real investment decisions to maximize total surplus? How do firms actually make capital budgeting decisions?
  - Capital structure ("financing")
    - What is the optimal mix of debt (D) and equity (E) in a firm's capital structure, or to finance a new investment opportunity? How is capital structure in fact determined in practice?
  - Corporate governance
    - What is the optimal way for shareholders to select, incentivize, and monitor managers given principal-agent problems? How do firms actually approach corporate governance?
- Theoretical approaches
  - The theoretical part of the course will address the capital structure question.
  - We first consider these issues a perfect world (no asymmetric information, taxes, agency problems, etc.).

Modigliani-Miller (1958): The Beginning!

- Common View of MM: In perfect world, firms should be indifferent between equity and debt when financing investment.
- My view: MM use debt and equity in proofs, but the point is much broader.
  - Applies to all aspects of security design.
  - Maturity, convertibility, risk management, covenants, etc.
- Under MM assumptions, there is no value to using different financial instruments to finance investment.
- If MM assumptions hold, corporate finance is uninteresting.
- But the point is that MM assumptions DO NOT hold in practice. The fact that they don't hold, and the extent to which they don't, provides a roadmap for understanding financing and investment decisions by firms.

MM and Capital Structure (No taxes)

- Starting point: consider a world without financial frictions
  - perfect and complete capital markets
  - no transactions costs
  - no taxes
  - no bankruptcy costs
  - no principal-agent problems
  - no asymmetric information
- Key: **Investment policy assumed to be independent of financing policy (Perfect Certainty)**.

- Begin by assuming that firm uses **only** equity (MM (1958), Sect I.A.)
- View firms and investments as financial securities that produce perpetual risky cash flow streams which can be valued using DCF.
- In capital market equilibrium, value of firm is given by discounted value of CFs, where discount rate is specific to risk of firm's assets (MM (1958), (1)):

$$V_i = E_i = \frac{\overline{X}_i}{r_{A,i}} \text{ where}$$

  - $\overline{X}_i$ = average annual cash flow for firm i
  - $r_{A,i}$ = opportunity cost of capital, the expected return on a security of equivalent risk, specific to firm (or project) assets

MM and Capital Structure (No taxes)

- Now suppose firms have some debt D in their capital structure
  - Simplest form of D is a pre-specified schedule of payments that firm must make to creditors.
  - Equity holders are residual claimants, entitled to all cash flows that remain after payments to D.
  - If D is not repaid, E receives nothing and D has claim to existing income.

- **MM Proposition 1:** Capital structure is irrelevant to value because value (V = D + E) is independent of mix of D and E, so $V_L = V_U$
  - Intuition of Value Additivity: How you divide cash flows does not affect the total value of the corporate pie

- Simple illustration from Tirole (2006)
  - Two period model, with $r_f = 0$
  - Define $\mathcal{E}(\cdot)$ as risk-neutral expectation w.r.t. distribution of cash flows X
  - Let F be face value of outstanding debt, which is zero-coupon
  - E + D = $\mathcal{E}(\max(0,X-F))$ + $\mathcal{E}(\min(X,F))$ = $\mathcal{E}(X)$, which is independent of D

Homemade Leverage Proof of MM Prop. 1

- Two periods (t=0,1), "Twin" firms A and B with identical cash flows X
  - A is all-equity financed, value of equity = $E_A = V_A$
  - B has debt (D) with face value F, value of equity = E_B; $V_B = E_B + D$
- If you buy all of B's equity:
  - you get max(0, X – F) = limited liability firm's net profits after debt repayment
  - This costs you E_B
- Alternatively, suppose you buy all of A's equity, but borrow on own account an amount D with face value F.
  - You get max(0, X – F) = firm's cash flow less personal debt repayment, assuming bank can't go after your other assets.
    - MM assumes that you can borrow on same terms as firm
  - So cost to you is $E_A – D$
- Since two strategies yield same net cash flow to you, must cost the same: $E_B = E_A – D$, so $E_B + D = E_A$, so $V_B = V_A$

MM Proposition 2 (No taxes)

$$r_E = r_A + \frac{D}{E}(r_A - r_D) \quad \text{or alternatively} \quad r_A = \frac{D}{D+E} r_D + \frac{E}{D+E} r_E$$

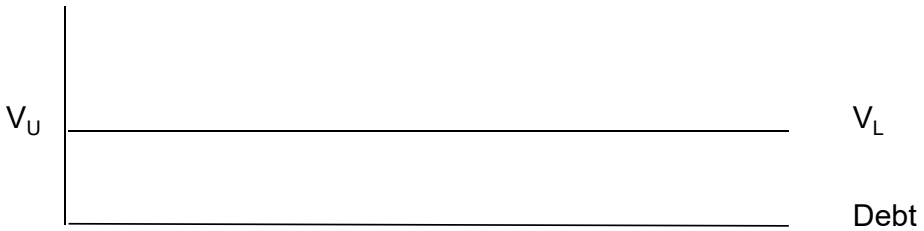
- Proof in MM (1958)
  - Define expected return on equity r_E as: (MM, (9))

$$r_{E,i} \equiv \frac{\overline{X}_i - r_{D,i} D_i}{E_i}$$

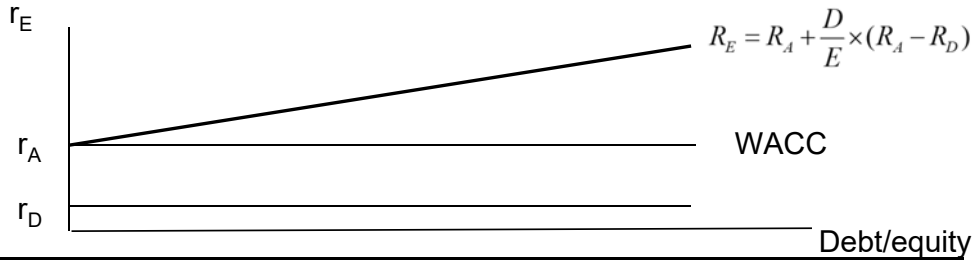
  - From Proposition I, $\overline{X}_i = r_{A,i} V_i = r_{A,i}(D_i + E_i)$ (MM, (3))
  - Substitute (3) into (9) and simplify.

Graphing the M&M No-Tax Relationships

Firm value (Proposition I)



Required return on equity (Proposition II)



MM and Dividend/Payout Policy

- Under MM (1961), payout policy (dividends and net share repurchases) has no impact on firm value
- Assumptions:
  - Perfect capital markets
  - Rational behavior
  - Perfect certainty
- Illustration from Tirole (2006), p.78
  - Consider discrete time (t = 0, 1, 2, …) and in each period t
    - firm receives random net revenue X_t
    - pays a per-share dividend d_t
    - adjusts number of shares from n_{t-1} to n_t
      - if it repurchases, then $n_t < n_{t-1}$
      - if it issues, then $n_t > n_{t-1}$
    - sinks I_t in investment projects
  - Under no-arbitrage, $P_t = \beta \mathcal{E}(d_{t+1} + P_{t+1})$

MM and Dividend Policy

- Illustration from Tirole (2006)
  - Consider discrete time (t = 0, 1, 2, …) and in each period t
    - firm receives random net revenue X_t
    - pays a per-share dividend d_t
    - adjusts number of shares from n_{t-1} to n_t
    - sinks I_t in investment projects
  - Under no-arbitrage, $P_t = \beta\mathcal{E}(d_{t+1} + P_{t+1})$
    - $V_t = n_t P_t = n_t \beta\mathcal{E}(d_{t+1} + P_{t+1})$
  - Accounting identity (sources = uses): $X_{t+1} + P_{t+1}(n_{t+1} - n_t) = n_t d_{t+1} + I_{t+1}$
    - Rearranging: $X_{t+1} - I_{t+1} + P_{t+1}(n_{t+1} - n_t) = n_t d_{t+1}$
  - $V_t = n_t \beta\mathcal{E}(d_{t+1} + P_{t+1}) = \beta\mathcal{E}(n_t d_{t+1} + n_t P_{t+1})$
  - $= \beta\mathcal{E}(X_{t+1} - I_{t+1} + P_{t+1}(n_{t+1} - n_t) + n_t P_{t+1}) = \beta\mathcal{E}(X_{t+1} - I_{t+1} + V_{t+1})$
  - $= \mathcal{E}\left[\sum_{\tau \geq 1} \beta^{\tau} (X_{t+\tau} - I_{t+\tau})\right]$
  - Therefore, value of the firm is independent of payout policy.

Dividend Irrelevance Example

- Consider the case of Ralph Inc.
  - Currently (time 0) Ralph Inc. is expected to survive another year in business (until time 1), at which time the firm will liquidate and all value will be distributed to claimants.
  - The firm is presently all-equity financed with 50,000 shares outstanding. The cash flow of the firm is risk free and it is common knowledge that Ralph Inc. will receive $1 million immediately and another $1 million at time 1.
  - The current dividend policy is for Ralph Inc. to pay out its entire cash flow as dividends as it is received. So $20 per share now and at time 1.
  - The risk-free rate in the economy is 5%. There are no taxes. And the firm *has no positive NPV projects* available.

Dividend Irrelevance Example

- Ralph, the CEO of Ralph Inc., is convinced that an alternative dividend policy would increase the current stock price.
- The current value of the firm and the price per share is: $V_0 = Div_0 + Div_1/(1.05)$
  $= \$1{,}000{,}000 + \$1{,}000{,}000/(1.05)$
  $= \$1{,}952{,}380.95$ or $P_0 = \$39.05$ per share.
- The share price will drop to $19.05 after the time 0 dividend is paid.
- Ralph wants you to evaluate the impact on the current stock price of an increase or a decrease of the current dividend of $2 per share.

Dividend Irrelevance Example

- $2 per share dividend increase:
  - A $2 dividend requires $1,100,000 in total, so the firm must raise an additional $100,000 to accomplish this policy change.
  - The firm can issue risk-free bonds to raise $100,000 today if they promise to repay $105,000 (5% risk free rate) in one year.
  - This will leave only $895,000 in total dividends, or $17.90 per share, for the existing shareholders at time 1.
  - The time zero stock price will then be:
    $P_0 = \$22 + \$17.90/(1.05) = \$39.05$. The price will drop to $39.05 - $22 = $17.05 when the time 0 dividend is paid.

Dividend Irrelevance Example

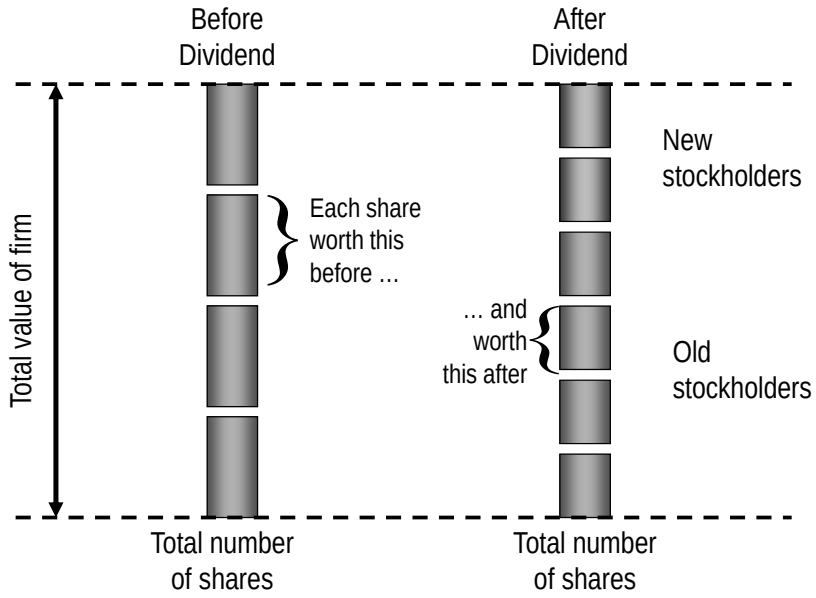
- $2 per share dividend decrease:
  - With an $18 per share dividend today, this leaves an extra $100,000 in cash within the firm.
  - Because the firm has no positive NPV projects it does the next best thing and makes a zero NPV investment, buying T-bills.
  - With a risk-free rate of 5%, the T-bills will return $105,000 at time 1. This implies a total dividend of $1,105,000 or $22.10 per share at time 1.
  - The current stock price is:

    $P_0 = \$18 + \$22.10/(1.05) = \$39.05$

Dividend Irrelevance Example

- What made this example work?
  - Two assumptions were critical:
    1. Perfect certainty: fixed cash flows, no positive NPV projects. Version of assumption that dividend policy will not alter investment policy.
    2. Perfect capital markets: no taxes or transactions costs.
  - Several were not:
    - The one year time frame.
    - The risk-free cash flows.
    - The fact that the firm was all-equity financed.
  - Insight: under the irrelevance assumptions, a change in dividend policy results in the firm simply moving money across time.
    - Moving money across time is what capital markets allow individual investors to do. Since NPV = 0, no value is created or destroyed and thus stock price is unchanged. So a change in dividend policy doesn't do anything for investors they couldn't do themselves.

MBA Picture of Dividend Irrelevance



Example of raising 1/3rd of value using new shares and paying out as dividend

Importance of MM no-tax case

- Stiglitz (1988): "it is ironic that a paper which purportedly established that one need not pay any attention to financial structure - that financial structure was irrelevant - should have focused economists' attention on finance… Miller gives what must be part of the explanation in his preceding paper in this issue: by providing conditions where financial policy was irrelevant, conditions which were close to the assumptions used by most conventional economists, the paper forced a reexamination of those…assumptions."

Importance of MM no-tax case

- Tells us where to look to determine whether capital structure affects value.
  - taxes
  - transaction costs (financial distress)
  - principal-agent problems (agency costs)
  - asymmetric information (signaling)
- MM forces us to think seriously about frictions.
  - Whenever you hear about "optimal capital structure," "optimal" financing, or see regressions suggesting that firms prefer one financial structure to another, MM says that there must be a friction lurking in the background (or else all financings would be equal).

MM and Corporate Taxes

(from the MM 1963 correction, section I.C. of 1958 is wrong!)

- MM ignored taxes in original model, but deductibility of interest payments changes the cash flows relative to no tax version
- Now:
  - Cash Flow to Debtholders (interest) = $R_B B$
  - Cash Flow to Stockholders = $[X_i - R_B B] (1- \tau_c)$
- Cash Flow to debt + equity = $[X_i - R_B B] (1- \tau_c) + R_B B$ (MM58, (10))
  - where X_i = avg annual cash flow generated by firm i and τ_c = corporate tax rate
  - $R_B B$ is the interest paid on principal amount of debt (B)
- With this substitution:
- *M&M Proposition I:* $V_L = V_U + \tau_C D$
- *M&M Proposition II:* $r_E = r_A + (D / E) (r_A - r_D) (1 - \tau_c)$

Intuition

- Debt creates a "tax shield."
- For every dollar in interest, firm saves T_c in taxes.
- For a firm with B dollars of debt facing an interest rate of R_B, it has an annual tax shield of $R_B * B * T_c$
- If B is fixed and permanent and R_B is an expected long term cost of debt, this tax shield should be constant in perpetuity.
- To determine PV of all future tax shields, we discount the annual tax shields at the market rate consistent with the risk of the cash flows.
- Present value of tax shields = $R_B * B * T_c / R_D = T_c * D$
  - R_D is the current market required return, so $D = R_B B / R_D$
  - If firm expects to be in a positive tax bracket, risk of tax shield = risk of debt.
  - If firms set debt at a level proportional to firm value, then tax shields are as risky as firm's assets, so correct discount rate is the cost of unlevered equity (R_A).
- The value of the levered firm equals the value of the unlevered firm plus the PV of this tax shield. Using the previous notation, $V_L = V_U + T_c * D$.

MM Proposition II (With Taxes)

Start with M&M Proposition I with taxes: $V_L = V_U + T_C D$

Since $V_L = E + D \Rightarrow E + D = V_U + T_C D$

$$V_U = E + D(1 - T_C)$$

The cash flows from each side of the balance sheet must equal:

$$ER_S + DR_D = V_U R_0 + T_C D R_D$$

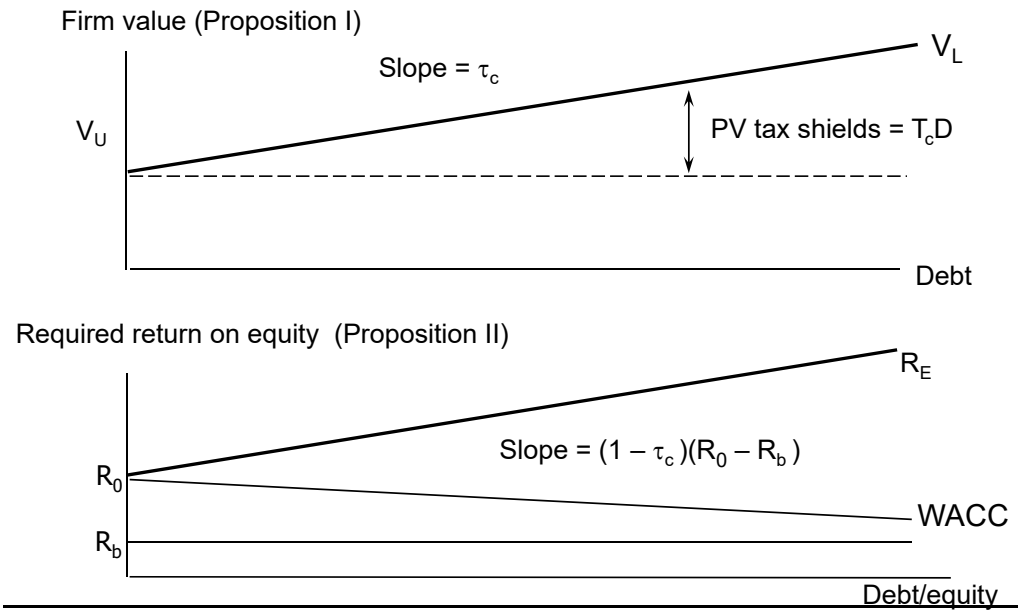
$$ER_S + DR_D = [E + D(1 - T_C)]R_0 + T_C R_D D$$

Divide both sides by S

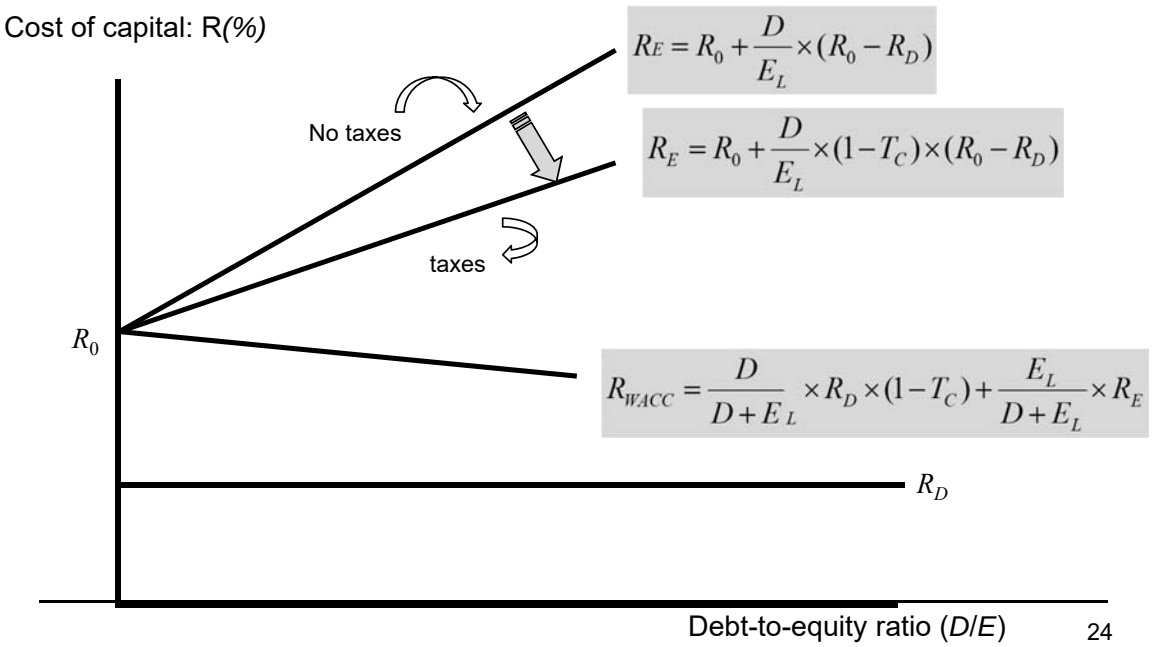
$$R_E + \frac{D}{E} R_D = [1 + \frac{D}{E}(1 - T_C)]R_0 + \frac{D}{E} T_C R_D$$

Which reduces to $R_E = R_0 + \frac{D}{E} \times (1 - T_C) \times (R_0 - R_D)$

Graphing the M&M Relationships



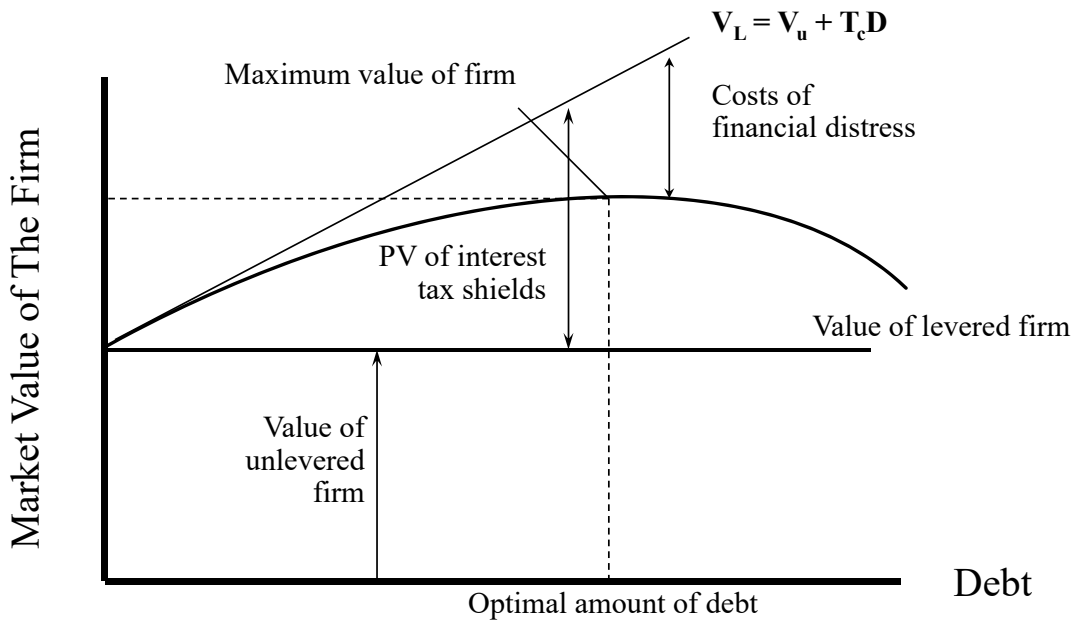
The Effect of Financial Leverage
(Proposition II)



MM, Taxes, and the Static Tradeoff Theory

- In the U.S. and many other countries, D and E are treated differently.
  - Corporate interest payments are deductible from corporate taxable income → firms prefer to finance with lots of D.
  - New tax law??? Starting in 2018, a company can only deduct interest expense of up to 30% of its EBITDA. In 2022, the deductibility of corporate debt will be capped at 30% of EBIT.
- However, higher D is associated with higher probability of bankruptcy and costs of financial distress (CFD).
  - What are the costs of financial distress?
- Static tradeoff theory (Kraus and Litzenberger (1973), Scott (1976)) says that there is an optimal internal solution that balances costs and benefits of debt.

Financial Distress



MM and Static Trade-Off Theory

- Static Trade-Off Theory:
  - APV = V_U + PV[DTS] - PV[CFD]
  - Optimal capital structure trades off benefit of debt tax shield (DTS) against costs of financial distress (CFD).
  - PV[DTS] = T_c* D.
- Harder to measure CFD.
  - But direct costs would seem small relative to DTS.
  - If a firm's value is 30% debt and Tc = 30%, then the value of tax shields is 9% of the firm (very large).
- It is possible that DTS is smaller than we think.
  - Miller (1977) shows that introducing personal taxes reduces DTS.
  - DeAngelo and Masulis (1980) – non-debt tax shields.
- Another explanation is that CFD is greater than just the direct costs of bankruptcy.

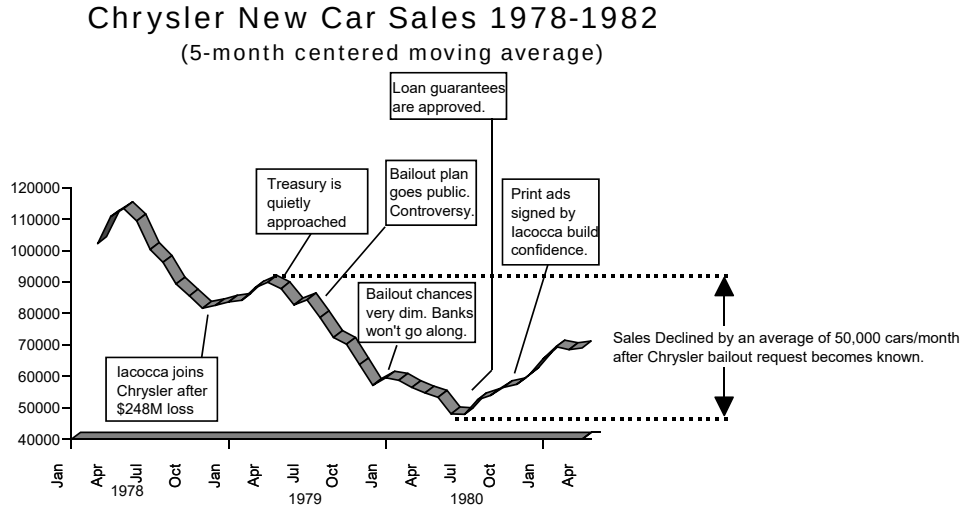
Direct and Indirect Costs of Financial Distress

- Direct Costs: Costs that a firm incurs at the moment a company defaults and files for bankruptcy or is liquidated.
  - Lawyers' fees, court costs, fire sale of assets, loss of intangible capital such as brand names or ongoing R&D.

- Indirect Costs: Costs that firm incurs before it actually defaults, because of a possible future default. Examples are:
  - Customers may be hesitant to buy product because they are concerned about future support and warranties.
  - Suppliers may be hesitant to enter into long term relationship with a company that is failing; or may refuse credit…
  - Employees may start looking for new jobs.
  - In general, impaired ability to conduct business.

- Another indirect cost is that a firm's investment decisions can be inefficient when the firm has "too much" debt.

Chrysler: Why Financial Distress is so Devastating



Lee Iacocca: "While the [bailout] hearings were going on, our sales dropped off dramatically. The percentage of consumers who were willing merely to *consider* a Chrysler product plunged overnight from 30 percent to 13 percent."

Lee Iacocca: "In a bankruptcy, our dealers would lose their ability to finance purchases from the factory. Nearly all dealer financing would be shut off within a day or two by the banks and the finance companies. We estimated that about half our dealers would themselves be forced into bankruptcy. Many others would be recruited by GM and Ford, leaving us without outlets in major markets."

Empirical Implications of the Tradeoff Theory

- Firms with high business risk ought to have low financial risk (debt)
  - Firms with stable, predictable CFs (utilities) tend to have more debt
- Firms with tangible assets can afford more debt since costs of bankruptcy are lower
  - Manufacturing vs. software companies
- Firms with high taxes should use more debt
  - Tax shield doesn't help unprofitable firms!
- Firms with few growth opportunities should have more debt
  - Example: Leveraged buyouts (LBOs) – mature cash cows with low growth opportunities
    - Have high free cash flows, so can afford high debt
    - Debt forces managers to be more efficient
  - Potential stockholder/bondholder conflicts (incentive to underinvest or take on risky projects) are low and cost of excess cash (manager/stockholder conflict) is high
    - More on this later…

Philip Morris Selected Financial Data

Basic earnings per share	4.48	4.42	4.76	5.26	5.17
Diluted earnings per share	4.48	4.42	4.76	5.26	5.17
Dividends declared per share	4.12	4.04	3.88	3.58	3.24
Capital expenditures	1,172	960	1,153	1,200	1,056
Depreciation and amortization	743	754	889	882	898
Property, plant and equipment, net	6,064	5,721	6,071	6,755	6,645
Inventories	9,017	8,473	8,592	9,846	8,949
Total assets	36,851	33,956	35,187	38,168	37,670
Long-term debt	25,851	25,250	26,929	24,023	17,639
Total debt	29,067	28,480	29,455	27,678	22,839
Stockholders' deficit	(10,900)	(11,476)	(11,203)	(6,274)	(3,154)
Common dividends declared as a % of Diluted EPS	92.0%	91.4%	81.5%	68.1%	62.7%
Market price per common share — high/low	104.20-84.46	90.27-75.27	91.63-75.28	96.73-82.86	94.13-72.85

Limitations of Static Trade-off and "Taxes vs CFD"

- Static trade-off doesn't explain everything.
  - Within industries, most profitable firm often has least debt (Merck, Microsoft).
  - Equity issues are rare and are met with stock price decreases.
- There are situations in which there might be credit rationing such that borrowers cannot obtain financing for positive NPV projects.
- Information economics and contract theory provide explanations.
  - Adverse Selection
    - Providers of finance cannot directly distinguish bad firms from good
    - Lowest quality firms are most likely to need or apply for finance
  - Moral Hazard
    - Reduced ownership stakes caused by debt finance de-motivate the borrower, shareholders may want to expropriate creditors
    - Management may pursue its own interests
- We will get back to these later on, but for now back to taxes…

Introducing Personal Taxes

- MM (1963) only considered corporate taxes, and showed that the value of the firm increases with debt.
  - What was the problem with this???
- Miller (1977) suggests that debt has both tax advantages and disadvantages
  - *Advantages* - tax deductibility of interest at the corporate level
  - *Disadvantages* - personal taxes on interest income usually exceed those on equity income (dividends and capital gains)
    - Why?
      - Non-dividend paying stocks
      - Capital gains aren't taxed until realized
      - Tax rates themselves differ
- What is the effect on firm value? If theories are right, it depends on tax rates…

Recent and Historical Top U.S. Statutory Rates

- Five tax rates that may be relevant for the firm

	C-Corporation		Individual		
Time Period	Ordinary Income (τ_c)	Capital Gains ($\tau_{c,cg}$)	Ordinary Income (τ_p)	Dividends ($\tau_{p,div}$)	Capital Gains ($\tau_{p,cg}$)
Pre-1981	46.0%	28.0%	70.0%	70.0%	28.0%
1982-1986	46.0%	20.0%	50.0%	50.0%	20.0%
1987	40.0%	28.0%	39.0%	39.0%	28.0%
1988-1990	34.0%	34.0%	28.0%	28.0%	28.0%
1991-1992	34.0%	34.0%	31.0%	31.0%	28.0%
1993-1996	35.0%	35.0%	39.6%	39.6%	28.0%
1997-2000	35.0%	35.0%	39.6%	39.6%	20.0%
2001-2002	35.0%	35.0%	38.6%	38.6%	20.0%
2003-2012	35.0%	35.0%	35.0%	15.0%	15.0%
2013-2017	35.0%	35.0%	39.6%	20.0%	20.0%
2018	21.0%	21.0%	37.0%	20.0%	20.0%

The Miller (1977) Model

Valuation under personal and corporate taxes

- "The supposed trade-off between tax shields and bankruptcy costs looks suspiciously like the recipe for the fabled horse-and-rabbit stew — one horse and one rabbit."
  - i.e., tax benefits are high but expected direct CFD are low (Warner, 1977)
- In reality, personal tax rates on dividends and interest affect cash flows to stockholders and bondholders
  - Money paid out as dividends face double taxation (firm and shareholder), so for every dollar of pre-tax corporate earnings, a stockholder receives the net amount:
    - **$1 x (1-$T_C$) x (1-$T_{ps}$)**
  - Interest on debt is only taxed at the individual level since it is tax deductible by the corporation, so a bondholder receives:
    - **$1 x (1-$T_{pb}$)**
  - BUT, $T_{ps} < T_{pb}$

Miller (1977) View of Static Tradeoff

- Personal taxes reduce the tax benefits of debt
  - Debtholders pay their marginal tax rate τ_{pB} on interest income
  - Shareholders pay special low tax rates τ_{pS} on capital gains (and since 2003 on qualified dividends)
  - A firm with $D debt saves $[(1-\tau_{pB}) - (1-\tau_C)(1-\tau_{pS})][r_D D]$ per year compared to making the same payment as equity
    - What is PV of annual perpetuity of $[(1-\tau_{pB}) - (1-\tau_C)(1-\tau_{pS})][r_D D]$?
    - Miller discounts it using the opportunity cost of investing in debt, $(1-\tau_{pB})r_D$

$$\text{Gains to Leverage} = \left[1 - \frac{(1-\tau_C)(1-\tau_{pS})}{1-\tau_{pB}}\right] * D$$

    - When $\tau_{pS} < \tau_{pB}$ gain is less than $\tau_C * D$

Implications of Miller (1977)

- The formula $$\text{Gains to Leverage} = \left[1 - \frac{(1-\tau_C)(1-\tau_{pS})}{1-\tau_{pB}}\right] * D$$
- has the following implications
  - If $\tau_{pS} = \tau_{pB}$ → Gains to Leverage = $\tau_C D$
  - If $\tau_{pS} < \tau_{pB}$ → Appeal of debt is reduced and often vanishes
  - So $\tau_C D$ probably overstates the tax benefits of debt
- Formula can be rearranged to show that D dominates E when $\tau_C > \frac{\tau_{pB} - \tau_{pS}}{1-\tau_{pS}}$

- Miller Equilibrium: Miller argues that economy-wide levels of debt and equity will adjust so that $\tau_C = \tau_{pB\text{-MARGINAL}}$, since firms will keep issuing debt until investors in higher and higher tax brackets absorb it.
  - then gains to leverage are going to be very small, equal to $\tau_{pS} D$.
  - equilibrium debt ratio exists for economy as a whole but irrelevant for each firm.
- More plausible in recent years, when τ_{pS} is closer to 0 and top brackets of $\tau_C \approx \tau_{pB}$, than during late 80s when top brackets of $\tau_C > \tau_{pB}$.

Miller Equilibrium (1977)

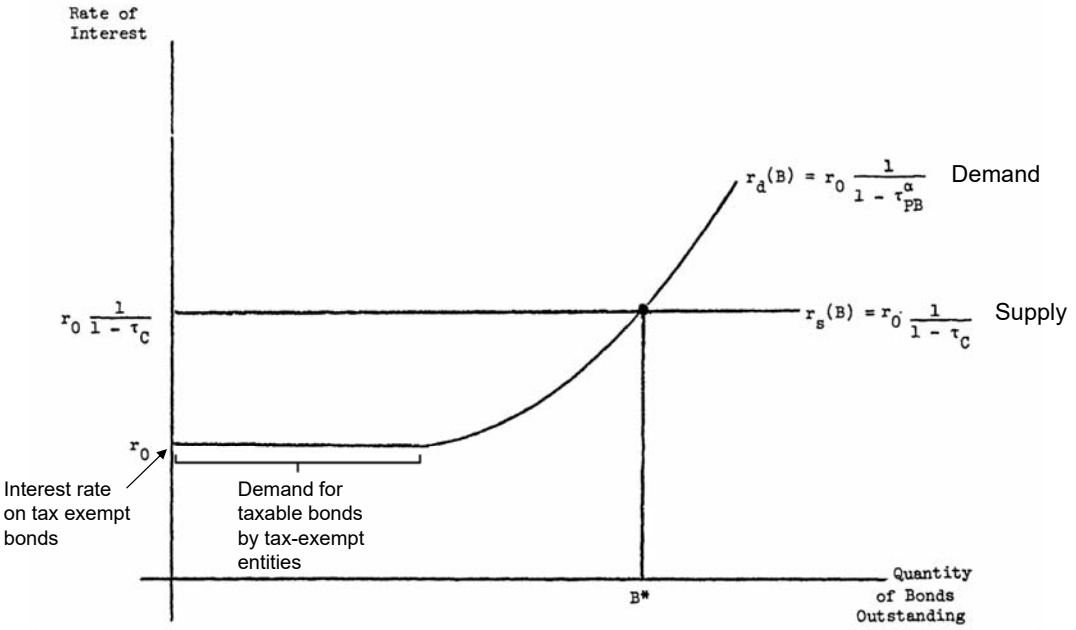


FIGURE 1. Equilibrium in the Market for Bonds

Miller Equilibrium (1977)

- "The market equilibrium defined by the intersection of the two curves will have the following property. There will be an equilibrium level of aggregate corporate debt, B*, and hence an equilbrium debt-equity ratio for the corporate sector as a whole. But there would be no optimum debt ratio for any individual firm. Companies following a no-leverage or low leverage strategy (like I.B.M. or Kodak) would find a market among investors in the high tax brackets; those opting for a high leverage strategy (like the electric utilities) would find the natural clientele for their securi-ties at the other end of the scale. But one clientele is as good as the other. And in this important sense it would still be true that the value of any firm, in equilibrium, would be independent of its capital structure, despite the deductibility of interest payments in computing corporate income taxes."

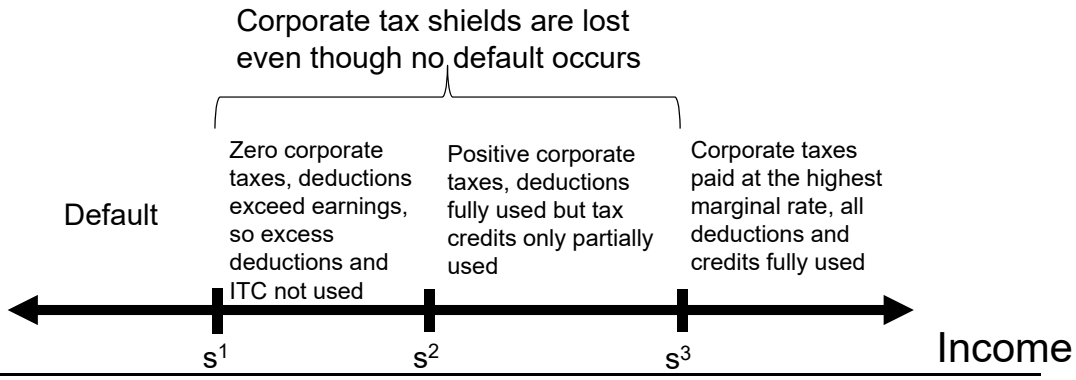
DeAngelo and Masulis (1980)

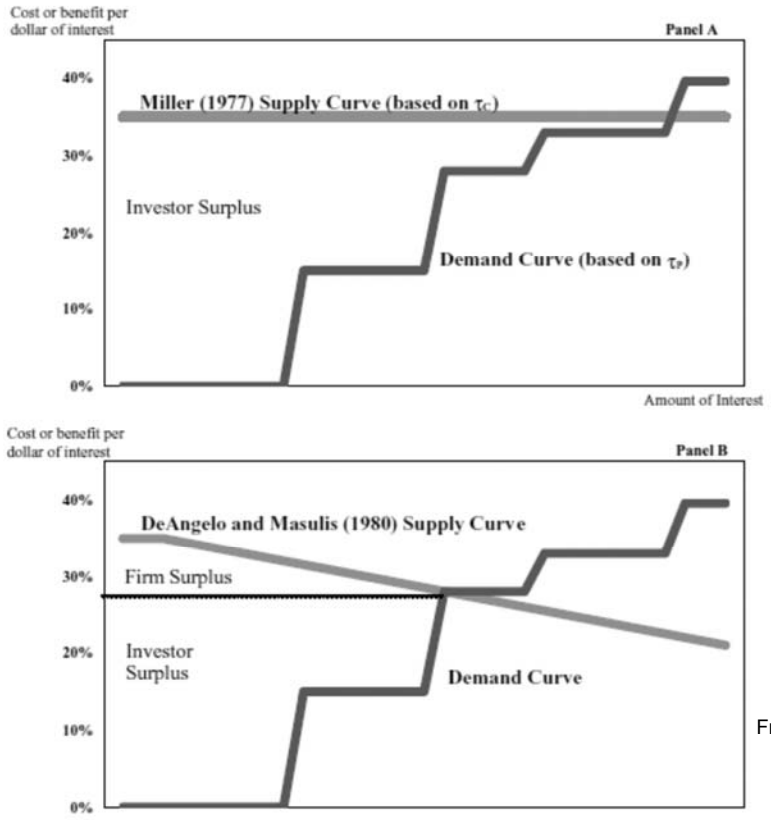
- Extend Miller (1977) to show that Miller's irrelevancy theorem is extremely sensitive to realistic modifications in corporate tax code.
  - Examine non-debt tax shields such as depreciation deductions and investment tax credits.
  - Inclusion of these features implies a unique interior optimum for each firm, in contrast to Miller (1977) who said that in a world of differential personal taxes, (1) the marginal personal tax disadvantage of debt combined with (2) supply side adjustments by firms will override the corporate tax advantage of debt and drive market prices to an equilibrium implying leverage irrelevancy to any given firm.
  - Bankruptcy costs become significant.

DeAngelo and Masulis (1980)

Debt and Taxes

As corporations increase their debt, they reduce the probability that they will pay the highest marginal tax rate and be able to fully utilize all tax credits and deductions.





From Graham (2006)

DeAngelo and Masulis
Debt and Taxes

- In equilibrium, each firm has a unique interior optimum leverage decision where the expected marginal corporate tax benefit just equals the expected marginal personal tax disadvantage of debt.
- This interior optimum exists because there is a *constant* expected marginal *personal* tax disadvantage to debt, but positive tax shield substitutes imply that the expected marginal *corporate* tax benefit *declines* as debt is added.

- Optimal leverage

$$B/V = B/V(\text{tax credits}^{-},\ \text{non-interest deductions}^{-},\ \sigma^{2\,-},\ \text{CFD}^{-},\ \tau_c^{+},\ \tau_p^{-})$$

DeAngelo and Masulis (1980)

- Testable implications
  - Firms will select a level of debt which is negatively related to the level of available tax shield substitutes for debt.
  - Ceteris paribus, decreases in firms' marginal bankruptcy costs will increase the use of debt financing. Cross-sectionally, firms with greater bankruptcy costs will use less debt.
  - Ceteris paribus, as the corporate tax rate increases, firms will substitute debt for equity financing. Cross-sectionally, firms subject to lower corporate tax rates will employ less debt.

What's Wrong With This Story?

- Large industrial firms with many physical assets typically have many noninterest deductions (like depreciation), large tax credits (the investment tax credit), and also high leverage.
- Holding other things constant, the logic of the model is sound; it provides useful information about optimal capital structure.
- The problem is that there are important variables that are not included in the model. As we examine firms in the real world, there seems to be important determinants of capital structure that are not captured by this model.

Agency Costs of Debt

conflicts between debtholders and equityholders

- The first way that economists tried to understand why there might be indirect costs of financial distress was actually to look at "costs" of too much debt (and not actual distress).
- (1) Jensen and Meckling (1976) followed up on a remark in Fama and Miller's book *The Theory of Finance*, that suggests that because stockholders' claims are junior to bondholders, stockholders and bondholders can disagree about investment decisions.
- (2) Myers (1977) examines why it is rational for firms to limit borrowing even when there is a tax advantage to debt. He considers suboptimal investment policy an agency cost of risky debt.

Equity's problem

- Firm value V depends on action, *a,* taken by equity holders
  - V(a) is a random variable
- Existing debt has face value F and can't be renegotiated
- Equity has residual (junior) claim: max {V(a) - F, 0}
- Fama and Miller point out that choosing *a* to maximize: max {V(a) - F, 0} need not maximize: V(a)
  - Why? Managers (who are equity holders) make investment decisions that maximize the value of equity even if this hurts the value of debt .

Agency Costs of Debt: Indirect Costs Arising from Investment Behavior

- What are effects of too much debt on the incentives of equity?
- Basic idea: When a firm faces potential distress, its debt is risky. If management acts on behalf of shareholders (rather than maximizing V(a)), risky debt can distort investment decisions.
  - Myers (1977): "Debt Overhang" (underinvestment arising when firm does not invest in safe positive NPV projects)
  - J-M (1976): "Asset Substitution" or "Risk Shifting" (overinvestment arising when firm invests in risky negative NPV projects)
- Note: these models relax the MM perfect certainty assumption that cash flow and investment policy are independent of capital structure!

Myers (1977)

"Debt Overhang" or Underinvestment Problem

- Myers notes that existing theories do not explain why firms don't borrow "as much as possible."
- Attempts to explain why rational firms limit debt even when debt is tax advantageous and markets are perfect.
- Starts with assumption that firms are going concerns and that value reflects an expectation of continued investment.
  - Part of value is accounted for by PV of ***options*** to make future investments
    - Book values reflect assets in place, as opposed to growth options
  - Firms with risky debt will follow a different decision rule regarding when to exercise options than firms without debt (or with risk-free debt).
  - Firms with risky debt will pass up valuable investment opportunities in some states, in particular when costs are borne by shareholders but benefits go to debtholders.
  - Thus issuing risky debt reduces PV of firm, and this loss in market value is borne by firm shareholders.

Myers (1977) Assumptions

- No corporate taxes and no bankruptcy costs.
- **Managers act in the shareholders' best interest.**
- Capital markets are perfect and complete.
- The investment is discretionary (no perfect certainty). The amount invested depends on the NPVs of opportunities as they arise in the future.
- $V = V_E + V_D = V_A + V_G$
  - Where V_G is PV of firm's options to make future investment (growth options)
- Two period model:
  - At t=0, $V_A = 0$ and all equity financed
  - Can invest *I* at t=1. If it invests, then firm obtains asset worth V(s). If it doesn't invest, option expires and has no value.

Case 1: No debt

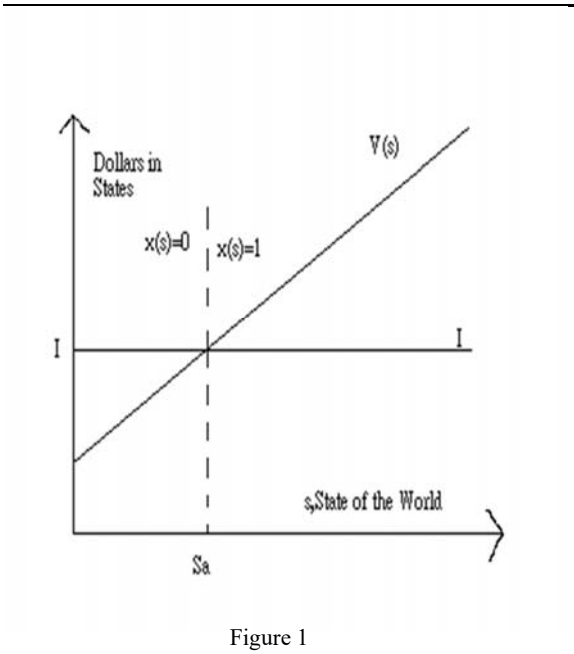


Figure 1

A firm with no assets in place (V_A=0) and only one future investment opportunity.

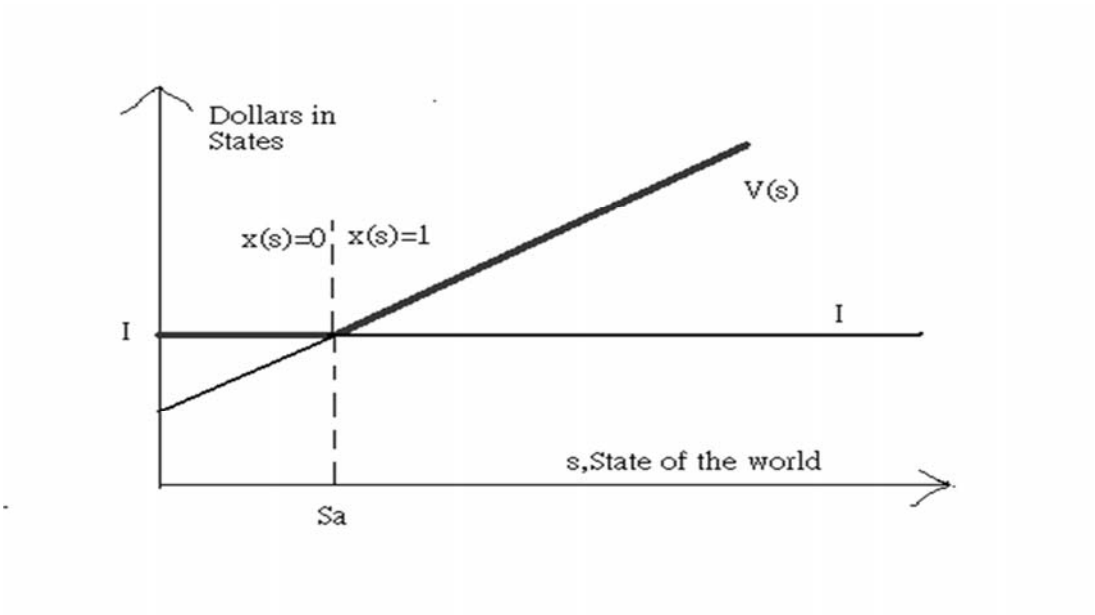
The firm is initially all-equity financed.

Balance sheet at t=0	
Value of growth opportunity V_G	0 Value of debt
	V_E Value of equity
Value of the firm V	V

If it decides to invest, additional shares must be issued to raise the required investment I.

Balance sheet at t=1	
Value of newly acquired asset V(s)	0 Value of debt
	V_E Value of equity
Value of the firm V(s)	V(s)

Assets as call options



Case 2:
Debt with promised payment P

Shareholders can issue risky debt with promised payment P. The debt matures *before* the investment decision is made, but *after* the true state of nature is revealed.

Balance sheet at t=0	
Value of growth opportunity V_G	V_D Value of debt
	V_E Value of equity
Value of the firm V	V

At t=1, the firm can raise amount I and exercise its investment option.

If $V(s) - I \geq P$, shareholders pay debtors off and exercise investment option.

If $V(s) - I < P$, shareholders default and bondholders take over. Bondholders exercise option if $V(s) \geq I$.

Shareholders can borrow as much risky debt as they wish.

Case 3: The interesting case!

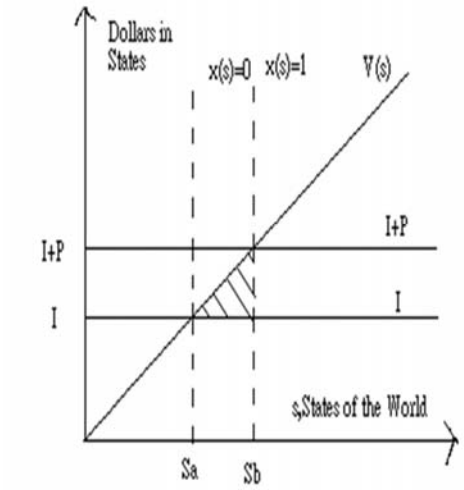


Figure 2

Debt with promised payment P, but now the debt matures *after* the investment option expires. Debt changes investment decision in some states.

Balance sheet at t=0	
Value of growth opportunity V_G	V_D Value of debt
	V_E Value of equity
Value of the firm V	V

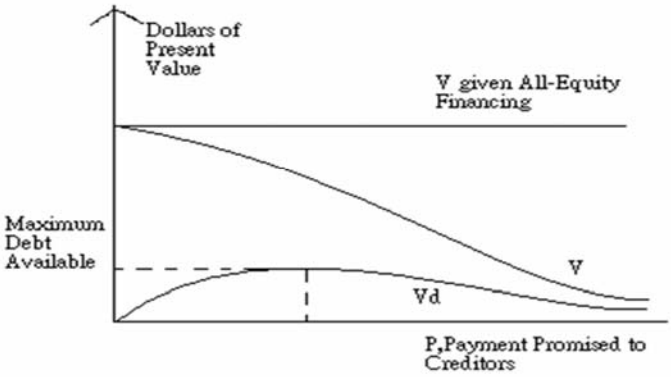
If the firm raises the amount I and exercises its investment option:

Balance sheet at t=1, given x(s) =1	
Value of newly acquired asset V(s)	Min[V(s),P] Value of debt
	Max[0,V(s)-P] Value of equity
Value of the firm V(s)	V(s)

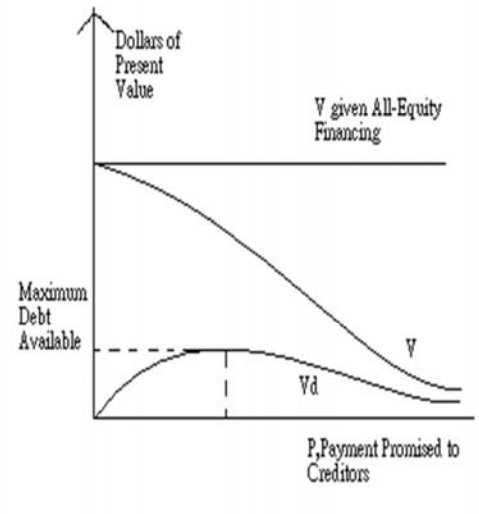
Debt and Value as a function of payment to creditors (P)

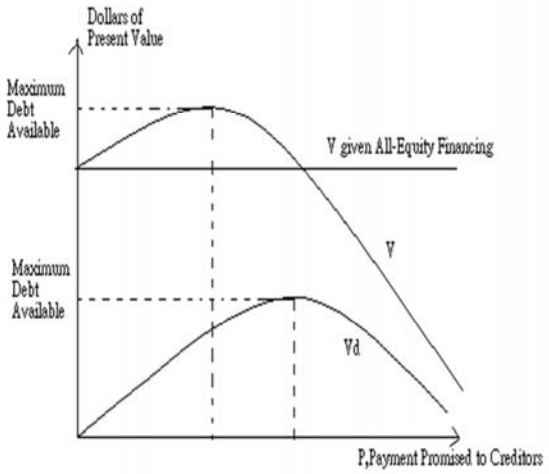
- There is a definite limit, V_D (max) < V to amount firm can borrow.
- V is less than all equity value.
- V is a monotonically decreasing function of P.
- If shareholders' objective is to maximize V, optimal policy is to issue no debt at all.

Figure 3



Appendix: Trade-off





Firm and debt values when debt interest is tax-deductible

Myers (1977) "Debt Overhang" problem

- Firm has given assets, and there are two equally likely states next period.
  - In up state, assets generate $100
  - In down state, assets generate $20
- Firm has debt with face value F = $50, due next period.
- Everybody is risk neutral, risk-free rate is zero.
- In this case, the market values (here, equal to expected values) are:
  - Equity is worth E = $25 (0.5 [100-50]) + (0.5[0])
  - Debt is worth D = $35 (0.5 [50] + 0.5 [20])
  - Value of firm is V = E + D = $60

Suppose there is a safe project

- Project requires initial investment of I = $10 and returns $15 in both states => NPV = $5
  - Profitable investment, it will increase the value of the firm
  - But need to raise the $10 to invest
- If we invest:
  - In good state have $115 total. Debt gets $50. Equity gets $65.
  - In bad state have $35 total. Debt gets $35. Equity gets $0.
  - Market value of equity = $32.5. Value of debt = $42.5. Value of firm $75.
- Say, management acts on behalf of shareholders. Can we raise **equity** for the investment?
- Investment increases value of equity from $25 to $32.5
- Equity holders will NOT contribute $10 to receive $7.5

Intuition behind Debt Overhang

- Debt is risky, i.e. underwater in some states.
- Debt is senior, so it captures part of return from project, leaving the equity holders with the residual.
- Debt reduces value of firm ex-ante. With debt, firm doesn't invest and is worth only $60. Without debt, firm would invest in positive NPV project and be worth more.
- Note: this can only happen when debt is risky, so this is an indirect cost of financial distress. When debt is safe, equity receives full return in all states and invests efficiently.

Getting Around Debt Overhang: Pari-Passu Debt

- Can we use pari-passu debt to finance project instead?
  - Pari-passu debt is debt at the same level of seniority as the existing debt.
- Say new debt has face value F'. In the two states:
  - Good state: Old debt gets $50. New debt gets F'. Equity gets $65 – F' (versus 50 without project)
  - Bad state: New debt gets $35 *[F' / ($50 + F')]
    - $35 is amount available to debt in bad state, if project is taken, and new debt gets its proportional share
- Equity is happy as long as F' < $15 (so in up state they gain and no effect in the down state)
- Market value of $10 of pari-passu debt
- = ½ F' + ½ $35 [F' / ($50 + F')] = $10.
  - F' = $12.9, so we can do this

Intuition behind Pari-Passu solution

- The new debt reduces the wealth transfer to old debt from the project. Now old is debt worth $39 after investment so transfer is only $4 (39 – 35).

- Is problem solved?
  - Existing (senior) debt often has covenants that restrict issues of new debt of equal or higher priority.
  - Why? If equity is free to issue debt that dilutes old debt even for bad projects, debt holders will not lend if they anticipate dilution.

Other Solutions to Debt Overhang

- Project Finance: Set up new project as independent entity, so old lenders don't receive part of profits.
  - Only feasible if project's cash flows can be clearly separated, i.e., won't work for continuing investments in existing line of business.
  - Has been used in oil exploration projects, for example.
- Renegotiation: According to Coase (1960) theorem, we can renegotiate with debtholders and invest efficiently.
  - May be possible with single existing debtholder. With many investors, renegotiation becomes harder (free-riding problems).
- Shorter debt maturity (Myers, 1977)
  - If debt matures before investment, problem disappears (continuous renegotiation, effectively).
- Dividend Restrictions may prevent firms from needing outside financing.

Empirical Implications of Debt Overhang

- Debt overhang problem is more likely for companies with more volatile earnings and more costly for firms with more investment opportunities (growth options).
  - For example, a stable mature company can borrow more than a young start-up.
  - Empirically, leverage appears negatively correlated with measures of growth options (market-to-book and R&D to sales) and positively associated with capital intensity and size.
- Sinking funds can be viewed as an attempt to reduce creditors' exposure in parallel with the expected decline in value of assets in place.

Jensen/Meckling (1976)
"Asset Substitution" or Overinvestment Problem

- Jensen and Meckling identify two separate conflicts:
- (1) Conflicts between shareholders and managers arise because managers hold <100% of equity. Consequently, they do not capture the entire gain from their effort, but they do bear the entire cost of these activities. This leads managers to overindulge in perks, relative to level that maximizes firm value.
  - This will be discussed further in the next section on agency costs
- (2) Conflicts between debtholders and equityholders arise because debt gives equity an incentive to overinvest in risky projects, i.e. the debt contract provides that if an investment yields large returns, equityholders capture most of the gain. If, however, the investment fails, because of limited liability, debtholders bear the consequences. As a result, equityholders may benefit from "going for broke," i.e., investing in very risky projects, even if they are value-decreasing.
  - Referred to as "asset substitution" and is an agency cost of debt financing.

Jensen/Meckling (1976)
"Asset Substitution" or Overinvestment Problem

- Same example as before. Assets worth $100 in up state and $20 in down state. Say, $10 of this is available today in cash.
- Now the project costs I = $10. Returns $15 up state and $0 in down state. Project is inefficient, NPV = -$2.5
- Without investing, value of equity is E = $25, value of debt is D = $35, and value of firm is V = $60
  - Same as in debt overhang problem
- After investing, cash flow is $105 in up state and $10 in down state. E = $27.5, D = $30, and V = $57.5
- Project increases value of equity by $2.5. Equity holders would want to invest in this (inefficient) project.
- The intuition is that equity is similar to a call option with strike price of $50. An increase in volatility increases value of option and shifts risk to debt holders ("Risk Shifting").
- More on J-M in the next section…

Empirical evidence of Asset Substitution

- Debt less attractive when management has possibility of engaging in risky investments when distressed.
- Classical examples: S&L crisis in 1980's and Marriott Corp. spin-off
  - Marriott Corporation issued $400 million of new investment grade senior notes in the spring of 1992 and then announced a spin-off in October. Under the plan, shareholders got a special dividend of one share of a new company, Marriott International, that concentrated on managing hotels, resorts and eateries. Marriott Corp. was renamed Host Marriott Corporation and retained ownership of all properties, as well as Marriott's $2.9 billion debt load. Notes that were trading as high as 110 in the fall of 1992, became junk bonds immediately following the announcement of the spin-off and traded as low as 80 by the end of October, without any change in Marriott's underlying business.
  - "Host Marriott will represent most of the bad things that Marriott Corporation now has in its portfolio," said Mr. Thorp, the analyst. "There is a very uneven split."
- This, may explain companies' use of convertible debt. Giving investors the option to convert to equity reduces incentives to increase variance (see Green, 1984).

Putting the two effects together

- When is it optimal to issue debt with a covenant that prevents the issue of pari-passu (and senior) debt?
- Debt overhang example: With covenant, safe project is not done. Without covenant, can issue debt and invest. Firm value increases from \$60 to \$65. Better off ex-ante without covenant.
- Keep everything the same, but now project is risky and negative NPV. You can invest \$10 and get \$18 in up state and \$0 in down state.
  - With covenant, project not done, firm value = \$60
  - Without covenant, you may issue pari-passu debt with F = \$15.3 to finance project. Afterwards, D = \$32.65, E = \$26.35, and V = \$59
  - Better off ex-ante with covenant. Covenant allows you to commit to not finance bad projects. This increases share value ex-ante.
- Intuition: A covenant restricts the ability to finance new investments. Thus, it exacerbates the debt overhang problem (underinvestment) but reduces the asset substitution problem (overinvestment). Berkovitch and Kim (1990) have a formal model of this trade-off.

Parrino/Weisbach (1999)

- While the distortions in real investment policies that can result from stockholder-bondholder conflicts are well known, the magnitudes of these distortions are not entirely clear.
- P/W use Monte Carlo simulation to estimate magnitudes of these distortions and how they vary with firm and project characteristics.
- Simulation:
  - Construct a model of the cash flows to the stockholders and bondholders of the firm.
  - Assume that the firm adopts a zero net present value equity-financed project with known cash flow characteristics.
  - Determine how the values of the debt and equity change.
  - Compute the return required to make the shareholders whole.
  - Sensitivity analysis shows how the agency costs of debt vary with firm and project characteristics.

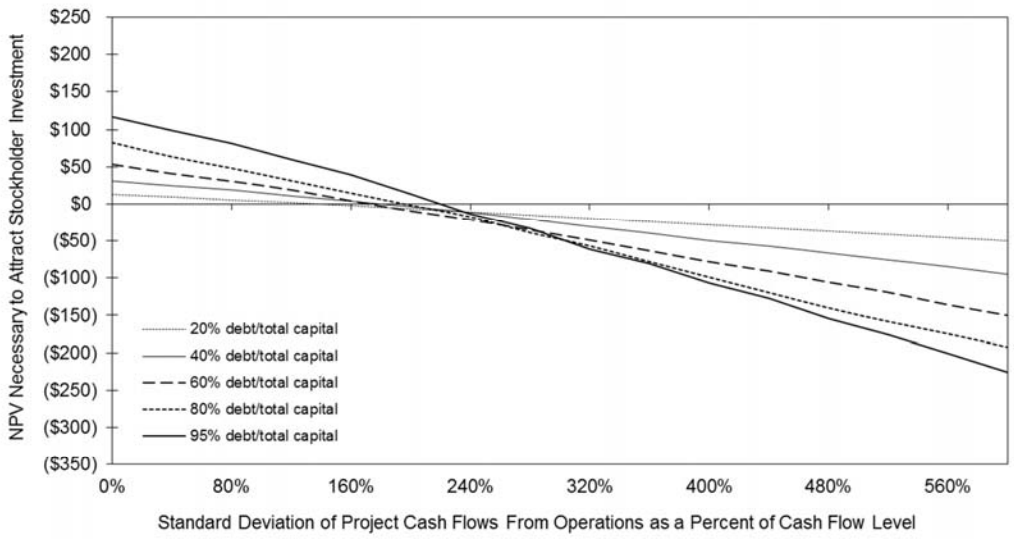


Fig. 1. Project NPV necessary to attract additional stockholder investment as a function of the volatility of project cash flows from operations for firms with varying debt to total capital ratios. Project cash flows from operations have a 0.50 correlation with the firm's cash flows from operations. Project cash flows from operations have an expected annual value of $100 and firm cash flows have an expected annual value of $1000. The project is financed with equity, the standard deviation of the firm's cash flows equals 72.38% of initial cash flows, and the firm's tax rate equals 34.40%.

Incremental Required Rates of Return for Typical Firm with Varying Leverage (Panel A, Table III)

	Standard deviation of project cash flows from operations as a percent of initial cash flow level					
	0%	120%	240%	360%	480%	600%
Debt/Capital						
20%	0.14%	0.03%	-0.21%	-0.68%	-1.40%	-2.35%
	(7.67%)	(11.91%)	(17.65%)	(23.79%)	(29.92%)	(36.06%)
40%	0.36%	0.15%	-0.23%	-1.11%	-2.46%	-4.42%
	(7.87%)	(11.94%)	(17.65%)	(23.79%)	(29.92%)	(36.06%)
60%	0.65%	0.26%	-0.42%	-1.77%	-3.90%	-6.96%
	(8.03%)	(11.97%)	(17.65%)	(23.79%)	(29.92%)	(36.06%)
80%	1.06%	0.43%	-0.36%	-2.23%	-5.26%	-9.08%
	(8.17%)	(12.00%)	(17.65%)	(23.79%)	(29.92%)	(36.06%)
95%	1.60%	0.86%	-0.28%	-2.35%	-5.93%	-10.93%
	(8.28%)	(12.01%)	(17.65%)	(23.79%)	(29.92%)	(36.06%)

Conclusions from Typical Firm Simulations

- Stockholder-bondholder conflicts are probably not important determinants of capital structure for many firms.
  - The typical firm would have to invest 1.58 times the value of the firm and 12.85 times the annual after-tax cash flow for the value of foregone projects to offset the incremental tax shield generated by increasing debt/total capital from 20% to 40%.
- However, stockholder-bondholder conflicts can be important under certain circumstances (e.g., highly levered firms).
- For a firm with a given level of debt, the importance of stockholder-bondholder conflicts depends on factors such as the
  - correlation between firm and project cash flows,
  - volatility firm's existing cash flow stream,
  - maturity structure of the debt, and
  - tax rates, as well as
  - the level of investment (growth opportunities).

Summary of MM, Taxes and Trade-Off

- MM provides benchmark for understanding issues related to financial structure and how firms raise capital.
- Should not be applied literally, but used as a roadmap for understanding financial structure. Identifies financial frictions that could be the underlying determinants of capital structure.
  - Taxes/bankruptcy costs are important frictions.
  - Conflicts of interests between equity and debt can lead to inefficient investments (underinvestment OR overinvestment) when management acts in the shareholders' interest.
- When debt is risky, investments create value and redistribute the CFs between debt and equity. Thus, investment incentives can be distorted, and this generates additional indirect costs of financial distress.