The Debt-Equity Choice

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Capital structure Choice

- Common stock
- Convertible debt
- Straight debt
Agenda

- Miller (1977): Debt and taxes
- Tradeoff vs. pecking order
- CFO Survey

Notation

Two firms, $U$ and $L$:
- Same stream of operating income.
- Differ only in capital structure.
- Value of unlevered firm: $V_U = E_U$
- Value of levered firm: $V_L = E_L + D_L$
**Sufficient conditions for \( V_L = V_U \)**

- Rational and frictionless markets, and
- no information asymmetries, and
- no taxes, and
- no agency costs, and
- no capital rationing

Proof by simple arbitrage: Buying/selling securities always a zero NPV project

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**Is \( V_L = V_U \) in practice?**

- Hard to test directly: Need to compare firms that differ only in their capital structures
  - The firms must have identical asset structures
- Look instead on the validity of the sufficient conditions (prior slide)
- Most would agree debt policy matters for \( V \)
- The more difficult question is WHY?
Effect of Corporate Taxes (only)

- Annual cash flow to levered firm
  \[ CF_L = CF_U + \tau I \]
  \[ PV(CF_L) = PV(CF_U) + \tau PV(I) \]
- If the firm’s debt is perpetual:
  \[ PV(I) = I/r_D = D_L \]
  \[ V_L = V_U + \tau D_L \]

Recap: With corporate tax

- WACC = \((D/V)(1 - \tau_C)r_D + (E/V)r_E\)
- Firms should be 100% debt financed!
  - assuming no cost of debt
- What about personal tax on interest income?
- Two-stage tax analysis
Effects of Personal Taxation

- The personal tax structure is typically biased in favor of equity (dividend and capital gains) over debt (interest) income.
- To induce debt to be held by investors, debt must now pay a tax-induced interest rate premium.
- If the debt coupon equals the market interest rate, the premium is in the form of an initial debt issue discount.
- The discount determines whether there is a net tax advantage to debt financing.

Miller’s (1977) Equilibrium

- Assumes:
  - (1) all firms face the same effective marginal corporate tax rate $\tau$
  - (3) there are no bankruptcy costs.
- Firms issue debt until the market price of debt is such that the debt tax premium equals the marginal corporate tax advantage of debt.
- At this point, the net tax advantage of debt to the corporation is zero.
Two-stage tax analysis

- Investors value corporate securities based on the risk-adjusted return after all taxes have been paid, corporate and individual.
  - Thus, firms maximize value by looking to minimize the total tax burden, not just the corporate tax bill.
- Suppose interest (debt) income is taxed at the personal level but equity (dividends and capital gains) income is not.
  - Now, debt financing has a tax advantage at the corporate level, but a tax disadvantage at the personal level, relative to equity.

Illustration with two tax rates

<table>
<thead>
<tr>
<th></th>
<th>Equity</th>
<th>Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxable income to firm</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Corporate tax</td>
<td>$\tau_C$</td>
<td>0</td>
</tr>
<tr>
<td>Income to security holder</td>
<td>1 - $\tau_C$</td>
<td>1</td>
</tr>
<tr>
<td>Personal tax (no dividend tax)</td>
<td>0</td>
<td>$\tau_D$</td>
</tr>
<tr>
<td>Income after all taxes</td>
<td>1 - $\tau_C$</td>
<td>1 - $\tau_D$</td>
</tr>
</tbody>
</table>
Two-stage tax example

- To maximize value, finance using the instrument yielding the largest return after all taxes have been paid.
- Thus, prefer debt financing if
  \[(1-\tau_D)>(1-\tau_C)\]
  or if
  \[T=1-(1-\tau_C)/(1-\tau_D) > 0\]
  so,
  \[V_L=V_U+T*D\]
**Miller’s Bond Market Equilibrium**

- **Investor demand:**
  - If $R < R^*$: Zero demand
  - If $R = R^*$: Demand from tax-exempt investors only
  - If $R > R^*$: Individual I demands bonds if $R(1-\tau_D) > R^*$

- **Corporate bond supply:**
  - Indifference between debt and equity when $R = R^*(1-\tau)$ (perfectly elastic supply)

- **Equilibrium:** (1) Marginal investor indifferent between holding debt or equity. (2) Personal tax advantage of equity exactly offset by corporate tax advantage of debt.

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**Illustration with three tax rates**

<table>
<thead>
<tr>
<th></th>
<th>Equity</th>
<th>Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxable income:</td>
<td>$1</td>
<td>$1</td>
</tr>
<tr>
<td>Corporate tax:</td>
<td>$\tau$</td>
<td>0</td>
</tr>
<tr>
<td>Income after corp. tax:</td>
<td>$1-\tau$</td>
<td>1</td>
</tr>
<tr>
<td>Personal tax:</td>
<td>$\tau_E(1-\tau)$</td>
<td>$\tau_D$</td>
</tr>
<tr>
<td>Income after all tax:</td>
<td>$(1-\tau)(1-\tau_E)$</td>
<td>$1-\tau_D$</td>
</tr>
</tbody>
</table>
Let $\Delta V = \text{change in firm value from issuing more equity ($\Delta E$) and debt ($\Delta D$)}$

$$
\Delta V = \Delta D(1- \tau_D) + \Delta E(1- \tau)(1- \tau_E) = 0
$$

- Since we are considering replacing one dollar equity by one dollar debt:
  $\Delta E = \Delta D$
- Thus, replace until
  $$(1- \tau_D) = (1- \tau)(1- \tau_E)$$

Again, $T_d$ is the net corporate tax-benefit from a dollar debt financing. Thus,
$$V_L = V_U + T_d D$$

$\rightarrow$ prefer debt financing if
$$(1-\tau_D) > (1-\tau)(1-\tau_E)$$
or, equivalently, if
$$T_d = 1 - \frac{(1-\tau)(1-\tau_E)}{(1-\tau_D)} > 0$$
Special cases:
If $\tau = \tau_D = \tau_E = 0$, then $V_U = V_L$
If $\tau = \tau_D$ and $\tau_E = 0$, then $V_U = V_L$.

In sum, what matters is not tax rates per se, but the relative magnitude of the tax rates at the corporate and personal level (so that $T_d > 0$)

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Miller and Non-Debt Tax Shields

- Above, each firm issues debt until the net tax advantage is driven to zero
- With non-debt tax shields (e.g., depreciation allowance), the firm can have more tax shield than it can use
- This reduces the effective tax shield on interest expense (at least in present value terms), increasing the cost of debt capital
- The cost increases because the firm must pay the debt tax premium set by the market, without realizing the corporate tax benefit
Miller (1977) and bankruptcy costs

- Miller (1977) assumes zero bankruptcy costs
- Let $E(BC) = $ increase in expected bankruptcy costs from adding one more dollar of debt
- Firms issue debt until $E(T_d) = E(BC)$
- Rule: issue debt until the expected tax advantage is reduced to the level of expected bankruptcy costs
Agenda

- Debt and taxes
- Tradeoff vs. pecking order
- CFO Survey

The Balancing Act (Tradeoff Theory)

- $E(T_d)$ and $E(BC)$ differ across firms
- As a firm raises its debt level, both the probability of having excess tax shields and the probability of bankruptcy increase
- As a result, the expected incremental tax benefit of debt falls with leverage while the expected incremental costs of leverage rise
- This leaves each firm with a unique optimum debt level
Firm Value

$V_U$

$D/E$

$\left(D/E\right)^*$

Balancing of tax shields and bankruptcy costs.

Predictions of Tradeoff Theory

- Firms with higher non-debt tax shields relative to earnings (EBIT), and higher expected bankruptcy costs, will tend to have lower leverage ratios.
- Firms with higher volatility of earnings have lower leverage.
- The expected marginal net corporate tax benefit is always lower than the corporate tax rate, and decreasing in leverage.
Debt Tax Shield Estimation

- Want to estimate \( T_d \equiv 1-(1-\tau)(1-\tau_E)/(1-\tau_D) \)

1. Marginal personal tax rate on debt \((\tau_D)\):
   - Let \( r_{MZ} \) denote the yield on a 1-year AAA municipal zero discount bond (muni), and \( r \) the yield on a 1-year T-bill
   - For the marginal investor, it must be that
     \[ r(1- \tau_D) = r_{MZ} \quad \text{or} \quad \tau_D = 1-r_{MZ}/r \]

2. Marginal personal tax rate on equity \((\tau_E)\):
   - \( \tau_E \) can be approximated by adjusting the personal tax rate on debt income \( \tau_D \) by the expected fraction \( \alpha \) of a stock’s expected return that that is due to taxable dividends, i.e.,
     \[ \tau_E = \alpha \tau_D \]

3. The probability \( p_d \) of realizing \( T_d \):
   - Can be estimated using scenarios for EBIT, and determine which scenarios have EBIT> All Firm Tax Shields. Then sum the probabilities of such scenarios to get \( p_d \)
The total expected net tax advantage of debt, given that we can fully use the debt tax shield, is now given by

\[ T_d \Delta D \]

4. Expected net tax cost of debt when we cannot use the debt tax shield

- When the firm no longer saves on taxes as another dollar debt is added, the term \( 1 - \tau \) is eliminated from the expression for \( T_d \)
  
  \[ [\text{recall: } T_d = 1 - (1 - \tau)(1 - \tau_E)/(1 - \tau_D)] \]

- Denote this adjusted value \( T_{da} < 0 \)

\[ \theta = \text{proportion of the new debt that gives rise to an excess tax shield} \]

\[ p_d = \text{probability that the firm is in full tax position (and deducts interest expense)} \]

\[ p_{da} = \text{probability that the firm has excess tax shields (firm pays no taxes)} \]

\[ T_{da}p_{da}\theta \Delta D = \text{expected net tax cost} \]

- Redefine: \( p_{da}^* = \theta p_{da} \)
  
  \[ p_{d*} = p_d + (1 - \theta p_{da}) \]

- This redefinition let the probabilities \( p^* \) reflect the partial use of debt tax shields
5. The total tax valuation effect of changing the firm’s debt level
\[ \Delta V = T_d p_d^* \Delta D + T_{da} p_{da}^* \Delta D \]

- **Note:** We have so far ignored the possibility of bankruptcy. If the probability of bankruptcy is estimated to be \( p_{bc} \), then it follows that
  \[ p_{da}^* + p_d^* + p_{bc} = 1 \]
  Default reduces, but does not necessarily eliminate, the debt tax shield
- The literature estimates the corporate tax advantage to be less than 10%

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- When estimating the firm’s tax shield it should also be kept in mind that the firm can adjust its tax shield position over time
- A sale-leaseback shifts the depreciation and tax credits on the leased asset to an outside lessor
- Vice versa, establishing a leasing subsidiary that loans funds to outside purchasers of assets transfers the leased asset’s depreciation and tax credits into the firm (the lessee)
Firm Value

Dynamic Tradeoff Theory: Refinancing with Symmetric Costs $C$

Cost

Retire equity $\rightarrow$ No refinancing $\rightarrow$ Retire debt

$D/E_{\text{min}}$ $\rightarrow$ $D/E$ 

The “pecking order”

- The order in which firms typically elect to finance investments
  - 65%+ through retained earnings
  - Next, straight debt issue
  - Next, convertible debt issue
  - Next, preferred share issue
  - Finally, common stock issue
Total Financing Sources 1970-1995: Retention dominates

US Corporate Security Offerings for Cash 1940-1990: Bonds dominate
Debt and the Financing Deficit

\[ \text{DEF}_t = \text{DIV}_t + I_t + \Delta W - C_t = \Delta D_t + \Delta E_t \]

\[ \Delta D_t = a + b\text{DEF}_t + e_t \]

- Shyam-Sunder and Myers (1999)
- Frank and Goyal (2005)

A Debt Puzzle

- Highly profitable firms (with a stable dividend policy) tend to have lower long-term leverage ratios
- Why?
  - They forego tax benefits
  - They seemingly maintain unused debt capacity
- Are firms underleveraged?
Possible resolution of puzzle

- Firms prefer internal (equity) financing to external equity
- If a profitable company needs cash for future investments, it builds financial slack (cash or short-term debt)
- If a profitable company does not expect to need capital, it uses the profits to pay down long-term debt
- Both actions reduces long-term leverage ratios

Tradeoff or pecking order?

- Tradeoff theory cannot explain the debt paradox
  - More profitable firms should have higher target debt ratios
- Tradeoff theory cannot explain market reaction to debt issues
  - It’s non-positive
Abnormal Stock Return

Price drop in practice

-3.0% 4,000+ Equity Issues

-1.5% 700+ Convertible Debt Issues

0% 2,000+ Straight Debt Issues

Day -100 Issue announcement day (0) Time (days)

Eckbo Debt-Equity Choice (46) 41

Abnormal Stock Return

Price drop in practice

-3.0% Firm commitment Underwritten offerings

-1.5% Standby rights offerings

0% Uninsured rights offerings

Day -100 Issue announcement day (0) Time (days)

Eckbo Debt-Equity Choice (46) 42
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The Debt-Equity Choice in Practice
Market-leverage vs. book-leverage

- **Market-leverage:** Total debt/Market assets
  - Market assets = Market equity + book debt
  - “Forward looking” leverage ratio

- **Book-leverage:** Total debt/Book assets
  - Book assets = Book equity + book debt
  - “Backwards looking” leverage ratio

**Reliable market-leverage factors**

- **Industry:** Firms that compete in industries in which the median firm has high leverage tend to have high leverage
- **Growth:** Firms that have a high M/B tend to have low levels of leverage
- **Asset tangibility:** Firms that have more tangible assets tend to have more leverage
- **Profits:** Firms that have more profits tend to have less leverage
- **Firm size:** Larger firms (book assets) tend to have high leverage
- **Dividends:** Dividend-payers have less leverage than non-payers