Chapter 14

Capital Structure Decisions: The Basics

Topics in Chapter

- Overview and preview of capital structure effects
- Business versus financial risk
- The impact of debt on returns
- Capital structure theory, evidence, and implications for managers
- Example: Choosing the optimal structure

Basic Definitions

- $V$ = value of firm
- $FCF$ = free cash flow
- $WACC$ = weighted average cost of capital
- $r_s$ and $r_d$ are costs of stock and debt
- $w_{ce}$ and $w_d$ are percentages of the firm that are financed with stock and debt.
How can capital structure affect value?

\[ V = \sum_{t=1}^{\infty} \frac{FCF_t}{(1 + WACC)^t} \]

\[ WACC = w_d (1-T) r_d + w_c r_s \]

A Preview of Capital Structure Effects

- The impact of capital structure on value depends upon the effect of debt on:
  - WACC
  - FCF

The Effect of Additional Debt on WACC

- Debtholders have a prior claim on cash flows relative to stockholders.
- Debtholders’ “fixed” claim increases risk of stockholders’ “residual” claim.
- Cost of stock, \( r_s \), goes up.
- Firm’s can deduct interest expenses.
  - Reduces the taxes paid
  - Frees up more cash for payments to investors
  - Reduces after-tax cost of debt
The Effect on WACC
(Continued)

- Debt increases risk of bankruptcy
  - Causes pre-tax cost of debt, $r_d$, to increase
- Adding debt increase percent of firm financed with low-cost debt ($w_d$) and decreases percent financed with high-cost equity ($w_e$)
- Net effect on WACC = uncertain.

The Effect of Additional Debt on FCF

- Additional debt increases the probability of bankruptcy.
  - Direct costs: Legal fees, “fire” sales, etc.
  - Indirect costs: Lost customers, reduction in productivity of managers and line workers, reduction in credit (i.e., accounts payable) offered by suppliers

Impact of indirect costs

- NOPAT goes down due to lost customers and drop in productivity
- Investment in capital goes up due to increase in net operating working capital (accounts payable goes down as suppliers tighten credit).
Additional debt can affect the behavior of managers.
- Reductions in agency costs: debt "pre-commits," or "bonds," free cash flow for use in making interest payments. Thus, managers are less likely to waste FCF on perquisites or non-value adding acquisitions.
- Increases in agency costs: debt can make managers too risk-averse, causing "underinvestment" in risky but positive NPV projects.

Asymmetric Information and Signaling
- Managers know the firm's future prospects better than investors.
- Managers would not issue additional equity if they thought the current stock price was less than the true value of the stock (given their inside information).
- Hence, investors often perceive an additional issuance of stock as a negative signal, and the stock price falls.

Business risk: Uncertainty about future pre-tax operating income (EBIT).

Note that business risk focuses on operating income, so it ignores financing effects.
Factors That Influence Business Risk

- Uncertainty about demand (unit sales).
- Uncertainty about output prices.
- Uncertainty about input costs.
- Product and other types of liability.
- Degree of operating leverage (DOL).

What is operating leverage, and how does it affect a firm’s business risk?

- Operating leverage is the change in EBIT caused by a change in quantity sold.
- The higher the proportion of fixed costs within a firm’s overall cost structure, the greater the operating leverage.

Higher operating leverage leads to more business risk: small sales decline causes a larger EBIT decline.
Operating Breakeven

- Q is quantity sold, F is fixed cost, V is variable cost, TC is total cost, and P is price per unit.
- Operating breakeven = Q_{BE}
- \( Q_{BE} = \frac{F}{P - V} \)
- Example: \( F=200, P=15 \), and \( V=10 \):
  \( Q_{BE} = \frac{200}{(15 - 10)} = 40 \).

Higher operating leverage leads to higher expected EBIT and higher risk.

Probability

Low operating leverage

High operating leverage

Business Risk versus Financial Risk

- Business risk:
  - Uncertainty in future EBIT.
  - Depends on business factors such as competition, operating leverage, etc.
- Financial risk:
  - Additional business risk concentrated on common stockholders when financial leverage is used.
  - Depends on the amount of debt and preferred stock financing.
Consider Two Hypothetical Firms

<table>
<thead>
<tr>
<th>Firm U</th>
<th>Firm L</th>
</tr>
</thead>
<tbody>
<tr>
<td>No debt</td>
<td>$10,000 of 12% debt</td>
</tr>
<tr>
<td>$20,000 in assets</td>
<td>$20,000 in assets</td>
</tr>
<tr>
<td>40% tax rate</td>
<td>40% tax rate</td>
</tr>
</tbody>
</table>

Both firms have same operating leverage, business risk, and EBIT of $3,000. They differ only with respect to use of debt.

Impact of Leverage on Returns

<table>
<thead>
<tr>
<th></th>
<th>Firm U</th>
<th>Firm L</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBIT</td>
<td>$3,000</td>
<td>$3,000</td>
</tr>
<tr>
<td>Interest</td>
<td>0</td>
<td>1,200</td>
</tr>
<tr>
<td>EBT</td>
<td>$3,000</td>
<td>$1,800</td>
</tr>
<tr>
<td>Taxes (40%)</td>
<td>1,200</td>
<td>720</td>
</tr>
<tr>
<td>NI</td>
<td>$1,800</td>
<td>$1,080</td>
</tr>
<tr>
<td>ROE</td>
<td>9.0%</td>
<td>10.8%</td>
</tr>
</tbody>
</table>

Why does leveraging increase return?

- More EBIT goes to investors in Firm L.
- Total dollars paid to investors:
  - U: NI = $1,800.
  - L: NI + Int = $1,080 + $1,200 = $2,280.
- Taxes paid:
  - U: $1,200; L: $720.
- Equity $ proportionally lower than NI.
Now consider the fact that EBIT is not known with certainty. What is the impact of uncertainty on stockholder profitability and risk for Firm U and Firm L?

---

**Firm U: Unleveraged**

<table>
<thead>
<tr>
<th>Economy</th>
<th>Bad</th>
<th>Avg.</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prob.</td>
<td>0.25</td>
<td>0.50</td>
<td>0.25</td>
</tr>
<tr>
<td>EBIT</td>
<td>$2,000</td>
<td>$3,000</td>
<td>$4,000</td>
</tr>
<tr>
<td>Interest</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>EBT</td>
<td>$2,000</td>
<td>$3,000</td>
<td>$4,000</td>
</tr>
<tr>
<td>Taxes(40%)</td>
<td>800</td>
<td>1,200</td>
<td>1,600</td>
</tr>
<tr>
<td>NI</td>
<td>$1,200</td>
<td>$1,800</td>
<td>$2,400</td>
</tr>
</tbody>
</table>

---

**Firm L: Leveraged**

<table>
<thead>
<tr>
<th>Economy</th>
<th>Bad</th>
<th>Avg.</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prob.*</td>
<td>0.25</td>
<td>0.50</td>
<td>0.25</td>
</tr>
<tr>
<td>EBIT</td>
<td>$2,000</td>
<td>$3,000</td>
<td>$4,000</td>
</tr>
<tr>
<td>Interest</td>
<td>1,200</td>
<td>1,200</td>
<td>1,200</td>
</tr>
<tr>
<td>EBT</td>
<td>$800</td>
<td>$1,800</td>
<td>$2,800</td>
</tr>
<tr>
<td>Taxes(40%)</td>
<td>320</td>
<td>720</td>
<td>1,120</td>
</tr>
<tr>
<td>NI</td>
<td>$480</td>
<td>$1,080</td>
<td>$1,680</td>
</tr>
</tbody>
</table>

*same as for Firm U
Conclusions

- Basic earning power (EBIT/TA) and ROIC (NOPAT/Capital = EBIT(1-T)/TA) are unaffected by financial leverage.
- L has higher expected ROE: tax savings and smaller equity base.
- L has much wider ROE swings because of fixed interest charges. Higher expected return is accompanied by higher risk.

(More...)
In a stand-alone risk sense, Firm L’s stockholders see much more risk than Firm U’s.

- U and L: $\sigma_{\text{ROIC}} = 2.12\%$.
- U: $\sigma_{\text{ROE}} = 2.12\%$.
- L: $\sigma_{\text{ROE}} = 4.24\%$.
- L’s financial risk is $\sigma_{\text{ROE}} - \sigma_{\text{ROIC}} = 4.24\% - 2.12\% = 2.12\%$. (U’s is zero.)

For leverage to be positive (increase expected ROE), BEP must be $> r_d$. If $r_d > \text{BEP}$, the cost of leveraging will be higher than the inherent profitability of the assets, so the use of financial leverage will depress net income and ROE.

In the example, $\text{E}(\text{BEP}) = 15\%$ while interest rate = 12%, so leveraging “works.”

**Capital Structure Theory**

- MM theory
  - Zero taxes
  - Corporate taxes
  - Corporate and personal taxes
- Trade-off theory
- Signaling theory
- Pecking order
- Debt financing as a managerial constraint
- Windows of opportunity
### MM Theory: Zero Taxes

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</tr>
<tr>
<td>NI</td>
<td>$3,000</td>
<td>$1,800</td>
</tr>
</tbody>
</table>

- CF to shareholder: $3,000, $1,800
- CF to debtholder: 0, $1,200
- Total CF: $3,000, $3,000

Notice that the total CF are identical.

### MM Results: Zero Taxes

- MM assume: (1) no transactions costs; (2) no restrictions or costs to short sales; and (3) individuals can borrow at the same rate as corporations.
- Under these assumptions, MM prove that if the total CF to investors of Firm U and Firm L are equal, then the total values of Firm U and Firm L must be equal: $V_U = V_L$.
- Because FCF and values of firms L and U are equal, their WACCs are equal.
- Therefore, capital structure is irrelevant.

### MM Theory: Corporate Taxes

- Corporate tax laws allow interest to be deducted, which reduces taxes paid by levered firms.
- Therefore, more CF goes to investors and less to taxes when leverage is used.
- In other words, the debt “shields” some of the firm’s CF from taxes.
**MM Result: Corporate Taxes**

- MM show that the total CF to Firm L’s investors is equal to the total CF to Firm U’s investor plus an additional amount due to interest deductibility: $\text{CF}_L = \text{CF}_U + r_d DT$.
- MM then show that: $V_L = V_U + TD$.
- If $T=40\%$, then every dollar of debt adds 40 cents of extra value to firm.

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**MM relationship between value and debt when corporate taxes are considered.**

![Graph showing the relationship between value and debt.](image)

Under MM with corporate taxes, the firm’s value increases continuously as more and more debt is used.

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**MM relationship between capital costs and leverage when corporate taxes are considered.**

![Graph showing the relationship between capital costs and leverage.](image)
Miller’s Theory: Corporate and Personal Taxes

- Personal taxes lessen the advantage of corporate debt:
- Corporate taxes favor debt financing since corporations can deduct interest expenses.
- Personal taxes favor equity financing, since no gain is reported until stock is sold, and long-term gains are taxed at a lower rate.

Miller’s Model with Corporate and Personal Taxes

\[ V_L = V_U + \left[ 1 - \frac{(1 - T_c)(1 - T_s)}{(1 - T_d)} \right] D \]

- \( T_c \) = corporate tax rate.
- \( T_d \) = personal tax rate on debt income.
- \( T_s \) = personal tax rate on stock income.

\[ T_c = 40\%, \ T_d = 30\%, \ \text{and} \ T_s = 12\%. \]

\[ V_L = V_U + \left[ 1 - \frac{(1 - 0.40)(1 - 0.12)}{(1 - 0.30)} \right] D \]
\[ = V_U + (1 - 0.75)D \]
\[ = V_U + 0.25D. \]

Value rises with debt; each $1 increase in debt raises L’s value by $0.25.
Conclusions with Personal Taxes

- Use of debt financing remains advantageous, but benefits are less than under only corporate taxes.
- Firms should still use 100% debt.
- Note: However, Miller argued that in equilibrium, the tax rates of marginal investors would adjust until there was no advantage to debt.

Trade-off Theory

- MM theory ignores bankruptcy (financial distress) costs, which increase as more leverage is used.
- At low leverage levels, tax benefits outweigh bankruptcy costs.
- At high levels, bankruptcy costs outweigh tax benefits.
- An optimal capital structure exists that balances these costs and benefits.

Signaling Theory

- MM assumed that investors and managers have the same information.
- But, managers often have better information. Thus, they would:
  - Sell stock if stock is overvalued.
  - Sell bonds if stock is undervalued.
- Investors understand this, so view new stock sales as a negative signal.
- Implications for managers?
Pecking Order Theory

- Firms use internally generated funds first, because there are no flotation costs or negative signals.
- If more funds are needed, firms then issue debt because it has lower flotation costs than equity and not negative signals.
- If more funds are needed, firms then issue equity.

Debt Financing and Agency Costs

- One agency problem is that managers can use corporate funds for non-value maximizing purposes.
- The use of financial leverage:
  - Bonds "free cash flow."
  - Forces discipline on managers to avoid perks and non-value adding acquisitions.

A second agency problem is the potential for "underinvestment".
- Debt increases risk of financial distress.
- Therefore, managers may avoid risky projects even if they have positive NPVs.
Investment Opportunity Set and Reserve Borrowing Capacity

- Firms with many investment opportunities should maintain reserve borrowing capacity, especially if they have problems with asymmetric information (which would cause equity issues to be costly).

Windows of Opportunity

- Managers try to “time the market” when issuing securities.
- They issue equity when the market is “high” and after big stock price run ups.
- They issue debt when the stock market is “low” and when interest rates are “low.”
- The issue short-term debt when the term structure is upward sloping and long-term debt when it is relatively flat.

Empirical Evidence

- Tax benefits are important—$1 debt adds about $0.10 to value.
- Supports Miller model with personal taxes.
- Bankruptcies are costly—costs can be up to 10% to 20% of firm value.
- Firms don’t make quick corrections when stock price changes cause their debt ratios to change—doesn’t support trade-off model.
Empirical Evidence (Continued)

- After big stock price run ups, debt ratio falls, but firms tend to issue equity instead of debt.
  - Inconsistent with trade-off model.
  - Inconsistent with pecking order.
  - Consistent with windows of opportunity.
- Many firms, especially those with growth options and asymmetric information problems, tend to maintain excess borrowing capacity.

Implications for Managers

- Take advantage of tax benefits by issuing debt, especially if the firm has:
  - High tax rate
  - Stable sales
  - Less operating leverage

Implications for Managers (Continued)

- Avoid financial distress costs by maintaining excess borrowing capacity, especially if the firm has:
  - Volatile sales
  - High operating leverage
  - Many potential investment opportunities
  - Special purpose assets (instead of general purpose assets that make good collateral)
Implications for Managers (Continued)

- If manager has asymmetric information regarding firm’s future prospects, then avoid issuing equity if actual prospects are better than the market perceives.
- Always consider the impact of capital structure choices on lenders’ and rating agencies’ attitudes.

Choosing the Optimal Capital Structure: Example

- Currently is all-equity financed.
- Expected EBIT = $500,000.
- Firm expects zero growth.
- 100,000 shares outstanding; \( r_s = 12\% \);
  \( P_0 = 25 \); \( T = 40\% \); \( b = 1.0 \); \( r_{RF} = 6\% \);
- \( RPM = 6\% \).

Estimates of Cost of Debt

<table>
<thead>
<tr>
<th>% financed with debt, ( w_d )</th>
<th>( r_d )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>-</td>
</tr>
<tr>
<td>20%</td>
<td>8.0%</td>
</tr>
<tr>
<td>30%</td>
<td>8.5%</td>
</tr>
<tr>
<td>40%</td>
<td>10.0%</td>
</tr>
<tr>
<td>50%</td>
<td>12.0%</td>
</tr>
</tbody>
</table>

If company recapitalizes, debt would be issued to repurchase stock.
The Cost of Equity at Different Levels of Debt: Hamada’s Equation

- MM theory implies that beta changes with leverage.
- \( b_u \) is the beta of a firm when it has no debt (the unlevered beta)
- \( b = b_u \left[ 1 + (1 - T)(D/S) \right] \)

The Cost of Equity for \( w_d = 20\% \)

- Use Hamada's equation to find beta:
  \[ b = b_u \left[ 1 + (1 - T)(D/S) \right] \]
  \[ = 1.0 \left[ 1 + (1-0.4) \left( \frac{20\%}{80\%} \right) \right] \]
  \[ = 1.15 \]
- Use CAPM to find the cost of equity:
  \[ r_s = r_{RF} + b_L \times (RPM) \]
  \[ = 6\% + 1.15 \times 6\% = 12.9\% \]

Cost of Equity vs. Leverage

<table>
<thead>
<tr>
<th>( w_d )</th>
<th>D/S</th>
<th>( b )</th>
<th>( r_s )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>0.00</td>
<td>1.00</td>
<td>12.00%</td>
</tr>
<tr>
<td>20%</td>
<td>0.25</td>
<td>1.15</td>
<td>12.90%</td>
</tr>
<tr>
<td>30%</td>
<td>0.43</td>
<td>1.257</td>
<td>13.54%</td>
</tr>
<tr>
<td>40%</td>
<td>0.67</td>
<td>1.400</td>
<td>14.40%</td>
</tr>
<tr>
<td>50%</td>
<td>1.00</td>
<td>1.600</td>
<td>15.60%</td>
</tr>
</tbody>
</table>
The WACC for \( w_d = 20\% \)

- \( \text{WACC} = w_d (1-T) r_d + w_{ce} r_s \)
- \( \text{WACC} = 0.2 (1 - 0.4) (8\%) + 0.8 (12.9\%) \)
- \( \text{WACC} = 11.28\% \)

- Repeat this for all capital structures under consideration.

WACC vs. Leverage

<table>
<thead>
<tr>
<th>( w_d )</th>
<th>( r_d )</th>
<th>( r_s )</th>
<th>WACC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>0.0%</td>
<td>12.00%</td>
<td>12.00%</td>
</tr>
<tr>
<td>20%</td>
<td>8.0%</td>
<td>12.90%</td>
<td>11.28%</td>
</tr>
<tr>
<td>30%</td>
<td>8.5%</td>
<td>13.54%</td>
<td>11.01%</td>
</tr>
<tr>
<td>40%</td>
<td>10.0%</td>
<td>14.40%</td>
<td>11.04%</td>
</tr>
<tr>
<td>50%</td>
<td>12.0%</td>
<td>15.60%</td>
<td>11.40%</td>
</tr>
</tbody>
</table>

Corporate Value for \( w_d = 20\% \)

- \( V_{op} = \frac{\text{FCF}(1+g)}{(\text{WACC}-g)} \)
- \( g = 0, \text{ so investment in capital is zero; so} \) \( \text{FCF} = \text{NOPAT} = \text{EBIT} (1-T) \).
- \( \text{NOPAT} = ($500,000)(1-0.40) = $300,000. \)
- \( V_{op} = \frac{$300,000}{0.1128} = $2,659,574. \)
Corporate Value vs. Leverage

<table>
<thead>
<tr>
<th>wd</th>
<th>WACC</th>
<th>Corp. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>12.00%</td>
<td>$2,500,000</td>
</tr>
<tr>
<td>20%</td>
<td>11.28%</td>
<td>$2,659,574</td>
</tr>
<tr>
<td>30%</td>
<td>11.01%</td>
<td>$2,724,796</td>
</tr>
<tr>
<td>40%</td>
<td>11.04%</td>
<td>$2,717,391</td>
</tr>
<tr>
<td>50%</td>
<td>11.40%</td>
<td>$2,631,579</td>
</tr>
</tbody>
</table>

Debt for wd = 20%

The dollar value of debt is:

\[ D = w_d \cdot V \]

\[ = 0.2 \cdot ($2,659,574) = $531,915. \]

Debt vs. Leverage

<table>
<thead>
<tr>
<th>wd</th>
<th>Debt, D</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>$0</td>
</tr>
<tr>
<td>20%</td>
<td>$531,915</td>
</tr>
<tr>
<td>30%</td>
<td>$817,439</td>
</tr>
<tr>
<td>40%</td>
<td>$1,086,957</td>
</tr>
<tr>
<td>50%</td>
<td>$1,315,789</td>
</tr>
</tbody>
</table>

(Note: these are rounded; see Ch 14 Mini Case.xls for full calculations.)
Anatomy of a Recap: Before Issuing Debt

<table>
<thead>
<tr>
<th>Before Debt</th>
<th>After Debt, Before Rep.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{op}$</td>
<td>$2,500,000$</td>
</tr>
<tr>
<td>$+$ ST Inv.</td>
<td>$0$</td>
</tr>
<tr>
<td>$V_{total}$</td>
<td>$2,500,000$</td>
</tr>
<tr>
<td>$-$ Debt</td>
<td>$0$</td>
</tr>
<tr>
<td>$S$</td>
<td>$2,500,000$</td>
</tr>
<tr>
<td>$+ n$</td>
<td>$100,000$</td>
</tr>
<tr>
<td>$p$</td>
<td>$25.00$</td>
</tr>
<tr>
<td>Total shareholder wealth: S + Cash</td>
<td>$2,500,000$</td>
</tr>
</tbody>
</table>

Issue Debt ($w_d = 20\%$), But Before Repurchase

- WACC decreases to 11.28\%.
- $V_{op}$ increases to $2,659,574$.
- Firm temporarily has short-term investments of $531,915$ (until it uses these funds to repurchase stock).
- Debt is now $531,915$.

Anatomy of a Recap: After Debt, but Before Repurchase

<table>
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</table>
After Issuing Debt, Before Repurchasing Stock

- Stock price increases from $25.00 to $26.60.
- Wealth of shareholders (due to ownership of equity) increases from $2,500,000 to $2,659,574.

The Repurchase: No Effect on Stock Price

- The announcement of an intended repurchase might send a signal that affects stock price, and the previous change in capital structure affects stock price, but the repurchase itself has no impact on stock price.
  - If investors thought that the repurchase would increase the stock price, they would all purchase stock the day before, which would drive up its price.
  - If investors thought that the repurchase would decrease the stock price, they would all sell short the stock the day before, which would drive down the stock price.

Remaining Number of Shares After Repurchase

- $D_0$ is amount of debt the firm initially has, $D$ is amount after issuing new debt.
- If all new debt is used to repurchase shares, then total dollars used equals
  \[ (D - D_0) = ($531,915 - $0) = $531,915. \]
- $n_0$ is number of shares before repurchase, $n$ is number after. Total shares remaining:
  \[ n = n_0 - (D - D_0)/P = 100,000 - $531,915/$26.60 \]
  \[ n = 80,000 \]

(Ignore rounding differences; see Ch 14 Mini Case.xls for actual calculations).
Anatomy of a Recap: After Rupurchase

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{op}$</td>
<td>$2,500,000</td>
<td>$2,659,574</td>
<td>$2,659,574</td>
</tr>
<tr>
<td>+ ST Inv.</td>
<td>0</td>
<td>531,915</td>
<td>0</td>
</tr>
<tr>
<td>$V_{total}$</td>
<td>$2,500,000</td>
<td>$3,191,489</td>
<td>$2,659,574</td>
</tr>
<tr>
<td>- Debt</td>
<td>0</td>
<td>531,915</td>
<td>531,915</td>
</tr>
<tr>
<td>S</td>
<td>$2,500,000</td>
<td>$2,659,574</td>
<td>$2,127,660</td>
</tr>
<tr>
<td>+ n</td>
<td>100,000</td>
<td>100,000</td>
<td>80,000</td>
</tr>
<tr>
<td>P</td>
<td>$25.00</td>
<td>$26.60</td>
<td>$26.60</td>
</tr>
</tbody>
</table>

Total shareholder wealth: $S + Cash

$2,500,000 $2,659,574 $2,659,574

Key Points

- ST investments fall because they are used to repurchase stock.
- Stock price is unchanged.
- Value of equity falls from $2,659,574 to $2,127,660 because firm no longer owns the ST investments.
- Wealth of shareholders remains at $2,659,574 because shareholders now directly own the funds that were held by firm in ST investments.

Shortcuts

- The corporate valuation approach will always give the correct answer, but there are some shortcuts for finding $S$, $P$, and $n$.
- Shortcuts on next slides.
Calculating S, the Value of Equity after the Recap

- \( S = (1 - w_d) V_{op} \)
- At \( w_d = 20\% \):
  - \( S = (1 - 0.20) \times 2,659,574 \)
  - \( S = 2,127,660 \).

(Ignore rounding differences; see CFA Ch 14 Min Case.xls for actual calculations).

Calculating P, the Stock Price after the Recap

\[
P = \frac{[S + (D - D_0)]/n_0}{100,000}
\]

\[
P = \frac{2,127,660 + (531,915 - 0)}{100,000}
\]

\( P = 26.596 \) per share.

Number of Shares after a Repurchase, n

- \# Repurchased = \( (D - D_0) / P \)
- \( n = n_0 - (D - D_0) / P \)
- \# Rep. = \( (531,915 - 0) / 26.596 \)
- \# Rep. = 20,000.
- \( n = 100,000 - 20,000 \)
- \( n = 80,000 \).
Price per Share vs. Leverage

<table>
<thead>
<tr>
<th>$\omega_d$</th>
<th>S</th>
<th>P</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>$2,500,000</td>
<td>$25.00</td>
<td>100,000</td>
</tr>
<tr>
<td>20%</td>
<td>$2,127,660</td>
<td>$26.60</td>
<td>80,000</td>
</tr>
<tr>
<td>30%</td>
<td>$1,907,357</td>
<td>$27.25</td>
<td>70,000</td>
</tr>
<tr>
<td>40%</td>
<td>$1,630,435</td>
<td>$27.17</td>
<td>60,000</td>
</tr>
<tr>
<td>50%</td>
<td>$1,315,789</td>
<td>$26.32</td>
<td>50,000</td>
</tr>
</tbody>
</table>

Optimal Capital Structure

- $\omega_d = 30\%$ gives:
  - Highest corporate value
  - Lowest WACC
  - Highest stock price per share
- But $\omega_d = 40\%$ is close. Optimal range is pretty flat.