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15.997 Practice of Finance: Advanced Corporate Risk Management
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Financial Policy

MIT Sloan School of Management
15. 997 Advanced Corporate Risk Management
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Outline

- Objective: why hedge?
- Liability Management – structuring debt
- Strategic Hedging – equity & investments

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Objective

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- Organize the company's contact with external capital markets…

… to facilitate the company's investment program and overall strategy.

- The company's strategy and competitive advantages are **CENTRAL**.
  - The financial policy should be custom tailored to fit its assets, strategy and competitive advantages.
  - The left-hand-side of the balance sheet should shape the right-hand-side of the balance sheet.

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Not Objectives

- To find "low cost" sources of capital
  - there is no such thing as a free lunch
  - MM theorem of hedging
- To execute profitable financial transactions
- To buy secure profits today in exchange for future risks

- The right-hand-side of the balance sheet is not the source of profitability. The right-hand-side of the balance sheet should not be autonomous, and certainly should not shape the left-hand-side of the balance sheet.

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Modigliani-Miller Theorem of Hedging

- First order, direct effect of hedging is zero gain to shareholder value
- Risks are bought and sold at fair market value
  - Firms that are long commodity price risk, capture the risk premium associated with it
  - Firms that hedge the commodity price risk by selling forward, give away the risk premium
  - Hedging doesn't change shareholder value

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Spot vs. Forward Sales

- Selling into the spot market is risky, but the expected future spot price offers a return for the risk
- Selling forward offloads that risk, but the forward or futures price is on average lower, representing the risk discount
- From a present value perspective, the two are equivalent.

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An Operations Research Problem That Isn’t

- An electric utility is trying to decide how best to source its coal.
- How much should it buy under long-term contracts – say 10 years – and how much to buy under medium-term contracts – say 5 years – and how much to leave for purchase under short-term contracts or in the spot market?
- The company has forecasts for long-term contract prices, medium-term contract prices and spot prices.
- Run an optimization model to find the right mix of contracts: trading off lower prices against risk.

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The Real Financing Problem

- Friction between the company and outside capital sources is the issue;
- there are incentive problems and information problems;
- these problems distort the company's operations and its investment program, hurting shareholder value.

Key Strategic Tasks

- Your Task: Organize the company's contact with external capital markets to minimize these frictions and problems.
  - minimize the need to access external capital markets,
  - optimize the timing for access to external capital markets,
  - efficiently redesign the financing to minimize the frictions.

- Minimizing the frictions and problems with the external capital market enables the company to exploit all of its opportunities and to capture the fullest value from its competitive advantages.

What’s $1 Worth?

What is the Market Value of a Dollar of Corporate Cash?

- Course packet: JACF, Pinkowitz & Williamson.
- Model: to estimate the marginal contribution of a company’s cash holdings to its value, we expressed the value of the firm as a function of several key variables, including holdings of liquid assets:

$$
\begin{aligned}
V_{i,t} = {} & \alpha_i + \gamma_t + \beta_1 E_{i,t} + \beta_2 dE_{i,t} + \beta_3 dE_{i,t+1} + \beta_4 dNA_{i,t} + \beta_5 dNA_{i,t+1} + \\
& \beta_6 RD_{i,t} + \beta_7 dRD_{i,t} + \beta_8 dRD_{i,t+1} + \beta_9 I_{i,t} + \beta_{10} dI_{i,t} + \beta_{11} dI_{i,t+1} + \beta_{12} D_{i,t} + \\
& \beta_{13} dD_{i,t} + \beta_{14} dD_{i,t+1} + \beta_{15} dV_{i,t+1} + \beta_{16} dL_{i,t} + \beta_{17} dL_{i,t+1} + \varepsilon_{i,t}
\end{aligned} \tag{1}
$$

  - V is the market value of the firm
  - E is earnings before extraordinary items plus interest, deterred tax credits and investment tax credits
  - L is liquid asset holdings (cash + marketable securities)
  - NA is net assets (total assets – liquid assets)
  - RD is research and development expense
  - I is interest expense
  - D is common dividends paid.

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What is the Market Value of a Dollar of Corporate Cash? (cont.)

- 40 years of data, 1965-2004
- Annual data on 12,888 different companies
- Result: $1 is worth $1.04 … close!
- Standard error of $0.06, so the 90% confidence interval includes $1.

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Liability Management

What are these Frictions?

- Direct costs of bankruptcy
- Moral hazard: the indirect cost of debt
  - risk shifting
  - failure to contribute equity capital
  - cash in and run
  - playing for time
  - bait and switch
- Asymmetric information: the cost of equity
  - lemons problem
- See Brealey, Myers & Allen, Ch. 18.3 and 18.4
- These frictions mean the MM theorem no longer holds; it matters how the company finances its business, whether with debt or equity, whether with short or long-maturity debt, and whether it hedges

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How to Do It

- Tailoring the risk structure of the liabilities to the risk structure of the assets produces shareholder value
- The risk structure of the assets is key

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Indirect Benefits of Hedging

- The benefits of hedging are INDIRECT
- Not through the value captured in the hedge itself, not through buying and selling risk at premia or discounts, but
- Through the private benefits captured by improving the firm's own operations
  - avoiding bankruptcy costs
  - minimizing agency costs
  - maximizing tax benefits
  - positioning the firm to maximize investment opportunities

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Copper Mine Example

- see course packet article in "e-lab" on "Natural resource projects: debt contracts that increase profits, decrease defaults"
- builds on the Brennan-Schwartz mine valuation case
  - original article ignores the financing problems, assuming away any frictions
- assumptions:
  - annual production rate of 10 million pounds
  - in-ground inventory of 150 million pounds of copper, i.e., 15 years
  - production costs of $0.50/pound
  - opening and closing costs of $2 million
  - zero cost to maintain a closed mine
  - real interest rate of 2%
  - current copper price $0.65/pound
  - copper price volatility of 28%
  - convenience yield of 1.5%

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Benchmark Valuation

- What is an asset optimization plan?
  - the copper price fluctuates; we need to decide when to produce, when to hold onto the inventory by closing temporarily, and when to abandon entirely
  - opening price
  - closing price
  - abandonment price
- Solution which maximizes the value of the mine:
  - opening price = $0.84/pound
  - closing price = $0.59/pound
  - abandonment price = $0.00/pound
  - value of the mine, currently open = $24.46 million

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The Effect of Debt

- Suppose the firm has debt outstanding
  - annual debt service (principal plus interest) fixed at $400,000
  - 15 year term
- The “benchmark” plan does NOT maximize the value of the equity.
- When the price falls below $0.40/pound, its no longer worthwhile to pay the debt service in order to hold onto the equity; best to default
- If the mine is open, and the price falls below $0.59, spending $2 million to close the mine is better for the combined interest of debt and equity; but it mostly serves the interest of the debt, while the money is put up by the equity owners; the equity owners prefer to keep operating and paying out the low margin as a dividend
- It is NOT in the interest of equity owners to maximize the value of the mine; it is in their interest to maximize the value of the equity

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Valuation of the Mine with Debt

- Solution which maximizes the value of the equity:
  - opening price = $0.79/pound
  - closing price = $0.54/pound
  - abandonment price = $0.40/pound
  - value of the mine, currently open = $22.85 million
  - value of the debt = $4.67
  - value of the equity = $18.18
- Deadweight cost of the debt: $1.61 million
  - 6.6% of the mine value when optimally managed
  - 33% of the debt value
- Source of the deadweight cost is the sub-optimal operation of the mine.

Source of the Deadweight Cost of Debt

- Sub-optimal operating and investment decisions
- Early abandonment when the mine still has valuable reserves
- Delayed closing in the face of low copper prices
  - negative NPV decision
- Early opening in the face of rising copper prices

The Incentive Problem

- Equity risk-return profile looks very different than the “mine” risk-return profile
- Debt skims a fixed payout, regardless of how the price of copper moves
- Equity gets a very levered payout; riskier with respect to the price of copper
- Equity makes decisions to maximize the value of this levered payout, not the original mine payout

Solution

- reshape the payoffs to debt and equity
- try to tailor the equity payoff to match the mine payoff as closely as possible; make it reflect price risk to the same degree; i.e., don’t lever the equity with price risk so much
- give the debt some of the price risk
- denominate the promised debt payments in pounds of copper
- set the annual debt service equal to 10 million pounds of copper @ 60% of the spot price of copper

The Effect of Commodity Linked Debt

- When the price falls below \$0.40/pound, some of the loss in value is born by the creditors, and the danger of further losses is also shared by the creditors, so the equity won't abandon the mine until it has dropped a good bit further, i.e., \$0.32
- Also improves the opening and closing decisions.

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Valuation of the Mine with Commodity Debt

- Solution which maximizes the value of the equity:
  - opening price = \$0.80/pound
  - closing price = \$0.55/pound
  - abandonment price = \$0.32/pound
  - value of the mine, currently open = \$23.27 million
  - value of the debt = \$4.87
  - value of the equity = \$18.40
- Deadweight cost of the debt: \$1.19 million
  - 4.9% of the mine value when optimally managed
  - smaller by \$0.42 million; i.e., company value is higher by this amount

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Freeport McMoRan

Chidambaran, Fernando & Spindt, Credit enhancement through financial engineering: Freeport McMoRan's gold-denominated depository shares, 2001, *Journal of Financial Economics* 60, 487-528

The Problem

- Mine expansion from 52,000 metric tons of ore per day to 90,000 would require an estimated $545 million.
- Additional expansion to 118,000 metric tons per day would cost more.
- Firm is already highly levered
- 1990 debt is 66% of book value of capital
- 1991-1993 issued $157 million LT bank debt, $219 million LYON, $560 million convertible preferreds, $174 million in equity
- facing restrictive covenants
- Does it have any remaining debt capacity?

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The Action

- Issue $450 million in Gold and Silver denominated bonds
- 3 issues
  - 1st gold note in August 1993
  - 2nd gold note in January 1994
  - 1st silver note in July 1995

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Gold denominated notes

- Quarterly Dividend, Dollar Equivalent Value in ounces of gold per share: 0.000875
  - Check price of gold, multiply price times DEV, equals dollar value quarterly dividend
- Redemption Value, Dollar Equivalent Value in ounces of gold per share: 0.10
  - Check price of gold, multiply price times DEV, equals dollar value of redemption

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Decomposing the gold notes

Equivalent to:

- A fixed rate bond, with default risk
- Plus a swap of the gold price, riskless
- Plus a credit enhancement, measuring the differential default risk in these instruments

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The Swap

- The easy alternative: price each gold payment using the respective forward price of gold…
  - yields a non-standard bond for which it would be difficult to construct comparables
- Use a swap rate instead
  - swap gives a single fixed price for a series of contingent (floating) cash flow
- Horizon for traded futures is too short
  - develop a model of gold and silver futures prices
  - 2-factor model, with mean reversion in the convenience yield
- Fair value swap rate for 1st gold note: $591.60/ounce

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Value the Credit Enhancement

- Swap the floating gold payments into fixed dollar payments
- Discount the fixed payments at an appropriate yield, 10.56%
  - incorporates a premium for default risk
- Value is $35.85
- Compare to market price of $37.00
  - difference of $1.15 is the value of hedge implicit in the gold note
- Equivalent to $8 million; 3.15% of the market value; 46 basis points

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The End