NOTES ON CAPITAL STRUCTURE: PRODUCT MARKET LINKS

Professor B. Espen Eckbo
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SESSION 5B

Contents

- **Product-Market/Capital Market Interactions**

  (a) Standard Corp. Fin. Paradigm models cash flows as a random variable affected only by the firm and ignoring the competitive interactions among firms that give rise to those cash flows. It focuses on how capital structure affects these random cash flows and financing costs

  (b) Standard IO Paradigm models cash flows in (sometimes excruciating) detail, focusing on how competitive interactions among firms gives rise to those cash flows. This literature assumes the firms maximize profits and ignores the problems associated with raising capital to finance product-market competition

- **Direct Effects of Capital Structure**
  (a) *Debt Makes You Strong* (a la Jensen (1986))
  If debt is a disciplinary mechanism that forces you to keep costs down, then firms will be more aggressive competitors
  (b) *Debt Makes You Weak* (a la Myers (1977))
  If debt overhang limits your ability to invest in good (say cost reducing) projects, then firms will be less aggressive competitors
- **Strategic Effects of Capital Structure**
  The idea is that capital structure affects firm's strategic incentives and the interplay among firms, even though capital structure has no direct effect on the firm's costs or technology
  (a) *Debt Makes You Tough*
  Brander and Lewis (1986)
  Rotemberg and Scharfstein (1990)
  (b) *Debt Makes You Weak*
  Fudenberg and Tirole (1986)
  Bolton and Scharfstein (1990)

2 Brander and Lewis (1986): Duopoly

- Following is an example based on ideas in Brander and Lewis (1986)
- Two firms 1 and 2, output q_1, q_2. Marginal cost of production of each duopolist = 0. Industry output $Q = q_1 + q_2$
- Industry demand is either high, with probability θ, or low:

$$p = \begin{cases} \overline{a} - bQ & \text{high demand} \\ \underline{a} - bQ & \text{low demand} \end{cases}$$

- Let $\hat{a} \equiv \overline{a} + (1-\theta)\underline{a}$.
- Expected profit: $E(\pi_i) = [\hat{a} - b(q_1+q_2)]q_i, \ i = 1, 2$
- Cournot quantity competition: In equilibrium, q_1 and q_2 are such that each duopolist mximize his profits, given the output of the other, and neither desires to alter output (Nash Equilibrium in quantities)

- Reaction functions: Firm 1's reaction function gives a relationship between q_1 and q_2 with the property that for any specified value of q_2 the corresponding value of q_1 maximizes π_1
- Let $\overline{q}_2$ be Firm 1's *conjecture* about q_2 (and vice versa). Profit maximization implies:

$$\frac{\partial E(\pi_1)}{\partial q_1} = \hat{a} - b(2q_1 + \overline{q}_2) = 0$$

$$\frac{\partial E(\pi_2)}{\partial q_2} = \hat{a} - b(\overline{q}_1 + 2q_2) = 0$$

- $\Rightarrow$ Reaction functions:

$$q_1 = \frac{\hat{a}}{2b} - \frac{1}{2}\overline{q}_2$$

$$q_2 = \frac{\hat{a}}{2b} - \frac{1}{2}\overline{q}_1$$

- Since the two firms have identical (zero) costs, the Nash equilibrium with all-equity finaning is symmetric (see Figure)

$$q_1^* = q_2^* = \frac{\hat{a}}{3b}$$

- Equilibrium expected profits are:

$$E(\pi_1) = E(\pi_2) = \frac{\hat{a}^2}{9b}$$

- Now, suppose that firm 1 has debt of D. Assume that D is high enough so that in the low demand state, the firm would default
  $\Rightarrow$ firm tries to maximize the value of equity ignoring the default state:

$$\theta[(\overline{a} - b(q_1 + \overline{q}_2))q_1 - D]$$

- New reaction functions given D:

$$q_1 = \frac{\overline{a}}{2b} - \frac{1}{2}\overline{q}_2$$

$$q_2 = \frac{\hat{a}}{2b} - \frac{1}{2}\overline{q}_1$$

  Since, in equilibrium, conjectures must be correct ($q_i = \overline{q}_i$), we have

$$q_1^* = \frac{\hat{a}}{3b} + \frac{2(1-\theta)\Delta}{3b} > \frac{\hat{a}}{3b}$$

$$q_2^* = \frac{\hat{a}}{3b} - \frac{(1-\theta)\Delta}{3b} < \frac{\hat{a}}{3b}$$

  where $\Delta \equiv \overline{a} - \underline{a}$ (see Figure)

- So, debt causes 1's reaction function to shift out, causing 1 to compete more aggresively, increasing 1's equilibrium output
- Even though Firm 2 is unlevered, it accommodates Firm 1's more aggressive stance, and produces less than before
- Total industry output is now
$$\frac{2\hat{a}}{3b} + \frac{(1-\theta)\Delta}{3b} > \frac{2\hat{a}}{3b}$$
which is greater than the standard Cournot output, so price is lower
- **Key question**: Will Firm 1 *want* to issue debt D in the first place?
- Firm 1 can raise debt proceeds of K to maximize
$$\theta(\overline{\pi}_1 - D) + K$$
s.t. zero creditor profits:
$$\theta D + (1-\theta)\underline{\pi}_1 = K$$
where $\underline{\pi}_1$ and $\overline{\pi}_1$ denote 1's profits in low and high demand states

- Firm 1 chooses D to maximize

$$E(\pi) = \theta\overline{\pi}_1 + (1-\theta)\underline{\pi}_1$$

which can be written as:

$$\frac{1}{9b}[\hat{a} - (1-\theta)\Delta][\hat{a} + 2(1-\theta)\Delta]$$

where the first bracket is an industry price term (lower) and the second is Firm 1 output term (higher)

- As a result of debt, profits are higher in high demand state but lower in high low demand state (relative to standard Cournot)
- All equity expected profit would be

$$\frac{1}{9b}\hat{a}^2$$

So profits with leverage are higher provided

$$\hat{a} - 2(1-\theta)\Delta > 0$$

or, alternatively:

$$\overline{a} - 3(1-\theta)(\overline{a} - \underline{a}) > 0$$

- This will be met when $\underline{a}$ is close to $\overline{a}$ and θ is large

- **Intuition**: Ex-post, the firm has an incentive to "bag the bondholder," ignoring $\underline{\pi}_1$. Ex-ante, however, the firm has to pay for this incentive with a higher D. So, while debt confers strategic advantages it has some costs. When the "bag-the-bondholder" cost isn't too large then it pays to lever up–θ large, $\underline{a}$ large.
- It may be in the interest of *any* single firm to lever up, given the capital structure of the other firm. The result may be that *everyone* levers up, shifting *both* firm's reaction curves outward. Prices fall further, and both firms will be worse off relative to the standard Cournot outcome.
- They would be better off committing to no debt (but can't)

- **Question**: How does firm-specific risk level affect incentives to debt finance in this model? Do relatively risky firms (e.g., small growth firms) tend to benefit more or less from excessive risk-taking behavior induced by debt?
- Points that emerge in more general model:

  (1) Some debt will be desirable because at very low levels of debt there is no bag-the-bondholder cost

  (2) In other models of competition it may be that in good states the firm would want to compete *less* aggressively. In this case debt makes the firm weak and no debt would be issued

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FIGURE: Cournot Duopoly with zero cost production