Corporate finance and product markets

(Two fundamentals of a firm in interaction.)

Two basic questions:

1. How market characteristics affect corporate financing choices.
2. How financial structure affects competition.

Ad 1.

Two basic mechanisms:

1. Hard competition destructs profits and makes financing both harder to get and less interesting to ask for.
2. Competitors provide investors with benchmarks useful in controlling their managers. Reduces agency costs and hence financing costs.

Ad 2.

Two ideas:

1. Using financial structure as a commitment device.
2. Fight your rival into bankruptcy (or loss of equity financing)

Will now study a famous contribution that combines elements from both the two basic questions: The market characteristics provide incentives for committing through financial structure.

Brander & Lewis (1986)

Recap:
Conflict of interest owners / creditors
→ Owners invest in projects more risky than creditors would like.
→ Argument against debt financing.

This disadvantage of debt financing may be turned into an advantage in some cases of imperfect competition in the product market.

Because aggressive action by a firm on the product market may result in the firm's rivals behaving *less aggressively*.

Debt financing may be one way to *credibly* commit to compete aggressively.

If so, debt may has an advantage over equity.

<u>A duopoly model:</u> Cournot with cost uncertainty
Two firms: 1 and 2

Inverse demand:
$P = a - bQ$,
where
$Q = q_1 + q_2$.

Uncertainty in costs of production:
$C_i(q_i, z_i) = (c_i - z_i)q_i$, $i = 1, 2$.
$E(z_i) = 0$
z_1 and z_2 are independent stochastic variables, distributed over the interval $[\underline{z}, \bar{z}]$,
with density function $f(z_i)$.

Expected costs: $EC_i(q_i) = c_i q_i$.

High z_i is a *positive* shock for firm i.
1's gross profit (before paying down any debt):
$R^1 = R(q_1, q_2, z_1) = [a - b(q_1 + q_2) - c_1 + z_1]q_1$.
Expected gross profit for firm 1: $ER^1 = [a - b(q_1 + q_2) - c_1]q_1$; similar for firm 2.

Nash equilibrium: Both firms simultaneously choose quantities.

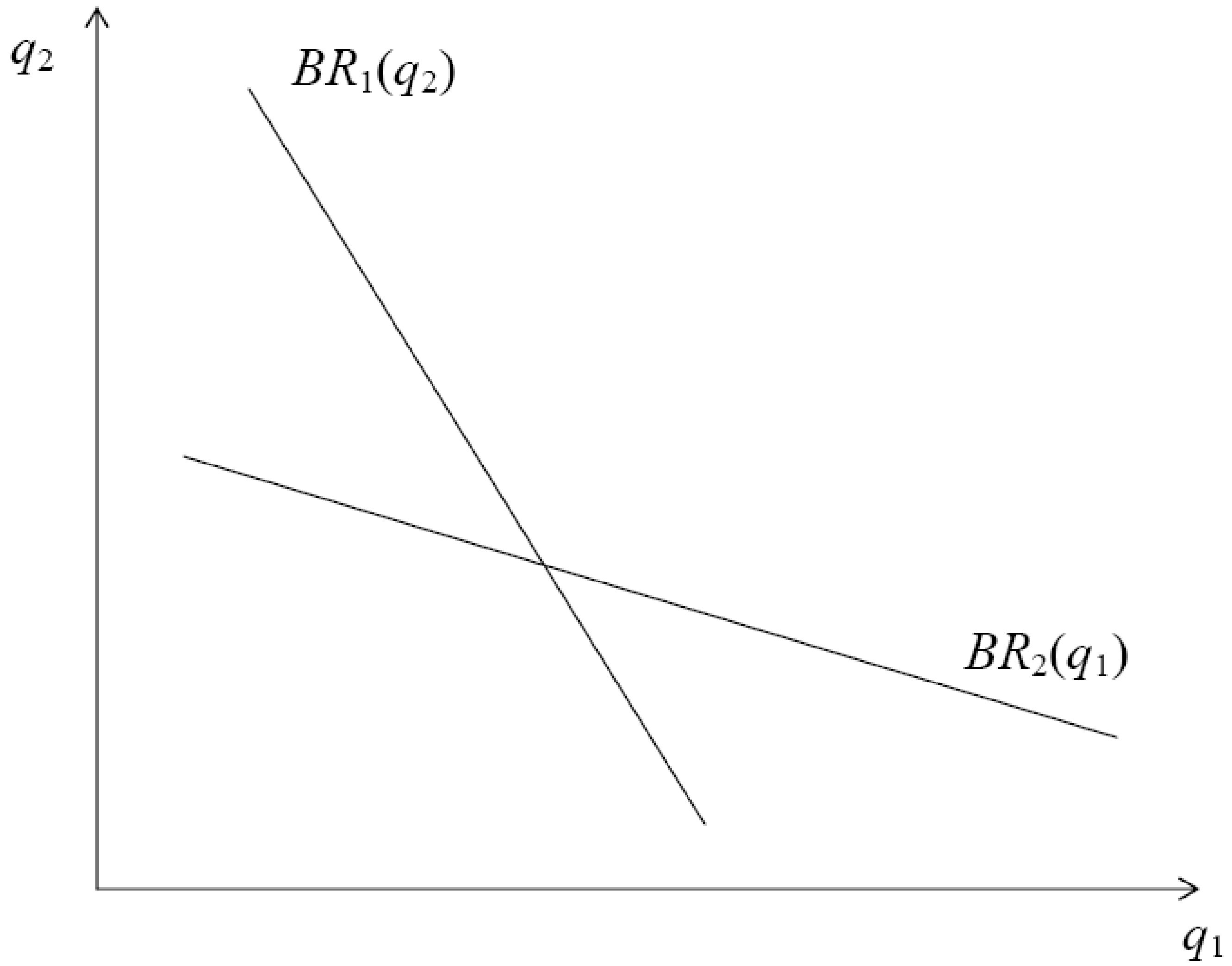
$$\frac{dER^1}{dq_1} = a - b(q_1 + q_2) - c_1 - bq_1 = 0$$

$$\frac{dER^2}{dq_2} = a - b(q_1 + q_2) - c_2 - bq_2 = 0$$

$$\Rightarrow$$

$$q_1 = \frac{a - 2c_1 + c_2}{3b}$$

$$q_2 = \frac{a - 2c_2 + c_1}{3b}$$


q_2
$BR_1(q_2)$
$BR_2(q_1)$
q_1

Aggressive behaviour may be profitable. Must be credible.

How to become more aggressive?
→ lower marginal costs
- investing in new technology
- somehow get lower financing costs (interest costs)

[see e.g. Maksimovic 1995 Handbook of OR & MS, vol.9]

→ committing to be aggressive

Debt financing can make the firm more aggressive:

$$R^1 = [a - b(q_1 + q_2) - c_1 + z_1]q_1$$

$$R_1^1 = \partial R^1 / \partial q_1 = a - 2bq_1 - bq_2 - c_1 + z_1$$

$$R_{11}^1 = -2b < 0$$

$$R_2^1 = -bq_1 < 0 \qquad R_{12}^1 = -b < 0$$

Firms' decisions are *strategic substitutes*

$$R_{z_1}^1 = q_1 > 0 \qquad R_{1z_1}^1 = 1 > 0$$

An increase in the shock z_1 is good *both* for gross profits and for marginal gross profits

Introducing firm *i*'s debt: D_i.

Timing:
Stage 1: Firms choose levels of debt financing, D_1 and D_2.
Stage 2: Firms choose quantities, q_1 and q_2.
"Stage 3": z_i is determined and hence R^i

Profit is positive only if z_i is such that $R^i > D_i$.

Define $\hat{z}_i$ according to:

$$R^i\left(q_i, q_j, \hat{z}_i\right) \equiv D_i.$$

Assumption:

$$\hat{z}_i \in (\underline{z}, \overline{z}).$$

Expected profit of firm *i*:

$$V^i\left(q_i, q_j, D_i\right) = \int_{\hat{z}_i}^{\overline{z}} \left[R^i\left(q_i, q_j, z_i\right) - D_i\right] f\left(z_i\right) dz_i$$

At *stage 2*, firm *i*'s first-order condition is (using Leibniz' formula):

$$V_i^i = \int_{\hat{z}_i}^{\bar{z}} R_i^i(q_i, q_j, z_i) f(z_i) dz_i - \underbrace{\left[R^i(q_i, q_j, \hat{z}_i) - D_i \right]}_{=0} f(\hat{z}_i) \frac{d\hat{z}_i}{dq_i}$$

$$= \int_{\hat{z}_i}^{\bar{z}} R_i^i(q_i, q_j, z_i) f(z_i) dz_i = 0$$

Stage-2 equilibrium quantities, q_1 and q_2, solve the system of equations
$V_1^1 = 0$, and $V_2^2 = 0$.
(The FOCs or reaction functions if you like.)

<u>Key question:</u> How do the equilibrium quantities q_i and q_j respond to an increase in D_i?

Total differentiation:

$$V^i_{ii} dq_i + V^i_{ij} dq_j + V^i_{iD_i} dD_i = 0$$

$$V^j_{ji} dq_i + V^j_{jj} dq_j + V^j_{jD_i} dD_i = 0$$

But:

$$V^j_{jD_i} = 0.$$

the direct effect of the competitors' debt level is zero; D_i does not enter in *j*'s expected profit.

Then rewrite:

$$\begin{bmatrix} V^i_{ii} & V^i_{ij} \\ V^j_{ji} & V^j_{jj} \end{bmatrix} \begin{bmatrix} dq_i \\ dq_j \end{bmatrix} = \begin{bmatrix} -V^i_{iD_i} dD_i \\ 0 \end{bmatrix}$$

Define

$$B = \begin{vmatrix} V^i_{ii} & V^i_{ij} \\ V^j_{ji} & V^j_{jj} \end{vmatrix}$$

Assumption: $B > 0$ (stability).

Solving the system, using Cramer's, we find:

$$\frac{dq_i}{dD_i} = -\frac{V^i_{iD_i} V^j_{jj}}{B}; \qquad \frac{dq_j}{dD_i} = \frac{V^i_{iD_i} V^j_{ji}}{B}$$

Want to find whether these are positive or negative:
Know already that:

$$R^j_{jj} < 0 \Rightarrow V^j_{jj} < 0$$

second-order conditions, and

$$R^j_{ji} < 0 \Rightarrow V^j_{ji} < 0$$

strategic substitutes.

Using Leibniz' twice again, we can show that:

$$V^i_{iD_i} = V^i_{i\hat{z}_i} \frac{d\hat{z}_i}{dD_i}$$

which, starting with the last part:

$$R^i(q_i, q_j, \hat{z}_i) = D_i \;\Rightarrow\; R^i_z d\hat{z}_i = dD_i \;\Rightarrow\; \frac{d\hat{z}_i}{dD_i} = \frac{1}{R^i_z} > 0.$$

which means that an increase in debt narrows the range of z over which the firm earns a profit. Intuitive.

the first part is less intuitive, however:…..

From Leibniz' we have that:

$$V^i_{i\hat{z}_i} = -R^i_i\left(q_i, q_j, \hat{z}_i\right) f\left(\hat{z}_i\right)$$

From simple Cournot analysis, we know that

$$ER^i_i = 0$$

when *i* behave optimally.

We also know, from the set-up, that

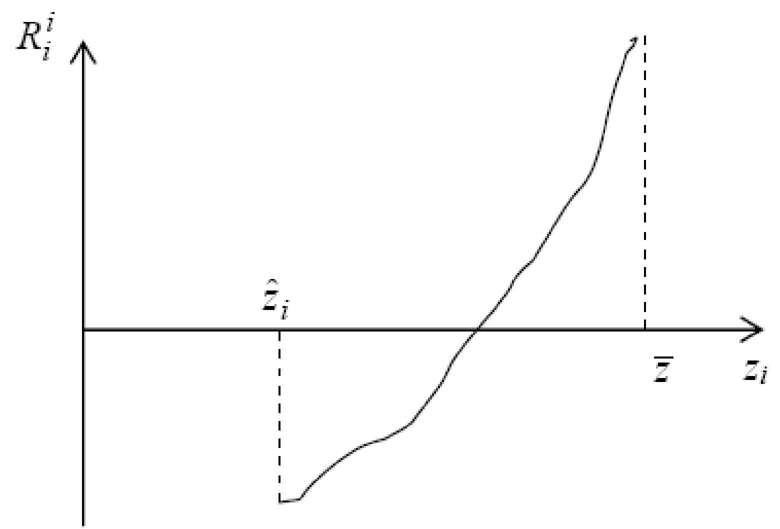
$$R^i_{iz} > 0$$

From this we can conclude that

$$\Rightarrow R^i_i\left(\cdot,\cdot,\hat{z}_i\right) < 0$$

Because: The firm ignores the states where it goes bankrupt (conf. asset substitution effect). It's (then) optimal to choose the q_i that is correct in expectation *given* the truncated interval you care about, namely where you earn money. In this truncated interval $\widehat{z_i}$ is the lower bound. With positive probability over the whole interval, the "truncated-expected" z is higher than $\widehat{z_i}$. Hence, if $\widehat{z_i}$ is realized, you have a too high q_i, in other words:

$$R_i^i\left(\cdot,\cdot,\hat{z}_i\right)<0$$



When the critical value of z increases, the firm's marginal expected profit increases, *i.e.*, the firm becomes more aggressive.

Intuition:
In order for it to have anything left after paying its debt, an increase in the debt level makes the firm more aggressive.

Now we can summarize the analysis of *stage 2*:

$$\frac{dq_i}{dD_i} = -\frac{V^i_{iD_i} V^j_{jj}}{B} > 0; \qquad \frac{dq_j}{dD_i} = \frac{V^i_{iD_i} V^j_{ji}}{B} < 0.$$

Stage 1: The owners negotiate with the creditors the level of debt that maximizes the *total expected value* of the firm:

$$Y^i = \int_{\underline{z}}^{\overline{z}} R^i(q_i, q_j, z_i) f(z_i) dz_i$$

Stage-1 first-order condition for firm *i*:

$$Y^i_{D_i} = \left[\int_{\underline{z}}^{\hat{z}_i} R^i_i(q_i, q_j, z_i) f(z_i) dz_i\right] \frac{dq_i}{dD_i} \quad \} < 0$$

direct effect of increased debt

$$+ \left[\int_{\hat{z}_i}^{\overline{z}} R^i_i(q_i, q_j, z_i) f(z_i) dz_i\right] \frac{dq_i}{dD_i} \quad \} = 0$$

(FOC stage 2)

$$+ \left[\int_{\underline{z}}^{\overline{z}} R^i_j(q_i, q_j, z_i) f(z_i) dz_i\right] \frac{dq_j}{dD_i} \quad \} > 0$$

strategic effect of increased debt

$$= 0$$

At $D_i = 0$, the direct effect is zero, while the strategic effect is positive. Therefore, *some debt is better than no debt.*

Behavioral corporate finance

Relaxes the rationality assumption.

Can be divided in two:

1. Assuming irrational entrepreneurs/managers, but rational investors.
2. Assuming irrational investors, but rational entrepreneurs.

Behavioral assumptions can be used to explain same outcomes as rational, optimizing agents with different objectives, (the agency literature).

We will look at
Landier and Thesmar (2005):

which is of type 1: Assuming irrational entrepreneurs/managers, but rational investors:

By selection entrepreneurs are typically too optimistic about their firm's future – does this have consequences for financial contracts?

Optimistic entrepreneurs will focus more on having control in good states.

A few words about the paper as such:
Not published, yet cited here and there. Arguably because their idea seems plausible and that they have data testable for their hypotheses.
However, the paper has its' flaws and seems immature – as this branch of literature in general.

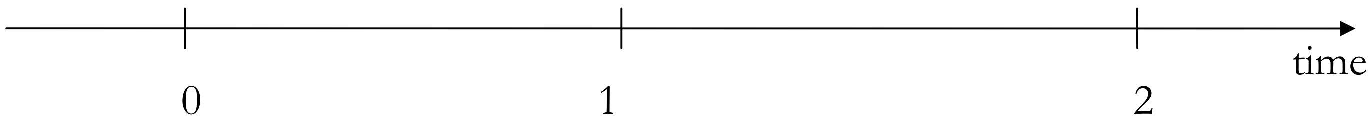
<u>Model:</u>

Two types of entrepreneurs, E: Optimists and realists.

Two types of project: good or bad.

Only debt is possible financing. (realistic for entrepreneurs? yes and no)

Timing:



0: I is invested with short or long term debt

1: E receives interm. cash flow y_1 (signal) and chooses strategy. D_{short} matures.

2: Final cash flow $y_2 =$ L or R, $L<R$. D_{long} matures.

The intermediate cash flow (signal), y_1 , which is *non-contractable*, is either y_1=R or $y_1=0$.

If the project is good, y_1=R with probability 1.

If the project is bad, y_1=R with prob. p and $y_1=0$ with prob. $(1-p)$.
(Hence, if signal is *0*, the project is sure to be bad.)

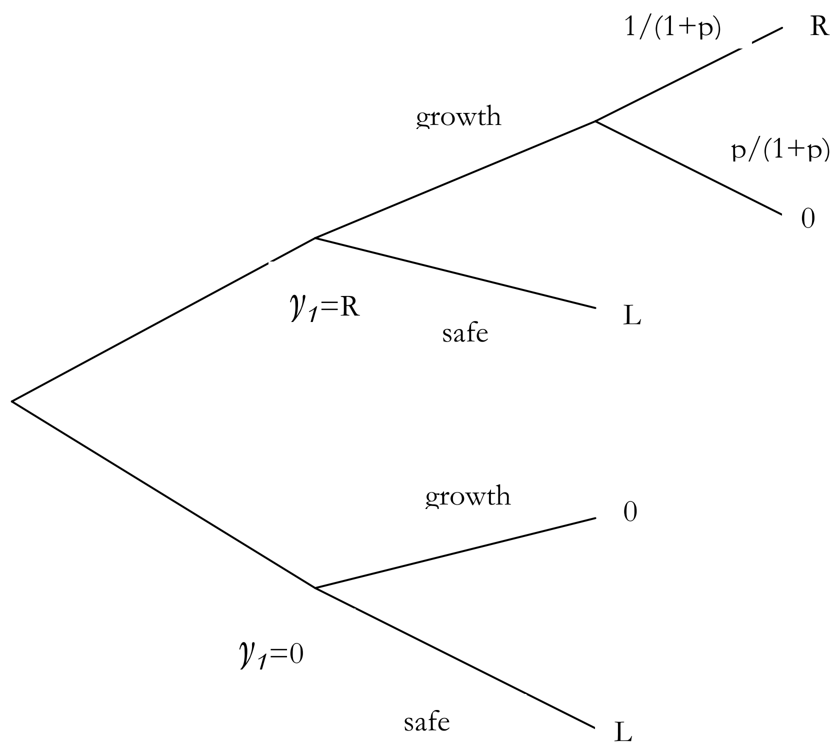
Strategies:
growth or *safe*

Socially optimal strategy choices:

If project is good, *growth* is the best strategy, (because $\frac{1}{1+p}R > L$)

If project is bad, *safe* is the best strategy.

If *safe* is chosen, both project types yield $y_2 = L$.
If *growth* is chosen on a good project, $y_2 = R$.
If *growth* is chosen on a bad project, $y_2 = 0$.


1/(1+p)
R
growth
p/(1+p)
0
y_1=R
safe
L
growth
0
y_1=0
safe
L

Ex ante there are equally many good and bad projects.
All entrepreneurs are risk averse.

Realists have correct priors (i.e. ½)
Optimists have wrong priors, they believe ex ante that their project is *certain* to be good.
(extreme case)

Investors earn/demand zero in expectation (i.e. perfect competition).
They have correct priors and know there are two types of entrepreneurs, but cannot distinguish them ex ante.

Consider the two debt contracts:

Short term: investor invests *I* at t=0 and demands D_{short} at t=1. If at t=1 entrepreneur doesn't have enough money to pay $D_{short,}$ investor gets control and chooses *safe* and gets *L* at t=2.

By assumption $L>I$. So, given that investors (because of competition) only demands to earn zero in expectation, it follows that $D_{short}<I$.

Long term: investor invests *I* at t=0 and demands D_{long} at t=2.

Given that investors (because of competition) only demands to earn zero in expectation, it follows that $D_{long}=I$ because investors are sure to get $D_{long}=I$ at t=2 if the correct strategy is chosen.

What debt contract will the two entrepreneur types choose? Will they self-select into a separating equilibrium?

Yes,

Optimists are sure they have a good project and are ex ante sure the intermediate cash flow at t=1 is more than enough to pay $D_{short.}$ Because $D_{short} < D_{long} = I$, optimists will choose the short term contract.

Realists won't choose D_{short} even though $D_{short} < D_{long} = I$, because they know they risk having zero payoff from the whole project if $y_1 = 0$ and investor takes control. With D_{long} realists avoid the possibility of getting 0 from the whole project (happens with D_{short} if $y_1 = 0$). This is better than the contract D_{short} because of risk aversion (even though $D_{short} < D_{long} = I$).

More technicalities come in Lecture7.