Competition, Incentives, and Governance

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Competition and Efficiency

- The idea that competitive pressure forces firms to be efficient goes back to Adam Smith and has also been discussed by John Hicks.
- Leibenstein (1966) introduced the concept of "X-inefficiency" to restate the idea that the "quiet life" of monopoly power introduces inefficiency.
- Yet, this idea is surprisingly difficult to nail down, both theoretically and empirically.

Brief Overview of Evidence

- Nickell (1996), using data on 700 UK manufacturing firms, find some evidence that the larger the market share, the lower firm's productivity levels.
- There is some evidence that an intermediate level of competition is best for productive efficiency (Caves and Barton (1990) using US data, Green and Mayes (1991) for UK data.
- Darwinian Selection: Competition will cause inefficient firms to exit and efficient firms to replace them. As a result, *industry productivity* will increase.
- Olly and Pakes (1996) study the impact of deregulation in the US Telecom industry during 1963-87 and conclude that productivity growth in the industry resulted from such Darwinian selection.

A Role for Governance?

- To some extent, the role of competition is to discipline managers and eliminate agency problems.
- Competition can discipline managers, but can also destroy incentives.
- Is more competition likely to be more effective in poorly governed firms, or in well governed firms?
- This question is not well-answered in the literature.
- Giroud and Mueller (2010, 2011) find that when managers get more entrenched, firm value and performance are adversely affected only in uncompetitive industries.

Raith, 2003

Key Intuition: Even in owner-managed firms and without agency problems, whether more competition creates incentives for effort (e.g. cost reducing effort) depends on how change in competition is modelled.

Consider the profit function of a firm

$$\pi_i = (p_i - c_i)q(p_i, \overline{p}_{j \neq i})$$

where $\overline{p}_{j \neq i}$ is a vector of prices of all other firms.

Firm i chooses p_i to maximize π_i.

- Consider now the effect of a cost reduction. Using the envelope theorem, this is given by

$$\frac{d\pi_i}{dc_i} = -q(p_i, \overline{p}_{j\neq i}).$$

- Thus, in equilibrium, the benefit of cost reduction is positively related to the equilibrium output.
- Raith considers 3 ways in which competition can increase. (Importantly, the number of firms is not one of these, as it is an endogenous variable in a free-entry/exit equilibrium.)
- The incentives such changes in competition create are related to whether, in equilibrium, output is higher or lower.

- Greater product substitutability: In free entry equilibrium this leads to lower N but higher q. So incentives for cost reduction increase.
- Change in market size: new firms enter and each firm also producs more. So incetives for cost reduction increase.
- Decrease in entry costs: New firms enter and firm-level output falls, leading to lower incentives for cost reduction.

Klaus Schmidt, Managerial Incentives and Product Market Competition, Review of Economic Studies, 1997, pages 191-213

- Manager can exert effort to reduce production cost.
- Cost c can be either high (c^H) or low (c^L), $c^H > c^L$.
- Effort leads to the low cost outcome with probability p.
- Without loss of generality, assume mananger chooses p at a cost $G(p)$.
- $G'(p) > 0, G''(p) > 0, G(0) = G'(0) = 0, \lim_{p \to 1} G' = \infty$.
- Manager chooses effort at date 0, and costs are realized at date 1.
- "Market game" starts at date 1.

Competition

- For now, we do not explicitly model the market game.
- Will examine specific settings later.
- Profit depends on the realized cost c, the degree of competition ϕ, and realized uncertainty ε

$$\pi = \pi(c, \phi, \varepsilon) \tag{1}$$

- The degree of competition may depend on the number of competitors, their costs, whether the competition is in prices or quantities etc.
- For convenience, assume $\phi \in \Phi \subset \mathbb{R}$ is a continuous variable.

The firm is liquidated if $\pi(c, \phi, \varepsilon) < 0$.

Assumption 1.

$$
\begin{aligned}
&\text{(a)} \quad \pi(c^L, \phi, \varepsilon) > \pi(c^H, \phi, \varepsilon) \\
&\text{(b)} \quad \pi(c^L, \phi, \varepsilon) \geq 0 \ \forall \phi \in \Phi, \ \varepsilon \in \mathbb{R} \\
&\text{(c)} \quad \frac{\partial \pi(c^j, \phi, \varepsilon)}{\partial \phi} < 0 \ \forall j \in \{L, H\}, \varepsilon \in \mathbb{R}
\end{aligned}
$$

The firm is never liquidated if the cost reduction effort is successful.

Moreover, if the degree of competition increases, profits go down.

- Managers and shareholders are both risk neutral. However, the manager is wealth constrained and faces limited liability.
- Shareholder's payoff is

$$U^P = \text{Max}\left\{0, \pi(c, \phi, \varepsilon)\right\} - w$$

where w is the wage paid to manager. The manager's payoff if the firm stays in the market is

$$U^m = w - G(p)$$

and if it is liquidated, the payoff is

$$U^m = w - G(p) - L^m$$

There can be a rich set of interpretations of the cost borne by managers in liquidation. We will discuss these later.

- Let $l(\phi)$ denote the probability the manager assigns to liquidation, conditional on $c = c^H$.
- Denote by $\Pi^L(\phi)$ and $\Pi^H(\phi)$, respectively, expected profit conditional on low and high cost being realized.
- The shareholder's optimization problem is

$$\text{Max}_{p,w^L,w^H}\ p(\Pi^L - w^L) + (1-p)(\Pi^H - w^H)$$

subject to

$$\begin{aligned}
\text{(IC)}\quad & p \in \arg\max \\
& p'w^L + (1-p')w^H - G(p') - (1-p')lL^m \\
\text{(PC)}\quad & pw^L + (1-p)w^H - G(p) - (1-p)lL^m \geq \underline{U}^m \\
\text{(WC)}\quad & w^L, w^H \geq 0.
\end{aligned}$$

- Note that since the manager's objective function in (IC) is concave in p, we can replace (IC) by the first-order condition

  (IC')

$$G'(p) = w^L - w^H + IL^m.$$

- We will call the solution to the shareholder's problem the second-best and denote the corresponding p by p^{SB}.
- For comparison, the first-best solution (the one the shareholders could impose on the manager if effort could be observed) is

$$\arg\max\ p\Pi^L + (1-p)\Pi^H - G(p) - (1-p)IL^m$$

- that is

$$G'(p^{FB}) = \Pi^L - \Pi^H + IL^m.$$

Observation: At the optimal solution, $w^L > w^H = 0$.

Why? Suppose otherwise. The shareholders can always increase w^L and lower w^H keeping the expected wage $pw^L + (1-p)w^H$ unchanged. Since the manager can always choose the same p as before, his participation constraint (PC) will be satisfied for the same p. However, increasing $w^L - w^H$ will then raise the marginal benefit from effort above the marginal cost (which remains unchanged if p does not change), so he will be better off increasing effort and PC will be satisfied. Since the shareholders can get higher effort at the same cost, they will be better off. This can go on until w^H hits the lower bound of 0.

We require two further assumptions.

- *Assumption 2.*

$$2G''(p) + pG'''(p) > 0.$$

This assumption ensures that the shareholder's optimization problem is globally concave and has a unique solution.

- *Assumption 3.*

$$\underline{U}^m + G(p^{FB}) + (1 - p^{FB})lL^m < p^{FB}(\Pi^L - \Pi^H).$$

What is the need for the latter condition? It ensures that the firm cannot be sold to the manager and the first-best achieved (since the manager is risk neutral, he will choose the first-best if he is the residual claimant). This requires that the profit in the high-cost state is less than the social surplus, that is

$$\Pi^H < p^{FB}(\Pi^L - \Pi^H) + \Pi^H - G(p^{FB}) - (1 - p^{FB})lL^m - \underline{U}^m$$

which is the same as the above condition.

- Now we characterise the second-best solution. First, notice that the IC' condition (with $w^H = 0$) implies

$$w^L = G'(p) - lL^m.$$

- The manager receives his reservation utility provided

$$\begin{aligned} & pw^L - G(p) - (1-p)lL^m \\ = \; & p(G'(p) - lL^m) - G(p) - (1-p)lL^m \geq \underline{U}^m \end{aligned}$$

or

$$pG'(p) - G(p) \geq \underline{U}^m + lL^m$$

- The derivative of the left-hand-side w.r.t. p is $pG''(p) > 0$. Moreover, it is zero for $p = 0$ and goes to infinity as $p \to 1$.

Thus, there is some $p = p_-$ for which the equality holds and the manager gets exactly his reservation utility. We have:

$$p_- G'(p_-) - G(p_-) = \underline{U}^m + IL^m$$

- Now consider the shareholder's optimal p subject only to IC and WC. This is given by

$$\begin{aligned} p^* &= \arg\max_p p\Pi^L + (1-p)\Pi^H - pw^L \\ &= \arg\max_p p\Pi^L + (1-p)\Pi^H - p(G'(p) - IL^m) \end{aligned}$$

Differentiating, p^*satisfies

$$\Pi^L - \Pi^H + IL^m = G'(p^*) + pG''(p^*)$$

It follows that if $p^* > p_-$, the manager's PC constraint is satisfied at $p^*$and then this is the second-best. However, if $p^* < p_-$, the p that is cloest to $p^*$and satisfies PC is p_-. Hence

Proposition 1. The optimal contract implements $p^{SB} = \max\{p_-, p^*\}$ and sets $w^H = 0$ and $w^L = G'(p^{SB}) - lL^m$.

Observation 1. $p^{SB} < p^{FB}$ (left as an exercise).

Corollary 1. The second-best effort level is increasing in the cost of liquidation, L^m.

Proof: Immediate from $G'' > 0$ assumption A2.

Interpretations:

- Governance
  - The ability of the manager to find another job subsequent to liquidation may depend on whether the board is willing to "protect" the manager's reputation.
  - If the board is "friendly" (less independent) it may allow the manager to stay on until he finds another job (before the outcome of effort is publicly revealed) and make the departure appear voluntary (low L^m).
  - If the board is more independent, it will fire the manager as soon as the outcome is known (high L^m).
  - Thus, the manager will exert more effort if the board is more independent.

- Debt Renegotiation
  - If the firm has debt, and the debt can be renegotiated to avoid liquidation, L^m will be lower.
  - Bank debt can be renegotiated more easily than public debt.
  - Bank debt can soften he incentives of the manager to exert effort.

Proposition 2.

1. If $p^* > p_-$, an increase in L^M increases shareholder payoff, and lower that of the manager if $G''' \geq 0$. If $G''' < 0$, the latter effect is ambiguous.
2. If $p^* < p_-$, an increase in L^M does not affect manager's payoff, and the effect on shareholder payoff is ambiguous.

Interpretation:

- Note that the level of $\underline{U}^m$ does not affect p^* but p_- is increasing in $\underline{U}^m$.
- Thus, a higher cost in liquidation only disciplines managers with weak outside opportunities (or those who enjoy "rents" in the company relative to what they would get outside).
- Turnover would be low in such markets, and managers would get entrenched.

Competition:

Competition is assumed to affect the probability of liquidation in the high-cost state.
Specifically, assume $\frac{dl(\phi)}{d\phi} \geq 0$.
The following is easy to derive:

Proposition 3.

$$\frac{dp^*}{d\phi} = \frac{\left(\frac{\partial \Pi_L}{\partial \phi} - \frac{\partial \Pi_H}{\partial \phi}\right) + \frac{dl(\phi)}{d\phi} L^m}{2G''(p*) + p^* G'''(p^*)}$$

and

$$\frac{dp_-}{d\phi} = \frac{\frac{dl(\phi)}{d\phi} L^m}{p_- G''(p_-)}$$

Discussion:

- There are two effects of more competition. One is only present when PC is not binding.
- There is always positive effect on effort incentives via the greater likelihood of liquidation.
- The second affects the "value of cost reduction" and need not be positive.
- In fact, it is more likely to be negative since in the high-cost state, the firm always has the option of liquidation for some realizations of ε.

- Suppose $\pi(c^L)$ is in the range $[50, 30]$ and $\pi(c^H)$ is in the range $[20, -10]$ but because of liquidation option, it will be in the range $[20, 0]$. ε is uniform so the distribution is uniform and $\Pi^L = 40$, and $\Pi^H = 13.33$. More competition reduces profit in every state by 15. Then $\Pi^L = 20$ and $\Pi^H = 3.33$. The gain in profit from cost reduction is lower when competition is greater ($\Pi^L - \Pi^H$ goes from $40 - 13.33 = 26.67$ to $20 - 3.33 = 16.67$.).

Interpretations

- Suppose the firm has some debt.
  - Even when default does not lead to a loss of a job for the manager (e.g. the firm goes into bankruptcy and comes out healthy), employees,customers,suppliers could leave the firm if the probability of liquidation increases.
  - In this case, Π^H is more adversely affected by competition than Π^L, and $\left(\frac{\partial \Pi_L}{\partial \phi} - \frac{\partial \Pi_H}{\partial \phi}\right)$ is likely to be positive even if L^m is zero.
- There is nothing in the model above to suggest that ϕ only captures competition.
  - Suppose a higher ϕ represents more debt (higher leverage).
  - More debt increases the likelihood of liquidation and incentivises more effort.

- Governance and Competition complement each other.
- The effect of $\frac{dI}{d\phi}$ is larger if L^m is higher. Recall earlier discussion that L^m could be higher for a more independent board.
- How does this fit with the findings in Dasgupta, Li and Wang (2018)?
- DLW find that more competition (tariff cuts) leads to higher turnover of CEOs – but the effect is stronger for poorly governed firms.
- The effect of L^m on p^{SB} is also higher if $I(\phi)$ is higher, that is, competition is more intense (or the firm has more debt).
- How does this last point fit with the findings in Giroud and Mueller (2010, 2011)?

- Interpretation: We noticed earlier (and confirmed empirically in DLW) that poorly governed firms are less productive and thus more likely to liquidate when competition becomes more intense.
- Consider the board as the agent – the board chooses effort p to find a replacement manager who can run the firm at a lower cost c^L.
- The board suffers a reputational cost L^m if the firm liquidates.
- The board could be paid a bonus w^L if it succeeds.
- In more productive good governance firms that are far from default under current management, $\frac{dl}{d\phi}$ is small, but it is larger in poorly governed firms.
- So the board chooses higher effort to avoid the liquidation cost L^m in poorly governed firms.

Dasgupta, Li and Wang (2018)

- Existing empirical evidence on how more competition affects firm performance/efficiency is limited and mixed.
- One channel through which competition can affect firm performance is through CEO replacement.
- The threat of liquidation could cause boards to get rid of poor quality CEOs and find replacements who can improve efficiency and increase survival likelihood.
- DLW examine how competition shocks affect CEO turnover, CEO incentive compensation, and subsequent firm performance.
- They use major tariff cuts to US industries to capture competition shocks.

- The estimation method is a “stacked DID”: treated firms are those in the industry that experiences a major tariff cut and control firms are those that have not been treated previously.
- Each cohort comprises of treated and control firms going back 3 years prior to the event and until 3 years after the event.
- Main Findings:
  1. Both CEO turnover and the sensitivity of turnover to firm performance increase in the 3 years after the tariff cut.
  2. The effects are limited to firms that are poorly governed.
  3. Incentive compensation for CEOs increases in well governed firms.
  4. Replacement CEOs have track records of cost cutting, selling assets.
  5. Performance improves after CEO dismissals.

Examples: Three Market Games

Fixed Costs in Cournot Oligopoly

- Each firm has a sunk cost c^i that has to paid prior to production, and constant marginal cost of production k
- Effort reduces fixed costs
- Cournot profits are

$$\Pi_i = \pi_i - c^i = \left(\frac{A-k}{\phi+1}\right)^2 - c^i$$

where the number of firms is ϕ.

- If ϕ increases, the profits fall. Assume that liquidation becomes more likely if the sunk cost is high and the firm makes a loss.
- Clearly, $\frac{\partial \Pi_i^L}{\partial \phi} - \frac{\partial \Pi_i^H}{\partial \phi} = 0$, so effort is increasing in ϕ even when PC is not binding.

Price-Cap Regulation

- Consider a monoploy with marginal cost c^j.
- A reulator sets a price cap – denote this by $\frac{1}{\phi}$.
- We interpret a lower price cap (higher ϕ) as more competition – it leads to a higher probability of liquidation.
- Let $D(1/\phi)$ denote demand.

$$\pi(c^i, \phi) = D(1/\phi)(\frac{1}{\phi} - c^i).$$

- Differentiation w.r.t. ϕ

$$\frac{\partial \pi}{\partial \phi} = -\frac{1}{\phi^2}\left[D'(1/\phi)(\frac{1}{\phi} - c^i) + D(1/\phi)\right]$$

- Thus,

$$\frac{\partial \pi(c^L, \phi)}{\partial \phi} - \frac{\partial \pi(c^H, \phi)}{\partial \phi} = \frac{1}{\phi^2} D'(1/\phi)(c^L - c^H) > 0.$$

- Even if $I(\phi) = 0$, here more competition (a tighter price cap) leads to more effort when PC is not binding.

Bertrand Competition with Increasing Number of Competitors

- First, consider a Monopolist. $\Pi^L(M)$ and $\Pi^H(M)$ denote the profits of the monopolist, with $\Pi^L(M) > \Pi^H(M) > 0$.
- There is no uncertaintly, so the firm is lever liquidated.
- Assume $\underline{U}^m = 0$.
- Effort cost is

$$G(p) = \frac{1}{4K} p^2.$$

- The second-best effort is

$$G'(p^*) + p^* G''(p^*) = \Pi^L(M) - \Pi^H(M)$$

or

$$p^* = K \left[\Pi^L(M) - \Pi^H(M) \right].$$

Now, we consider 2 firms (Duopoly) and assume the cost-reduction is "drastic", so that if only one firm is successful, it can earn monopoly profit $\Pi^L(M)$. If both are successful or unsuccessful, they earn zero profit.

- The expected profit of firm i if it is successful is $\Pi^L = (1 - p^j)\Pi^L(M)$ and zero if unsuccessful
- Thus

$$G'(p^*) + p^* G''(p^*) = (1 - p^j)\Pi^L(M) + p_j L^m$$

- We have

$$p_i = K[(1 - p_j)\Pi^L(M) + p_j L^m].$$

- Solving for the unique symmetric Nash Equilibrium

$$p = K\left[(1-p)\Pi^L(M) + pL^m\right].$$

$$p_1^*(D) = p_2^*(D) = \frac{K\Pi^L(M)}{K\Pi^L(M) + 1 - KL^m}.$$

- Thus, effort under Duopoly is higher than under Monopoly if and only if

$$K\left[\Pi^L(M) - \Pi^H(M)\right]\left[\Pi^L(M) - L^m\right] < \Pi^H(M)$$

- Thus, effort under Duopoly is higher than under Monopoly if
  1. The cost of liquidation (which now becomes "real" under Duopoly) is sufficiently high
  2. The gain from higher effort under Monopoly $\left[\Pi^L(M) - \Pi^H(M)\right]$ is sufficiently small
  3. The effort cost function is more convex $(G'' = (1/2K))$, so that K is small.

Consider next the case with $N > 2$ firms.

- As before, if firm i is successful in reducing costs when other firms are not, it becomes a Monopolist.
- If any other firm is successful, it gets zero profit. Thus,

$$G'(p^*) + p^* G''(p^*) = \prod_{j \neq i} (1 - p_j^*) \Pi^L(M) + (1 - \prod_{j \neq i} (1 - p_j^*)) L^m. \tag{2}$$

We now show by contradiction that if $\Pi^L(M) > L^m$, then it must be the case that $p^*(N) < p^*(N-1)$.

Suppose not, i.e., $p^*(N) > p^*(N-1)$.So $(1 - p^*(N)) < (1 - p^*(N-1))$, and $(1 - p^*(N))^{N-1} < (1 - p^*(N-1))^{N-2}$. Therefore, since $\Pi^L(M) > L^m$

$$\begin{aligned} & (1 - p^*(N))^{N-1}\Pi^L(M) + (1 - (1 - p^*(N))^{N-1})L^m \\ < \quad & (1 - p^*(N-1))^{N-2}\Pi^L(M) + (1 - (1 - p^*(N-1))^{N-2})L^m \end{aligned}$$

By Assumption 2 and Equation (2), this implies that $p^*(N) < p^*(N-1)$ – a contradiction.

Thus, as N increases from the value of 2, while the threat of liquidation increases since the probability that at least one competitor is successful in cost-reduction goes up, the probability that a firm will be a Monopolist goes down. When $\Pi^L(M) > L^m$, the latter effect dominates.