Economics of Industrial Organization

Lecture 12: Mergers

Mergers

- Thus far we have talked about industry dynamics in terms of firms entering and exiting the industry, and have assumed that all these firms have remained completely separate.
- In reality, many changes in industry concentration are caused by the merger of two firms, rather than by a firm just exiting the market.
- This leaves us with a key question: why do firms merge? Are they beneficial or harmful?
- Cost savings? Better pricing/service? Creating cartels?
- Depending on the motivation, mergers could be beneficial or harmful to society. So policymakers need to be able to distinguish between these.

Types of Mergers

- Horizontal mergers: mergers of firms competing in the same product market; the pre-merger firms produce goods that consumers view as substitutes. Eg: two electricity generators merge, or two car manufacturers merge.
- Vertical mergers: mergers of firms at different stages in the vertical production chain, where the pre-merger firms produce complementary goods. i.e., a firm and its supplier merge. Eg: an electricity generator and an electricity distributor merge. Or a farm company merges with a meat processing company. Or two railway companies that served adjacent but non-overlapping markets.
- Conglomerate mergers: mergers of firms without either clear substitute or complementary relationship. Eg: purchase of a bank by an aircraft manufacturer.

Horizontal Mergers and the Merger Paradox

- Horizontal mergers replace two or more competitors with a single firm. The merger of two firms in a three-firm market creates a duopoly; the merger of two firms in a duopoly creates a monopoly. So clearly there is some scope for mergers to be profitable in the horizontal case.
- But it turns out that it is actually quite difficult to construct a simple model where there are sizable gains for firms participating in a horizontal merger that is not a merger to monopoly (i.e. there remain two or more firms post-merger). This is known as the ***merger paradox***. If increased profits from mergers are small, and merger costs are significant, why do firms merge?

- Consider a simple example: suppose we have have 3 firms with constant MC = c = 30, facing an industry demand curve P = 150 – Q. Cournot equilibrium results in each firm producing (150 – 30)/4 = 30, so total output is 90. Price is 60, and each firm earns profit of 30(60-30) = 900.
- What if two of these firms merge? In the wake of a two-firm merger, the industry will become one with two firms. The Cournot duopoly equilibrium results in each firm producing (150-30)/3 = 40, so total output falls to 80, and the price rises to 70 and firm profits rise to 1600.
- Impacts of the merger:
  Bad for consumers: output falls and prices rise.
  Good for the non-merging firm: profit rises 900 -> 1600.
  Bad news for merging firms: combined profit falls 1800 -> 1600.
- So, not rational for the firms to merge.

- The preceding example is not a special case; it is easy to show that a merger will almost certainly be unprofitable in the basic Cournot model whether it is between two firms or more than two firms, as long as it does not create a monopoly.
- Suppose we have N > 2 firms in a Cournot game. Firms have identical cost structures with constant MC = c. Market demand is linear, given by $P = A – BQ = A – B(q_i + Q_{-i})$.
- Profits for firm i are: $\pi_i(q_i,Q_{-i}) = q_i[A - B(q_i + Q_{-i}) – c]$
- In Cournot, firms choose outputs simultaneously to maximize profits, and the resulting equilibrium profit is: $\pi_i^C = (A – c)^2/[B(N+1)^2]$
- Suppose that $M \geq 2$ firms decide to merge. These leads to an industry with N – M + 1 firms in the industry.
- The new merged firm is just like every other firm in the industry, and will choose the same post-merger output as every other firm.

- So, post-merger we have:
  $q_m^C = q_{nm}^C = (A - c)/[B(N - M + 2)]$
  $\pi_m^C = \pi_{nm}^C = (A - c)^2/[B(N - M + 2)]$
- There is a free-riding opportunity afforded to non-merging firms; a non-merging firm gets an increase in profit from the decrease in the number of competitors.
- In order for the merged firms profit to be greater than their aggregate pre-merger profit, it must be that:
  $(A - c)^2/[B(N - M + 2)] > M(A - c)^2/[B(N+1)^2]$
  which requires that
  $(N + 1)^2 > M(N - M + 2)^2$
- This requirement is not a function of any demand parameters or costs, so it holds true for all linear demand curves/constant MC cost functions.
- This condition is very difficult to satisfy as long as the merger does not end up creating a monopoly. In particular, no two-firm merger is ever profitable for N > 3.

Other Reasons for Mergers

- Stylized facts suggest that mergers are commonplace.
- Thus, need to examine what features of the simple model is wrong in order to explain why we observe mergers occurring.
- Cost synergies: fixed costs, variable costs.
- Merged firm as Stackelburg leader.
- Product differentiation
- Firm-specific assets/capacity
- Transaction cost issues.
- Principal/agent issues.

Mergers and Cost Synergies

- In developing the merger paradox we assumed that all firms had identical costs, and that there are no fixed costs. What if we relax these assumptions?
  If a merger creates sufficiently large cost savings it should be profitable.
- Suppose the market contains 3 Cournot firms. Demand is P = 150 – Q.
- Two of the firms are low-cost firms with a MC = 30, so total costs are given by: $C_1(q_1) = f + 30q_1$; $C_2(q_2) = f + 30q_2$
  The third firm is a potentially high-cost firm with total costs given by:
  $C_3(q_3) = f + 30bq_3$
  where $b \geq 1$ is a measure of cost disadvantage.

Merger reduces Fixed Costs

- Consider first the case where b = 1, so all three firms are in fact identical. Suppose however that after a 2-firm merger, the merged firm has fixed costs *af* with $1 \leq a \leq 2$.
- What this means is that the merger allows the merging firms to economize on fixed costs, by saving on overhead costs, combining HQs, eliminating unnecessary overlaps, combining R&D functions, and avoiding duplicated marketing efforts.
- Because the merger leaves marginal costs unaffected, this is similar to our first example, but now with fixed costs. Recall that pre-merger firms earn a profit of \$900 – f. In the most-merger 2-firm market, one firm earns a profit of \$1600 – f, while the merged firm earns \$1600 – *af*. So for the merger to be profitable, it must be that $1600 - af > 1800 - 2f$ i.e. that $a < 2 - 200/f$.
- So the merger is more likely to be profitable when fixed costs are relatively high and the merger gives large fixed cost savings.

Merger reduces Variable Costs

- Now consider the case where the source in cost savings is a reduction variable costs, i.e. we assume $b > 1$.
- Firm 3 is a high variable cost firm, but after merging with a low-cost firm it gains access to low-cost production techniques (by shutting down or redesigning inefficient operations). To simplify matters, we assume $f = 0$.
- Outputs and profits prior to the merger are:
  $q_1^c = q_2^c = (90 + 30b)/4$ $\qquad$ $q_3^c = (210 - 90b)/4$
  $\pi_1^c = \pi_2^c = (90 + 30b)^2/16$ $\qquad$ $\pi_3^c = (210 - 90b)^2/16$
  ie low cost firms produce larger quantities and get higher profits than the high cost firm.
- Pre-merger price and output are:
  $P^C = (210 + 30b)/4$ $\qquad$ $Q = (390 - 30b)/4$

- Now suppose that firms 2 and 3 merge. All production will be transferred to firm 2's technology. So the market now contains two identical firms, 1 and 2, each with MC = 30.
- So post merger, each firm produces q = 40, p = 70, π = 1600.
- For the merger to be profitable, it must be that:
  $1600 - (90 + 30b)^2/16 - (210 - 90b)^2/16 > 0$
  ie $25/2(7 - 3b)(15b - 19) > 0$.
- If $7 - 3b \leq 0$, then clearly $q_i^c = (90 + 30b)/4 < 0$. So it must have been that 7 – 3b in order for firms to be in the market.
- So the relevant term is (15b – 19). If b > 19/15, then the merger is profitable.
- So a merger between a low-cost and high-cost firm will be profitable provided that the cost disadvantage of the high-cost firm prior to the merger is large enough.

- Note that in all of these models, prices rise and quantities fall, so consumers are made worse off by the mergers. Mergers are increasing the market power of firms, which reduces consumer surplus. We should be skeptical about cost-savings leading to gains for consumers from mergers.

- Empirical evidence suggests that merger-related productivity gains (i.e. marginal cost reductions) are positive but small, typically 1-2%. (Lichtenberg and Siegel 1992, Maksimovic and Phillips 2001).
- Evidence also suggests that fixed cost savings are small. (Salinger 2005).
- In all these models, part of the paradox remains since firms that do not merge gain larger benefits than the firms that do merge, so there are strong incentives to free-ride.

Merged firm as Stackelburg Leader

- Another possible way of solving the merger paradox is to consider some feature that gives the merged firm an advantage over its non-merging rivals.
- One possibility is that merged firms become Stackelburg leaders in the post-merger market. This is a plausible interpretation; a Stackelburg leader's advantage comes from its ability to pre-commit to higher output, and two exist firms already produce higher output, and if output levels are costly to adjust (eg because of sunk cost capacity levels) then a higher output level could be seen as a credible commitment.
- Suppose that demand is linear, $P = A - BQ$. There are N+1 firms in the industry, and each of the N+1 firms has constant $MC = c$. The pre-merger equilibrium is:
  $q_i = (A - c)/[(N+2)B]$ which implies
  $Q = [(N+1)(A-c)]/[(N+2)B]$ $P = [A + (N+1)c]/(N+2)$
  $\pi_i = (A - c)^2/[(N+2)B]^2$

- Suppose now that two of the firms merge, and become a Stackelburg leader. There will then be F = N-1 follower firms, and one leader firm.
  In stage one, the leader firm chooses its output Q^L. In the second stage, the follower firms simultaneously choose their out levels q_f. We use $Q_{F\text{-}f}$ to denote the output of all follower firms other than firm f.
- So aggregate output $Q = Q^L + Q_{F\text{-}f} + q_f$
  The residual demand for firm f (ie demand left after taking into account leader output and all other follower output) is
  $P = [A – B(Q^L + Q_{F\text{-}f})] – Bq_f$
- Equating this with marginal cost (or solving firm f's profit maximization problem) gives the best response for firm f:
  $A – 2Bq_f – BQ^L – BQ_{F\text{-}f} = c$
  $q_f^* = (A\text{-}c)/2B – Q^L/2 – Q_{F\text{-}f}/2$
- Imposing symmetry (ie that all N-1 follower firms produce the same output) means that $Q_{F\text{-}f}^* = (N – 2)q_f^*$

- Substituting this into the follower's best response gives the optimal output for each follower firm as a function of the output of the merged firm:
  $q_f^* = (A-c)/(BN) – Q^L/N$
- This means aggregate output of all followers as a function of merged firm output is:
  $Q^F = (N-1)q_f^* = (N-1)(A-c)/(BN) – (N-1)Q^L/N$
- We can use the same technique to determine output for the leader firm in stage 1. The residual demand function for the leader firm is the industry demand function less the demand of all the follower firms, which we just found. So the residual demand for the leader is:
  $P = A – B(Q^F + Q^L)$
  $= A – B[(N-1)(A-c)/(BN) – (N-1)Q^L/N] – BQ^L$
  $= A – (N-1)(A-c)/N – (B/N)Q^L$.
- Marginal revenue for the leader is:
  $MR_L = A – (N-1)(A-c)/N – 2(B/N)Q^L$
- Equating this with MC lets us solve for optimal leader output:
  $MR_L= c$ -> $Q^L = (A-c)/2B$

- This implies the following industry equilibrium values:
  $q_f^* = (A\text{-}c)/(2BN)$ $\quad\quad$ $Q^F = (N\text{-}1)(A\text{-}c)/(2BN)$
  $Q = Q^L + Q^F = (2N\text{-}1)(A\text{-}c)/(2BN)$
  $P = [A + (2N\text{-}1)c]/(2N)$
- Profits for leader and follower firm are then:
  $\pi^L = (A\text{-}c)^2/(4BN)$
  $\pi^F = (A\text{-}c)^2/(4BN^2)$
- Compare this to pre-merger profit:
  $\pi_i = (A - c)^2/[(N+2)B]^2$
  For any N >2, a two-firm merger that creates a Stackelburg leader will be profitable.
- However, non-merging firms (who have become followers) are worse off as a result of the merger. So we should consider some further response from these firms.
  We can also note that while the merger has raised the profits of merging parties, it has lowered prices, and so the merger was good for consumers.

- We should consider the response of other firms to the merger. Since leadership confers additional profits, other firms will also have an incentive to merge and try to become a leader.
- So we should consider what will happen if there is a second or third two-firm merger.
  Suppose we assume that any firms that merge become members of a “club” of Stackelburg leaders. So merged firms simultaneously choose quantities in stage 1, and then non-merging firms choose quantities in stage 2.
- We can analyze this using the same model from above.

Horizontal mergers and product differentiation

- Here we consider two changes to our previous Cournot analysis; we introduce product differentiation, and we shift to a price-setting (Bertrand) environment.
- Shifting to Bertrand strengthens the incentive to merge; recall that in a Cournot model, firms had downward sloping best response functions, their choice variables were strategic substitutes. So when the merged firm decreased its output (relative to combined output of pre-merger firms), other firms responded by increasing their output.
- With price, firms have upward sloping best response functions, their choice variables are strategic complements.
- This means a merger leading to an increase in the merged firms' price will encourage other firms to also increase their prices, which potentially increases the incentive to merge.

Bertrand product differentiation

- Suppose there are 3 firms in the market, each producing a single differentiated product. Inverse demand is given by:
  $p_1 = A – Bq_1 – s(q_2 + q_3)$
  $p_2 = A – Bq_2 – s(q_1 + q_3)$
  $p_3 = A – Bq_3 – s(q_1 + q_2)$
  where $0 \leq s \leq B$
  Assume all three firms have a constant marginal cost c.
- This is very similar (and has the same properties) as our previous Bertrand product differentiation model.
- Solving this Bertrand problem by solving profit maximisation problems, finding best response functions and solving simultaneously (see Chapter 16, Appendix A) we find that:
  $p_{nm}^* = [A(B-s)+c(B+s)]/(2B)$
  $q_{nm}^* = (A-c)(B+s)/[2B(B+2s)]$
  $\pi_{nm}^* = (A-c)^2(B+s)(B-s)/[4B^2(B+2s)]$

- Now, suppose that firms 1 and 2 merge, but that the merged and nonmerged firms continue to set their prices simultaneously. The two previous firms are now product divisions of the merged firms, coordinating their prices to maximize the joint profits of the two divisions.
  This is different to many of the Cournot models we looked at; the merged firm is no longer identical post-merger to non-merging firms, the merged firm has 2 products while non-merging firm has 1.
- The merged firm solves:
  $\text{Max}_{p1,p2}$: $q_1(p_1,p_2,p_3)\ (p_1 - c) + q_2(p_1,p_2,p_3)\ (p_2 - c)$
- We can solve this to find a best response function for the merged firm, and combine this with the (unchanged) best response function of the nonmerged firm, and solve these simultaneously to find the post-merger equilibrium.
  $p_1^m = p_2^m = [A(2B+3s)(B-s)+c(2B+s)(B+s)]/2(2B^2+2Bs-s^2)$
  $p_3^{nm} = [A(B+s)(B-s)+cB(B+2s)]/[2B^2+2Bs-s^{2]}$

- It is straightforward to confirm that the merger increases the prices for all three firms, as we would expect since the market is now less competitive.
- The profits of each product division of the merged firm and the independent nonmerged firm are:
  $\pi_1^m = \pi_2^m = (A-c)^2B(B-s)(2B+3s)^2/[4(B+2s)(2B^2+2Bs-s^2)^2$
  $\pi_3^m = (A-c)^2(B-s)(B+s)^3/[(B+2s)(2B^2+2Bs-s^2)^2$
- To compare these to pre-merger profits, let us normalize $A – c = 1$ and $B = 1$ (and so $0 \leq s \leq 1$). So we have:
  $\pi_{nm}^* = (1+s)(1-s)/[4(1+2s)]$
  $\pi_1^m = \pi_2^m = (1-s)(2+3s)^2/[4(1+2s)(2+2s-s^2)^2$
  $\pi_3^m = (1-s)(1+s)^3/[(1+2s)(2+2s-s^2)^2$
- We can confirm (eg plus in some values of s and test) that profits are higher post merger for both the merging firms and the nonmerged firm (see next page).
- This holds true in this setting for any merger of $M \geq 2$ firms.

s =	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Premerger profits	0.206	0.171	0.142	0.117	0.094	0.073	0.053	0.035	0.017
Post-merger profits 1, 2	0.207	0.173	0.146	0.122	0.101	0.081	0.062	0.042	0.022
Post-merger profits 3	0.208	0.177	0.153	0.131	0.112	0.092	0.073	0.051	0.027

Mergers in a spatial market

- Another way to capture the idea that a merged firm retains multiple product lines while a non-merged firm does not is in a spatial setting.
- Consider a circular Hotelling product differentiation setting. This is just like the linear product space setting that we had before, except that we have bent the ends of the line together so that they touch, so the product space has no end.
We do this to avoid asymmetry issues.
- Now, we have a product space circle of circumference L. Imagine that this is a road around a circular island, or the 24 hours of the day. (eg: preferred departure time for a plane ticket).
- Consumers are uniformly distributed around the circle; their location represents their preferred product type.

- Each consumer is willing to buy at most one unit of the good, and has a reservation price V. A consumer suffers “transport costs” td, where d is the distance (around the edge of the circle) between the product they buy and their preferred location, and t is a constant marginal cost per unit of distance.
- We can either think of these as physical transport costs, or disutility from buying a less-preferred product (eg getting a less preferred departure time).
- Suppose there are 5 firms selling to a group of N consumers. For simplicity, normalize N = 1.
  A firm is differentiated only by its location on the circle, and we assume that firms are evenly spaced around the circle (so the distance between any two firms is L/5).
- Each firm has identical costs, C(q) = F + cq. Suppose for simplicity that c = 0, so the net revenue per unit is just the “mill price” m.

- Suppose that firms do not price discriminate; so each firm sets a single price m that consumers pay at the firm's location, and then consumers pay the fee to transport the good back to their home location.
- The full price paid by a consumer who buys from firm i is $m_i + td_i$, and consumers buy from whichever firm offers them the lowest net price. Clearly this will be one of the two firms closest to them.
  The profit earned by the firm for each unit they sell is m.
- Suppose that V is large enough so that all consumers buy the good in equilibrium.
- Consider any one of the (identical) 5 firms; for example, firm 3. Demand to the "left" of firm 3 is dependent on the location of the marginal consumer indifferent between buying from firm 2 and firm 3, at location r_{23}.

- r_{23} is defined by:
  $m_3 + tr_{23} = m_2 + t(L/5 – r_{23})$
  Which implies: $r_{23} = (m_2 – m_3)/2t + L/10$
- Similarly, demand to the "right" of firm 3 comes from r_{34}, and we can similarly show that $(r_{34} = m_4 – m_3)/2t + L/10$
- Firm 3 profit is therefore:
  $\pi_3 = m_3(r_{23} + r_{34}) = m_3[(m_2 + m_4 – 2m_3)/2t + L/5]$
- Differentiating this wrt m_3 gives the FOC:
  $(m_2+m_4)/2t – 2m_3/t + L/5 = 0$
- Since the 5 firms are identical, in equilibrium we have $m_2 = m_3 = m_4$, and so we get the equilibrium price $m^* = tL/5$
- At this price, the profit earned by each firm is:
  $\pi_i^* = tL^2/25 – F$
- Now, consider a merger within a subset of firms. The merged firm will continue to operate each "location" as its own product line, but will make pricing decisions jointly to maximize combined profit across product lines.

- First, note that a merger will have no effect unless it is made between neighboring firms. The merging firms hope to gain by softening price competition between them, but this happens only if they are competing for the same consumers. Non-adjacent firms do not compete for the same consumers, so there are no effects on the solution to each product's maximization problem.
- Consider a merger between firms 2 and 3. They will have an incentive to raise their prices, and they will lose some customers to firms 1 and 4, but they will not lose customers located between firms 2 and 3.
- To solve for the post-merger equilibrium, take the same profit functions that we had pre-merger, but now have the merged firm maximize over the sum of π_2 and π_3. (see page 429).
- Taking FOCs and solving simultaneously, we find that:
  $m_2^* = m_3^* = 19tL/60$
  $m_1^* = m_4^* = 14tL/60$ $m_5^* = 13tL/60$

- Profits to each product are:
  $\pi_2^* = \pi_3^* = 361tL^2/7200 – F \quad = (0.050)tL^2 - F$
  $\pi_1^* = \pi_4^* = 49tL^2/900 – F \quad = (0.054)tL^2 - F$
  $\pi_5^* = 169tL^2/3600 – F \quad = (0.047)tL^2 - F$
- Comparing these to $\pi_i^* = tL^2/25 – F = (0.04)tL^2 - F$ shows us that the merger is profitable for the merging firms and the non-merging firms.