Horizontal mergers, entry, and efficiency defences[*]

by

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Abstract

In standard models of Cournot competition, it is well-known that if large-scale entry is impossible, then any merger failing to create technological synergies must harm consumers through a higher price level (Farrell and Shapiro, 1990). This paper shows that this is true irrespective of entry conditions: any profitable Cournot merger failing to generate synergies must raise price, even if large-scale entry is possible or if the merger allows the avoidance of fixed cost duplication.

1 Introduction

This paper provides a theoretical contribution to the analysis of horizontal mergers under the assumption of Cournot competition by extending the results of Farrell and Shapiro (1990) and Werden and Froeb (1998). The result presented below establishes that in industries in which products are homogeneous, firms compete in quantities, and

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marginal costs are increasing or mildly decreasing, any profitable merger failing to generate technological synergies raises prices and harms consumers, irrespective of entry conditions and of the presence of fixed costs.

Since ease of entry and the presence or absence of merger-specific synergies are among the most important criteria used by antitrust authorities when assessing whether an attempted merger should be challenged, an improved understanding of the relationship between these two elements is of paramount importance for policy.[1] The result established in this paper implies that if competition policy aims to protect consumers, then in markets where marginal costs are nondecreasing (or mildly decreasing) and the Cournot model is applicable, any merger inducing no technological synergies should be prevented, even if entry appears to be relatively easy.

Relation to the literature

Farrell and Shapiro (1990) address the effect of mergers on prices, but they rule out the possibility that a merger might trigger entry of large firms behaving oligopostically. They ask how the antitrust authority ought to respond to the claim that a merger will allow firms to reap efficiency gains, and find a very striking result. They note that a merger may yield two kinds of efficiency gains. First, even if a merger does not affect the technologies available to firms, it may induce a cost-saving reorganization of production: for example if may allow firms to shift production from high-cost facilities to low-cost

[1] According to the Merger Guidelines issued in 1992, the U.S. Department of Justice and the Federal Trade Commission consider three elements when a merger is likely to significantly increase market concentration: "[They] assess whether entry would be timely, likely and sufficient either to deter or to counteract the competitive effects of concern. [Then, they] assess any efficiency gains that reasonably cannot be achieved by the parties through other means. Finally [they] assess whether, but for the merger, either party to the transaction would be likely to fail, causing its assets to exit the market."

ones. Second, a merger may create *synergies*, through learning for example, and expand the post-merger production set beyond the sum of the pre-merger production sets. Farrell and Shapiro (1990) show (Proposition 2, p. 112) that if firms compete in quantities and marginal costs are increasing or mildly decreasing (they assume no fixed costs), the first type of efficiency gain is not enough to make a merger beneficial for consumers. Although a merger not accompanied by synergies may raise aggregate welfare by improving productive efficiency, it necessarily causes prices to rise and thus consumers to be harmed. Deneckere and Davidson (1985) prove a similar result in the case of differentiated products and price competition. If the goal of antitrust policy is to maximize consumer welfare, the policy consequence seems quite clear: in the absence of entry and of any economies of scale, the antitrust authority should reject all mergers which do not generate technological synergies[2].

But these assumptions are very strong. Even though ease of entry varies across industries, some entry is usually possible at least at some cost, and it is important to understand how concerns about entry and merger-specific synergies should be articulated. Also, the industries in which mergers warrant scrutiny are usually highly concentrated, and high concentration often results from the presence of large fixed costs. This paper addresses these two issues by analyzing a model in which fixed costs and potential entry are present and thus allows us to discuss how efficiency defences and entry conditions should be jointly dealt with.

The paper most closely related to the present one is Werden and Froeb (1998). Under specific assumptions about costs and demand, they find that in the absence of synergies, a merger followed by entry is necessarily unprofitable for the merging firms, and accordingly

[2]See Farrell and Shapiro (2001) for a policy discussion.

that any profitable merger must raise price.

This paper significantly extends their result in the case of quantity competition: under very general conditions, a profitable, no-synergy merger must raise price, even if it induces entry or if it reduces the merging parties' costs by allowing them to reallocate production across plants, or by eliminating fixed cost duplication[3].

2 The model

2.1 Assumptions

I present below a general model in order to analyze the price effects of profitable mergers in Cournot markets. Its assumptions are very standard and coincide with those of Farrell and Shapiro (1990), with the exception that I allow for entry.

Demand

There is only one good, and demand is given by the equation $p=p(X)$, where X is industry output and p is price. It satisfies

$$p'(X) < 0 \tag{1}$$

and, if q_i denotes firm i's output and X is total industry output:

$$p'(X) + q_i p''(X) < 0. \tag{2}$$

The first inequality simply means that demand is downward-sloping, while the second ensures that each firm's reaction function is downward-sloping. Notice that the second inequality is automatically satisfied if for any X, $p'(X) + Xp''(X) < 0$

[3] This paper is also related to the literature on contestable markets (Baumol *et al.*, 1982), which stresses the constraint that potential entry imposes on incumbent firms.

Technology

All firms' cost functions are of the form

$$C_i(q_i) = \begin{cases} F_i + c_i(q_i) \text{ if } q_i > 0 \\ 0 \text{ if } q_i = 0 \end{cases},$$

(F_i and the function c_i vary by firm), where $F_i \geq 0$ and the variable cost function c_i is increasing and satisfies the inequality

$$c_i''(q_i) > p'(X), \tag{3}$$

(with q_i and X denoting respectively firm i's output and total industry output). Conditions (2) and (3) are very standard in the literature about Cournot oligopoly, and they are exactly the assumptions made by Farrell and Shapiro (1990).[4] If we define firm i's reaction function by

$$R_i(Z) = \underset{q_i \geq 0}{ArgMax} \left[q_i p(Z + q_i) - C_i(q_i) \right], \tag{4}$$

then, given the presence of fixed costs, R_i may have at most one discontinuity (corresponding to a "jump" from a strictly positive value to zero). But, as was noted in Dixit (1986) and Seade (1980), (2) and (3) imply that R is decreasing and that, on the range of values of Z such that $R_i(Z) > 0$, R is continuous, differentiable and satisfies

$$-1 < R' < 0. \tag{5}$$

Condition (5) means that as the combined output of all other firms increases, then, unless firm i decides to stop production completely, it chooses to decrease its output by an amount smaller than the combined increase of all other firms, so that total output rises.

The game

[4] In particular, (3) holds as soon as marginal costs are nondecreasing.

There is a finite set of firms, divided into two categories: some firms are initially present in the market, while others are potential entrants. Each potential entrant is characterized by an idiosyncratic entry cost, which is common knowledge. This partition is exogenous: it reflects the state of the industry before the merger. The timing of events is as follows.

1. Prior to the merger, all firms initially present in the market compete in quantities.

2. An exogenously determined subset of these firms merges and forms a single entity[5]. This is common knowledge.

3. Each potential entrant decides whether to enter or not.

4. All firms present in the market (i.e. the firms initially present, including the merged entity, together with those which entered in period 3) compete in quantities.

I assume that this game has a unique equilibrium, in which firms play pure strategies.[6]

In what follows, a merger is said to be (strictly) profitable if the merged entity's total profit (earned in stage 4 of the game) is (strictly) greater than the sum of all merging firms' pre-merger profits (earned in stage 1 of the game).

2.2 The result

Proposition 1 *If*

(i) each of the merging firms was producing a strictly positive amount of output pre-merger;

(ii) the merger is strictly profitable; and

(iii) it does not generate technological synergies,

[5] For a dynamic model where mergers, entry and exit are endogenous, see Gowrisankaran [1999].

[6] See Vives (1999, pp. 93-96) and the references therein for a survey of existing results about existence and uniqueness of equilibrium in Cournot games.

then it causes price to rise, even if entry is possible and the merger allows the avoidance of fixed cost duplication.

The formal proof is in the appendix, but its logic can be explained in a few words. For a merger to be profitable, at least one of the merging firms, say firm 1, must earn a greater profit post-merger than pre-merger. Firm 1's profit post-merger is less than the profit it would earn if it maximized its profit alone (rather than the whole post-merger's firm profit) given all other firms' output levels. But, since firm 1's maximal profit is a decreasing function of the sum of all other firms' outputs, the sum of all other firms' output levels must be lower post-merger than pre-merger. If firm 1 maximized its own profit both pre- and post-merger, a decrease in all other firms' output levels would cause firm 1 to increase its output, but not by an amount sufficient to offset other firms' output fall, and total output would fall. The fact that firm 1 maximizes the merged firm's profit rather than its own only reinforces this conclusion, because taking into account the adverse effect of any output increase on the other merging parties causes firm 1 to produce less than if it cared only about its own profit. Therefore aggregate output falls, and the price rises[7].

It is worth contrasting this paper to Werden and Froeb (1998). They find that merger-induced entry necessarily makes a merger unprofitable because it causes price to fall below its pre-merger level. This paper states that another outcome is possible: a merger may still be profitable while inducing entry, but this can happen only if post-entry price remains above the pre-merger level. This is true even if the merger allows the merging firms to avoid wasteful duplication of fixed costs: such savings cannot suffice to make a merger profitable if merger-induced entry causes price to fall.

[7] If a merger allows firms to reallocate capital across plants, the result does not hold in the short-run, but still holds in the long-run if the merger is assumed to raise profits in the long-run (the argument is the same as in Farrell and Shapiro, 1990, p. 112).

The apparent discrepancy between this paper and Werden and Froeb (1998) comes from the fact that the latter consider a representative firm model where potential entrants are identical to non-merging incumbents. Entry necessarily depresses price and makes merger unprofitable. In this paper however, firms' cost functions are idiosyncratic. This makes it possible that a merger will induce entry by a small, high-cost firm which finds it profitable to enter now that price has risen. If this firm's output is small enough (as a result of its high costs), its entry does not bring price back to its pre-merger level and does not necessarily makes the merger unprofitable.

This result implies that if the assumptions made in this section (quantity competition and nondecreasing or mildly decreasing marginal costs) apply, then one can be certain that a proposed merger generating no synergies will raise prices, without any need to ponder entry conditions. In addition, since merger-induced entry is likely to come from high-cost firms, the trade-off between lower costs and higher prices, which is frequent in merger analysis, is altered: cost savings may be lower than they would be if entry were not considered.

3 Conclusion

The general result proved in this paper in the case of quantity competition has two striking consequences.

First, an efficiency defence relying on the idea that a merger allows firms to exploit scale economies is not convincing if these scale economies result only from the presence of fixed costs. While the elimination of fixed cost duplication may cause a merger to increase aggregate welfare, such a merger necessarily harms consumers if it does not also generate synergies. This remark is of some importance, both because such scale economies are

very frequent in the literature (many models assume fixed costs in addition to constant or increasing marginal costs), and because they may be even more likely in merger cases, as they provide a rationale for merging. The result, however, is not surprising: because fixed costs do not affect the first-order conditions determining equilibrium prices, the price effect of mergers should not depend on their presence or absence.

Second, and perhaps more importantly, in the absence of synergies or economies of scale (other than those induced by fixed costs), a profitable merger necessarily harms consumers through higher prices, irrespective of entry conditions.

This result does not imply that entry conditions are irrelevant for merger analysis. Rather, it sheds light on how merger policy should articulate the assessment of merger-specific synergies with that of entry conditions in industries where the Cournot model accurately describes firms' behavior. Its main policy implication is that, in these industries, a merger unambiguously generating no synergies should be prevented, without delving into the question of entry[8].

Several caveats limit the relevance of this paper.

The proposition applies to mergers which are profitable even after the entry of new firms. But if entry takes time, the profitability of a merger might result only from the temporary high profits earned prior to other firms entering, after which prices and profits may fall below their pre-merger levels. When handling such a merger, the antitrust authority must strike a balance between the short-run harm to consumers and the long-run benefits. Also, mergers may occur for reasons not considered in this paper, such as fiscal optimization, or they may serve as substitutes for agreements prohibited by antitrust

[8] This statement may sound overly confident in antitrust authorities' ability to assess merger-specific synergies. But this qualification, however justified, casts doubt on the possibility of enforcing a sound merger policy in general.

regulations.

More fundamentally, as Hay and Werden (1991) write, "the Cournot model has endured a century of criticism". Just as Farrell and Shapiro (1990), this paper is subject to this remark. While this paper does not contribute any new ideas to the debate about the relevance of the Cournot model, a large body of theoretical and empirical research suggests that the observation that firms often seem to set prices rather than quantities does not suffice to discard the Cournot model.[9] In any case, it must be applicable at least in *some* sectors, as the U.S. Merger Guidelines implicitly recognize by dividing industries between those in which products are differentiated and firms compete primarily in prices (section 2.21), and those in which products are close to each other, and firms compete by setting capacities (section 2.22)[10]. Finding economically meaningful conditions under which a similar result applies to differentiated product markets and price competition should be the goal of future research.[11]

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[9] See Kreps and Scheinkman (1983) for a theoretical defence of the Cournot model, Froeb and Werden (1991) and Schmalensee (1989) for an empirical one.

[10] The European Commission embraces a similar distinction (see the Draft Commission Notice on the Appraisal of Horizontal Mergers, available at http://europa.eu.int/comm/competition/mergers/review/final_draft_en.pdf).

[11] The literature on endogenous product differentiation may provide a starting point (see chapter 7 of Tirole, 1988, pp. 276-295).

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APPENDIX

Proof of Proposition 1

Step 1. Consider the r merging firms, labeled, without loss of generality, firm 1 to firm r. For every firm i (irrespective of whether it is one of the merging firms), let q_i and q_i' denote, respectively, firm i's output level prior to the merger of firms 1 through r, and firm i's output level subsequent to the merger (if firm i is one of the merging firms, then q_i' denotes the output produced using firm i's facilities). Let Q and Q' denote aggregate output pre- and post-merger, respectively.

Since the merger is profitable, the merging firms' total post-merger profit,

$\sum_{1\leq i\leq r}\left[q_i'p(Q')-C_i(q_i')\right]$ is strictly greater than the sum of these firms' pre-merger profits $\sum_{1\leq i\leq r}\left[q_ip(Q)-C_i(q_i)\right]$. This implies that for at least one merging firm, say firm 1, profit is greater post-merger than pre-merger:

$$q_1'p(Q')-C_1(q_1')>q_1p(Q)-C_1(q_1). \tag{6}$$

Therefore $q_1'>0$ (firm 1's initial profit is nonnegative because firm 1 always had the option of earning a zero profit by producing nothing). Also, $q_1>0$ by assumption (all merging firms are assumed to produce more than zero pre-merger).

Step 2. Consider firm 1's reaction and profit functions $R(.)$ and $\pi(.)$, defined respectively by (4) above and by $\pi(Z)=\underset{q_1\geq 0}{Max}\left[q_1p(Z+q_1)-C_1(q_1)\right]$ (for tractability the subscript is dropped from the reaction function as defined in (4)). The downward-sloping demand curve implies that $\pi(.)$ is decreasing, and (2) implies that $R(.)$ is as well. As explained above, on the range of values where it is strictly positive, R is continuous, differentiable, and satisfies (5). The inequality $q_1>0$ is equivalent to $R(Q-q_1)>0$. This implies that in the interval $[0,Q-q_1]$, R is differentiable and satisfies $-1<R'<0$.

Step 3. The definition of the function $\pi(.)$ implies that $q_1' p(Q') - C_1(q_1') \leq \pi(Q' - q_1')$. This inequality and (6) together imply $\pi(Q' - q_1') \geq q_1' p(Q') - C_1(q_1') > q_1 p(Q) - C_1(q_1) = \pi(Q - q_1)$. Therefore,

$$Q' - q_1' < Q - q_1. \tag{7}$$

Step 4. I show now that $q_1' \leq R(Q' - q_1')$. The reason is simple: when firm 1's response to all other firms' output levels is set to maximize the merged firm's profit, it produces less than it would if it maximized only its own profit, that is, less than $R(Q' - q_1')$. Indeed, if we write $Q_{2,r}'$ for $\sum_{2 \leq i \leq r} q_i'$ and Q_{-1}' for $Q' - q_1'$, q_1' satisfies the first-order condition

$$\frac{\partial}{\partial q}\left((q + Q_{2,r}')p(q + Q_{-1}') - c_1(q)\right) = 0,$$

while $R(Q' - q_1')$ $(= R(Q_{-1}'))$ satisfies the first-order condition.

$$\frac{\partial}{\partial q}\left(qp(q + Q_{-1}') - c_1(q)\right) = 0.$$

Defining $f(q, x)$ by $f(q, x) = \frac{\partial}{\partial q}\left((q + x)p(q + Q_{-1}') - c_1(q)\right) = p(q + Q_{-1}') + (q + x)p'(q + Q_{-1}') - c_1'(q)$, the above first-order conditions can be written as

$$f(q_1', Q_{2,r}') = 0 \tag{8}$$

and

$$f(R(Q_{-1}'), 0) = 0. \tag{9}$$

If $x \leq Q_{-1}'$, then (2) implies that

$$\begin{aligned}
\frac{\partial}{\partial q}(f(q, x)) &= 2p'(q + Q_{-1}') + (q + x)p''(q + Q_{-1}') - c_1''(q) \\
&< p'(q + Q_{-1}') + (q + x)p''(q + Q_{-1}') - c_1''(q) \\
&= \frac{q + x}{q + Q_{-1}'}\left(p'(q + Q_{-1}') + (q + Q_{-1}')p''(q + Q_{-1}') - c_1''(q)\right) \\
&\quad + \frac{Q_{-1}' - x}{q + Q_{-1}'}\left(p'(q + Q_{-1}') - c_1''(q)\right) \\
&< 0.
\end{aligned}$$

Similarly,

$$\frac{\partial}{\partial x}(f(q,x)) = p'(q + Q'_{-1}) < 0.$$

Since both 0 and $Q'_{2,r}$ are less than Q'_1, the last two inequalities hold in the interval $[0, Q'_{2,r}]$. Together with the first-order conditions (8) and (9), they imply that

$$q'_1 \leq R(Q'_{-1}). \tag{10}$$

Step 5. Inequalities (5), (7), and (10) together imply

$$Q' = Q'_{-1} + q'_1 \leq Q'_{-1} + R(Q'_{-1}) < Q - q_1 + R(Q - q_1) = Q.$$

(The second inequality results from the fact that (5) holds on the interval $[Q'_{-1}, Q - q_1]$ where the function R takes strictly positive values.) Therefore, output is lower post-merger than pre-merger, and price is greater. **QED**