LOSSES FROM HORIZONTAL MERGER: THE EFFECTS OF AN EXOGENOUS CHANGE IN INDUSTRY STRUCTURE ON COURNOT-NASH EQUILIBRIUM

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The consequences of a horizontal merger are typically studied by treating the merger as an exogenous change in market structure that displaces the initial Cournot equilibrium. In the new equilibrium the merged firm is assumed to behave like a multiplant Cournot player engaged in a noncooperative game against other sellers. The purpose of this article is to evaluate an unnoticed comparative-static implication of this approach: some exogenous mergers may reduce the endogenous joint profits of the firms that are assumed to collude. Cournot's original example is used to illustrate this and other bizarre results that can occur in the Cournot framework if the market structure is treated as exogenous.

I. INTRODUCTION

In the Cournot [1838] solution to the oligopoly problem, each firm's output choice is profit-maximizing given the outputs of the other firms. The Cournot approach is conventionally extended to industries with merged firms and cartels by treating each merged entity as a collection of plants under the control of a particular player in a noncooperative game. The payoff to each coalition is the sum of the profits that accrue to each of its members. For each exogenous specification of market structure (partition of plants into coalitions), outputs, profits, and market prices are endogenously determined.

The purpose of this article is to explore and evaluate an unnoticed comparative-static implication of such Cournot models: some exogenous mergers may reduce the endogenous joint profits of the firms.
that are assumed to collude. Similar results arise using other solution concepts [Cave, 1980]. In the Cournot case losses from horizontal merger may seem surprising, since the merged firm always has the option of producing exactly as its components did in the premerger equilibrium. But such a situation is not an equilibrium following the merger, since—given unchanged outputs of the other players—the merged firm would then have an incentive to alter its production (i.e., to reduce it).

In the next section we raise the possibility diagrammatically that some exogenous mergers may be unprofitable. Section III then establishes that this outcome can in fact arise by examining Cournot’s original example where identical firms with constant unit costs of production sell a homogeneous product to consumers with a linear demand curve. The section also establishes a number of other bizarre comparative-static results for this example. At the conclusion of the section, the example is modified to show that exogenous mergers can still cause losses even when the merger creates such large efficiency gains through scale economies that it would be socially advantageous.

We wish to emphasize at the outset that Cournot’s example is chosen merely as the simplest in which to display various puzzling phenomena. In particular, the loss-from-merger result can also arise in more complex Nash equilibrium models—with differentiated products, dynamics, increasing marginal costs, and so forth. Indeed, we first observed losses from merger in a dynamic oil model where each Cournot player chooses a time-dated vector of extraction (subject to capacity and exhaustion constraints) and incurs marginal costs that are increasing functions of the rate of extraction. The parameters used in this computerized model [Salant, 1981 and 1982] were not intended to generate peculiar behavior, but rather to approximate the current world oil market. Nor does the loss-from-merger result arise because of the partial-equilibrium nature of the analysis. In an independent analysis using a general-equilibrium framework, Okuno et al. [1980, p. 29] display an example with the same characteristic.

Section IV discusses the significance of our paradoxical comparative-static results for attempts to build a theory of horizontal mergers. Should the Cournot-Nash equilibrium concept—and indeed any solution concept where an exogenous merger can cause a loss—be discarded? Few solution concepts would survive such a test. Or should the decision to merge be endogenized as a move in a larger game? This latter approach is exciting because it would permit predictions about which mergers are contained in the set of equilibria and which mergers
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will never occur. Antitrust authorities need not concern themselves with blocking mergers outside the equilibrium set, since market forces would prevent their occurrence; for the same reason, the government could not cause such mergers to occur (without using supplementary incentives) even if they would be socially desirable. Finally, such models may ultimately help us understand the evolution of industry structure over time as coalitions form and regroup.

To illustrate how the decision to merge can be endogenized as a move in a larger game, a simple model is outlined with a single stage of coalition formation. In this model all of the mergers in the equilibrium set are profitable, thus eliminating the paradoxes that arise when mergers are treated as exogenous. Furthermore, among the equilibria are not only merger to monopoly but also less complete mergers. Such a characteristic seems important in a model of horizontal mergers; otherwise, its predictions will conflict with the structure of every industry in existence that is not a complete monopoly. The simple model outlined in Section IV is provided only as an illustration of a promising approach. A more complex but realistic model using this same approach is under construction.

II. THE POTENTIAL LOSS FROM HORIZONTAL MERGERS

Consider a Cournot equilibrium in which each firm in an industry operates independently. This can be compared with the Cournot equilibrium in which a subset of the firms merge, while the other firms remain independent. Such a comparison can be used to examine those cases in which the joint profits of the merged firms would be smaller than the sum of their profits prior to merger. It is convenient to refer to the subset of firms that will participate in the proposed merger as “insiders” and those firms that will continue to behave independently after the merger as “outsiders.” We shall make use of Figures I and II. To simplify these figures, we have drawn the functions in each as linear; however, no result depends on the linearity of our drawing. Denote by $R_0(Q)$ the total amount that noncooperating outsiders would produce for any given aggregate production ($Q$) by insiders. $R_0(Q)$ can easily be computed by deducting the given aggregate production by insiders ($Q$) from the consumer demand curve, computing the Nash equilibrium among the noncooperating outsiders relative to this residual demand curve, and adding up the equilibrium production at each outsider firm. Denote by $R^{NC}(q)$ the total amount that the noncooperating insiders would produce (prior to merger) for any given aggregate production ($q$) by outsiders. $R^{NC}(q)$ can easily
be computed by deducting from the consumer demand curve the given aggregate production by the outsiders \((q)\), computing the Nash equilibrium among the noncooperating insiders relative to this residual demand curve, and adding up the equilibrium production at each insider firm. We can then use these curves to determine outputs prior to the merger. In Figure I, a Nash equilibrium occurs at \(A\), where the reaction functions of the outsiders \((R_O)\) and the noncolluding insiders \((R_I^{NC})\) intersect. Outsiders produce the horizontal component of \(A\) \((q_{NC})\) in aggregate and insiders produce the vertical component \((Q_{NC})\). An exogenous merger will displace the equilibrium. Graphically, it will cause some of these curves to shift. Since the response of the noncolluding outsiders to the aggregate supply of the insiders does not depend on whether that supply was produced by a merged firm or a set of noncolluding firms, \(R_O\) does not shift. In contrast, the reaction function of the insiders will shift when the insiders merge. Denote by \(R_U(q)\) the production of the insiders after the merger, given outsider production \(q\). Then, \(R_U(q) < R_I^{NC}(q)\). For any given output by outsiders, insiders will contract their aggregate output when they
merge because they will then internalize the inframarginal losses that they impart to each other.

We conclude, therefore, that a merger causes the equilibrium output of the insiders to contract and the output of the outsiders to expand. To determine its effects on profits, we examine Figure II. Denote the sum of the profits of the insiders prior to and following the merger, respectively, as $\Pi_{\hat{f}}^{NC} (q)$ and $\Pi_{\hat{f}}^C (q)$. For any given level of production by outsiders, the aggregate profits of the insiders can only increase (since they can always run their plants so as to mimic the premerger equilibrium). Hence $\Pi_{\hat{f}}^C$ lies above $\Pi_{\hat{f}}^{NC}$. But as the outputs of the outsiders increase, the profits of the insiders decrease. Hence the possibility arises that the increase in production by outsiders following the merger will reduce insider profits by more than the increase in profits that would have occurred had outsider production remained constant. This possibility is illustrated in Figure II, where the profits following the merger (the vertical component of $B'$) are smaller than the profits prior to the merger (the vertical component of $A'$). Thus, it is the output expansion of the outsider
firms that can in principle cause a reduction in profits for the merging firms.\(^1\)

Of course, the model has more structure than we have considered. Hence, conceivably the possibility illustrated in Figure II can never occur. To demonstrate that the possibility can indeed arise, we need look no further than Cournot's classic example.

### III. COURNOT'S EXAMPLE

In the previous section we showed how the profits of a designated group of insiders depended on whether they were colluding or not. The profits of this group also depend on its composition. As a simplifying assumption, suppose that there are \(n\) identical firms in an industry. Then we can specify the composition of the insider group merely by describing the number of firms it contains. Suppose that there are \(m + 1\) insiders (for \(m\) an integer between 0 and \(n - 1\)).

Denote by \(\Pi^{NC}(n,m)\) the joint profits to insiders prior to the merger if the insider group contains \(m + 1\) noncolluding firms (and the outsider group the residual). Denote by \(\Pi^C(n,m)\) the joint profits to the insiders subsequent to the merger if the insider group contains \(m + 1\) colluding firms (and the outsider group the residual).

Denote by \(g(n,m)\) the increase in joint profits that results if \(m + 1\) insiders in an industry of \(n\) firms collude. Then, by definition,

\[
g(n,m) = \Pi^C(n,m) - \Pi^{NC}(n,m).
\]

To simplify further, we assume that marginal costs are constant. Then if each firm in an \(x\)-firm equilibrium earned \(\Pi(x)\),

\[
(1) \quad \Pi^{NC}(n,m) = (m + 1)\Pi(n);
\]
\[
(2) \quad \Pi^C(n,m) = \Pi(n - m);
\]

and

\[
(3) \quad g(n,m) = \Pi(n - m) - (m + 1)\Pi(n).
\]

Equation (1) follows from the assumption that all firms are identical. Hence prior to the merger, the \(m + 1\) insiders earn jointly \(m + 1\) times as much as the typical firm in the \(n\)-firm equilibrium. Equation (2) depends, in addition, on the assumption of constant marginal costs.

\(^1\) It should be noted, however, that industry profits will always increase in response to the merger. If the merger is unprofitable, the profits of the noncolluding firms will have increased by more than the loss in the profits of the insiders.
Because of this assumption the insiders—once they have merged—behave exactly like any of the other firms in an \( n - m \) firm symmetric equilibrium. Equation (3) follows by substitution.

In Cournot's example with constant marginal costs \((\alpha)\) and linear\(^2\) demand \((P = \beta - \sum_{i=1}^{n} Q_i)\), it is straightforward to calculate \( \Pi(n) \):

\[
\Pi(n) = (\frac{[\beta - \alpha]}{[n + 1]})^2.
\]

To verify this, we first deduce the output of each firm in an \( n \)-firm symmetric Cournot equilibrium and then calculate the resulting profit per firm as a function of \( n \). Firm \( j \) maximizes profits by setting \( Q_j \) to solve

\[
\max_{Q_j \geq 0} Q_j \left[ \beta - Q_j - \sum_{i \neq j} Q_i - \alpha \right].
\]

If optimal production by firm \( j \) is positive, then \( \beta - \sum_{i \neq j} Q_i - \alpha - 2Q_j = 0 \). In a symmetric Nash equilibrium, the output of each firm in the industry will be identical so that \( Q_i = Q_j = Q \). Therefore, \( Q = \frac{[\beta - \alpha]}{[n + 1]} \). Since \( \Pi(n) = (P - \alpha)Q \), we can substitute the equilibrium output per firm and verify equation (4):

\[
\Pi(n) = (\beta - nQ - \alpha)Q = (\frac{[\beta - \alpha]}{[n + 1]})^2.
\]

The change in insider profits due to merger (equation (3)) can, therefore, be reexpressed as

\[
(3') \quad g(n,m) = \frac{(\beta - \alpha)^2}{n - m + 1} - (m + 1) \left( \frac{\beta - \alpha}{n + 1} \right)^2
\]

\[
= (\beta - \alpha)^2 \left[ (n - m + 1)^{-2} - (m + 1)(n + 1)^{-2} \right].
\]

For any specified number of firms \( n \) in the premerger equilibrium, equation \((3')\) can be used to determine whether collusion by \( m + 1 \) insiders would be profitable. Losses from merger occur if and only if \( g < 0 \). In Figure III we plot \( \Pi^n C(n,m), \pi^{NC}(n,m) \) and \( g(n,m) \) against \( m \) (for a fixed \( n \)). The \( g(n,m) \) function can be used to deduce several noteworthy properties of this example (for \( n \geq 2 \)).

A. If there is no merger, there will be neither gain nor loss. Trivially, if a single insider is joined by no others in a merger, then its profits will be unchanged \( g(n,0) = 0 \), for \( n = 2,3,\ldots \). The profit of the firm will be \( \Pi(n) \) both before and after this degenerate merger.

2. Since any linear demand curve can be expressed in this form if the output units are defined appropriately, the assumption of a unitary slope is unrestrictive.
B. Merger by a larger number of firms may cause a loss to the colluding firms. This result follows, since

$$\frac{\partial g(n,m)}{\partial m} \bigg|_{m=0} < 0.$$ 

Indeed, over a range of $m$, losses from merger are larger the greater

3. $$\frac{\partial g(n,m)}{\partial m} = (B - \alpha)^2[2(1 + n - m)^{-3} - (1 + n)^{-2}].$$
the number of firms in the coalition. For example, if \( n = 12 \), a merger by seven firms \((m = 6)\) generates even larger losses than a merger by any smaller number of firms.\(^4\)

C. Merger to monopoly is always profitable. When all the firms in an \( n \)-firm equilibrium collude, so that there are no outsiders, profits must increase, since joint profits will then be maximized. Formally, \( g(n,n - 1) > 0 \), for \( n = 2, 3, \ldots \).

D. For any given number of firms in the premerger equilibrium, if a merger by a specified number of firms causes losses (respectively, gains), a merger by a smaller (larger) number of firms will cause losses (gains). We have noted that \( g(n,0) = 0 \), \( \partial g(n,0)/\partial m < 0 \), and \( g(n,n - 1) > 0 \), from properties A, B, and C, respectively. Since \( g(\cdot,\cdot) \) is continuous in its second argument, there must exist at least one root \( x^* > 0 \) such that \( g(n,x^*) = 0 \). Furthermore, since \( g(n,x) \) is strictly convex\(^5\) in its second argument, \( g(n,x) < 0 \) for \( x^* > x > 0 \). Similarly, \( g(n,x) > 0 \) for \( x > x^* \).

E. For any \( n \), it is sufficient for a merger to be unprofitable that less than 80 percent of the firms collude. Consider the gain-from-merger function \( g(n,m) \) defined above. Let \( x^*(n) + 1 \) be the (unique) number of firms in the coalition that will lead to neither gains nor losses for an industry with \( n \) firms in the premerger equilibrium. Let \( \alpha + (m + 1)/n \) be the number of insiders as a proportion of all the firms in the industry. Then a merger causes neither losses nor gains if \( \hat{\alpha} = [x^*(n) + 1]/n \). This break-even fraction \( \hat{\alpha} \) reaches its minimum value of 0.8 when \( n = 5 \). In other words, the break-even value for all other industry sizes exceeds 80 percent.\(^6\) The result, therefore, follows from property D. To illustrate, note that if \( n = 3 \), a merger by a pair of firms is unprofitable; and if \( n = 4 \), a merger by either two or three firms is unprofitable.

\(^4\) To illustrate, when there are twelve firms in the premerger equilibrium \((n = 12)\), a merger by seven firms \((m = 6)\) will generate larger losses to the insiders than the losses that would be incurred by three merging firms. For \( m = 6 \), \( g(n,m)/(B - \alpha)^2 = -0.021 \), while for \( m = 2 \), \( g(n,m)/(B - \alpha)^2 = -0.010 \). Indeed, the loss is more than twice as large.

\(^5\) \( \partial^2 g(n,m) \)/\( \partial m^2 \) = \((B - \alpha)^2[6(1 + n - m)^{-4}] > 0 \).

\(^6\) \( g(n,\alpha n - 1) = (B - \alpha)^2 \left( (1 + n)^2 - \alpha n(2 + n - \alpha n)^2 \right) \left( 2 + n - \alpha n \right)^2 (1 + n)^2 \),

where \( g(n,\alpha n - 1) = 0 \) when the numerator \((N)\) of the bracketed term equals zero: \( N = (1 + n)^2 - \alpha n(2 + n - \alpha n)^2 = 0 \). This equation is a cubic in \( \alpha \) and has three roots:

\[ \alpha_1 = 1/n, \quad \alpha_2 = \frac{(2n + 3) - \sqrt{4n + 5}}{2n}, \quad \text{and} \quad \alpha_3 = \frac{(2n + 3) + \sqrt{4n + 5}}{2n} . \]

(continued)
F. If any given fraction \( \alpha (<1) \) of an industry is assumed to merge, there is an industry size \( (n) \) large enough for this merger to cause losses. Let \( R \) be the ratio of the postmerger profits of the insiders to their premerger profits. That is, \( R = \Pi^C(n,m)/\Pi^{NC}(n,m) = \Pi^C(n,\alpha n - 1)/\Pi^{NC}(n,\alpha n - 1) \), where \( \alpha = (m + 1)/n \). If \( R < 1 \) for a merger by a proportion \( \alpha \) of an industry of size \( n \), then such a merger would be unprofitable. The proposition follows by noting that (for any \( \alpha < 1 \) \( R \rightarrow 0 \) as \( n \rightarrow \infty \). For example, even when 98 percent of the firms in an industry merge, there exists an industry size large enough for this "virtual" monopolization to cause a loss.

G. Mergers that create efficiency gains through scale economies can still cause losses. Suppose, in our example, that a merger of two firms resulted in a loss of \( L \). If instead each firm had positive fixed costs but the same constant marginal costs as before, the postmerger equilibrium would be unchanged, but the entire output of the merged firm would be produced by a single plant—the plant with the lower fixed cost. As long as the fixed cost of each plant was less than \( L \), the fixed cost saved by shutting down the highest cost plant would be too small to make the exogenous merger profitable.

H. A merger that provides efficiency gains may be socially beneficial even if it is privately injurious to the merging parties. Consider a merger that results in a loss to insiders. Since the merger results in a price increase, it also injures consumers. Nonetheless, in some cases, those producers not party to the merger gain so much that these other losses are outweighed. We define any situation where the sum of consumer and producer surpluses increases as an improvement in social welfare. To see how such a case can be constructed, consider again the Cournot example. In the absence of fixed costs, the gain to the merging firms is \( g(n,m) \), defined in equation (3'). It was shown

6. (Continued from preceding page).

The third root exceeds unity and is inadmissible; the first is the root associated with the degenerate merger. The second is the root of interest—that is, \( \hat{\alpha} = \alpha_2 \)—and is itself a function of \( n \):

\[
\frac{d\hat{\alpha}}{dn} = \frac{(2n + 5)(4n + 5)^{1/2} - 3(4n + 5)}{2n^2(4n + 5)},
\]

\[
\frac{d^2\hat{\alpha}}{dn^2} = \frac{6(4n + 5) - (2n + 10)(4n + 5)^{1/2} - (4n^2 + 10n)(4n + 5)^{-1/2}}{2n^3(4n + 5)}.
\]

Thus, \( \hat{\alpha}(n) \) reaches a relative minimum at \( n = 5 \) and a relative maximum at \( n = -1 \). Hence for \( n \geq 1 \), \( \hat{\alpha}(n) \geq \hat{\alpha}(5) = 0.8 \).

7. \( R = \frac{(n + 1)^2}{(m + 1)(n - m + 1)^2} = \frac{(n + 1)^2}{\alpha n(n - \alpha n + 2)^2} \).

For any \( \alpha < 1 \), \( \lim_{n \to \infty} R = 0 \).
that \( g(n,m) \) is zero for \( m = 0 \), is a strictly convex function of \( m \), and initially decreases in \( m \). Similarly, we can write the gain in social welfare when \( m + 1 \) firms out of \( n \) firms merge as \( S(n,m) \), where

\[
S(n,m) = (B - \alpha)^2 \left\{ \frac{n - m}{1 + n - m} - \frac{n}{1 + n} \right\} - \frac{1}{2} \left( \frac{n - m}{1 + n - m} \right)^2 + \frac{1}{2} \left( \frac{n}{1 + n} \right)^2.
\]

It can be verified that \( S(n,m) \) is zero for \( m = 0 \), is a strictly concave function of \( m \), and initially decreases in \( m \)—but at a slower rate than \( g(n,m) \). It follows, therefore, that for small \( m \) the social loss is smaller than the loss to the merging parties. Now, if each firm has a fixed cost of \( F \), the social gain from a merger by \( m + 1 \) firms is \( \hat{S}(n,m) \), where

\[
\hat{S}(n,m) = S(n,m) + mF.
\]

Similarly, the gain to the merging firms is \( \hat{g}(n,m) \), where \( \hat{g}(n,m) = g(n,m) + mF \). That is, both the merging parties and society benefit by the same amount when the \( m \) plants are shut down following the merger. Since the social loss was smaller than the loss to these firms, it is possible to select \( F \) so that \( \hat{S}(n,m) > 0 > \hat{g}(n,m) \). We illustrate this in Figure IV, where \( S(n,m) \), \( g(n,m) \), \( \hat{S}(n,m) \), and \( \hat{g}(n,m) \) are plotted against \( m \) (holding \( n \) fixed). Denote the merger size that results in zero social gain (respectively, zero private gain to the merging parties) as \( l \) (as \( k \)). For \( m > l \), mergers cause private gains (\( \hat{g} > 0 \)) but social losses (\( \hat{S} < 0 \)). Such mergers are presumably ones antitrust authorities should discourage. For \( k < m < l \), mergers create both private and social gains. For \( m < k \), however, mergers would create social benefits but would injure the merging parties. Such mergers are presumably ones antitrust authorities would like to occur.

**IV. SIGNIFICANCE OF THE RESULTS**

Since the results of this paper seem counterintuitive, it is important to ponder their significance. Our analysis has ruled out one possibility—that firms can act like Cournot players in deciding how much to produce, can merge with anyone, and can always benefit from merger. In this section we consider the three remaining logical al-
ternatives: (1) Firms produce like Cournot players, and some horizontal mergers may cause losses; (2) firms do not always act like Cournot players in deciding how much to produce; and (3) firms do produce like Cournot players, and some specifiable mergers never occur.

The first of these alternatives treats our analysis not as showing that received theory is in need of revision but as deducing a testable proposition about the real world. After all, if mergers never cause losses, the evidence of profitable mergers should be overwhelming. In fact, as Scherer [1980, p. 546] notes, "... the weight of the post-merger profitability evidence for an assortment of nations suggests that on average the private gains from mergers were either negative or insignificantly different from zero."
Economists who give little weight to such evidence must logically espouse the second or third alternative. The second questions the appropriateness of the Cournot solution concept. Some economists feel the Cournot solution is never appropriate, while others believe that firms sophisticated enough to merge will not subsequently be naive enough to play Cournot even if they behaved that way prior to the merger. Now the Cournot solution concept (as generalized by Nash [1951]) underlies most of noncooperative game theory. Before dispensing with so serviceable a concept, it seems reasonable to contemplate possible replacements and to ask on what foundation, if not the Nash-Cournot solution, is a theory of mergers to be based? In response to our earlier draft, Cave [1980] has shown that exogenous mergers may cause losses under a large variety of cooperative and noncooperative solution concepts including Nash noncooperative equilibrium, Nash (trembling hand) perfect equilibrium, strong equilibrium, Nash-Harsanyi bargaining with either fixed or variable threats, and the Shapley value. Moreover, Aumann [1973] discovered that mergers may be disadvantageous using the core solution. If every solution concept which implies that exogenous mergers may cause losses is to be shunned, there remain few candidates on which to base a theory of mergers, and these seem inappropriate on other grounds. Under such circumstances—and without the necessary empirical information to choose among solution concepts—it seems imprudent to reject any solution concept simply because it predicts that exogenous mergers can generate losses.

Instead, it may be more useful to extend the existing Cournot theory so as to endogenize the merger decision. The new theory would then predict that specific mergers—being disadvantageous—would not occur in equilibrium. This underlies the third alternative mentioned above.

To illustrate, we sketch a simple model where firms decide whether or not to merge and how much to produce. The model uses the Nash-Cournot solution concept and treats the merger decision as a move in an enlarged noncooperative game. In equilibrium, no merger causes a loss.

9. If this latter view is correct, it would have an important implication. The behavior of a multiplant player in an oligopolistic industry could not be predicted without knowing the historical circumstances under which the many plants came to be operated by that player.
10. Okuno, Postlewaite, and Roberts [1980] have independently shown that exogenous mergers may cause losses, using a Nash noncooperative solution to a Shapley-Shubik exchange game with a continuum of traders. Their article provides a useful review of the literature on disadvantageous coalitions, which grew out of Aumann's work.
11. For a related approach see Selten [1973].
The players in our illustrative game are the $n$ independent firms. Each player's strategy consists of a partition of the firms in the industry into coalitions and an output proposal for each firm in the coalition to which the particular player belongs. Each player's payoff depends on the strategies of the $n$ players. If players pick different partitions, the unmerged "status-quo" profits result. If all players pick the same partition, each firm shares equally in the profits of the coalition to which he belongs. The profits result from each firm producing the mean of what is proposed for him by all participants in his coalition.\footnote{12. An alternative specification may seem more plausible and will generate the identical set of equilibria. Suppose that a strategy for each player consists of a description of whom he would like to collude with and the proposed total output of that coalition. That is, the player specifies nothing about mergers to which he is not a party, nor does he propose how the total output is to be produced within his own coalition. Given the strategies of the players, the payoffs are determined as follows. If any player proposes a coalition whose other members do not propose that same coalition, no mergers occur, and the status quo profits result. If there is agreement about coalitions, each player gets an equal share of the profits of the coalition to which he belongs. Profits of any particular coalition depend on market price (a decreasing function of the sum of average joint output proposals of each coalition), and on the average proposed output of the particular coalition, and on the cost of producing the average proposed output in the cheapest way. In equilibrium, given the proposals of the other players, none of the $n$ firms has any incentive to alter the average proposed output of his own coalition, although he perceives himself able to do so by altering his own proposal for its total output.}

It should be evident that no Nash equilibrium in this game can be disadvantageous, since any player can always propose a different partition than the other players and thereby obtain the status quo profit. This makes valid our intuition that (in equilibrium) firms cannot do worse than they did prior to merger, since they can always replicate what they did earlier. In addition, every advantageous merger in the game where industry structure is exogenous can be supported as a Nash equilibrium in the extended game. This follows, since each firm perceives itself to control the outputs of every member of its own coalition and gets a given fraction of the coalition profits; it therefore will make the same choices as the multiplant Cournot player in the game with the market structure exogenous. Finally, no extraneous equilibria have been introduced by enlarging the game, since any equilibrium in the extended game must also be an equilibrium in the game with exogenous market structure. An analysis of this as well as more realistic but complex games where mergers are endogenous is reported in Cave and Salant [1981].

We conclude by noting the implications for policy by recognizing that the merger decision is endogenous. In any model with endogenous mergers, the only mergers the private market will let stand are those
in the equilibrium set. Socially injurious mergers that are not in the set of equilibria need not be guarded against, since they are disadvantageous and will not occur. Socially beneficial mergers that, although they create efficiency gains, are not in the set of equilibria cannot be achieved (without using supplementary incentives) for the same reason.

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13. The reader should note that the decision to spin-off from a parent corporation or to defect from a cartel is simply the reverse of the merger decision. Hence our analysis has implications for these issues. Consider, for example, the question of cartel stability. All cartels contain at least one destabilizing force, since each member can benefit from cheating given an unchanged price or unchanged outputs of other producers. But if the other cartel members would be injured by the defection, they may make attempts to deter it. Such attempts, if successful, impart stability to the cartel. In contrast, if circumstances prevail where a merger would be disadvantageous, the defection may be beneficial to every member of the cartel. In that case, the cartel is unstable, and the defection is assured.

14. See the end of Section III.