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On Merger Profitability and the Intensity of Rivalry

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Abstract

This paper considers a general symmetric quantity-setting oligopoly where the "coefficient of cooperation" defined by Cyert and DeGroot (*An Analysis of Cooperation and Learning in a Duopoly Context*, 1973) is interpreted as the parameter indicating severity of competition. It is obtained that horizontal mergers are more likely to be profitable in a more competitive market structure. Consequently, the results by Salant, Switzer and Reynolds (*The Effects of an Exogenous Change in Industry Structure on Cournot-Nash Equilibrium*, 1983) about merger profitability are sensitive to the assumption of pre-merger Cournot competition.

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1 Introduction

In a symmetric linear Cournot oligopoly with homogenous goods, Salant, Switzer and Reynolds (1983) (henceforth, SSR) showed that horizontal mergers are generally not profitable and that the minimum profitable merger involves at least 80 percent of the firms. Mergers typically are not profitable for insiders but are profitable for non-merging firms. Unprofitability comes from the fact that non-merging firms react to the merger by increasing their output. This is often known as the merger paradox and makes it hard to explain how merger activity gets started, since a firm would always prefer to remain an outsider.[1] This approach, however, leaves out the competitive intensity and assumes Cournot behaviour. In fact, most of the literature considers the absence of collusion as the most plausible scenario in which mergers take place and only very few papers address related aspects of mergers in a (possibly) collusive environment. Among the exceptions, Escrihuela-Villar (2008) analyzes the price effects of mergers in a dynamic collusive environment and Rodrigues (2001) provides numerical examples to illustrate the determinants of merger occurrence showing that the equilibrium market concentration is increasing in the expected competitive intensity. The main purpose of this note is to fill this gap in the literature by studying the effect of pre-merger competitive intensity on merger profitability.

Following a recent trend in the literature, we model the intensity of competition assuming that firms care about their profits plus a weighted average of the profits of the other firms.[2] Using a payoff function based on relative performance, the intensity of competition can be parameterized. Intermediate values of this parameter then, might represent imperfect collusion and may be justified by reference to some implicit dynamic model of collusion, a reduced-form representation of which being the quantity competition subgame of this model. This formulation is closely related to the "coefficient of cooperation", defined by Cyert and DeGroot (1973) and has also been justified by other arguments. For instance, it captures the relative performance approach that is evolution-

[1] This paradox though is weakened for instance by convex demand (Faulí-Oller, 1997) or cost functions (Perry and Porter, 1985).

[2] See for instance Symeonidis (2008) for a duopoly or Matsumura et al. (2013) for an oligopoly. Equivalently, d'Aspremont and Ferreira (2009) add some positive weight also to the total surplus.

ary stable (Vega-Redondo, 1997). Furthermore, it can also be assumed that sufficiently patient firms always achieve the highest level of collusion that is sustainable as equilibrium of an infinitely repeated game given a number of parameters taken as exogenous at the competition stage. Under this interpretation, a fall in the importance given to rivals' profits might correspond to a lower critical discount factor in an infinitely repeated game.

Our main result shows that the incentive to merge is increasing in the intensity of competition. Intuitively, in industries where firms are already cooperating, mergers add less to the high profits that firms are otherwise achieving. A simple illustration is provided using a linear demand function to show that the result of SSR mentioned above is only valid in Cournot environments, and fails to hold in a quantity-setting model with a different competitive intensity since the well-known output expanding response of non-merging firms is smaller in a more competitive market. Consequently, the minimum required proportion of participants in the merger decreases with the intensity of competition.[3] A possible policy implication is that, since mergers may be seen as an alternative to cooperation, it seems plausible to argue that mergers should be more closely scrutinised where collusion is absent.

Despite its theoretical viewpoint, this note is also motivated by real cases. Empirical evidence is copious suggesting that merger incentives are related to the pre-merger degree of competition, showing that in industries characterised by cartelist activities firms resort to mergers when cartels become less viable. Bittlingmayer (1985) shows that during the Great Merger Wave (1898-1902), mergers in several (cartelised) industries in the US (cotton oil, sugar, cast iron pipe, oil, meat packaging or steel and railroading), appear to have been the result of antitrust actions taken against cartels after the Sherman Act was passed. Equivalently, the Restrictive Trade Practices Act (1956), which outlawed cartels, triggered a wave of mergers in the UK (see Symeonidis, 2002). In the same line, Evenett et al. (2001) examine international cartels during the 1990s, and observe that mergers are among the different measures adopted by firms for survival in collusive industries where

[3]We also note that this result resembles a well-known result in the literature on managerial compensation where the increased profit from any reduction in the number of firms is higher under delegation (see for instance Ziss, 2001 or Straume, 2006). In these papers thus, the profitability of merger in oligopoly is significantly enhanced if firms delegate output decisions to a manager.

cartel formation is restricted. A similar trend regarding the substitutability between merging and colluding has also been noticed in Germany where Neumann (2001) argues that German industries like cement, food processing machine building etc. adopted cartelist activities in order to attain monopolistic power only when mergers were not possible. One could argue thus that a stricter legal enforcement against a cartel increases the relative cost of collusion as compared to merger and consequently firms resort to mergers.

2 Model and results

Assume an n-firm homogenous product oligopoly where $2 \leq n$. The inverse demand function is given by $P(Q)$ where $Q = \sum_{i=1}^{n} q_i$ is the industry output and q_i is the output of the i-th firm. The demand function is twice continuously differentiable, downward sloping, and has a downward sloping associated marginal revenue function. Production costs are normalised to 0. Demand at price 0 is positive but finite and satisfies $2P'(Q)+P''(Q)Q < 0$ so that the second-order conditions always hold implying that $\beta(Q) > -2$, where $\beta(Q) \equiv \frac{P''(Q)Q}{P'(Q)}$ is defined as the degree of concavity of demand. The profit function of firm i, to be maximised by choice of q_i, is:

$$\Pi_i(q_i, Q_{-i}) = P(Q)q_i \tag{1}$$

with $Q_{-i} \equiv Q - q_i$ representing the quantity supplied by the $(n-1)$ competitors of firm i.

In this baseline framework, a particular way of modelling the intensity of competition is considered. Following the approach of the coefficient of cooperation defined in Cyert and DeGroot (1973), we obtain a model in which firms are concerned about relative profits (the average profits of the other firms) as well as their own profits.[4] The payoff of a firm is given by $\Pi_i - \frac{\lambda}{n-1}(\sum_{j\neq i}^{n} \Pi_j)$, where Π_i is the profit of firm $i = 1, 2, ..., n$ and $\lambda \in [1-n, 1]$ that we assume to be symmetric across firms.[5] The present model encompasses the Cournot case if $\lambda = 0$, the joint profit maximizing allocation if $\lambda = 1 - n$ and the perfectly competitive

[4]Escrihuela-Villar (2015) shows that the conjectural variations solution replicates that of a model using the coefficient of cooperation as the parameter indicating severity of competition. The results presented in this note thus also carry over to the conjectural variations approach.

[5]Admittedly $\lambda > 0$ might seem counterintuitive at first sight. We follow here however the reason-

outcome for $\lambda = 1$.[6] Hence λ may represent the severity of competition and enables us to treat the severity of competition as a continuous variable. Additionally, we consider the possibility that a group of $m+1$ firms merge without cost synergies associated. Once $m+1$ firms have merged there will be $n-m$ firms that behave like we described above. Admittedly, since the range of values of λ depends on n it could also be argued that the pre-merger degree of competition is modified after the merger.[7] This, however, is not our approach. Instead, we consider how the expected pre-merger competitive intensity affects the incentives to merge. A merger is considered to be profitable if the profits of merging firms increase after merger. Since the function in (1) depends on n and λ, we can denote the incentives to merge for $m+1$ firms by:

$$\Pi_i(n-m,\lambda) - (m+1)\Pi_i(n,\lambda). \tag{2}$$

We assume $\beta(Q) \geq \beta > -2$ for any Q. In other words, β is the lower bound of the degree of concavity and a set of demands satisfying $\beta(Q) \geq \beta$ is considered. We obtain:

Proposition 1 *The incentive to merge defined by (2) is increasing in λ.*

The intuition can be easily illustrated applying our model to the linear demand case as in SSR ($\beta(Q) = 0$).[8] Assume that $P(Q) = a - Q$. Then, firm's output in equilibrium

ing in Matsumura and Matsushima (2012) stating that objective functions are often based on relative performance since, for instance, evaluations of management activities are also based on their relative performances. Furthermore, some experimental works already pointed out reciprocal or altruistic behaviour (see for instance Cason et al., 2002) that is closely related to firms' objective functions based on relative performance.

[6] Note that the first order condition for a firm i when $\lambda = 1$ becomes $p(Q) + \frac{\partial p(Q)}{\partial q_i}(q_i - \frac{1}{n-1}\sum_{j\neq i}^{n} q_j) = 0$. In a symmetric equilibrium $q_j = q_i$ and therefore $p(Q) + \frac{\partial p(Q)}{\partial q_i}(q_i - q_i) = 0$ implies that price is equal to marginal cost (0 in our case) and thus, a firm behaves as if it is a price taker.

[7] In this line, the literature on horizontal merger assessment is huge and has often focused on coordinated effects (if a merger induces rivals to alter their strategies, resulting in some form of price-increasing coordination). As an example Vives (2001) obtains that reducing the number of competitors facilitates collusion.

[8] It can also be easily checked that the result in Faulí-Oller (1997) where the degree of concavity of the demand function reduces merger profitability in a Cournot setting can also be generalized to a model which contains the whole range of market structures.

is given by:

$$q_i = \frac{a}{1 - \lambda + n}. \tag{3}$$

Firms' profits are given by:[9]

$$\Pi_i(n, \lambda) = \frac{a^2(1-\lambda)}{(1-\lambda+n)^2}. \tag{4}$$

We can easily obtain:

Proposition 2 *If $\beta(Q) = 0$, the merger of $m+1$ firms is profitable if $m \geq \bar{m} \equiv n - \lambda + \frac{1}{2}(1 - \sqrt{5 + 4(n-\lambda)})$. Hence, the minimum proportion of participants in order for the merger to be profitable ($\frac{\bar{m}+1}{n}$) decreases with λ.*

In a Cournot setting even though mergers increase price, they are (generally) not profitable because outsiders react to the merger by expanding their output. This is still true in our model because in (3) $\frac{\partial q_i}{\partial n} = -\frac{1}{(1+n-\lambda)^2} < 0$. However, $\frac{\partial^2 q_i}{\partial n \partial \lambda} = \frac{2a}{(\lambda-1-n)^3} < 0$ when $\lambda \in [1-n, 1]$. In words, the reaction of non-merging firms is to expand production but in a more competitive market this expansion is smaller rendering mergers more profitable. The result of SSR thus is only valid in a Cournot competition environment. If $\lambda > 0$, a higher degree of competition compared to Cournot competition increases firms' incentives to merge. If $\lambda < 0$ firms are already sustaining a collusive agreement and mergers lose attractiveness as an anti-competitive device.[10]

Admittedly, we treat λ as an exogenous parameter and although we build a direct link to the degree of competition, the reader might feel more comfortable when such link is made explicit and based on a direct behavioural assumption like the output produced. We show in the appendix that Proposition 2 also holds in a model where firms' strategy set is $q \in [\frac{1}{2n}, \frac{1}{n}]$, a quantity in the interval between full collusion and perfect competition.

[9]Note that the outcome gradually approaches the competitive outcome as λ increases. So, in the view of behaviourism (or the revealed preference approach), λ can be regarded as the parameter of competitiveness. Additionally, we can also justify λ as a measure of the intensity of competition since the equilibrium price is monotonically decreasing with λ, while an increase in competitiveness increases consumer surplus and decreases producer surplus.

[10]In fact, in the linear case if λ is low enough mergers are never profitable since the required proportion of firms involved in the merger is larger than 1. More precisely, if $\lambda \in [1-n, 1-\sqrt{n}]$ mergers among firms are never profitable.

Therefore, the profitability of horizontal mergers crucially depends on the pre-merger output (namely, the intensity of competition).

3 Conclusions

A theoretical framework has been developed to study merger profitability in an imperfectly competitive environment. We found that mergers are more likely profitable in rivalrous environments. Consequently, the results in SSR are sensitive to the assumption of pre-merger Cournot competition. The well-known merger paradox regarding merger profitability thus might be alleviated or exacerbated if the pre-merger degree of competition is considered. An additional remark is that perhaps mergers should be more closely scrutinised where collusion is absent.[11] The results presented are also robust to other approaches to the intensity of competition like conjectural variations and seem consistent with existing empirical evidence regarding the substitutability between merging and colluding.

Appendix

Proof of Proposition 1. From (1) we obtain the first order condition (FOC) for firm i; $\frac{\partial \Pi_i(q_i,Q_{-i})}{\partial q_i} = P(Q) + \frac{\partial P(Q_{-i}+q_i)}{\partial q_i} q_i - \frac{\lambda}{n-1}[\sum_{j \neq i}^{n} \frac{\partial P(Q_{-j}+q_j)}{\partial qj} q_j] = 0$. Since pre-merger equilibrium is symmetric, ($q_i = q_j \; \forall i \neq j$), FOC becomes $P(Q) + \frac{\partial P(Q_{-i}+q_i)}{\partial q_i} q_i[1-\lambda] = 0$ where since $q_i = \frac{Q}{n}$ and using the notation $\frac{\partial P(Q_{-i}+q_i)}{\partial q_i} = P'(Q)$, we can also express as:

$$P(Q) + P'(Q)\frac{Q}{n}[1-\lambda] = 0. \qquad (5)$$

As in Faulí-Oller (1997), (5) defines implicitly the quantity in equilibrium as a function of the number of firms $Q(n)$. We abuse notation and suppress the functions in the derivatives.

[11] We note also that the mergers considered here are all welfare reducing as they involve a reduction in output and no efficiency gains. However, following Farrell and Shapiro (1990), we could still examine the effects of merger on the nonparticipant firms and consumers, whom they call “outsiders”. It can be easily checked that in a very competitive market, outsiders can also benefit from the merger since in a very competitive market the increase in price could be more than compensated by the increase in firms' profits due to the merger.

Differentiating (5) with respect to n we obtain $[P''Q'\frac{Q}{n}+P'\frac{Q'}{n}-\frac{P'Q}{n^2}][1-\lambda]+P'Q'=0$. Rearranging terms, $\frac{Q'}{Q}=\frac{P'(1-\lambda)}{n^2[P''\frac{Q}{n}[1-\lambda]+\frac{P'[1-\lambda]}{n}+P']}$ can be interpreted as the proportional increase in output due to a marginal increase in n. Since $\beta\equiv\frac{P''Q}{P'}$, the last equation is:

$$\frac{Q'}{Q}=\frac{1-\lambda}{n[\beta[1-\lambda]+[1-\lambda]+n]}. \tag{6}$$

Equilibrium profits for each firm are $\Pi_i(n,\lambda)=\frac{P(Q(n))}{n}$. If we differentiate profits with respect to n, and simplifying notation we obtain $\Pi'=P'Q'\frac{Q}{n}+Q'\frac{P}{n}-\frac{PQ}{n^2}$. The proportional increase in firms' profits due to a marginal increase in n is given by: $\frac{\Pi'}{\Pi}=\frac{Q'}{Q}[\frac{P'Q}{P}+1]-\frac{1}{n}$. Using (5) and (6) we obtain $\frac{\Pi'}{\Pi}=\frac{1-\lambda}{n[\beta[1-\lambda]+[1-\lambda]+n]}[1-\frac{n}{1-\lambda}]-\frac{1}{n}$ and $-\frac{\Pi'}{\Pi}=\frac{\beta[1-\lambda]+2n}{n[1+\beta-\lambda[1+\beta]+n]}$. By integrating the previous expression we obtain: $\int\limits_{N-m}^{N}-\frac{\Pi'}{\Pi}dn=\ln[\frac{\Pi(N-m)}{\Pi(N)}]=\int\limits_{N-m}^{N}\frac{\beta[1-\lambda]+2n}{n[1+\beta-\lambda[1+\beta]+n]}dn$. Consequently, the proportional increase in profits due to a merger of $m+1$ firms is $\frac{\Pi(N-m)}{\Pi(N)}=\exp[\int\limits_{N-m}^{N}\frac{\beta[1-\lambda]+2n}{n[1+\beta-\lambda[1+\beta]+n]}dn]$. A merger of $m+1$ firms is profitable if $\exp[\int\limits_{N-m}^{N}\frac{\beta[1-\lambda]+2n}{n[1+\beta-\lambda[1+\beta]+n]}dn]\geq(m+1)$. As in Faulí-Oller (1997), we solve the integral to obtain that if the degree of concavity is constant a merger is profitable if $g(N,m,\beta,\lambda)\geq(m+1)$ where $g(N,m,\beta,\lambda)\equiv(\frac{N}{N-m})^{\frac{\beta}{1+\beta}}(\frac{1+\beta-\lambda(1+\beta)+N}{1+\beta-\lambda(1+\beta)-m+N})^{\frac{\beta+2}{\beta+1}}$. Also, if $\beta(Q)$ is not constant but it is not lower than β, we have $\frac{\Pi(N-m)}{\Pi(N)}\leq g(N,m,\beta,\lambda)$. Finally, $\frac{\partial g(N,m,\beta,\lambda)}{\partial\lambda}=\frac{(2+\beta)m(\frac{N}{N-m})^{\frac{\beta}{1+\beta}}(\frac{1+\beta-\lambda(1+\beta)+N}{1+\beta-\lambda(1+\beta)-m+N})^{\frac{1}{\beta+1}}}{(\lambda-\beta+\lambda\beta+m-N-1)^2}>0,\ \forall\beta>-2$. ■

Proof of Proposition 2. Since $g(n,m,0,\lambda)=\frac{(1-\lambda+n)^2}{(1-\lambda-m+n)^2}$, the merger of $m+1$ firms is profitable if $\frac{(1-\lambda+n)^2}{(1-\lambda-m+n)^2}\geq m+1$ or $m\geq\bar{m}\equiv n-\lambda+\frac{1}{2}(1-\sqrt{5+4(n-\lambda)})$. The minimum proportion of firms involved in the profitable merger is $\frac{\bar{m}+1}{n}=\frac{3+2(n-\lambda)-\sqrt{5+4(n-\lambda)}}{2n}$. Hence, $\frac{\partial\frac{\bar{m}+1}{n}}{\partial\lambda}=\frac{1}{n\sqrt{5+4(n-\lambda)}}-\frac{1}{n}<0$. ■

Assume $P=1-Q$. In a symmetric equilibrium $q_i=q_j=q\ \forall i\neq j$, $\Pi_i(n,q)=q(1-nq)$ where Π_i decreases with q in the range considered and it is maximised at $q=\frac{1}{2n}$. (2) can be written as an inequality by $\Pi_i(n-m,q-x)-(m+1)\Pi_i(n,q)=x(1-(n-m)x)-(m+1)q(1-nq)>0$ where x and q are the quantities produced by firms after and before the merger respectively. The inequality holds if $x\leq\frac{1}{2}(\frac{1}{n-m}+\sqrt{\frac{1-4(1+m)(n-m)q(1-nq)}{(n-m)^2}}$. In (3) $q=\frac{1}{1+n-\lambda}$, and hence the condition on x is $x\leq\frac{1}{2}(\frac{1}{n-m}+\sqrt{\frac{\lambda^2+(n-2m-1)^2+2\lambda(n-1-2m(1+m-n))}{(n-m)^2(1+n-\lambda)^2}})$.

We just have to check that, since the quantity produced after the merger of $m+1$ firms in our model is given by $\frac{1}{n-m-\lambda}$, the solution to the equation $\frac{1}{n-m-\lambda} = \frac{1}{2}(\frac{1}{n-m} + \sqrt{\frac{\lambda^2+(n-2m-1)^2+2\lambda(n-1-2m(1+m-n))}{(n-m)^2(1+n-\lambda)^2}})$ for λ is $\lambda = n - m - \sqrt{m+1}$ that coincides with the value of λ solving (2) with equality.

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References

-d'Aspremont, C., & Dos Santos Ferreira, R., 2009. "Price-quantity competition with varying toughness". *Games and Economic Behavior. 65(1), 62–82.*

-Bittlingmayer, G., 1985. "Did Antitrust Policy Cause the Great Merger Wave?". *Journal of Law and Economics. 28(1), 77–118.*

-Cason, T. N., Saijo, T., & Yamato, T., 2002. "Voluntary participation and spite in public good provision experiments: an international comparison". *Experimental Economics. 5(2), 133–153.*

-Cyert, R. M. & DeGroot, M. H., 1973. "An analysis of cooperation and learning in a duopoly context". *The American Economic Review. 63, 24–37.*

-Escrihuela-Villar, M., 2008. "Partial coordination and mergers among quantity-setting firms". *International Journal of Industrial Organization. 26(3), 803–810.*

-Escrihuela-Villar, M., 2015. "A note on the equivalence of the conjectural variations solution and the coefficient of cooperation". *The B.E. Journal of Theoretical Economics. 15(2), 473–480.*

-Evenett, S. J., Levenstein, M. C., & Suslow, V. Y., 2001. "International cartel enforcement: lessons from the 1990s". *The World Economy. 24(9), 1221–1245.*

-Farrell, J., & Shapiro, C., 1990. “Horizontal mergers: an equilibrium analysis”. *The American Economic Review. 80(1), 107–126.*

-Faulí-Oller, R., 1997. “On merger profitability in a Cournot setting”. *Economics Letters. 54, 75–79.*

-Matsumura, T., & Matsushima, N., 2012. “Competitiveness and stability of collusive behavior”. *Bulletin of Economic Research. 64(1), 22–31.*

-Matsumura, T., Matsushima, N. & Cato, S., 2013. “Competitiveness and R&D competition revisited”. *Economic Modelling. 31, 541–547.*

-Neumann, M., 2001. “Competition Policy: History, Theory and Practice”. *Edward Elgar Publishing.*

-Perry, M. K., & Porter, R. H., 1985. “Oligopoly and the incentive for horizontal merger”. *The American Economic Review. 75, 219–227.*

-Rodrigues, V., 2001. “Endogenous mergers and market structure”. *International Journal of Industrial Organization. 19(8), 1245–1261.*

-Salant, S., Switzer, S., & Reynolds, R., 1983. “The Effects of an Exogenous Change in Industry Structure on Cournot-Nash Equilibrium”. *The Quarterly Journal of Economics. 98(2), 185–199.*

-Straume, O.R., 2006. ”Managerial Delegation and Merger Incentives with Asymmetric Costs”. *Journal of Institutional and Theoretical Economics. 162(3), 450–469.*

-Symeonidis, G., 2002. “The effects of competition: Cartel policy and the evolution of strategy and structure in British industry”. *MIT Press Books, 1.*

-Symeonidis, G., 2008. “Downstream competition, bargaining, and welfare”. *Journal of Economics and Management Strategy. 17(1), 247–270.*

-Vega-Redondo, F., 1997. “The evolution of Walrasian behaviour”. *Econometrica. 65, 375–384.*

-Vives, X., 2001. “Oligopoly pricing: old ideas and new tools”. *MIT Press.*

-Ziss, S., 2001. ”Horizontal Mergers and Delegation”. *International Journal of Industrial Organization. 19, 471–492.*