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WHEN DOES NEW ENTRY DETER COLLUSION*

John Simpson

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John Simpson
Federal Trade Commission
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I) Introduction

For collusion to be successful, the colluding parties must be able to detect and to punish those firms that cheat on the collusive agreement.[1] Several factors determine how difficult such detection and punishment will be.[2] One of these factors is the number of available opportunities in which to observe and to punish defection during the collusive agreement. While game theory models and experimental tests of these models suggest that collusion can be sustained where firms have many opportunities to observe and punish defection from a collusive agreement, these game theory models and their experimental tests suggest that collusion is unlikely where firms have very few opportunities to observe and punish defection from a collusive agreement.

The U.S. Department of Justice (DOJ) and Federal Trade Commission (FTC) Merger Guidelines assume that entry that is likely and sufficient will ultimately correct any anticompetitive harm resulting from a merger. If this anticompetitive harm takes the form of collusion, then such entry will ultimately end the collusive agreement. If there are few opportunities to observe and to punish defection from the collusive agreement before this entry is expected to occur, then the prospect of this entry may deter collusion completely. Thus, entry that takes more than two years, if it is both likely and sufficient,[3] may deter collusion in markets where the time

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[1] For instance, see Stigler, George J., 1964, "A Theory of Oligopoly," Journal of Political Economy, 72, 44-61.

[2] These are listed in Carlton, Dennis, and Jeffrey Perloff, 1990, Modern Industrial Organization, Scott, Foresman and Company, Glenview, Illinois, Chapter 9.

[3] The Merger Guidelines define entry as likely if it would be profitable at premerger prices, and if such prices could be secured by the entrant. According to the Merger Guidelines, entry is sufficient if its scale and scope would deter or counteract the competitive

required to observe and to punish cheating is lengthy. On the other hand, entry that takes less than two years may not deter collusion in industries where cheating can be quickly detected.

This paper is structured as follows. The second section reviews recent theoretical and experimental research that suggests that sustaining collusion is difficult when firms believe that the collusive agreement will soon end. The third section considers how this research can used to assess the likelihood of collusion in particular industries. Section Four examines several hypothetical cases in order to demonstrate the types of evidence that would be required to show that future entry would hamper collusion. Section Five concludes.

II) Competition in Finitely Repeated Games

Although firms have a collective incentive to collude to restrict output and increase price, each individual firm has an incentive to cheat on a collusive agreement by cutting price and increasing sales. To prevent such cheating, the colluding parties must be able to threaten credibly to impose on a cheating firm long-term losses in excess of any short-term gains that it would obtain from cheating. Credibly making such threats becomes increasingly difficult as the number of periods remaining in a collusive agreement falls.

To see this, consider the following simple example in which two firms choose whether to adhere to or to defect from a collusive agreement lasting one period. Table 1 (on following page) shows the various payoffs associated with each set of choices. If both firms adhere to the collusive agreement, then they each receive a payoff of

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effect of concern.

3. If one firm defects from the collusive agreement while the other firm adheres to this agreement, then the defector receives a payoff of 5 while the other firm receives a payoff of -2. Finally, if both firms defect, then each receives a payoff of 2. Thus, if both firms defect, then each does worse than if they both cooperated, but each does better than if they had cooperated while the other defected. Consequently, although cooperation maximizes the two firms' joint payoff, each firm has an incentive to defect since, for each firm, defection yields a higher payoff no matter what the other firm does.

Table 1

		COLUMN	
		adhere	defect
ROW	adhere	3,3	-2,5
	defect	5,-2	2,2

payoff = (row,column)

Now suppose that two firms repeat the game described in example 1 a known, finite number of times (T). In this case, there is no incentive for the firms in a collusive agreement to punish a defector in any period beyond T since such punishment could not restore the collusive agreement. Because the colluding firms know that no punishment will occur after period T, they all find defection in period T to be individually profitable. Also, each of the colluding firms expect that all of the other colluding firms will defect in period T, so they anticipate that no punishment can occur in period T, and consequently they find defection to be individually profitable in period T-1. This logic can be repeated to show that colluding firms

will defect in period T-2, T-3, and so on, until we find that the colluding firms will defect even in the first period of this agreement.[4] This result suggests that collusion will not occur when firms believe that a collusive agreement will not exist past some future date. A collusive agreement could end through entry by new firms or the imposition of government price regulation.

Although the basic model described above suggests that collusion is unlikely ever to occur, two variants of this model suggest that collusion sometimes can occur. The first notes that collusion can occur if firms believe that a collusive agreement will continue forever and thus that there will always be subsequent periods in which a cheating firm can be punished. This result would also hold if the colluding firms believe that there is only a small probability that the collusive agreement will end in any particular period. The problem with this variant is that firms are unlikely to believe that collusion can continue forever.

The second variant notes that even if firms believe that a collusive agreement will ultimately end, collusion can still occur if at least some firms do not always behave rationally. For instance, Selten (1978)[5] suggests that firms are unlikely to use backward induction to select a strategy of defecting in every period. Instead, he suggests that firms intuitively decide to cooperate for a set number of periods and defect only when proximity to the end of the

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[4] The argument that cooperation breaks down in finitely repeated games was first presented in Selten, Reinhard, 1978, "The Chainstore Paradox," Theory and Decision, 9, 2: 127-59. A discussion of the application of this argument to theories of collusion can be found in Wiley, John S., 1988, "Reciprocal Altruism as a Felony: Antitrust and the Prisoner's Dilemma," Michigan Law Review, 86, 8: 1906-1928.

[5] R. Selten, supra note 3.

collusive agreement makes defection especially compelling. Theoretical research by Kreps and Wilson (1982) and Milgrom and Roberts (1982)[6] suggests that collusion could also occur if some external constraint, such as a strong predisposition toward cooperation, prevents some firms from ever defecting first from a collusive agreement. In this case, the other firms might choose to cooperate until the last several periods. For these firms, the probability of competing against a cooperative firm may be high enough so that the expected payoff from cooperating in early periods and defecting only in later periods exceeds the expected payoff from defecting immediately and having the other firm defect in all subsequent periods.

Experimental tests of these game theory models generally support the conclusion that firms initially cooperate but then cheat in the last few periods of a collusive agreement. Economists have examined whether firms are likely to collude by setting up experiments in which two individuals are given the choice between cooperating or not cooperating in a series of repeated games (a supergame) with payoffs similar to those shown in Table 1. In each game, both individuals receive some payoff if they both cooperate. If one individual defects while the other cooperates, then the defector obtains a higher payoff and the other player obtains a much lower payoff. If both individuals defect, then each does worse than if they had both cooperated, but each does better than if they had cooperated while the other defected. Consequently, although cooperation maximizes the two players' joint

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[6] Kreps, David, and Robert Wilson, 1982, Reputation and Imperfect Information, Journal of Economic Theory, 27, 2: 253-79; Milgrom, Paul, and John Roberts, 1982, Predation, Reputation, and Entry Deterrence, Journal of Economic Theory, 27, 2; 280-312.

payoff, in each game, each player has an incentive to defect since defection yields a higher payoff no matter what the other player does.

Experiments in which this game is repeated for a finite number of times (a supergame) have generally found that individuals cooperate until the very last periods of this supergame at which point they defect.[7] For instance, Selten and Stoecker (1986)[8] had six groups of six players participate in twenty-five 10-period supergames. For the last thirteen of the twenty-five supergames, Selten and Stoecker computed the mean period in which players intended to defect from cooperation. These computations show that players choose to defect in earlier periods as they become more familiar with the supergame. For example, while the mean period in which players intended to defect was 9.2 in the thirteenth supergame, the mean period in which players intended to defect was 7.4 in the twenty-fifth supergame. Thus, Selten and Stoecker found that cooperation tends to break down near the end of the supergame and that cooperation breaks down earlier as players become more experienced.

McKelvey and Palfrey (1992)[9] structure an experiment in which two players alternately can take the larger portion of an amount of money that increases exponentially for a finite number of periods known to the participants. Since this supergame ends as soon as one person takes the money, this supergame would end on the first move if there is no cooperation and would continue to the end if there was total

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[7] See Selten, Reinhard, and Rolf Stoecker, 1986, End Behavior in Sequences of Finite Prisoner's Dilemma Supergames, Journal of Economic Behavior and Organization, 7, 47-79, and references contained therein.

[8] Ibid.

[9] McKelvey, Richard D., and Thomas Palfrey, 1992, An Experimental Study of the Centipede Game, Econometrica, 60 (4) 803-836.

cooperation. In this experiment, McKelvey and Palfrey find that cooperation generally breaks down in the last two or three periods. For instance in a six-move supergame, McKelvey and Palfrey find that 1 percent of the time the supergame ends by the first move, 9 percent of the time it ends by the second move, 32 percent of the time it ends by the third move, 76 percent of the time it ends by the fourth move, 93 percent of the time it ends by the fifth move, and 99 percent of the time it ends by the sixth move.

The game theory models and experimental tests of these models model an environment that is much less complex than an actual market.[10] Thus, it should be noted that the predictions of these models may not hold when applied to actual markets. Nevertheless, these models currently provide the best information available with which to analyze the effect of future entry on collusion. While these theoretical models and the experimental tests of these models do not precisely predict at what point a collusive agreement will break down, they both predict that cooperation breaks down in the last periods of a collusive agreement. This result, by itself, suggests that collusion is unlikely where there are only one or two remaining periods before a collusive agreement ends. Where only several periods (e.g., 3-5 periods) remain before a collusive agreement ends, the fewness of remaining periods may combine with other factors, such as the presence of large buyers, to make successful collusion unlikely.

[10] These models ignore some institutional features, such as the number of sellers and heterogeneity among these sellers, that might either facilitate or frustrate collusion.

III) Applying Game Theory to Markets

In order to use the predictions of game theory and the results of experimental tests of these theories to assess the likelihood of collusion in a particular market, we must first define a period. In game theory and experimental economics, a new period gives individuals both the opportunity to observe their competitor's previous move and the opportunity to change their strategy. This suggests that we should define a period as the time required both to discover defection from a collusive agreement (observe a competitor's move) and to punish this defection (choose a new strategy).

The time required to discover defection from a collusive agreement depends on institutional factors in the industry. Consider a simple collusive agreement that assigns market shares to the participating firms. A participant could defect from this agreement and obtain a larger market share by cutting price, improving quality, or investing in research and development in order to obtain a long-run competitive advantage. Sometimes, firms can quickly observe that a competitor has defected. In industries like retailing, where firms can frequently observe the price and quality of their competitors' products, firms could probably quickly discover that a competitor had cut price or improved quality in order to increase market share. In other industries, a collusive agreement may assign particular buyers or contracts to particular firms. A firm could cheat on this agreement simply by bidding competitively on a contract that had been assigned to another firm. Where buyers quickly announce the winning bid, competing firms can quickly discover such cheating. Where buyers delay announcement of the winning bid, competing firms cannot quickly discover such cheating. Finally, a firm could defect from a collusive

agreement by investing in research and development in order to get a long-run competitive advantage that would enable it to gain market share in the future. Where a firm can keep its investment secret, this type of defection would not be quickly discovered.

The speed with which a firm can punish a defector depends on institutional factors in the industry. Punishment can occur rapidly in some industries. For instance, in an industry where prices can be quickly adjusted, a firm could respond to any form of cheating on a collusive agreement simply by lowering its price. In other industries, institutional features (e.g., infrequency of sales opportunities) prevent firms from rapidly punishing a defector. For example, consider a market in which firms infrequently bid for contracts and in which a collusive agreement assigns one of the firms every fourth contract. If this firm defects from this collusive agreement and wins a contract that had been assigned to another firm, then it could not be punished until other firms could compete for the next contract that it had been assigned.

Although the length of time required to both discover and punish cheating is exogenous in some industries, in other industries, both buyers and sellers can act strategically to affect this length of a time.[11] For instance, in some industries, sellers can shorten the time required to detect cheating by forming a trade association that

[11] In some industries, the time required for entry may also be endogenous. After a merger, the incumbent firms in an industry may be able to collude if they can increase the number of periods over which they can collude. Thus, the incumbent firms may act to delay entry in order to earn cartel profits. Any delay that these firms could impose on an entrant should be added to the time required for entry.

would frequently collect and disseminate price data.[12] On the other hand, in industries where sales are made through a bid process, buyers can increase the time required to detect cheating simply by soliciting bids long before announcing a winner.

In summary, the time that constitutes a period varies across industries because the combined time required to both discover and punish cheating varies across industries. In those industries where a period is very short, firms may be able to collude even when entry by new firms will soon end the collusive agreement. In contrast, in those industries where a period is very long, firms may be unable to collude even though entry by new firms may be several years in the future.

IV) Three Hypothetical Examples

For the most part, recent antitrust enforcement has been directed at preventing the accretion of market power through merger. In some mergers, collusion is the anticompetitive effect of concern: By combining two firms, a merger may facilitate collusion among the remaining firms. The Merger Guidelines assume that entry that is both likely and sufficient will ultimately correct any anticompetitive harm resulting from a merger. If this anticompetitive harm takes the form of collusion, then such entry will ultimately end the collusive agreement. Where only one or two periods remain before such entry would occur, game theory models and experimental tests of these models suggest that collusive behavior would be unlikely. Where only several

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[12] See Salop, Steven, 1986, "Practices that Credibly Facilitate Oligopoly Co-ordination," in Joseph Stiglitz and G. Frank Mathewson, eds., New Developments in the Analysis of Market Structure, Cambridge: The MIT Press.

periods (3-5 periods) remain before such entry would occur, the game theory models and their experimental tests suggest that sustaining collusion would be difficult. To show how these results can be applied to merger analysis, this section reviews three hypothetical merger cases.

Merger of High-tech Products Sold Through Competitive Bidding

In our first example, let us assume the following. Four firms, each with a 25 percent market share, sell some high-tech product. These sellers compete in terms of both price and technological innovation. Roughly every three months, one of several large buyers of this product selects a supplier through a bidding process. In other words, one sales opportunity occurs every three months. Finally, entry that is likely and sufficient can occur in four years.

Two of the four firms in this industry decide to merge. Thus, after the merger, one firm would have a 50 percent market share, and the other two firms would each have a 25 percent market share. A collusive agreement among the three remaining firms likely would restrict development of new products and divide the market (for instance, the collusive agreement could assign the firm with the 50 percent market share one customer every six months and assign each of the two firms with the 25 percent market shares one customer every 12 months). Defection from such an agreement could take one of two forms. In the first, a firm could defect by developing a superior product. In this case, a period would be the length of time between when a firm began to develop a new product and when its competitor discovered this. If discovering such defection takes a long time, then the small number of periods before entry would end the collusive

agreement would make sustaining collusion difficult. For instance, if we assume that the other firms would have discovered such defection after two years and could have promptly punished the defector, then there would be two two-year periods before the collusive agreement ended. In this case, given that only two periods exist, sustaining collusion would probably be very difficult.

A firm could also defect from this collusive agreement by lowering its price in order to win a larger number of bids. For instance, the collusive agreement allocates one winning bid (one customer) per year to each of the two firms that have a 25 percent market share. After winning its allocated bid, one of these firms could defect by bidding competitively for all bids thereafter. While the other firms could easily observe this behavior, they could not punish the defector until the time of the next bid that he had been allocated. In this example, this would essentially be one year after he first defected. Therefore, in this example, there would be four periods before entry restored the pre-merger competitive equilibrium. Game theory models and their experimental tests suggest that the fewness of periods could make sustaining collusion difficult.

Merger in the Consumer Products Industry

Our second example considers a hypothetical merger in a consumer products industry. Assume the following. Five firms produce some standard consumer product. The nature of this product is such that there is little scope for quality improvement or new product development. The first three firms each have a 25 percent market share, the fourth firm has a 15 percent market share, and the fifth firm has a 10 percent market share. Information on price and market

share is collected monthly and distributed to all five firms in the industry. New entry would take eighteen months and would be likely and sufficient.

Suppose that the fourth and fifth firms propose to merge. Such a merger could increase the likelihood of successful collusion by reducing the number of firms in the industry and by reducing the heterogeneity among these firms. A collusive agreement among the four remaining firms presumably would fix price or allocate market shares. If one of the firms defected from this collusive agreement, the other three firms seemingly could quickly discover and punish this defection. Let us assume that a period lasts one and one-half months since defection would be discovered as soon as the monthly price and market share data was distributed, and since the other firms could punish defection simply by lowering their price. Assuming this, there would be 12 periods before entry would end the collusive agreement. In this case, game theory models and experimental tests of these models suggest that collusion could be sustained in the early periods but not in the later periods. Thus, as this hypothetical case shows, even entry that takes less than two years may not always deter collusion.

Hospital Mergers

Our third example considers a hypothetical merger in the hospital industry. Two recent changes in the hospital industry may have made collusive behavior less likely. First, over the past ten to fifteen years, the identity of the customer has changed. In the past, patients and their physicians largely selected hospitals based on quality considerations, because insurance plans gave patients little

incentive to select less expensive hospitals. In this environment, hospitals largely competed by offering superior service. Because hospitals often had overlapping medical staffs and frequently had to obtain regulatory approval before they offered new services, hospitals probably were able to readily observe the efforts of competing hospitals to improve service. Therefore, a collusive agreement in which hospitals collectively agreed to restrict the quality of their service probably could have been readily monitored and punished. In other words, a period probably was short in this environment.

More recently, health maintenance organizations (HMO's) and preferred provider organizations (PPO's) have emerged as the patient's agent in identifying and contracting with those hospitals willing to offer quality service at a low price. In this environment, collusion by hospitals presumably would limit the discount offered to HMO's and PPO's. However, because HMO's and PPO's generally negotiate contracts lasting a year or more, hospitals probably cannot discover and punish defection from a collusive agreement as rapidly as they once could. Thus, a period probably lasts longer in the current environment.

The second change that has occurred in the hospital industry is the elimination of certificate of need (CON) regulation by some states (notably California and Texas). CON regulation, which forces hospitals to obtain state approval before making capital expenditures, makes new entry both less likely and more time consuming. In states that have eliminated these regulations, new entry, if it is likely and sufficient, can now correct any anticompetitive harm resulting from a merger in several years.[13]

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[13] In states that do not have CON regulations (e.g., California, Texas, Colorado, Utah), three to seven years would be a very rough estimate of the length of time required for entry by a new hospital.

Let us consider a hypothetical merger in order to see how the combination of longer periods and entry that is both quicker and more likely could possibly combine to make collusive behavior less likely in some hospital markets.[14] Let us assume the following: 1) Within the market, two hospitals each have a one-third market share and two hospitals each have a one-sixth market share; 2) None of the hospitals can increase price unilaterally because all three hospitals have excess capacity; 3) There are three equally large health care buyers; 4) Every year each of these buyers signs a one year contract with one of the hospitals; 5) Although entry by new hospitals is both likely and sufficient, it would take four years.

Suppose that the two small hospitals propose to merge. This proposed merger could increase the likelihood of successful collusion by reducing the number of hospitals in the market. A collusive agreement among the remaining hospitals presumably would assign particular buyers to particular hospitals. For instance, the collusive agreement could assign one buyer every year to each hospital. A hospital that defected from this collusive agreement by obtaining contracts with two or three buyers at one time could not be punished until the following year. Thus, a period lasts one year, and there are only four periods before new entry restores competition and ends the collusive agreement. In this example, the fact that there are only a limited number of periods before the collusive agreement ends possibly could be used along with other factors to show that

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[14] In other markets, the competitive environment may differ substantially from the competitive environment assumed in this example. For instance, many states still have CON laws that both restrict and slow entry. Also, in many markets, the market shares of buyers will not be as large relative to the market shares of the hospitals.

collusion is unlikely. These other factors might include the presence of large buyers who could destabilize a collusive agreement and differences in location, mission, level of service, and level of vertical integration, which might make reaching terms of collusion difficult.

Let us change one of the assumptions in this example so that every six months each of the three buyers signs a six month contract with one of the hospitals. A period now lasts six months, because a hospital that defected from the collusive agreement could be punished in six months. Consequently, there are now eight periods before the collusive agreement ends. In this case, economic theory and experimental evidence suggests that collusion might occur in early periods and only break down in later periods.

V) Summary

The Merger Guidelines' two-year benchmark for determining the timeliness of entry represents a "rule of thumb" measure for separating mergers where entry would be quick enough to deter or counteract anticompetitive behavior from mergers where entry would not be this quick. Game theoretical models of collusion and the experimental tests of these models suggest that we may be able to define timeliness more accurately in those cases where collusion is the anticompetitive effect of concern. These models and their tests indicate that sustaining collusion becomes difficult when firms have only a few opportunities to observe and to punish defection from a collusive agreement before that collusive agreement ends. The Merger Guidelines assume that entry that is likely and sufficient will ultimately correct any anticompetitive harm resulting from a merger.

Together, these two statements imply that, in determining whether future entry would deter any collusive behavior that resulted from a merger, the timeliness of entry should be judged in reference to the time required to observe and to punish cheating. On the one hand, entry that takes more than two years, if it is both likely and sufficient, may deter collusion in markets where the time required to observe and to punish cheating is lengthy. On the other hand, entry that takes less than two years may not occur soon enough to deter collusion in industries where cheating can be quickly detected and punished.

In some cases where collusion is the anticompetitive effect of concern, the available evidence will strongly suggest that the length of time required to detect and to punish cheating is either very long (e.g., 1-2 years) or very short (e.g., 1 month). In these cases, we may be able to improve antitrust enforcement by appropriately adjusting the timeliness benchmark.[15,16] In other cases where collusion is the anticompetitive effect of concern, the available evidence will not allow us to define accurately the length of time required to observe and to punish cheating. In these cases, the above analysis gives no reason to deviate from using the Merger Guidelines' two-year benchmark.

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[15] In addition to separating mergers where entry would be quick enough to deter or counteract anticompetitive behavior from mergers where entry would not be this quick, the two year benchmark also acts to direct antitrust resources toward cases where the potential anticompetitive harm would last longer and thus be greater. To the extent that this role is important, we should be cautious about adjusting the two-year benchmark downward.

[16] The argument that the two year time frame used to assess the timeliness of entry should sometimes be adjusted to fit industry characteristics has been made elsewhere. See Report to the Defense Science Board Task Force on Antitrust Aspects of Defense Industry Consolidation, April 1994.