

# The Role of Capacity in Antitrust Analysis

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## Abstract

Issues of productive capacity can play a role in nearly every aspect of competition analysis. This paper provides an overview of the economic literature on capacity and the role that capacity has played in actual antitrust and competition law enforcement. The goal is to aid the analysis in matters where capacity issues potentially play a significant role. For the most part, the theoretical role of capacity in various aspects of competition analysis is ambiguous and the empirical literature is similarly inconclusive. Moreover, in many situations, measuring excess capacity may be quite difficult. Given the theoretical and empirical ambiguity regarding the role of excess capacity, or the lack thereof, the overall conclusion is that capacity issues should play a role in competition analysis only when there is strong case-specific evidence regarding their effects.

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## I. INTRODUCTION

Productive capacity has the potential to affect nearly every aspect of competition analysis, including market definition, the evaluation of competitive effects, the likelihood of entry, and the cognizability of various efficiency or business justifications for a merger or practice. Nevertheless, at least from a theoretical perspective, these effects are not necessarily consistent in terms of whether a particular transaction or practice will pass antitrust muster. For example, economic theory suggests that excess capacity makes anticompetitive effects more likely under certain conditions, and less likely under other conditions. Alternatively, excess capacity, and the ability to rationalize it, can be a powerful business rationale for a merger, joint venture or any other kind of asset acquisition. However, if the excess capacity also appears to have promoted a competitive atmosphere, under certain circumstances this can outweigh any procompetitive effects from rationalizing excess capacity.

The economic literature on the role and impact of capacity is vast. There appears to be a need to synthesize the implications of this literature for purposes of competition analysis. This paper seeks to address this gap by both providing an overview of the economic literature on capacity and the role that capacity has played in actual antitrust and competition law enforcement.

While capacity considerations have a possible role in all types of antitrust and competition matters, we organize this paper according to the topics in the Horizontal Merger Guidelines.<sup>1</sup> Nevertheless, many nonmerger applications have merger parallels and we discuss these applications where appropriate. In each section, the discussion begins with an overview of economic theory regarding the possible role or roles of capacity in analyzing that issue. Following this is a discussion of empirical evidence on the issue. Next is a discussion of prominent cases, followed by a summary and advice for practitioners.

The next section briefly discusses the economic definitions of capacity and excess capacity. Section three focuses on the role of capacity in market definition. Section four discusses the role of capacity issues in evaluating coordinated interaction, which has relevance in both the merger and cartel contexts. Section five discusses the potential role of capacity in unilateral firm behavior, including unilateral merger effects as well as analyses of dominance or monopolization matters. Section six discusses theory and evidence regarding the role of capacity issues in the analysis of entry. Section seven discusses the interactions between capacity and efficiency issues. Section eight provides advice on how to analyze capacity when it has the potential to affect several steps of the analysis. A final section concludes.

The overarching theme is that capacity issues should affect competition analysis only when there is strong case-specific evidence regarding its effects.. For example, while economic theory suggests that the existence of some excess capacity is a necessary condition for anticompetitive coordinated interaction, we argue that there is no clear theoretical or empirical relationship between the amount of excess capacity and the likelihood or degree of coordination. Similarly, the degree of excess capacity of merging firms does not lead to any given conclusion about the likelihood of unilateral effects. Further, while excess capacity may be a symptom of an industry in which entry is difficult, excess capacity is neither necessary nor sufficient for a conclusion that future entry is unlikely. Moreover, in any of these situations, precisely measuring excess capacity may be quite difficult, which provides a further reason for caution.

## II. DEFINING CAPACITY AND EXCESS CAPACITY

For purposes of this paper, we define a firm's *capacity* as the maximum level of goods and/or services that the firm is capable of producing in the short run, at a marginal cost at or near its current marginal cost. A firm has *excess capacity* if its actual output is below this point. A firm is *capacity constrained* if it is currently producing at its capacity.

At times, the capacity constraint can be "sharp." For example, a factory may have some strict level of maximum output. However, often the capacity constraint can be "fuzzy." For example, a factory may be able to operate beyond its nameplate capacity for some critical time period.<sup>2</sup> Further, firms may be able to increase output

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<sup>1</sup> See U.S. DEP'T OF JUSTICE & FEDERAL TRADE COMM'N, HORIZONTAL MERGER GUIDELINES (2010) (hereafter *2010 Guidelines*) available at <http://ftc.gov/os/2010/08/100819hmg.pdf>.

<sup>2</sup> Reynolds provides examples of utilization rates above 100% of nameplate capacity in the steel industry. (Stanley Reynolds, *Strategic Capital Investment in the American Aluminum Industry*, 34 THE JOURNAL OF INDUSTRIAL ECONOMICS 225 (1986).)

beyond a given level by shifting productive resources from another product that it produces; importing the product sold by others for resale to customers or entering into a supply agreement with competitors or other firms.<sup>3</sup> The latter situation requires judgment as to the importance of capacity constraints in a given market and their relevance to competition analysis.

### III. MARKET DEFINITION

While market definition is solely a function of demand substitution factors, supply-side considerations play a role in the determination of which firms are market participants.<sup>4</sup> Consequently, through its impact on the supply-side, capacity issues have a role to play in market definition.

#### A. Theory

The *2010 Guidelines* indicate that firms that are not current producers in a relevant market, but that would enter quickly and without incurring significant sunk costs in the event of a small but significant nontransitory increase in price (“SSNIP”), are considered “rapid entrants,” and thus market participants. Rapid entrants would be considered to have an impact comparable to that of firms that are currently earning revenues in the market. A rapid entrant must have the capability and incentive to enter the market. Clearly, the capacity of a firm is a key determinant of whether or not that firm is capable of profitably entering the market in a timely manner.

A key distinction in the analysis is whether the capacity is currently idle or whether it is devoted to other uses. If a firm can bring idle capacity online rapidly and inexpensively, then supply substitution comes at no significant opportunity cost. Nevertheless, a SSNIP may be insufficient to incentivize deployment of idle capacity; for example, the firm may not operate efficiently at a greater scale, or transportation costs may put a given geographic market out of reach. Therefore, whether or not to count a firm with idle capacity as a market participant requires judgment as to the profitability of deploying this capacity in the event of a SSNIP.

If a potential market participant’s capacity is currently devoted to other uses, it is possible the firm’s capacity would be reallocated. As an example, it is a relatively simple matter for flour mills currently designed for milling soft wheat flours to switch to a configuration that is appropriate for milling hard wheat flours (and vice versa). More generally, the margins on the product the firm is currently manufacturing may be high enough that the producer would not be tempted to switch production in the event of a SSNIP. It may be the case that only a portion of the divertible capacity would shift and therefore be assigned shares in the relevant market. Further, a transitory reallocation of capacity may involve permanently relinquishing a certain amount of current business. Upon returning to manufacturing their former product, such firms may find they have lost some customers to competitors and may not be able to locate enough new customers to keep their facilities running at as great a level as before “hit and run” entry. The present value of any loss in expected future sales as a result of such shifting is a relevant consideration in determining the overall profitability of such a move and should be considered a sunk cost of reallocating capacity.

#### B. Cases

Empirical evidence regarding the role of capacity in market definition appears limited. As noted by former FTC Commissioner Thomas Leary:

The hypothetical “uncommitted entrants,” who can enter and exit without incurring significant costs, have proven as elusive as the Abominable Snowman; the category appears to be an empty box, like its theoretical godparent the “contestable market.”<sup>5</sup>

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<sup>3</sup> E.g., see Nicole Friedman & Bob Tita, *The New Oil-Storage Space: Railcars*, WALL ST. JNL., Feb. 28, 2016 at p. A1 (discussing how energy traders have increased oil storage capacity by using surplus railcars and noting other alternatives to terminals such as underground caverns and oil tankers).

<sup>4</sup> See *2010 Guidelines* at §4.

<sup>5</sup> Thomas Leary, *The Essential Stability of Merger Policy in the United States*, 70 ANTITRUST LAW JOURNAL 105 (2002).

Of course, this absence of agency matters or case law pointing to the impact of rapid entrants may actually reflect the success of applying this concept, as it may be that when such entry is possible, the agencies or potential litigants do not seek to block such transactions.<sup>6</sup>

The 2006 *Commentary on the Merger Guidelines* note several instances where the sunk costs of obtaining capacity were not considered significant.<sup>7</sup> For example, in the DOJ's 2002 analysis of the consummated *Playbill-Stagebill* matter, involving two of the largest publishers of theater programs, the Department found that the merger was not likely to be anticompetitive because outsourcing capacity was readily available for printing. Similarly, in *Wrigley-Kraft* (2005) the FTC recommended closing its investigation because it found relatively easy access to both manufacturing and distributive capacity for various breath mint and chewing gum products through the contractual outsourcing of these functions.

Issues of capacity and rapid entry played a role in *Par-Mid Pac* (2015).<sup>8</sup> This matter involved the Hawaiian market for the bulk supply of Hawaii-grade gasoline blendstock (HIBOB). There were only two refineries in Hawaii that produce bulk supply of HIBOB, one each operated by Par and Chevron. Mid-Pac had a long-term agreement for capacity at the only non-refinery terminal in Hawaii that could economically import bulk supply of HIBOB. The two refineries produced more gasoline than was consumed in Hawaii, rendering imports unnecessary. While Mid-Pac had never used its terminal space to import gasoline, the FTC alleged that it had the ability to credibly threaten to import HIBOB, thereby constraining the prices charged by the local refiners and, ultimately, the price paid by Hawaii gasoline consumers. The FTC's claim was that Mid-Pac should be considered a participant in Hawaii's gasoline bulk-supply market in that the terminal capacity gave them the capability to import cargoes of refined gasoline rather than purchasing from Hawaii's refineries.

In contrast, in *Steris-Synergy* (2015), a merger of companies providing contract sterilization services to medical device manufacturers and related customers, the FTC claimed that manufacturers with in-house sterilization facilities should be excluded from an antitrust market for contract sterilization services because capacity at in-house facilities was unlikely to be redeployed to handle contract business in the event of a SSNIP.<sup>9</sup> The FTC cited the fact that no in-house facility in the contiguous U.S. had ever sold excess capacity to its competitors as justification for this claim as well as a general movement away from in-house and toward contract sterilization. This case illustrates that the mere presence of idle capacity may not be sufficient to render a firm a market participant, perhaps due to technological factors such as insufficient scale<sup>10</sup> or geographic disadvantages.<sup>11</sup>

#### IV. COORDINATED EFFECTS

There are a number of references to the possible impact of excess capacity on coordinated interaction in various iterations of the *U.S. Horizontal Merger Guidelines*. These references appear to pull in different directions. For example, the 2010 *Guidelines* suggest that excess capacity is a necessary condition for a market participant to be a "maverick" and thus particularly disruptive to arriving at a collusive understanding.<sup>12</sup> This context views excess capacity as reducing the likelihood of collusion. On the other hand, as noted in the 1992 *Guidelines*, "[e]xcess

<sup>6</sup> For a discussion of this point, see Jonathan Baker, *Responding to Developments in Economics and the Courts: Entry in the Merger Guidelines*, 71 ANTITRUST LAW JOURNAL 189 (2003).

<sup>7</sup> U.S. Dep't of Justice & Fed. Trade Comm'n, *Commentary on the Horizontal Merger Guidelines* (2006) at 41-42.

<sup>8</sup> See Federal Trade Commission, *Complaint and Statement In the Matter of Par Petroleum Corporation and Mid Pac Petroleum, LLC*, March 18, 2015.

<sup>9</sup> See Federal Trade Commission, *Complaint for Temporary Restraining Order and Preliminary Injunction, FTC v. Steris/Synergy Health [Redacted Public Version]*, May 29, 2015, available at <https://www.ftc.gov/enforcement/cases-proceedings/151-0032/ftc-v-sterissynergy-health>.

<sup>10</sup> E.g., see *Complaint for Temporary Restraining Order and Preliminary Injunction, FTC v. Steris/Synergy Health [Redacted Public Version]*, *supra* note 10 at 43 ("Steris, Sterigenics and Synergy have the experience and scale and scope of operations to meet the needs of large medical device manufacturers effectively and economically. No potential entrant has the reputation or size of operations that these large customers require.").

<sup>11</sup> E.g., see *Complaint for Temporary Restraining Order and Preliminary Injunction, FTC v. Steris/Synergy Health [Redacted Public Version]*, *supra* note 10 at 22-23 ("Contract radiation sterilization customers are located throughout the country, but most [customers] strongly prefer to purchase services in the areas around their manufacturing and distribution sites in order to minimize transportation costs and turnaround times.").

<sup>12</sup> See 2010 *Guidelines* §2.1.5 "A firm that may discipline prices based on its ability and incentive to expand production rapidly using available capacity also can be a maverick, as can a firm that has often resisted otherwise prevailing industry norms to cooperate on price setting or other terms of competition." See also, U.S. DEP'T OF JUSTICE & FEDERAL TRADE COMM'N, HORIZONTAL MERGER GUIDELINES (1992) (hereafter 1992 *Guidelines*) available at <http://www.ftc.gov/bc/docs/horizmer.shtm>, §2.12 "in a market where capacity constraints are significant for many competitors, a firm is more likely to be a maverick the greater is its excess or divertible capacity in relation to its sales or its total capacity, and the lower are its direct and opportunity costs of expanding sales in the relevant market."

capacity in the hands of non-maverick firms may be a potent weapon with which to punish deviations from the terms of coordination.”<sup>13</sup> Under this view, excess capacity increases the likelihood of coordinated interaction, by allowing firms to punish rivals’ attempts to gain market share. In a cartel context, the presence or absence of excess capacity may play a role in investigating whether or not an agreement took place, particularly in the absence of explicit evidence of a cartel (e.g. tapes of meetings or written communication between corporate representatives discussing such an agreement). Importantly, all discussion in this section applies to both tacit and explicit collusion. While the mechanism for collusion is clearer when there is explicit communication between rival executives, tacit collusion carries identical incentives.

## A. Theory

### 1. Economic models of collusion

This subsection argues that the theoretical relationship between excess capacity and collusion is ambiguous.<sup>14</sup> In particular, we explore two views on the relevance of excess capacity to the likelihood of coordinated effects. The first view is that a greater level of excess capacity increases the likelihood of collusion; under this view, firms that interact repeatedly are able to “punish” rivals who deviate from a collusive arrangement by increasing their production, provided they have excess capacity. The second view is that greater excess capacity, particularly when concentrated within a small number of firms, decreases the likelihood of collusive behavior. The logic behind this view is that firms with relatively more excess capacity will have a greater incentive to “cheat” on a collusive arrangement, thus making collusion less sustainable.

Firms have an incentive to collude in order to increase collective and individual profits by restricting output or raising prices. While colluding firms earn a higher profit than they would under competition, each firm has an incentive to cheat on the collusive agreement. This is because individual firms can obtain even higher profits by individually setting a lower price or producing a greater quantity than is beneficial for the cartel as a whole. For example, colluding duopolists may set a monopoly price and divide the market in half. While the monopoly price maximizes the total profit of the colluding firms, either firm acting on its own could increase its individual profits by setting a slightly lower price or producing a slightly greater quantity than its rival.

Collusive arrangements are thus not inherently stable, and depend on the threat of punishment should one or more firms deviate from a collusive quantity or price. Punishment can take a number of forms, but the economics literature often considers the simplest punishment reversion to a non-collusive atmosphere.<sup>15</sup> Under certain conditions, the threat of a return to competition will suffice to sustain a cartel.

The decision to cheat on a collusive agreement involves a trade-off between higher current profits versus the loss of future profits that results from the breakdown of cartel discipline engendered by cheating. For the threat of a return to competition to deter cheating and thus maintain collusion, firms must be sufficiently forward-looking. That is, deterring cheating requires that firms must put sufficient weight on future cartel profits.

The weight that colluding firms put on future profits is determined by the time value of money and the likelihood that collusion will be sustainable in future periods. The interest rate and a firm’s internal policies determine the former, while the risk of entry, decreased demand, antitrust enforcement, rivals’ changes in strategies, or anything else that could make future collusion less likely affect the latter. The total weight that a firm puts on profits one time period in the future relative to current profits is called its discount factor, and is often denoted by the letter  $\delta$ . A “period” could be a week, a month, or a year. Profits  $t$  periods in the future are discounted by  $\delta^t$ . The less valuable are future profits relative to current profits, the lower is  $\delta$ .<sup>16</sup>

<sup>13</sup> 1992 Guidelines, fn. 19.

<sup>14</sup> Ivaldi *et al* raise many of the same issues discussed herein. (See Marc Ivaldi, Bruno Jullien, Patrick Rey, Paul Seabright & Jean Tirole, *The Economics of Tacit Collusion*, (Final Report for DG Competition, IDEL, Toulouse, 2003) at 41-45 and 59-62).

<sup>15</sup> See 1992 Merger Guidelines, §2.12: “Credible punishment, however, may not need to be any more complex than temporary abandonment of the terms of coordination by other firms in the market.” The notion that non-Nash equilibrium outcomes emerge as equilibria of infinitely repeated games has a long history in economics. Characterizing the set of equilibrium outcomes in repeated games was formalized by papers such as James W. Friedman, *A Non-cooperative Equilibrium for Supergames* 38 REVIEW OF ECONOMIC STUDIES 1 (1971) and Drew Fudenberg & Eric Maskin, *The Folk Theorem in Repeated Games with Discounting or Incomplete Information*, 54 ECONOMETRICA 533 (1986). For a general introduction to this literature, see chapter 2 of Robert Gibbons, *GAME THEORY FOR APPLIED ECONOMISTS* (1992).

<sup>16</sup> For example, given an interest rate of  $r$ , the present discounted value (PDV) of a payment of  $F$  made  $t$  periods in the future would be  $PDV = \frac{F}{(1+r)^t}$ . Absent other risk, the discount factor from one period to the next is  $\delta = \frac{1}{1+r}$ . The discount factor is between 0 and 1. For instance, if interest rates are 5 percent, a payment of \$10 two years in the future would be worth  $\$10 * \frac{1}{(1+.05)^2} = \$9.51$  today.

By the preceding discussion, there is a minimum discount factor, denoted  $\bar{\delta}$ , such that it is possible for firms to coordinate only if all firms have a discount factor  $\delta \geq \bar{\delta}$ .<sup>17</sup> In other words, as long as  $\delta \geq \bar{\delta}$ , firms put sufficient weight on future profits for collusion to be sustainable. This is not to say that economic theory predicts that firms *will* coordinate so long as  $\delta \geq \bar{\delta}$ , merely that they *could*. There are a number of factors that affect the likelihood of collusion, such as: the number of firms, firm and product heterogeneity, the transparency of production levels or prices, and industry practices. A discount factor  $\delta \geq \bar{\delta}$  merely means that firms value future profits enough that collusion cannot be ruled out. Other factors might rule out collusion. Thus, a lower  $\bar{\delta}$  indicates that a collusive outcome is more likely, not that it will necessarily occur. We now turn to a discussion of the relationship between excess capacity and the ease of collusion, as measured by  $\bar{\delta}$ .

## 2. Excess capacity has ambiguous effects on collusion likelihood

An increase in unused capacity that is uniformly distributed across all colluding firms (say, from a market-wide negative demand shock) has two effects on the intertemporal tradeoff the firms face. First, cheating becomes more attractive for each colluding firm; as a firm's excess capacity increases, it is able to capture a relatively greater market share by cheating on a collusive arrangement. Second, profits under competition decrease; as excess capacity increases, competition becomes more intense, resulting in greater output, a lower price and lower profits.<sup>18</sup> These effects work in opposite directions, with the former making collusion less likely (since firms will be more tempted to cheat), and the latter making it more likely (since the 'punishment' to deviating from collusion is relatively harsher). Either effect can dominate, meaning that there is no general relationship between excess capacity and likelihood of collusion.

The appendix discusses this intuition in the context of an economic model of a repeated oligopoly game.<sup>19</sup> Total industry capacity is split across two oligopolists. We consider equilibria in which the two firms collude to the maximum extent possible so long as neither has previously cheated, but permanently return to competition following any cheating. We study the interaction between industry capacity and the minimum discount factor necessary to sustain collusion,  $\bar{\delta}$ . We show that, as industry capacity increases,  $\bar{\delta}$  first decreases, then increases. In other words, more capacity has an ambiguous effect on the ease of collusion, and an increase in capacity may make collusion easier to sustain, or more difficult.<sup>20</sup> See Figure A1 for a graphical depiction of the relationship between  $Q$  and  $\bar{\delta}$  in the model.

The intuition behind this result is the same as above: higher industry capacity both makes cheating more attractive (since a firm can capture a larger market share by cheating if its capacity is larger) and competition less attractive (since the punishment of increased output is greater). At a low level of industry capacity ( $Q$ ), the latter effect dominates. At lower levels of  $Q$ , the higher is  $Q$ , the ability of all firms to meet the expanded demand at the lower competitive price increases more quickly than the ability of a lone defecting firm to benefit fully from price-cutting. However, starting from some intermediate level of  $Q$ , greater capacity has no effect on profits under competition (as collectively all firms already have sufficient capacity to reach the unconstrained competitive outcome), while continuing to make cheating for a single firm more attractive, thus making collusion more difficult.<sup>21</sup>

Now, consider the case where firms have unequal capacities. Again, assume an industry with two firms and fixed industry capacity  $Q$ . Assume that Firm 1 has a larger share of total industry capacity than Firm 2. What happens to the likelihood of collusion as Firm 1's share of fixed industry capacity increases (and Firm 2's decreases)?<sup>22</sup> The answer is again ambiguous.

<sup>17</sup> Specifically,  $\bar{\delta}$  is the minimum value of  $\delta$  satisfying  $\frac{\text{Profit(collusion)}}{1-\delta} \geq \text{Profit(cheating)} + \frac{\delta}{1-\delta} \text{Profit(competition)}$ .

<sup>18</sup> Indeed, much of the modern economic literature on excess capacity's role in facilitating coordinated interactions thus focuses on its function as a punishment device. E.g., see Martin Osborne & Carolyn Pitchik, *Cartel, Profit and Excess Capacity*, 28 INTERNATIONAL ECONOMIC REVIEW 413 (1987); Carl Davidson & Raymond Deneckere, *Excess Capacity and Collusion*, 31 INTERNATIONAL ECONOMIC REVIEW 521 (1990).

<sup>19</sup> We assume linear demand, constant marginal costs, an infinite horizon without entry, Cournot competition, and a common discount factor  $\delta$ .

<sup>20</sup> There are countless other examples of equilibrium strategies. This multiplicity induces uncertainty regarding the form that collusive strategies would take in real-world industries. However, this uncertainty only strengthens the point that there is no consistent relationship between the degree of excess capacity and the likelihood of collusion.

<sup>21</sup> Brock and Scheinkman use a repeated Bertrand model to argue that if each firm has equal capacity, the relationship between the number of firms and the minimum discount factor required to sustain collusion is non-monotonic, first decreasing, then increasing. (See William Brock & Jose Scheinkman, *Price Setting Supergames with Capacity Constraints*, 52 REVIEW OF ECONOMIC STUDIES 371 (1985)).

<sup>22</sup> By definition, since industry capacity is fixed, firm two's share of capacity decreases as firm one's increases. In other words, the distribution of capacity becomes more asymmetric.

Suppose first that colluding firms choose to equally split cartel profits, regardless of the distribution of capacity. In this case, an increase in Firm 1's share of industry capacity has two effects. First, it increases the profit that Firm 1 can gain by cheating on a collusive agreement. Second, it lowers the capacity available to Firm 2, and thus constrains Firm 2's ability to punish Firm 1 following a deviation. Each of these effects makes cheating more attractive for Firm 1 and thus makes sustaining collusion more difficult; the minimum discount factor necessary to sustain collusion,  $\bar{\delta}$ , increases.<sup>23</sup>

Now suppose that the colluding firms take into account relative capacities when determining how to split cartel profits, so that a higher share of industry capacity implies a higher profit for Firm 1 under collusion.<sup>24</sup> In this case, the effect of increasing Firm 1's share of capacity (and hence decreasing Firm 2's) on the ease of collusion is ambiguous. As Firm 1's share increases, the relative gain to Firm 1 from cheating on collusion decreases (since it earns a relatively higher profit under collusion). However, just as in the previous case, Firm 2's ability to punish Firm 1 in the event collusion breaks down decreases. On net, an increase in Firm 1's capacity share may increase or decrease  $\bar{\delta}$  in this case.<sup>25</sup> It might be tempting to generalize from these theoretical models to make predictions about the real world. For example, it might seem appropriate to apply the model where firms have equal capacities to situations where excess capacity is, more or less, symmetrically distributed among firms in an industry. A practitioner might then argue that if excess industry capacity is "low," collusion is more likely, but if industry excess capacity is "high," collusion is unlikely. Further, one might be tempted to apply the second, asymmetric capacity, model to situations where excess capacity is unevenly distributed and is in the hands of a single firm or only a few firms.

We believe the predictions of these theoretical models are unlikely to be easily applicable to real world antitrust markets for a number of reasons. First, as noted above, these models only indicate whether collusion is feasible, not whether it will actually occur. Numerous other considerations still affect collusion likelihood. Secondly, key factors, such as whether the distribution of capacity is symmetric or asymmetric or whether it is "high" or "low" are not easy to benchmark and likely vary across industries and over time. For example, whether a given level of excess capacity is "high" or "low" is determined by cost and demand conditions. This makes it difficult, if possible at all, to determine whether the industry under consideration is in a region where excess capacity is more likely to induce competition or collusion. Finally, difficulties in determining whether a firm or firms actually have excess capacity as discussed in Section II, *supra* may also limit the application of these models from a practical standpoint. Overall, the lesson from standard theoretical models of collusion is that there is no *a priori* reason to believe there is any particular relationship between excess capacity and likelihood of collusion.

### 3. A maverick with excess capacity deters collusion

Whether excess capacity increases or decreases the likelihood of coordinated interactions depends to some extent on which firm or firms are holding it. Particular attention should be given to the effects of excess capacity in the hands of a maverick. Maverick firms are often identified as firms that are particularly disruptive to potential coordination,<sup>26</sup> but can also simply be firms that find it optimal, from either a short or long-term perspective, to charge a lower price or choose other terms that are more competitive than their rivals.<sup>27</sup> While some excess capacity would be necessary for a maverick to increase its share following an attempt by its rivals to coordinate on increased price, the presence of a firm with significant excess capacity is neither necessary nor sufficient for that firm to be a maverick. In other words, a firm must have some excess capacity to be a maverick, but excess capacity does not mean that a particular firm is a maverick. Indeed, there is no definitive methodology for identifying whether a firm is a maverick and this issue is likely to be of some contention in an adversarial context. Moreover, while excess capacity may be a necessary condition in order for a firm to be a maverick, as noted in Section II *supra*, identifying

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<sup>23</sup> An increase in Firm 1's share of capacity may also decrease Firm 2's incentive to deviate from collusion.

<sup>24</sup> See the discussion of collusion in the Norwegian cement market in section III.C.3 for an example of a cartel that allocated shares based on total capacity.

<sup>25</sup> In a related setting, but using a Bertrand model, Compte et al. argue that asymmetries in capacity makes collusion less likely, and, in particular, that mergers that concentrate capacity (say, in the hands of the merged firm) are likely to disrupt the potential for collusion. (See Oliver Compte, Frederic Jenny, & Patrick Rey, *Capacity Constraints, Mergers, and Collusion*, 46 EUROPEAN ECONOMIC REVIEW 29 (2002)). Other papers arguing that asymmetric capacity hinders collusion include: Davidson & Deneckere, *supra* note 18 ; Carl Davidson & Raymond Deneckere, *Horizontal Mergers and Collusive Behavior*, 2 INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION 117 (1984); and Val Lambson, *Optimal Penal Codes in Nearly Symmetric Bertrand Supergames with Capacity Constraints*, 24 JOURNAL OF MATHEMATICAL ECONOMICS 22 (1995).

<sup>26</sup> See, e.g., 1992 Guidelines, §2.12.

<sup>27</sup> For a further discussion of factors that can be used to identify maverick firms, see Jonathan Baker, *Mavericks, Mergers, and Exclusion: Proving Coordinated Competitive Effects Under the Antitrust Laws*, 77 NYU LAW REVIEW 135 (2002) at 173-177.

whether a firm has excess capacity may not be straightforward to the extent a firm is able to quickly scale its business with a low expenditure of sunk costs.

#### 4. Capacity as a strategic variable

The theoretical discussion in section III.B.2 treats capacity as fixed, and outside of a firm's control. Suppose that in addition to choosing price and quantity, firms are able to choose capacity. "Endogenous" capacity is an appropriate assumption given a time horizon long enough to allow new capacity to be built. This raises the potential for firms to choose capacity levels they believe will facilitate coordination with their rivals, or even for firms to coordinate on capacity itself.

First, suppose firms are able to coordinate prices, but not their capacity investment decisions. Thus, while in this model firms are able to choose their capacity levels, they are not able to coordinate on that decision. This setting is appropriate if some marketplace interaction with rivals over time is necessary to foster collusion, or if colluding in capacity is more costly than colluding in prices. An important result is that as conditions become more conducive to collusion (say, because firms become more patient, meaning that future punishments are more of a deterrent to cheating), firms choose higher capacity levels.<sup>28</sup> This is because with greater collusion (as measured by the deviation from the competitive outcome), cheating becomes more attractive, and so greater punishments are necessary to support collusion. However, greater punishments require greater capacity, in order to support the greater quantities and lower prices in a punishment. Hence, while excess capacity need not imply coordination, in this model the absence of excess capacity effectively rules out any coordinated interaction on output or price.

Alternatively, suppose that firms are capable of colluding in their choices of capacity, prices, or both. If firms cheat by building more or less capacity than called for by the collusive arrangement, they can be punished by their rivals setting lower prices in the future. Once again, in any equilibrium of this game involving collusion in price and/or capacity, firms carry excess capacity.<sup>29</sup> The reason is the same as in the case where firms could not collude on capacity: absent excess capacity, firms would be unable to punish cheating rivals who either build too much capacity or set prices too low. Incentivizing firms in this situation against deviating from collusive arrangements requires some excess capacity.<sup>30</sup>

This literature implies that excess capacity is a necessary condition for coordination on output or price.<sup>31</sup> Indeed, if demand and supply are equalized at a point where there is no excess capacity, full-fledged competition could not reduce prices any further. Raising prices at this point (assuming downward sloping demand curves) would induce at least some excess capacity.<sup>32</sup>

### C. Empirical Evidence

Given the theoretical ambiguity regarding the relationship between excess capacity and collusion, it is perhaps unsurprising that the empirical economic literature on the issue offers no clear consensus. Broadly, three types of studies purport to empirically characterize the relationship between excess capacity and coordinated interaction. The first type involves forensic case studies of individual industries uncovered during antitrust investigations. The second involves explicit cartels that preceded antitrust laws in the region in which they operated. The third involves creative empirical work to characterize collusion in industries likely to be susceptible to coordination. We examine what studies of each type say on the relationship between excess capacity and collusion, while concluding that there is no empirical consensus.

#### 1. Antitrust Case Studies

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<sup>28</sup> This is the main result of Davidson & Deneckere, note 18 *supra*.

<sup>29</sup> See Jean-Pierre Benoit & Vijay Krishna, *Dynamic Duopoly: Prices and Quantities*, 54 REVIEW OF ECONOMIC STUDIES 23 (1987).

<sup>30</sup> One exception to this intuition is the case of lumpy capacity investments in an industry with rising demand. Consider an industry in which demand is growing, and firms are at or near their capacity constraints. Each firm may either build a new plant or do nothing; incremental capacity expansion is impossible. If each firm believes that its own capacity expansion would result in its rivals expanding capacity as well, each firm could choose to do nothing, causing price to rise as demand increases. This form of collusion is consistent with no observed excess capacity.

<sup>31</sup> In a merger context, lack of pre-merger excess capacity can be interpreted to mean that the firms are not currently colluding. This does not necessarily mean that there would be no collusion after the merger.

<sup>32</sup> See *F.T.C. v. Elders Grain, Inc.*, 868 F.2d 901 (7th Cir. 1989) ("But of course excess capacity may be a symptom of cartelization rather than a cure for it").



We begin with a forensic study of the lysine cartel of the 1990's.<sup>33</sup> The FBI had access to audio and video recordings of almost 300 cartel meetings. Hence, detailed information about the workings of the cartel are in the public record. ADM entered the lysine market in 1991 by constructing a gigantic factory with capacity equal to nearly two-thirds of total nameplate capacity at all other worldwide lysine factories combined prior to the ADM plant's opening. In the eighteen months after the ADM plant opened, lysine prices fell by nearly half, while the ADM plant increased its capacity utilization to about 40%. In the summer of 1992, ADM began explicitly courting its competitors in price fixing discussions. The lysine price increased 75% by the end of the year, before falling again the next summer, and then rising back to nearly double the pre-cartel price in winter of 1993, where it stayed for the duration of the cartel. Central to ADM's success at cartelizing the industry was its plant's enormous capacity; ADM gave its rivals' executives unrestricted tours of the plant, and in the cartel's meetings explicitly threatened its rivals with production increases if they deviated from agreed-upon prices. While ADM itself could have profited in the short-run from exceeding its own production quotas, the fact that ADM was losing money in 1992, before the cartel took effect, meant that its rivals had sufficient excess capacity to effectively deter a deviation from cartel behavior by ADM with a price war.

Second, ADM was also a central player in the citric acid cartel of the 1990's.<sup>34</sup> Here, cartel members seem to have been spurred into action by low prices resulting from the entry of a new plant and the expansion of existing plants. Cartel members evidently coordinated to maintain market shares while raising prices. Cartel members shared production numbers, which an independent accounting firm audited. Within two years of the cartel's formation, citric acid prices rose to pre-entry levels. Unlike with lysine, the citric acid cartel was vulnerable to increases in imports by Chinese firms with excess capacity, which were not part of the cartel.<sup>35</sup> To stem this threat, US cartel participants successfully lobbied the US government to impose a prohibitive tariff on Chinese citric acid imports, effectively neutralizing the impact of excess capacity in the hands of non-colluding market participants.

Third, the Taiwanese flour industry was characterized by only 40-50% capacity utilization for more than 20 years.<sup>36</sup> Using data uncovered during a Taiwanese antitrust investigation, Ma found that a 1% increase in capital investment decreases rivals' output by .25%, as the resulting excess capacity was used to threaten cartel members. Ma argues that the ability to decrease rivals' production via investment in one's own capacity led to the apparent overinvestment in capacity in the Taiwanese flour industry. During the final years of the cartel, the country's seven largest flour producers all utilized less than half of their capacity, meaning that the industry had the ability to punish any firm that competed too aggressively.

## 2. *Explicit Cartels*

Turning to the second type of study, the Chicago Eastbound Dead Freight Pool explicitly cartelized eastbound railroad shipping from Chicago during the 1880's, prior to the passage of the Sherman Act. The pool's Joint Executive Committee published weekly statistics on members' shipping volume, and punished deviations from prescribed market share by cutting the cartel's prices.<sup>37</sup> Price wars were reported in the Chicago Tribune. Demand experienced both seasonal and random variation. As a result, cartel members' excess capacity fluctuated as well. Rotemberg & Saloner argue that price wars seemed to occur during high demand years, when excess capacity would have been lower; implying that excess capacity is predictive of collusion.<sup>38</sup> However, Ellison and Porter analyze the same data and argue that the balance of the evidence is that price wars occur during low-demand periods, when firms have excess capacity, suggesting that excess capacity is not predictive of collusion.<sup>39</sup> All three studies agree that there was a price-fixing cartel, and that price wars occurred, but disagree as to the role of excess capacity in those price wars.

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<sup>33</sup> John Connor, "Our Customers are our Enemies": *The Lysine Cartel of 1992-1995*, 18 REVIEW OF INDUSTRIAL ORGANIZATION 5 (2001).

<sup>34</sup> John Connor, *The Global Citric Acid Conspiracy: Legal-Economic Lessons*, 14 AGRIBUSINESS 435 (1999).

<sup>35</sup> Notably, the two largest citric acid importers, both European, eventually plead guilty to price fixing.

<sup>36</sup> Tay-Cheng Ma, *Strategic Investment and Excess Capacity: A Study of the Taiwanese Flour Industry*, 8 JOURNAL OF APPLIED ECONOMICS 153 (2005).

<sup>37</sup> For details on the Joint Executive Committee's workings, see Robert Porter, *A Study of Cartel Stability: The Joint Executive Committee, 1990-1886*, 14 THE BELL JOURNAL OF ECONOMICS 301 (1983).

<sup>38</sup> Julio Rotemberg and Garth Saloner, *A Supergame-Theoretic Model of Price Wars During Booms*, 76 AMERICAN ECONOMIC REVIEW 309 (1986).

<sup>39</sup> Glenn Ellison, *Theories of Cartel Stability and the Joint Executive Committee*, 25 THE RAND JOURNAL OF ECONOMICS 37 (1994); Robert Porter, *A Study of Cartel Stability: The Joint Executive Committee, 1880-1886*, 14 THE BELL JOURNAL OF ECONOMICS 301 (1983).

Two studies characterize explicit collusion in the Norwegian cement market.<sup>40</sup> Importantly, both studies argue that the Norwegian cartel allocated shares to each of three manufacturers based on their share of total domestic capacity. While the cartel was effective in controlling price, it created an incentive for manufacturers to increase capacity, in order to be allocated a higher share. Remarkably, over 40% of Norwegian domestic production was exported at the cartel's peak, even though the export price was at times below the marginal cost of domestic production. Only by a merger to monopoly did the firms solve the problem of excess capacity; the merged firm quickly reduced capacity until domestic supply was equal to domestic demand, without a significant change in prices.

Scherer and Ross cite the experience of explicit cartels in the rayon, cement and steel industries during the Great Depression to support the contention that price wars result from excess capacity.<sup>41</sup> For example, citing a study by Markham, Scherer and Ross note that rayon manufacturers instituted a formal price fixing agreement.<sup>42</sup> However, given that even industry leaders were only operating at 55 percent of capacity during the Depression, the agreement broke down. In terms of cement, Scherer and Ross claim that U.S. cement manufacturers entered into a series of price-fixing arrangements, but these tended to collapse under financial stress, particularly during the Great Depression when the average realized price per barrel declined 30 percent while unit overhead costs were rising. Finally, while the steel industry tended to exercise stronger pricing discipline, it also experienced significant price deterioration episodes during the period 1929-1938.

While these experiences might suggest that excess capacity hinders collusion, it is possible that the correlation between excess capacity and price reductions is not causal. The demand reduction experienced during the Depression makes it difficult for firms to earn profits even at the collusive price. In such a situation, producers cut prices in the hope of surviving the "recession" and that others will be driven from the market. Thus, the reduction in demand may have caused the excess capacity as well as the collusive breakdown rather than causality running from the excess capacity to the collusive breakdown.

### 3. Empirical Studies

Turning now to our final category of studies, recent empirical literature on the correlation between excess capacity and collusion is limited and would appear to provide little guidance on which theoretical effect of excess capacity can be expected to dominate. Some studies find a negative correlation between excess capacity and industry performance with others finding no significant relation or a positive one. One study conducted a laboratory experiment using a computerized posted offer session.<sup>43</sup> Levels of excess capacity among the participants were varied. It was found that excess capacity in this experiment led to lower prices, lending support to the view that excess capacity discourages collusion. Another study examines the impact of capacity in the Texas lodging industry, and finds that asymmetries in the distribution of excess capacity tend to decrease prices.<sup>44</sup> This is consistent with the previous theoretical discussion, in that a firm whose rivals do not have sufficient excess capacity to punish that firm for deviating from collusion will have an incentive to lower its price, particularly if that firm has excess capacity. Finally, Rosenbaum found that industry excess capacity bolstered a non-cooperative oligopoly price in the American aluminum ingot market.<sup>45</sup>

### D. Case Examples

Excess capacity has played a role in the analysis of coordinated interaction in a number of merger and cartel matters. This section highlights some of the case history regarding such applications. Importantly, despite the ambiguous theoretical and empirical relationship between excess capacity and collusion, most of the cases involving excess capacity have focused on excess capacity as an inducement to competition.

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<sup>40</sup> Frode Steen & Lars Sorgard, *Semicollusion in the Norwegian Cement Market*, 43 EUROPEAN ECONOMIC REVIEW 1775 (1999) and Lars-Hendrik Roller & Frode Steen, *On the Workings of a Cartel: Evidence from the Norwegian Cement Industry*, 96 THE AMERICAN ECONOMIC REVIEW 321 (2006).

<sup>41</sup> F.M. Scherer and David Ross, *Industrial Market Structure and Economic Performance* (1990) at 290-294

<sup>42</sup> Jesse Markham, *COMPETITION IN THE RAYON INDUSTRY* (1952).

<sup>43</sup> Bradley Ewing & Jamie Kruse, *An Experimental Examination of Market Concentration and Capacity Effects on Price Competition*, 5 JOURNAL OF BUSINESS VALUATION AND ECONOMIC LOSS ANALYSIS (2010).

<sup>44</sup> Mike Conlin & Vrinda Kadiyali, *Capacity and Collusion: An Empirical Analysis of the Texas Lodging Industry*, (mimeo, 2007).

<sup>45</sup> David Rosenbaum, *An Empirical Test on the Effect of Excess Capacity in Price Setting, Capacity-constrained Supergames*, 7 INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION 231 (2000).

### *1. Cases emphasizing the “competition-inducing” aspects of excess capacity*

The *FTC v. Owens Illinois* (1988) matter concerned a merger of two firms involved in the manufacture and distribution of glass containers.<sup>46</sup> The FTC noted that there was very high capacity utilization in this industry, and argued that this was conducive to collusion. Thus, the FTC appears to have emphasized that the presence of excess capacity increases the incentives to cheat on a collusive understanding.

While the parties disputed whether there was a lack of excess capacity in this industry as a factual matter, they also raised arguments concerning the fact that the FTC was alleging price discrimination markets. A relevant product market question was whether containers made from plastics or metals competed with glass containers. The government alleged that there were certain uses for which such alternatives were in the product market and others for which they were not. Uses for which such alternatives were not in the product market comprised about 26% of total glass tonnage. As a result, the FTC argued that competitive concerns only arose for such products.

The defense’s expert, Sam Peltzman, argued that this provided a strong incentive to cheat on a cartel. That is, given the contention that anticompetitive concerns only arose regarding about a quarter of production, even postmerger, the majority of sales of glass containers would be at competitive prices. This provided an incentive to divert sales from the competitive market(s) to the market(s) where supracompetitive pricing was instituted. Consequently, even if there was not excess capacity relative to the entire production of glass containers, there was, in a sense, excess (in the form of divertible) capacity relative to the sale of those products that faced an inelastic demand. This argument appears to be more akin to a market definition argument than to an argument that excess capacity harms pricing discipline. In other words, all of the excess capacity devoted to glass containers should have been considered a “rapid entrant” into any other demand-side glass container market.

Another case emphasizing the collusion reducing aspects of excess capacity was *Blomkest Fertilizer, Inc. v. Potash Corp. of Saskatchewan*.<sup>47</sup> This case involved a class action suit by customers alleging a price fixing conspiracy by several producers of potash, a mineral used in fertilizer. The majority of the appeals court, sitting *en banc*, ruled against the plaintiffs (i.e., found that there was not adequate evidence of price fixing), but there is also an extensive dissent on the record.

Most of the case involved issues of communication among the defendant firms, with the majority finding such evidence highly ambiguous and the dissent finding it persuasive. Nevertheless, issues of excess capacity were raised.

Although not representing the prevailing legal opinion in the case, the dissent highlights how courts have frequently tried to grapple with issues of excess capacity. Thus, the dissent stated the following:

The purely situational factors in this case are the market structure and the crisis in the potash industry. The structure of the potash market was conducive to collusion, featuring an oligopoly, barriers to new sellers entering the market, inelastic demand, and a standardized product... However, there was excess production capacity, which spurs competition, and a price war, which shows the producers had not been able to achieve a stable interdependent equilibrium. Individual attempts in 1986 by Noranda, Kalium, PCA, and PCS to initiate a price rise had failed. The producers were losing millions of dollars. The producers had good reason to wish for a truce.<sup>48</sup>

As the FTC did with the *Owens Illinois* matter mentioned above, the dissent here emphasized the collusion mitigating aspects of excess capacity (i.e., its tendency to give firms an incentive to cheat on a collusive understanding). However, it did not do this to indicate that price fixing likely did not occur, but rather to buttress its argument that it did indeed occur. Thus, the dissent was arguing that it gave firms a strong motivation to come to an explicit agreement. Similar arguments have been made in a number of other cartel cases.<sup>49</sup> This reasoning would appear incomplete. If the effect of excess capacity is to spur competition, it is unclear how it could contribute to

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<sup>46</sup> *FTC v. Owens-Illinois, Inc.*, 681 F. Supp. 27, 49 (D.D.C. 1988).

<sup>47</sup> *Blomkest Fertilizer, Inc. v. Potash Corp. of Saskatchewan*, 203 F.3d, 1028 (8<sup>th</sup> Cir. 2000).

<sup>48</sup> See *Blomkest*, 203 F.3d at 47.

<sup>49</sup> E.g., see *Haley Paint Co. v. E.I. Dupont De Nemours & Co.*, 804 F. Supp. 2d 419 (D. Md. 2011); *In re Carbon Black Antitrust Litig.*, CIV.A.03-10191-DPW, 2005 WL 102966 (D. Mass. Jan. 18, 2005); *In re Pressure Sensitive Labelstock Antitrust Litig.*, 566 F. Supp. 2d 363 (M.D. Pa. 2008).

creating a cartel. An appeal to the punishment aspects of excess capacity might have more closely harmonized the dissent's reasoning with economic theory.

## 2. Case involving the "competition-inhibiting" theory of excess capacity

In *In re High Fructose Corn Syrup Antitrust*, the defendants continued to add to their capacity during the alleged cartel period.<sup>50</sup> The defendants argued this was evidence that the market was behaving competitively. The Court of Appeals Circuit Judge, Richard Posner, rejected these arguments noting that according to economic theory:

Maintenance of excess capacity discourages new entry, which supracompetitive prices would otherwise attract, and also shores up a cartel by increasing the risk that its collapse will lead to a devastating price war ending in the bankruptcy of some or all of the former cartelists.

This decision demonstrates that practitioners would be ill advised to use simple "checklist" type arguments regarding the effects of excess capacity given the ambiguity of both the theoretical and empirical work regarding its impacts. If practitioners use excess capacity as either a defense or affirmative argument regarding antitrust liability, they should be prepared to present evidence of its actual effects.

## 3. Cases involving maverick type theories of excess capacity

As was noted above, quite often it matters who it is that is holding the excess capacity. For example, in the *Arch Coal* matter the FTC argued, in part, that that the proposed transactions would have substantially increased the risk of coordinated output-constraining behavior because the transaction would have placed most of the excess capacity in the hands of firms most likely to restrict production.<sup>51</sup> Similarly, the DOJ argued in *UPM/Kymmene Oyj* that that transferring excess capacity from a rival to a dominant firm through merger threatened to raise prices.<sup>52</sup> This matter involved the acquisition of a major seller of label stock (Morgan Adhesive Company ("MAC")) by another (UPM-Kymmene Oyj ("UPM")). The DOJ noted that MAC had a lot of excess capacity and that this transaction would put the only capacity capable of undermining a price increase in the hands of a market leader that would control over 70% of sales.

Maverick type concerns appear to have played a role in the DOJ's *Formica-International Paper* matter.<sup>53</sup> This matter involved the merger of the two largest producers of certain high-pressure laminates used to make durable surfaces. On the one hand, the DOJ was concerned because the smaller competitors that would remain post-merger did not have significant capacity to expand production. On the other hand, the target of the acquisition, *International Paper*, did have significant excess capacity and, according to the DOJ, in the fashion of a maverick had previously undermined coordination.

As noted above, excess capacity is a necessary condition for a firm to behave like a maverick (although just because a firm possesses excess capacity does not mean it necessarily must be a maverick). Nevertheless, transfer of excess capacity from firms that have behaved like mavericks to firms that do not can certainly remove the constraint that the maverick had on competition. On the other hand, perhaps due to significant variable cost savings, the acquisition of a maverick could enhance the maverick's constraint on pricing, although this effect is less likely.<sup>54</sup>

## 4. Case involving coordination on capacity

In its cruise ships mergers investigation, the FTC considered questions of whether the merger would facilitate coordination on capacity.<sup>55</sup> Thus, the investigation considered whether the major cruise lines could coordinate on reducing capacity and cause prices to rise by either reducing future capacity additions or redeploying current capacity.

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<sup>50</sup> *In re High Fructose Corn Syrup Antitrust Litig.*, 295 F.3d 651 (7th Cir. 2002).

<sup>51</sup> *F.T.C. v. Arch Coal, Inc.*, 329 F. Supp. 2d 109 (D.D.C. 2004) case dismissed, 04-5291, 2004 WL 2066879 (D.C. Cir. Sept. 15, 2004).

<sup>52</sup> *United States v. UPM-Kymmene Oyj*, 03 C 2528, 2003 WL 21781902 (N.D. Ill. July 25, 2003).

<sup>53</sup> *Formica Corp. and International Paper Co.*, materials available at [http://www.usdoj.gov/archive/atr/public/press\\_releases/1999/2174.htm](http://www.usdoj.gov/archive/atr/public/press_releases/1999/2174.htm), [http://www.usdoj.gov/archive/atr/public/press\\_releases/1999/2177.htm](http://www.usdoj.gov/archive/atr/public/press_releases/1999/2177.htm).

<sup>54</sup> See Baker, note 27 *supra* at 179.

<sup>55</sup> See Mary T. Coleman, David W. Meyer & David T. Scheffman, *Empirical Analyses of Potential Competitive Effects of a Horizontal Merger: The FTC's Cruise Ships Mergers Investigation* 23 REVIEW OF INDUSTRIAL ORGANIZATION 121 (2003).

In its analysis of capacity coordination, staff considered whether firms, either explicitly or tacitly, could come to some kind of common understanding, and if the participants would be able to enforce the understanding through the detection and punishment of any deviations. Staff noted that capacity additions and slowdowns would be readily apparent in this industry. Announcements regarding new ship orders and ship itineraries took place well in advance and the information about such orders and itineraries are readily available. Therefore, monitoring an agreement would not be problematic. However, staff was more skeptical the other two prongs of collusion could be overcome. Staff noted that given the growth in this industry, and the temptations to capture that growth, coming to an agreement might not be a simple matter. Further, staff noted that it would be unclear how punishment would work. Building more capacity to punish is problematic since once built it does not go away. Moreover, it would not be possible to target easily the cheating firm as all firms in the industry competed on all “itineraries.” Given these considerations, among others, staff concluded that a coordination scheme involving future capacity reductions or repositioning was not sustainable.

#### **E. Summary/Practitioner’s Advice**

There is no clear theoretical prediction about the relationship between excess capacity and the likelihood of collusion; even taking attempted coordination as a given, adding excess capacity to an industry may increase or decrease the likelihood it is successful. Further, different industries may be more or less prone to collusion for reasons unrelated to excess capacity (for example, the presence of a strong trade association may make collusion more likely).

Because of the lack of a clear theoretical prediction, whether there is a general tendency for excess capacity to encourage or discourage collusion is ultimately an empirical question. However, markets that are both known to be collusive and for which sufficient data exist to allow estimation of the relationship between excess capacity and collusion are extremely rare. Indeed, only a handful of cartels that were investigated by antitrust authorities or which existed before antitrust legislation present such an opportunity, limiting the applicability of any empirical conclusions arising from these specific investigations. While there is a small literature which offers some evidence for a negative relationship between own capacity and rivals’ output as a general principle, this literature is again hamstrung by data problems (observing capacity is rare) and is of limited potential applicability to the antitrust practitioner. Consequently, the fine level of institutional detail that emerges during an antitrust investigation is likely to be more useful in determining the likelihood of coordination than the broad predictions of the economics literature.

Despite the ambiguities in the economic evidence, the potential for excess capacity to encourage or inhibit collusion in a given case *does* appear to play a role in the decision making of the courts and the antitrust agencies. Clearly, decision-makers and other practitioners should avoid a simple “checklist” approach to excess capacity when seeking to adjudicate whether coordinated interaction did (in retrospective matters) or will (in prospective matters) occur. In other words, decision makers and other practitioners should not simply point to the presence or absence of excess capacity to buttress arguments without evidence that it has actually had an effect. Evidence that excess capacity affected actual decision making is more dispositive than simple pretextual statements of market participants. Nevertheless, even in the presence of evidence that excess capacity affects the competitive atmosphere decision makers should proceed cautiously. Clearly, the disparate empirical findings of Rotemberg & Saloner, Ellison and Porter regarding the explicit rail cartel of the 1880s suggest that even in-depth econometric evidence on these issues is potentially contentious.<sup>56</sup>

#### **V. UNILATERAL EFFECTS**

Excess capacity can also play a role in the analysis of unilateral firm actions. This involves both unilateral effects in the analysis of mergers and the analysis of whether a firm holds a dominant position in “abuse of dominance” and “monopolization” matters.

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<sup>56</sup> See notes 38 and 39 *supra*.

## A. Theory

In the merger context, agencies and courts may be concerned with whether or not a merged firm will raise its prices, even if all of its competitors leave their prices unchanged. Any profit-maximizing firm sets price so that if it raised prices any further, the increase in profit from customers that would continue to purchase the product at the higher price would be offset by the loss in profit from customers who switch to one of the firm's rivals. If a firm merges with one of its rivals, customers who switch to that rival following a price increase will now be retained, meaning that the firm has a greater incentive to increase price post-merger. Thus, economic theory predicts that, absent efficiencies or the threat of entry or product repositioning, a merger between two rivals will generate a price increase, with the size of the price increase depending on the percentage of the purchasing firm's customers that are likely to switch to the purchased firm should the purchasing firm raise its prices.<sup>57</sup> The *2010 Guidelines* refer to this prediction of a post-merger price increase as upward pricing pressure.<sup>58</sup>

If neither merging firm is capacity constrained, the amount of excess capacity each firm has would generally not affect the likelihood that the merged firm would increase prices. This is simply because a price increase is effected by a quantity reduction, and so if capacity constraints do not bind prior to the merger, there is no reason they would bind after the merger.

On the other hand, if one or both merging firms are capacity constrained prior to the merger, merger effects are ambiguous. By definition, a capacity-constrained firm would profitably increase quantity (and reduce price) if only it had available capacity. Hence, a merger of one capacity-constrained firm and one firm with a great deal of excess capacity creates an incentive for the merged firm to increase total production (by increasing the quantity produced of the first firm, using capacity of the second firm).<sup>59</sup> However, this incentive to increase quantity must be balanced against a countervailing incentive: the merged firm will generally face less elastic firm-specific demand than either firm did pre-merger, and so, all else equal, would prefer a higher price and a lower quantity.

Now, suppose two competitors, both capacity-constrained, propose to merge. Since both are constrained, each would choose to increase quantity and decrease price if it had more capacity. Does it follow that the merged firm would also be capacity-constrained, and thus prefer a lower price and a greater quantity? Not necessarily; the merged firm would face less elastic demand as a monopolist than either firm did individually with a competitor, and so the merged firm's profit-maximizing quantity may be below its total capacity. In this instance, the merger could result in a price increase, despite both firms being capacity-constrained pre-merger.<sup>60</sup>

Capacity in the hands of non-merging firms may offset reductions in output by the merged firm. However, the competitive constraint imposed by non-merging firms depends on the substitutability of non-merging firms for the merged firms. If the diversion ratios between the two merging firms are high (meaning that a large percentage of each merging firm's customers view the other merging firm as the market's closest substitute), then excess capacity of non-merging firms is unlikely to stem the ability of the merged firm to raise prices. If, on the other hand, diversion ratios between the merging parties are relatively low, meaning that many customers of the merging firms view a non-merging firm as the closest available substitute, then the availability of capacity at non-merging firms is crucial to determining the merger's likely effects.<sup>61</sup> If one or more non-merging firms are close to capacity, then diversion from the merged firm to those firms will fall as each firm reaches capacity and cannot take new

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<sup>57</sup> Of course, the purchased firm has a similar incentive to raise its prices following a merger, as some of the customers it will lose will go to the purchasing firm, and thus be retained by the merged firm.

<sup>58</sup> See *2010 Guidelines* at §6.1.

<sup>59</sup> Any merger involving exactly one capacity-constrained firm thus has a potential built-in efficiency: the ability to transfer production from a constrained plant to an unconstrained plant. See Section VII for further discussion of the relationship of capacity to merger efficiencies.

<sup>60</sup> This can be clearly seen in a mathematical example. Consider Cournot duopolists with zero marginal costs facing market demand  $P = 1 - q_1 - q_2$ . Absent capacity constraints, the Cournot-Nash outcome is  $q_1 = q_2 = \frac{1}{3}$ . Now suppose that each firm has a capacity constraint of  $\bar{q} = .3$ . In this case, each duopolist will maximize profits by producing  $q = .3$ , and the market price will be  $P = .4$ . Now, consider a merger that combines the capacity of the two firms, so that the resulting monopolist's capacity is  $\bar{q}^M = .6$ . The monopolist's demand curve is  $P = 1 - q^M$ . The monopolist maximizes its profits by producing  $q = \frac{1}{2}$ , and setting a price of  $P = \frac{1}{2}$ . Thus, even though each duopolist was individually capacity-constrained pre-merger, the merged firm still prefers to increase price in response to a less elastic demand curve. It is not difficult to construct an alternative scenario where both firms are more tightly capacity constrained and the merger does not have an impact on output.

<sup>61</sup> Determinants of diversion may be either vertical or horizontal in nature. Vertical differentiation refers to "quality" which is often defined by economists as attributes of a product regarding which virtually all consumers would agree that the product or service is improved with higher levels of the attribute. The processing speed of a computer might be an example of this. Products are horizontally differentiated if consumers have heterogeneous preferences regarding the most preferred mix of different attributes. Examples of this might include preferences regarding the Beatles vs. the Rolling Stones, thick vs. thin-crust pizza, light vs. regular beer, or a plant in the Midwest vs. a plant on the East Coast.

customers.<sup>62</sup> If, on the other hand, non-merging firms have plenty of capacity, then the merged firm is unlikely to raise prices significantly.

In a non-merger context, whether or not a firm holds a dominant position may rely on the extent to which its rivals hold excess capacity that would enable them to expand to meet any unsatisfied market demand. In other words, if the “fringe” has the ability to expand, a putative dominant firm may not hold any market power, regardless of its current market share. This consideration could be relevant in a number of types of monopolization/dominance cases such as exclusive dealing, tying and bundling, and loyalty discounts, where market power on the part of the plaintiff firm is a requirement for a finding of liability. The caveats regarding the substitutability of output across firms raised in the unilateral merger context apply here as well.

On the other hand, at times capacity constraints (or the lack thereof) on the part of the putative dominant firm may be relevant. In predatory pricing matters, the defendant must have had sufficient capacity with which to increase output during the predatory episode in order to drive price below costs. Further, the defendant must also have excess capacity with which to absorb the market shares of rivals once driven from the market. Alternatively, in this situation, the alleged predator may be able to quickly create or purchase new capacity, including any capacity abandoned by its prey.<sup>63</sup>

## B. Empirical Evidence

Economic literature on the effects of capacity in a unilateral context is limited. Indeed, much of it is not empirical in nature, but rather involves measuring the impact of capacity issues in simulation models.

Froeb *et al.* is the only simulation of unilateral merger effects we are aware of that explicitly incorporates capacity constraints.<sup>64</sup> They simulate the effect of a parking lot merger. In their model there are several companies each of which own multiple lots, differentiated by location and capacity. As in any merger simulation, mergers tend to raise prices. However, this effect is mitigated if either of the merging firms are capacity-constrained, or competitors have excess capacity. Importantly, they argue that the former effect is more important. While a merger tends to produce a larger price increase the more capacity-constrained the merging firms’ competitors are, capacity constraints for the merging firms are particularly likely to attenuate any price effects from the merger. This is simply because a capacity-constrained firm would prefer to increase quantity and lower price if it had more available capacity. Indeed, if the merged firm is capacity constrained, there will be no price effect from the merger. The authors suggest that antitrust authorities should allow mergers between capacity-constrained firms, even if their competitors are also capacity-constrained.<sup>65</sup>

Chen looks at price effects from mergers in a simulation model where, over time, firms are able to choose how much to invest in capacity accumulation.<sup>66</sup> Success or failure is uncertain; new plants may cost more than anticipated or fail to get regulatory approval, or existing plants may break down. Here, firm heterogeneity is explained by differences in capacity, instead of differences in costs. Chen finds that price effects from mergers are greater in this context, particularly in the long run. This is because mergers decrease firms’ incentives to invest in additional capacity, resulting in higher prices.

Ho demonstrates empirically that capacity-constrained hospitals negotiate relatively higher prices from insurers, and argues that this may be due to their ability to reach capacity without contracting with every insurer in the market.<sup>67</sup> While this paper is not explicitly about unilateral merger effects, the implication would be that while a hospital merger would normally be expected to increase the bargaining power of the merged hospital, a merger in which only one hospital has excess capacity might mitigate any increase in bargaining power.

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<sup>62</sup> Diversion ratios are normally a function of demand characteristics. Capacity is a supply characteristic, so its description as a factor in determining diversion ratios may appear contradictory. However, diversion ratios can be seen as the percentage of buyers who would see the alternative product as the next best *available* option. Even though some consumers may prefer a non-merging product to the other merging product, if the non-merging product is not available, the relevant question for the merger is whether the other merging product would be seen as the next best product the consumer could actually purchase.

<sup>63</sup> A possible exception is if the alleged predatory episode is about disciplining competitors rather than driving them from the market. If this is the case, the alleged predator may not be seeking to increase its output post-predation and, therefore, excess capacity may not be a necessary condition for such behavior to be profit maximizing.

<sup>64</sup> See Luke Froeb, Steven Tschantz, & Philip Crouke, *Bertrand Competition with Capacity Constraints: Mergers Among Parking Lots*, 113 JOURNAL OF ECONOMETRICS 49 (2003).

<sup>65</sup> Froeb *et al.* do not appear to consider the case discussed in section IV.A *supra* in which two capacity-constrained firms merging prefer to reduce production and raise price post-merger.

<sup>66</sup> See Jiawei Chen, *The Effects of Mergers with Dynamic Capacity Accumulation*, 27 INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION 109 (2009).

<sup>67</sup> See Kate Ho, *Insurer-Provider Networks in the Medical Care Market*, 99 AMERICAN ECONOMIC REVIEW 393 (2009).

### C. Case Examples

A number of cases in the predatory pricing area have noted the importance of excess capacity for the success of a predatory scheme. These include the seminal *Brooke Group* predatory pricing case, where the court noted:

In certain situations—for example, where the market is highly diffuse and competitive, or where new entry is easy, *or the defendant lacks adequate excess capacity to absorb the market shares of his rivals and cannot quickly create or purchase new capacity*—summary disposition of the case is appropriate.<sup>68</sup>

Similar conclusions were drawn in the *PeaceHealth* and *Spirit Airlines, Inc. v. NW Airlines* matters.<sup>69</sup>

There are numerous cases where excess capacity on the part of a fringe (or lack thereof) contributed to whether or not there was a finding of dominance. These include *Forsyth v. Humana*; *Pilch v. French Hospital*; *Joseph Ciccone & Sons, Inc. v. E. Indus., Inc.*; and *Smith Wholesale Co. v. Philip Morris USA Inc.*<sup>70</sup> As noted above, excess capacity alone should not be dispositive if there are issues regarding the substitutability of the products produced by the fringe and the putative dominant firm.

Outside the predatory pricing context, excess capacity's main relevance for an analysis of monopolization or abuse of dominance occurs when firms other than those accused of dominance hold the excess capacity. The *Ford v. Stroup* case involved accusations of attempted monopolization by a defendant physician and his practice group.<sup>71</sup> The district court granted summary judgment, in part, because there was substantial excess capacity in the market. Plaintiffs successfully appealed noting that it was the defendant firm (i.e., the firm accused of dominance) that controlled the excess capacity. Excess capacity in the marketplace as a defense to accusations of dominance is only meaningful if rivals to the dominant firm hold it.

### D. Summary / Practitioner's Advice

In the unilateral merger context, if both merging firms have excess capacity then excess capacity should have no impact on the analysis. However, if one or both firms are capacity constrained, the merged firm has countervailing incentives, which may offset any incentive to increase price and/or reduce output. Of course, the extent to which this is actually the case is a fact specific matter.

In the dominance context, excess capacity on the part of fringe firms can be a possible defense to allegations of dominance provided the products of the fringe are sufficiently substitutable with those of the dominant firm. In the predatory pricing context, excess capacity on the part of the alleged predator to absorb the output of rivals may be necessary to a finding of liability. Nevertheless, practitioners should always be mindful of measurement issues in determining whether a firm or firms actually have excess capacity as discussed in Section II, *supra*. As noted above, economic research on the relationship between capacity and unilateral effects appears limited and this might be an area for further research.

## VI. ENTRY

While not necessarily an antitrust concern in and of itself, ease of entry is a consideration in all types of antitrust matters.<sup>72</sup> In merger matters, if entry will be timely and sufficient, it can counteract a competitive effect of concern.

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<sup>68</sup> See *Brooke Group Ltd. v. Brown & Williamson Tobacco Corp.*, 509 U.S. 209, 113 S. Ct. 2578, 125 L. Ed. 2d 168 (U.S.N.C. 1993). (Emphasis added.)

<sup>69</sup> *Cascade Health Solutions v. PeaceHealth*, 515 F.3d 883 (9th Cir. 2008) (predators must have excess capacity from which to produce the increased output); *Spirit Airlines, Inc. v. NW Airlines, Inc.*, 431 F.3d 917 (6th Cir. 2005) (noting that when the defendant has market power and excess capacity, summary judgment may be inappropriate).

<sup>70</sup> *Forsyth v. Humana, Inc.*, 827 F. Supp. 1498 (D. Nev. 1993) (“Excess capacity if it can reasonably be determined may limit the exercise of market power”); *Pilch v. French Hosp.*, CV 98-9470 CAS(CWX), 2000 WL 33223382 (C.D. Cal. Apr. 28, 2000) (asserting that a market share of less than 50% cannot be considered to have market power if other firms in the market have excess capacity which they could employ if the defendant were to try to exercise monopoly power); *Joseph Ciccone & Sons, Inc. v. E. Indus., Inc.*, 559 F. Supp. 671 (E.D. Pa. 1983) (dismissing the case, in part, because of excess capacity held by “fringe firms.”); *Smith Wholesale Co. v. Philip Morris USA Inc.*, 2:03-CV-221, 2005 WL 1981452 (E.D. Tenn. Aug. 17, 2005) (A firm also lacks market power when its competitors have excess capacity) .

<sup>71</sup> *Ford v. Stroup*, 113 F.3d 1234 (6th Cir. 1997).

<sup>72</sup> But see §V.C *infra* for a discussion of the *Titanium Dioxide* matter where the firm's behavior regarding entry may have been a violation in and of itself.



In monopolization matters, it can be a counter to claims of dominance. In price fixing matters, in the absence of explicit evidence of a cartel, ease of entry can be a factor in ascertaining whether an agreement actually took place.

Excess capacity can play a role in ascertaining the ease of entry.<sup>73</sup> However, this section notes, as with coordinated interaction, there is no clear theoretical prediction about the relationship between excess capacity and the likelihood of entry. Moreover, as described more fully below, excess capacity is more a symptom of an industry that is unattractive to entry than an entry deterrent in and of itself. Further, the empirical literature is generally inconclusive or unresponsive of the notion that excess capacity is held for purposes of entry deterrence. As such, practitioners should not simply point to the presence or absence of excess capacity to buttress arguments regarding the ease of entry without case specific evidence that it has actually had such effects.

## A. Theory

The likelihood of entry is a function of both the price levels that can be expected to prevail if entry occurs and the quantity of sales an entrant can expect to obtain. Incumbents that wish to deter entry may find it profitable to make sunk investments in reducing their marginal costs, potentially by expanding plant capacity. This can deter entry in two possible ways, which are not necessarily mutually exclusive.

First, an irreversible investment in capacity by an incumbent that also reduces marginal cost may mean that in order to compete effectively with the incumbent, entrants would need to achieve a greater scale and make greater irreversible investments than would otherwise be the case. In other words, the entrant must obtain a greater level of sales to be viable than would be the case in the absence of such investments by the incumbent. If the increase in scale necessary to compete effectively is great enough, entry is deterred. Clearly, numerous alternative investments would deter entry in the same way, including investments in quality and advertising.<sup>74</sup>

Second, by potentially lowering marginal costs, irreversible capacity investments can form a credible commitment by incumbents to produce more than they otherwise would if entry actually occurred, thereby deterring entry. A seminal model in this area is by Dixit.<sup>75</sup> In his model, there is an incumbent firm and a potential entrant. The incumbent firm moves first by choosing an irreversible capacity level. To produce up to its capacity level, the incumbent incurs a low marginal cost, while to produce beyond its capacity, the incumbent pays a high marginal cost. The potential entrant makes its entry decision in the second stage, after observing the incumbent's irreversible capacity investment. The entrant's marginal cost is high at all levels of production.<sup>76</sup>

An increase in capacity that lowers marginal cost raises the incumbent's equilibrium output. This, in turn, reduces the demand available to a potential entrant and makes it less likely that it will achieve a viable scale. Because the incumbent's investment is irreversible, or sunk, it serves as a credible commitment to a higher output level, and thus as an entry deterrent.<sup>77</sup> How does the incumbent determine the appropriate capacity level? He essentially uses his first mover advantage and looks at the potential entrants' options depending on the various investments in capacity from which the incumbent can choose.

Thus, by potentially lowering an incumbent's marginal cost, an investment in capacity may both increase the minimum viable scale needed to compete and lower the amount of sales a potential entrant can expect to obtain. Either effect may deter entry. The profitability of entry deterrence through capacity expansion depends on the expense of the sunk capacity investment, the likelihood of deterring entry, and the profit from deterring entry. It is not a given that excess capacity deters entry. For example, in the *Lysine* case discussed in section IV.C.2 *supra*, ADM entered the lysine market even though its competitors had excess capacity.

It is also important to note that the welfare implications of investing in excess capacity to deter entry are ambiguous. On the one hand, the incumbent might deter entry. This capacity would not be profitable "but for" its

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<sup>73</sup> The 1992 *Guidelines* at §3.3 in discussing the likelihood of entry notes that among the "factors that reduce the sales opportunities available to entrants include...any anticipated sales expansion by incumbents in reaction to entry, either generalized or targeted at customers approached by the entrant, that utilizes prior irreversible investments in excess production capacity." See also, European Union, *Guidelines on the Assessment of Horizontal Mergers under the Council Regulation on the Control of Concentrations Between Undertakings* (2004) at ¶71(c): "Barriers to entry also encompass situations where the incumbents have already committed to building large excess capacity."

<sup>74</sup> Sutton describes industries in which firms pursue quality improvements over time, raising the cost of entry. Sutton's model is equivalent to one in which firms face tradeoffs between sunk costs and marginal costs as described in this section. (See John Sutton, *Sunk Costs and Market Structure* (1991).)

<sup>75</sup> Avinash Dixit, *A Model of Duopoly Suggesting a Theory of Entry Barriers*, 90 *ECONOMIC JOURNAL* 20 (1980).

<sup>76</sup> Dixit's model thus essentially allows an incumbent to pre-pay part of its future marginal cost by, for example, constructing a state-of-the-art factory with low production costs, while any potential entrants are constrained to use older technology with higher marginal costs.

<sup>77</sup> Note that when the 1992 *Guideline's* discuss anticipated sales expansion by incumbents in reaction to entry, it indicates that such anticipated sales expansions utilize prior "irreversible investments in excess production capacity." *Supra* note 73. (Emphasis added.)

entry deterring effect. On the other hand, by lowering its marginal cost, the incumbent's profit-maximizing price is lower and output is greater than it would be without this strategic consideration.<sup>78</sup>

Note excess capacity is not an entry deterrent in and of itself. Rather, the excess capacity is merely a *symptom* of an industry that is unattractive to further entry since an entrant will have to pay a high entry cost to compete effectively with incumbents or can expect less hospitable conditions if it enters than would otherwise be the case.<sup>79</sup> As part of their analysis, practitioners should consider the nature of the excess capacity before concluding there are entry barriers. If capacity is idle because it uses outdated technology, that capacity is likely irrelevant to the probability of entry. On the other hand, capacity using state-of-the-art technology and in the hands of an experienced producer may indicate entry is unlikely, but even this is unclear.

## B. Empirical Evidence

As noted above, while excess capacity *can* be indicative of barriers to entry, this doesn't necessarily mean entry into an industry with excess capacity is difficult. Overall, the empirical literature is unsupportive of the notion that incumbents' excess capacity deters entry.

A number of studies have found that firms are more likely to hold excess capacity for precautionary reasons than strategic ones. Driver notes that firms may hold excess capacity both for strategic reasons and because of uncertainty in demand, which he calls the precautionary motive.<sup>80</sup> He studied twelve industries and found that firms hold excess capacity for reasons of strategic entry deterrence in only three, characterized by high growth and low product differentiation. Smiley employed a survey approach to measure how frequently firms attempt to limit entry and which strategies, including the deployment of excess capacity, they may use.<sup>81</sup> For existing products, he found maintenance of excess production capacity was among the least frequently chosen strategies for deterring entry, behind strategies such as filling product niches, advertising and limit pricing. Lieberman studied excess capacity in a sample of thirty-eight chemical product industries.<sup>82</sup> He found that incumbents rarely built excess capacity in an effort to deter entry. Masson and Shaanan considered the use of capacity for purposes of entry deterrence in 26 industries.<sup>83</sup> While they found that excess capacity deters entry, there was little evidence that the capacity was strategically added with this purpose in mind. On the other hand, Reynolds finds support for the entry deterrence hypothesis in the aluminum industry.<sup>84</sup>

## C. Case Examples

As mentioned above, the decision in the *In re High Fructose Corn Syrup Antitrust Litigation* discussed the collusion-inducing aspects of excess capacity. Further, as seen in the above quote, Judge Posner also referred to presence of excess capacity as an entry barrier.<sup>85</sup> Nevertheless, given the ambiguity in whether or not excess capacity forms a barrier to entry, practitioners should not assume the mere presence of excess capacity deters entry without case specific evidence. Such evidence might consist of internal firm documents indicating that the need to install a high level of capacity to be competitively viable has had entry deterring effects.

A matter where strategic capacity deployment for possible purposes of deterring entry played a central role was the *Titanium Dioxide* matter.<sup>86</sup> This matter involved the manufacture and sale of a chemical used in the production of paint and other products to make them whiter or opaque. The FTC contended that DuPont strategically announced its intentions to build new capacity in order to inhibit competitive expansions and that DuPont actually constructed and brought new capacity on stream prematurely to place competitors in a tenuous

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<sup>78</sup>Similarly, investments in quality or advertising to deter entry can have similar ambiguous welfare effects.

<sup>79</sup> Similarly, excess capacity can be a symptom of declining demand. When demand is declining, entry is generally considered unattractive. However, as with lowering marginal costs, it is not the excess capacity that is deterring entry.

<sup>80</sup> Ciaran Driver, *Capacity Utilisation and Excess Capacity: Theory, Evidence and Policy*, 16 REVIEW OF INDUSTRIAL ORGANIZATION 69 (2000).

<sup>81</sup> Robert Smiley, *Empirical Evidence on Strategic Entry Deterrence*, 6 INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION 167 (1988).

<sup>82</sup> Marvin Lieberman, *Excess Capacity as a Barrier to Entry: An Empirical Appraisal*, 35 JOURNAL OF INDUSTRIAL ECONOMICS 607 (1987).

<sup>83</sup> Robert T. Masson and Joseph Shaanan, *Excess Capacity and Limit Pricing: An Empirical Test*, 53 ECONOMICA 365 (1986).

<sup>84</sup>Note 2 *supra*.

<sup>85</sup>Note 50 *supra* at 23.

<sup>86</sup> *E.I. DuPont de Nemours & Company*, 96 F.T.C. 653 (1980). Similar allegations played a role in the seminal Alcoa matter (*United States v. Aluminum Company of America*, 148 F.2d 416 (2d Cir. 1945)). Such allegations also played a role in *American Football League v. National Football League*, 323 F.2d 124 (4th Cir. 1963) and *Philadelphia World Hockey Club v. Philadelphia Hockey Club* 352 F. Supp. 462 (E.D. Pa 1972).

expansion position.<sup>87</sup> The FTC alleged that part of the reason this was an effective entry blockading strategy was because “learning by doing” was important to reducing costs. That is, only by gaining experience in the production of titanium dioxide could competitors lower their average costs to the level attained by DuPont with its years of experience in the industry. DuPont countered that its expansion plans were consistent with its own projections of demand growth and would not create excess capacity for either itself or other producers.

This matter involved difficult issues regarding whether such behavior is a reasonable part of the competitive process, even if it has exclusionary effects, or whether it was, on balance, anticompetitive. As noted above, economic theory predicts there are potential trade-offs from a strategy of capacity preemption. That is, by lowering marginal cost, an incumbent’s profit-maximizing price will be lower than otherwise, although in the long run, prices may be higher given the absence of entry. DuPont’s internal projections were consistent with this theoretical trade-off. Thus, their projections showed that in the short-run, its prices and profitability were lower under its “growth” strategy involving the capacity deployments than under alternative scenarios where it did not pursue this path. However, in the longer run, as its market dominance increased, DuPont forecast higher prices. The administrative law judge, and the FTC on appeal, eventually acquitted DuPont, at least, in part, because its prices at the time of the trial were lower than they projected absent the growth strategy.<sup>88</sup>

#### **D. Summary / Practitioner’s Advice**

As a theoretical matter, while excess capacity *can* be symptomatic of barriers to entry; this doesn’t necessarily mean that entry is precluded. Overall, the empirical literature on excess capacity as an entry barrier is generally inconclusive or unresponsive of the notion that firms hold excess capacity for purposes of entry deterrence. Once again, as in other contexts regarding excess capacity, practitioners should not assume its mere presence has an effect, although some antitrust jurisprudence appears to have done this. The basis for such a determination should be the types of institutional detail that emerge during the course of an antitrust investigation.

### **VII. EFFICIENCIES**

Firms can find themselves with excess capacity for a variety of reasons having nothing to do with strategic behavior, including simple miscalculations (such as incorrectly anticipating growth opportunities) or secular declines in demand. Declines in demand can result from changes in taste, changes in technology, increased foreign competition, shifting comparative advantages, changes in regulations, or rising costs. Whether the excess capacity is due to changes in circumstances or miscalculation, both types of situations may present opportunities for cost savings. However, it is important to note that such considerations are probably limited to merger analysis, other forms of asset acquisitions, or joint ventures. It is unlikely other horizontal behaviors, such as price fixing, or various monopolization matters would result in such benefits.<sup>89</sup>

Like all efficiency claims, a number of threshold issues arise with whether such efficiencies will be credited by the competition agency or the courts. One is the issue of pass-through (i.e., the extent to which cost savings will be reflected in customer prices). Variable cost savings are more likely to affect customer prices than fixed cost savings. Of course, classifying costs into fixed and variable is not a simple matter as in the long run all costs are variable.<sup>90</sup> Particularly difficult to deal with here might be what economists refer to as “avoidable” fixed costs. These costs do not vary with the quantity of production, but are incurred only if production takes place.<sup>91</sup> The startup and shut down costs associated with production runs might fall into such a category. Clearly, practitioners should be aware of such differences in presenting or evaluating efficiency claims regarding excess capacity. Another threshold issue is merger specificity. As noted in various iterations of the Horizontal Merger Guidelines, merger specificity should not be a mere theoretical possibility, but must be practical in terms of the business situation faced by the merging firms.<sup>92</sup>

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<sup>87</sup> See Douglas Dobson, William Shepherd and Robert Stoner, *Strategic Capacity Preemption: Dupont (Titanium Dioxide) (1980)*, in THE ANTITRUST REVOLUTION, 157, 165 (John E. Kwoka, Jr. & Lawrence J. White eds., 1994).

<sup>88</sup> *E.I. DuPont de Nemours & Company*, 96 F.T.C. 653 (1980) at 715.

<sup>89</sup> Indeed, the opposite might be the case as such arrangement might increase the amount of excess capacity in a market. Further, predatory or exclusionary actions are unlikely to be justified by arguments pointing to a need to eliminate the excess capacity of the target.

<sup>90</sup> E.g., see Gary Roberts & Steven Salop, *Efficiency Benefits in Dynamic Merger Analysis*, (Georgetown University Law Center, Mimeo), 1993.

<sup>91</sup> As opposed to sunk fixed costs, which are incurred even if production does not take place.

<sup>92</sup> *2010 Guidelines*, §10.

## A. Theory

### 1. Consolidation of capacity as a deal rationale

Consolidation of capacity can generate reductions in fixed overhead. Given the consumer welfare standard followed by most antitrust regimes, since such cost savings are less likely to be passed through to consumers, they are less likely to lead the agency to conclude they will mitigate an adverse competitive effect.<sup>93</sup> Nevertheless, where there is not overwhelming evidence of adverse competitive effects such efficiencies can be useful in demonstrating a rationale for the deal that is not anticompetitive. Hence, we treat such fixed cost savings separately from variable cost savings and classify them as possible “deal rationales.”

Moving production from one facility to another allows at least a partial shutdown of another facility and thereby reduces or removes the avoidable fixed overhead costs associated with the mothballed facility. Obviously, the more production the merged firm is able to transfer from one facility to another, the greater such cost savings.<sup>94</sup> Practitioners should consider such efficiencies net of any increased costs, such as possible increased transportation costs due to the possibility that some customers might be located further from the efficient plant, or the costs of transitioning production from one plant to another.

Excess capacity may not only take the form of unused capital equipment but can involve other types of assets with significant sunk components. For example, patent expirations in the pharmaceutical industry and the associated shock to sales can generate significant excess sales and marketing labor capacity among such firms. Merging with a firm that has pipeline drugs but lacks adequate marketing and sales capacity to optimally launch these drugs may create value.<sup>95</sup>

### 2 Consolidation of capacity as an efficiency

As noted above, variable cost savings are more likely to affect customer prices than fixed cost savings and therefore are more likely to be credited as offsetting potential adverse competitive effects. While moving production from one facility to another facility can reduce avoidable fixed overhead costs, variable cost savings can also result if one merging party’s facilities are more efficient than the other’s. Thus, one firm may have productive assets that are more state of the art than the other’s. If there is excess capacity at the lower cost facilities, reallocating production among such facilities can reduce variable costs. Such efficiencies can result even if excess capacity is not eliminated provided there is excess capacity at the more efficient firm. Indeed, if there is sufficient excess capacity at the more efficient facility, the less efficient facility can be shutdown entirely. Further, as noted above, even if there is not sufficient capacity, an acquisition involving such assets can facilitate a partial shutdown, resulting in reduced excess capacity for at least some of the productive assets. Similar efficiencies can result if firms can fit complementary processes together. For example, one firm’s facilities may be more efficient at one stage of production and outmoded for another, while for another firm the opposite configuration may hold. Additionally, shifting production from one plant to another can allow firms to take advantage of longer and less costly (per unit of output) production runs.<sup>96</sup>

### 3. Consolidation of capacity as a competitive effect

Previously we noted that excess capacity could have numerous effects on the competitive atmosphere. These effects need not take place in isolation. Thus, while a transaction may reduce costs through the elimination of excess capacity, there can also be concerns that this excess capacity functioned in a manner that engendered competitive

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<sup>93</sup> E.g., see *2010 Guidelines* at §10:

“The greater the potential adverse competitive effects of a merger, the greater must be the cognizable efficiencies, and the more they must be passed through to customers, for the Agencies to conclude that the merger will not have an anticompetitive effect in the market.”

(Emphasis added.)

<sup>94</sup> While a partial shutdown of a plant will not eliminate all its fixed costs, it may reduce them by, for example, avoiding the need for a third shift.

<sup>95</sup> See Patricia Danzon, Andrew Epstein, & Sean Nicholson, *Mergers and Acquisitions in the Pharmaceutical and Biotech Industries*, 307 *MANAGERIAL AND DECISION ECONOMICS* 28 (2007).

<sup>96</sup> Some of the savings from longer production runs may result from reductions in the costs associated with starting or ending a production run. Economists would characterize such as “avoidable fixed costs.” The extent to which such cost saving would be passed along to customers is an empirical question.

behavior in the marketplace. It is theoretically ambiguous as to which effects will predominate. Below we discuss several matters where such trade-offs were regarded as significant.

## B. Empirical Evidence

The notion that mergers can result in some variable cost savings by moving production from less efficient facilities to more efficient ones has some support in the literature. Thus, such efficiencies may have figured prominently in the railroad industry where declines in demand for freight and passenger traffic, largely due to intermodal competition, allowed for the consolidation of parallel routes using only the best equipment from each partner and the most favorable grades of track.<sup>97</sup> Similar efficiencies have also been claimed in the steel industry. Thus, certain plants had newer vintage raw steelmaking processes and outmoded finishing processes, while others had the opposite configuration.<sup>98</sup> In the 1960s, baby food manufacturers may have been able to shift assets to the production of other processed foods such as ketchup and producers of electric percolators were able to shift production to other small appliances such as drip coffee makers.<sup>99</sup>

## C. Case Examples

One case where the elimination of capacity through consolidation appears to have played a major role was *BPCL/ICI* (1984).<sup>100</sup> This matter primarily involved a “swap” of assets located in the United Kingdom for the manufacture and sale of certain chemicals. Thus, Imperial Chemicals Industries Limited (ICI) sold its assets for the manufacture of low-density polyethylene (LDPE) to BP Chemicals Limited (BPCL), while BPCL sold its assets for the manufacture of polyvinyl chloride (PVC) to ICI. In a market for LDPE in the United Kingdom, BPCL would have had a post-merger capacity share of 62.5%, while only one competitor (Shell) would remain with a share of 37.5%. For PVC, ICI’s share of capacity in the United Kingdom would have been 80%, with only one remaining competitor (Norsk Hydro) having a share of 20%.

The European Commission noted that both manufacturers, as well as western European producers of bulk petro-chemicals in general, were facing situations of considerable over-capacity. The ability of the agreement to reduce this overcapacity in a manner that did not harm competition appears to have been key in the Commission’s decision to not challenge the agreements.

The EC noted that the increased loading reduced unit costs and led to more efficient production. This was accomplished by shifting production to the more efficient plants as well as reducing the number of temporary shut downs and their concomitant startup costs.

The EC further noted that despite this overcapacity situation, given the sunk nature of their investments, it is unlikely either company would have withdrawn from the respective markets in the near-term. While this might be expected to have anticompetitive implications in that each firm was in it for the long haul, the Commission also noted that there were procompetitive implications of the merger in that the cost savings from reduced excess capacity could be felt more immediately than through a drawn out competitive process.

Thus, the ability to eliminate excess capacity through asset acquisitions appears to have played a major role in this matter despite the high concentration. Whether or not it played a dispositive role though is difficult to ascertain fully from the decision. Finally, while it noted that concentration was extremely high in the UK, there were a number of producers of the products at issue in the EU as a whole, and that given the relatively low costs of transportation for LDPE and PVC, “it would be exaggerated to define the United Kingdom as the relevant market for both PVC and LDPE.”

One example that illustrates how the cost saving aspects involving excess capacity interact with its other impacts and the tendency of the antitrust agencies and the courts to view efficiency claims skeptically are the drug wholesaling mergers.<sup>101</sup> In 1998, the FTC challenged two concurrent proposed mergers in drug wholesaling:

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<sup>97</sup> E.g., see Alan Fisher & Richard Lande, *Efficiency Considerations in Merger Enforcement*, 71 CALIFORNIA LAW REVIEW 1582 (1983); Robert Harris and Clifford Whinston, *Potential Benefits of Rail Mergers: An Econometric Analysis of Network Effects on Service Quality*, 65 REVIEW OF ECONOMICS AND STATISTICS 32 (1983).

<sup>98</sup> See Mark Dutz *Horizontal Mergers in Declining Industries*. 11 INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION 7 (1989) and the references cited therein.

<sup>99</sup> See Mark Frankena & Paul Pautler, *Antitrust Policy for Declining Industries*, Bureau of Economics (Staff Report to the Federal Trade Commission, Washington, DC) (1985).

<sup>100</sup> BPCL/ICI Commission decision 84/387/EEC [1984] OJ L 212/1.

<sup>101</sup> *F.T.C. v. Cardinal Health, Inc.*, 12 F. Supp. 2d 34 (D.D.C. 1998).

Cardinal Health's acquisition of Bergen Brunswig and McKesson's acquisition of AmeriSource. Both pairs of merging parties indicated there would be substantial consolidation of their distribution centers pursuant to the mergers, an undertaking that would remove considerable excess capacity. The defendants represented this would reduce costs. On the other hand, a number of company documents indicated that the merger was a way to achieve "rational" pricing by removing excess capacity from the market; some documents complained about price competition and stated the hope that removing excess capacity would have price-stabilizing results for the industry. Thus, in addition to eliminating costs, the role of excess capacity in enhancing competition was also relevant. The District Court granted the Commission's motions enjoining both proposed mergers and the parties abandoned their respective merger plans soon after that decision.

A similar case is the baby food litigation.<sup>102</sup> This matter involved the merger of the second and third largest baby food manufacturers in the United States, Heinz and Beech Nut, with shares of 17.4 percent and 15.4 percent respectively. Gerber was the industry leader and held almost all the remaining share. Heinz had recently updated its manufacturing facilities and was operating at about 40 percent of capacity when it agreed to acquire Beech Nut in February 2000. In July 2000, the Federal Trade Commission voted to file a preliminary injunction to block this merger. A district court denied injunctive relief primarily based on efficiencies, many stemming from issues of excess capacity. The FTC appealed and the appeals court reversed the district court's decision and granted injunctive relief. The parties subsequently abandoned the transaction.

The district court noted a number of efficiencies, many of which stemmed from the excess capacity at the Heinz plant and the ability to shift the entire production from the antiquated Beech Nut facilities. The Beech Nut facilities operated in a labor-intensive manner. Further, even after shifting total production to the Heinz facility, there would still be substantial opportunity for growth. The ability to shift production to the Heinz facility would result in substantial savings in "salaries and operating costs." Indeed, the parties claimed a 43% reduction in the cost of processing baby food at the Beech Nut plant. The appeals court recognized that there were efficiencies from the merger, but held that the high concentration levels required proof of extraordinary efficiencies, which the plaintiffs did not supply. There are a number of other matters where claims of cost savings from the reduction of excess capacity were not found to outweigh competitive harms.<sup>103</sup>

#### **D. Summary / Practitioner's Advice**

The elimination of excess capacity through merger or other horizontal transaction is like any other efficiency in merger analysis. As such, claims regarding such efficiencies must be well documented and merger specific. Claims regarding merger specificity should be taken seriously to the extent it would be difficult for nonmerging firms to undertake such consolidations contractually. As with other efficiencies, cost savings from reductions in excess capacity are more likely to impact the analysis to the extent they are passed on to customers.

One question raised in this section is what to do when excess capacity issues have an impact on more than one aspect of the competitive analysis. For example, in the *Drug Wholesaling* matters, there was evidence that the transaction would lead to cost savings through the elimination of excess capacity but that excess capacity had also contributed to a competitive atmosphere. This question is addressed more generally in the next section, but it would appear that when there are efficiencies from eliminating or reducing excess capacity along with possible anticompetitive concerns, there is a very high legal barrier for crediting the efficiencies. However, it is ultimately an economic question as to which effect would predominate.

### **VIII. CAPACITY AND MULTIPLE LEVELS OF ANALYSIS**

With the possible exception of the *Drug Wholesaling* mergers discussed above, the discussion has focused on the implications of excess capacity for only one segment of the analysis. Since excess capacity can affect nearly every aspect of antitrust analysis, the question might arise as to what role it should play when more than one impact is of interest.

In the first place, we again emphasize that the role of excess capacity in many steps of the analysis is ambiguous. Unless there is case-specific evidence that excess capacity has affected these issues one way or the

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<sup>102</sup> F.T.C. v. Heinz, 116 F. Supp.2d 190 (2000), rev'd 246 F.3d 708 (D.C.C. 2001).

<sup>103</sup> E.g., see F.T.C. v. Tenet Healthcare Corp., 17 F. Supp. 2d 937 (E.D. Mo. 1998) rev'd sub nom. and F.T.C. v. Tenet Health Care Corp., 186 F.3d 1045 (8th Cir. 1999) (Expected efficiencies did not justify the proposed merger of hospitals, as defense to antitrust claims, though both hospitals had excess bed capacity).

other, practitioners should not presume there is an effect. Thus, if the record indicates that excess capacity is symptomatic of a barrier to entry but is silent on issues of coordinated effects, then the focus should be on entry barriers. It would appear most cases in the record have followed this approach. It is only when using a “check list” of possible effects that there seem to be contradictions.

At other times, one consideration may simply take precedence over the other. For example, if the concern is unilateral effects from a merger, and there is case-specific evidence indicating that the output expanding incentives of the merger of a firm with excess capacity with one that is capacity constrained will offset any incentive to raise price, the possibility that excess capacity may also raise entry barriers is not relevant. Alternatively, its effects may be pointing in the same direction. Thus, excess capacity may have both enhanced collusion and entry barriers, both reinforcing the anticompetitive nature of the transaction or practice.

It seems that only when there is evidence of both cost savings and evidence that the excess capacity has enhanced competition in the merger context as was the case in the *Drug Wholesaling* mergers as mentioned *supra* that the trade-off appears most complicated. A similar trade-off may arise if excess capacity can be expected to offset unilateral incentives to raise price. As noted, legal precedent suggests it would be difficult for the cost savings to overcome strong evidence of anticompetitive effects.

## IX. CONCLUSION

Capacity issues can play a role in nearly every aspect of competition analysis. It may appear that these effects are not necessarily consistent in terms of whether a particular transaction or practice will pass antitrust muster. The goal of this paper has been to aid decision makers and other practitioners in matters where capacity issues potentially play a significant role.

In terms of collusion, we showed that the theoretical relation between excess capacity and coordinated interaction is ambiguous and the empirical literature reflects this ambiguity. However, if firms coordinate on prices and/or output, excess capacity is a necessary condition for such coordination to have taken place.

In the unilateral merger context, mergers involving capacity-constrained firms have the potential to offset incentives to raise price. Whether this actually holds is a fact specific matter. In the monopolization context, excess capacity could be relevant since it can impact the ability of fringe firms to expand and offset the exercise of market power by the putative dominant firm. In the predatory pricing context, excess capacity on the part of the alleged predator may be necessary in order to accommodate the output of firms driven from the market, although if this firm is able to quickly create or purchase new capacity this would not hold.

Further, while excess capacity may be a symptom of an industry in which entry is difficult, excess capacity is neither necessary nor sufficient for a conclusion that future entry is unlikely. Finally, the elimination of excess capacity can be achieved through merger or other acquisitions. Cost savings in this context are treated like cost savings in any other context in terms of their cognizability.

Given the theoretical and empirical ambiguity regarding the impact of excess capacity, practitioners should not presume any effects in the absence of case specific evidence. A “checklist” approach to capacity issues should be avoided. Moreover, determining whether a firm has excess capacity is not straightforward. When excess capacity issues affect several aspects of the analysis, in most cases this should not be a problem since one issue will frequently obviate the need to analyze another. When there are possible contradicting effects, legal precedent and economic analysis can help adjudicate which impact is likely to predominate.

APPENDIX  
A SIMPLE MODEL OF EXCESS CAPACITY AND THE EASE OF COLLUSION

Assume an industry that consists of two identical Cournot oligopolists with zero marginal costs, demand given by  $P = 1 - q_1 - q_2$ , total industry capacity of  $Q$ , a common discount factor  $\delta$ , and an infinite time horizon without entry.<sup>104</sup>

Table A1 below gives output, prices and profits under collusion, cheating, and competition under these assumptions. In the first case, each firm shares an exogenous capacity constraint of  $Q \in [1/2, 2/3]$ . In this range, total industry capacity is below the quantity demanded under competition in the absence of capacity constraints. In the second case, each firm shares an exogenous capacity constraint of  $Q \in [2/3, 3/4]$ . This case begins at the level of industry capacity sufficient to supply the unconstrained competitive outcome. The final row gives the minimum discount factor necessary to support collusion under each scenario.<sup>105</sup>

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<sup>104</sup> Capacity-constrained Bertrand competitors behave identically to Cournot competitors as long as  $Q$  is below some cutoff, while no Bertrand equilibrium exists for  $Q$  greater than the cutoff.

<sup>105</sup> Allowing punishments with payoffs lower than those under Cournot competition (e.g. minmax punishments) would lower the payoff from competition as  $Q$  increased. This latter effect ( $\delta$  increasing in  $Q$ ) also appears if one firm has a disproportionate share of total industry capacity; here, as  $Q$  increases, that firm's incentive to cheat increases, without any offsetting decrease in the profit from competition.



**Table 1.** Output, prices and profits under collusion, cheating and competition

	Case 1: $Q \in \left[\frac{1}{2}, \frac{2}{3}\right]$			Case 2: $Q \in \left[\frac{2}{3}, \frac{3}{4}\right]$		
Collusion	$q_1 = q_2 = \frac{1}{4}$	$P = \frac{1}{2}$	$\pi_1 = \pi_2 = \frac{1}{8}$	$q_1 = q_2 = \frac{1}{4}$	$P = \frac{1}{2}$	$\pi_1 = \pi_2 = \frac{1}{8}$
Firm 1 cheats	$q_1 = \frac{Q}{2}$ $q_2 = \frac{1}{4}$	$P = \frac{3}{4} - \frac{Q}{2}$	$\pi_1 = \left(\frac{3}{4} - \frac{Q}{2}\right)\frac{Q}{2}$ $\pi_2 = \left(\frac{3}{4} - \frac{Q}{2}\right)\frac{1}{4}$	$q_1 = \frac{Q}{2}$ $q_2 = \frac{1}{4}$	$P = \frac{3}{4} - \frac{Q}{2}$	$\pi_1 = \left(\frac{3}{4} - \frac{Q}{2}\right)\frac{Q}{2}$ $\pi_2 = \left(\frac{3}{4} - \frac{Q}{2}\right)\frac{1}{4}$
Competition	$q_1 = q_2 = \frac{Q}{2}$	$P = 1 - Q$	$\pi_1 = \pi_2 = (1 - Q)\frac{Q}{2}$	$q_1 = q_2 = \frac{1}{3}$	$P = \frac{1}{3}$	$\pi_1 = \pi_2 = \frac{1}{9}$
Collusion optimal if	$\delta \geq \frac{Q\left(\frac{3}{2} - Q\right) - \frac{1}{2}}{Q\left(Q - \frac{1}{2}\right)}$			$\delta \geq \frac{Q\left(\frac{3}{2} - Q\right) - \frac{1}{2}}{Q\left(\frac{3}{2} - Q\right) - \frac{4}{9}}$		

Figure A1 plots the relationship between  $\bar{\delta}$  and  $Q$  derived from the equations in final row of Table A1. As can be seen, the  $\bar{\delta}$  first decreases and then increases.

**Figure A1.** Relationship between total industry capacity  $Q$  and  $\bar{\delta}$

