Chapter XX

Information Exchange, Market Transparency and Dynamic Oligopoly

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Abstract

Economic literature often offers conflicting views on the likely efficiency effects of information exchanges, communication between firms, and market transparency. On the one hand, it is argued that increased information dissemination improves firm planning to the benefit of society (including buyers) and allows potential buyers to make correct decisions given their preferences. On the other hand, economic literature also shows that increased information dissemination can raise prices through tacit or explicit collusion to the benefit of firms but at the expense of society at large. This chapter provides a general analytical framework to reconcile these views and presents some basic conclusions for antitrust practice. In addition, the chapter reviews cases from both sides of the Atlantic where informational issues have played a significant role.

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1 Introduction and Motivation

Antitrust policy and consumer protection often have different attitudes toward information dissemination and market transparency. Antitrust law and practice focus on the potential *coordinating/collusive effects* of the flow of information between firms, and, as a consequence, take a dim view of such flows. In contrast, consumer agencies focus on the ability of buyers to do *comparison shopping*, and, thus, insist that easy access to information on prices and product characteristics is a *sine qua non* of intensive inter-firm competition. Despite the fact that the references made to information flows may relate to the flow of *different pieces of information* and/or to the flow between *different groups of economic decision makers*, it seems clear that there is a potential conflict between these views. The following analysis attempts to reconcile these views and develops some conclusions for antitrust policy.

Two observations help to reconcile the two views above. First, the views have somewhat different temporal perspectives. Antitrust practitioners have in mind a *dynamic* model of oligopoly coordination between rival suppliers. In such a model, it is relatively well-established in the economics literature that collusion (whether tacit or explicit) is made difficult, if not impossible, when firms compete under a veil of ignorance concerning the actions of rivals.[1] Hence, oligopolistic firms will have a common interest in improving the information flows between themselves. Speedy access to accurate information about the individual past transactions and future intentions of rivals will generally have a strong potential for collusion. Business history is replete with examples of rival oligopolists setting up various institutions (legal as well as clandestine) with a view to exchanging strategically sensitive, firm-specific information.

Consumer protection advocates tend to take a more *static* perspective. On the assumption (heroic as it may sometimes be) that competing firms are fully informed about each others strategies, the purpose of enabling a more liberal flow of information is largely to benefit weak buyers and potential entrants. The archetypical example *du jour* is online shop-bots, which allow potential buyers to compare a multitude of different market offerings by pressing a few keys (thus, at low cost). This allows buyers to shop around easily, turning competition between suppliers of close substitutes into something akin to intensive *Bertrand*-style competition. Consequently, proponents of this view have not only suggested that information should be allowed to flow freely, but even that the gathering, processing and dissemination of the information to potential buyers should be subsidized by the public purse or by levying a duty on firms to foot the bill. Thus, government-sponsored or -funded information-transmission mechanisms have been set up.

Second, the information referred to under the different views above may not be the same. Antitrust practitioners refer largely to the exchange of information—such as prices (past, present or future), meet-or-beat competition clauses, quantities, capacities, buyer identities, investment plans, etc.—*between* firms to the possible exclusion of potential buyers and entrants, whereas consumer groups refer to information—such as retail prices, product characteristics, and warranty terms—flowing *from* firms *to* potential buyers and entrants, that is, to the public. So, properly interpreted, it is entirely possible that the "antitrust view" and the "consumer view" may both be on the right track, but in different dimensions.

This suggests that antitrust, which encompasses a general efficiency concern embodying both seller and buyer interests, must pay attention to the detailed features and effects of the information exchanged: Is the information exchanged kept proprietary by existing firms, or does it flow to the public (potential buyers and entrants)? When do the different parties gain access to the information exchanged? Absent formal information exchange, who has access to which pieces of information? Does the information exchanged relate to the past, the present or to future intentions? Can the information exchanged subsequently be retracted or revised? If the information exchanged relates to future intentions, does it commit firms *vis-à-vis* potential buyers?

[1] *See* e.g. George Stigler, 1964, A Theory of Oligopoly, *Journal of Political Economy* Vol 72, pp. 44-61, Jean Tirole, 1989, *The Theory of Industrial Organization*, MIT Press, Cambridge: MA (ch. 6), Kai-Uwe Kühn, 2001, Fighting Collusion: Regulation of Communication between Firms, *Economic Policy* Vol 32, pp. 1-37, or Peter Møllgaard & Per Baltzer Overgaard, 2001, Market Transparency and Competition Policy, *Rivista di Politica Economica* Vol. 91, p. 11-58.

Whatever the view on information dissemination and market transparency in a specific case may be, both antitrust and consumer protection in market economies must fundamentally be based on the presumption that markets work. This position can be traced at least as far back as to the *invisible hand* of Adam Smith in 1776.[2] Hayek in 1945 showed how the economy of the price system (as opposed to a planning-and-command system) was necessary for the optimal allocation of resources.[3] For markets to work, the price system must aggregate the dispersed information on consumer wants and the fundamental scarcity of resources. It follows that opaque prices, hidden discounts, etc., cause problems for the efficient functioning of markets. Thus, some public dissemination of prices and purchase options is necessary and whatever reservations are expressed below on the competitive and efficiency effects of information dissemination should not be taken too far. The main point of the modelling and discussion below is to show that under certain *identifiable* circumstances, the effects of *certain* kinds of information dissemination and communication between economic agents may be ambiguous or even malign from the perspective of competition and efficiency of resource allocation. Changing the flow information may be a two-edged sword in those market conditions with which antitrust is most concerned: concentrated oligopoly.

This chapter deals with information and market exchange within a dynamic oligopoly. Dynamic oligopoly models were developed to improve our understanding of the scope for *coordinated* behavior within imperfectly competitive markets. Coordinated behavior includes a wide range of anticompetitive activities including cartels, explicit collusion, and tacit collusion. Cartels include public agreements to restrict competition whereas explicit collusion covers secret agreements to restrict competition. Tacit collusion covers the situation where there is an implicit agreement or even a more vague understanding among rivals of which competitive behavior is acceptable and which behavior will illicit a response of intensified competition. But whether an oligopoly forms a cartel, explicitly colludes, or tacitly colludes, certain informational requirements must be met to maintain the coordination. In the theoretical sections, the terms coordination and collusion are used interchangeably and generally refer to all types of coordinated behavior.

The outline of this chapter is as follows. The next section briefly summarizes some analyses and views from economics of the role of information in static oligopoly. Section 3 outlines a general model of dynamic oligopoly competition, which is flexible enough to illustrate the main theoretical points related to information dissemination. Then, Section 4 briefly presents some cases from both sides of the Atlantic, in which information transmission and communication have played a central role, while Section 5 pulls out some relatively general lessons for antitrust. Finally, Section 6 contains a few concluding remarks.

2 A Primer on Information in Static Oligopoly

The *perfectly competitive ideal* is the standard against which different forms of actual competition is measured. The perfectly competitive ideal is predicated on a series of assumptions: the existence of many actual competitors, absence of entry barriers, free access to identical technologies, homogenous goods and *perfectly informed agents*. Although not always stated very explicitly, the latter refers to some free availability of price information to existing firms, potential buyers and potential entrants. For competition to play out according to this ideal, there must be some well-defined and commonly known way of producing the homogenous good in a cost minimizing way that drives prices to minimum cost. If some prices differ from this cost minimum, then buyers costlessly shopping around, firm entry, and firm exit will quickly realign prices to minimum average costs. Thus, one could say that the functioning of *the invisible hand* requires the *information aggregated in the system of prices*. But note that the price information is mainly required by potential buyers and entrants for competition to work, and that information is not needed to assess quality because of the homogeneity assumption. This would seem to suggest that

[2] Smith, Adam, 1976 [1776], *An Inquiry into the Nature and Causes of the Wealth of Nations*. Roy H. Campbell and Andrew.S. Skinner, eds., 1976, Clarendon Press, Oxford.

[3] Friedrich von Hayek, 1945, The Use of Knowledge in Society, *American Economic Review* Vol 35, pp. 519-530.

the availability of information is important to understanding the likely intensity of competition in actual markets, the central theme of this chapter. But it also raises the following question: Under imperfect competition, is it always good—in terms of intensified competition—to improve the flow of information on both sides of a market?

Stiglitz presents a theoretical study in which he maintains the assumptions of the perfectly competitive ideal except for the informational assumptions: potential buyers are imperfectly informed about the prices quoted by different suppliers and incur search costs associated with obtaining accurate price information.[4] The most basic modelling assumes that one group of buyers is perfectly informed of the prices at different suppliers, while another group is initially imperfectly informed and must conduct search to discover prices. This may lead to several interesting market phenomena, such as absence of (pure strategy) solutions and market breakdown, prices significantly in excess of average costs, prices which do not decrease as new firms enter the market, and price dispersion even for homogenous goods. All these phenomena represent fundamental departures from the perfect competition solution and, thus, illustrate the importance of the assumption of full information on the part of potential buyers. With missing price information and significant search costs, some buyers are locked into particular suppliers (they are said to be *captive*). On the one hand, this explains that prices can be dispersed and exceed average costs, and, on the other, that an increase in the number of firms does not necessarily lead to intensified price competition.[5] It follows from models of this type that if only consumer search costs can be brought down significantly, through, e.g., the introduction of free and effective *search engines* and *shop-bots* to accompany the spread of *online trading* and/or the establishment of specialized *price-comparison sites* on the *internet*, then consumer prices can be brought down significantly. This line of argument might explain the lobbying of consumer groups for the facilitation (and public subsidization) of price comparisons relating to credit and insurance products. Indeed, this has led some commentators to hail the *digital market place* as the coming of the perfectly competitive ideal making regulation and antitrust redundant.[6]

The evaluation of the effects of information dissemination on competition is complicated further when one turns to oligopoly also drops the assumption of many suppliers. As stated in the introduction, in the oligopoly setting it is important to make a distinction between information flowing on the firm side and on the consumer side of a given market, and the time horizon also plays a crucial role.

In the case of *static* oligopoly, Kühn & Vives[7] were the first to systematically assess the incentives of firms to share information on key variables such as demands and costs as well as the welfare implications of information sharing between firms, when firms compete non-cooperatively by setting prices, quantities, or capacities. Firm incentives to share information trade off the privately beneficial effects for firms related to improved precision of planning against the (possibly) negative strategic (competition) effects of sharing information with rivals. The welfare implications of information sharing between firms, in

[4] Joseph Stiglitz, 1989, Imperfect Information in the Product Market, ch. 13 in Richard Schmalensee & Robert Willig (eds.), *Handbook of Industrial Organization*, North-Holland, New York: NY. For the seminal study of the role of consumer search costs, *see* George Stigler, 1961, The Economics of Information, *Journal of Political Economy* Vol. 68, pp. 213-225.

[5] An increased number of firms may imply that a given consumer will have to conduct a larger (expected) number of costly searches before a low price is found, and this dampens the consumer incentive to search. This, in turn, implies that even with a substantial number of firms, no single firm firm may have an incentive to lower price.

[6] *See* Carl Shapiro & Hal Varian, 1999, *Information Rules: A Strategic Guide to the Network Economy*, Harvard Business School Press, Cambridge: MA, for a rather critical assessment of this point of view. More detailed accounts of the challenges to antitrust in the *online economy* can be found in FTC, 2000, *Entering the 21st Century: Competition Policy in the World of B2B Electronic Market Places*, Staff Report, Federal Trade Commission, Washington: DC, and Frontier Economics, 2000, *E-Commerce and Its Implications for Competition Policy*, Discussion Paper, Office of Fair Trading, London: UK. A brief account can be found in Møllgaard & Overgaard (2001), who focus on dynamic issues to which we return below.

[7] Kai-Uwe Kühn & Xavier Vives, 1995, *Information Exchanges among Firms and Their Impact on Competition*, Office of the Official Publications of the European Communities, Luxemburg. For more recent presentations of the subject matter, building in large part on Kühn & Vives, *see* e.g. Kühn (2001), Xavier Vives, 2002, Private Information, Strategic Behavior and Efficiency in Cournot Markets, *RAND Journal of Economics* Vol. 33, pp. 361-376, OECD, 2001, *Price Transparency*, Document DAFFE/CLP(2001)22, Paris: France, and Rainer Nitsche & Nils von Hinten-Reed, 2004, Competitive Impacts of Information Exchange, Charles River Associates, Brussels: Belgium. A detailed account is beyond the scope of this paper, and the following is just meant to convey the flavor of some key results.

turn, depend on both the nature of competition (Cournot quantity-competition vs. Bertrand price-competition) and on the nature of the initially dispersed information (random shocks predominantly affecting all firms or shocks predominantly affecting individual firms). Even though Kühn & Vives are able to generate relatively clear and unambiguous analytical results for model specifications they studied, the results provide little practical antitrust guidance because of the limited information available to antitrust enforcement agencies.

Finally, additional issues arise when firms or their executives are at an informational disadvantage *vis-à-vis* either potential buyers or employees.[8] It should be fairly evident that absent competition concerns, individual firm performance (cost minimization) in an uncertain world may sometimes improve significantly when employee compensation can be tied to information from outside the firm. Relative performance evaluation and benchmarking requires information relating to firms in similar circumstances, which typically would include the most immediate rivals. Thus, inter-firm sharing of sales and cost data may, potentially, be efficiency-enhancing. However, exchange of *detailed, firm-specific* information among rivals also has significant coordinating potential, as explored more fully below. More *aggregated industry* data may be sufficient from the efficient contracting perspective, while having less coordinating potential. Aggregate data is certainly sufficient for benchmarking against some industry average.

Similarly, firms in oligopolistic industries sometimes find themselves in a situation where they, initially, lack some relevant information about the characteristics of their potential buyers. For example, in the credit and insurance industries, buyers may shop around between a limited number of providers. Without inter-firm information exchange, firms may have relatively limited information about the past payment or accident records of individual new buyers. An asymmetry of information may lead to severe adverse selection problems, resulting in inefficient market outcomes—inefficiencies which are unrelated to the oligopolistic nature of the industries. In such a setting, inter-firm exchange of information (in the form of individual customer records) may well be efficiency-enhancing.

3 A General Model of Dynamic Oligopoly Competition

This section illustrates how information exchange, communication, and market transparency (and changes thereof) relate to competition and market efficiency in dynamic markets. A very general dynamic oligopoly model captures the essential differences between static and dynamic oligopoly competition. The model is largely void of institutional detail and functional form assumptions relating to demand and costs. At the same time, it is flexible enough to introduce various assumptions about information flows on both the supply side (that is, between firms) and the demand side (that is, between buyers or potential buyers) of the relevant product in question. This latter feature produces insights for antitrust practice without relying on specific modelling details.

Consider a market with at least two but a limited number of identical firms, *i.e.*, an oligopoly.[9] Firms transact every period in some market place and simultaneously choose their strategies for that period. For now, the exact nature of the strategies is unimportant, but well known models of price or quantity setting behavior spring to mind. More generally, firms might be competing in promotional strategies (marketing and advertising), investments in production capacities, R&D intensities, or product characteristics. The strategic interaction unfolding in a given period is referred to as a *stage-game*. Suppose that this stage-game has a unique so-called *Nash* solution with associated (symmetric) Nash profits π^N to each firm where it non-cooperatively chooses its strategy. A key to the Nash solution is that no firm has an incentive to change its strategy given the strategies of others. Alternatively, if the firms were somehow able to collude or coordinate perfectly in their simultaneous choice of strategies, then profits to each firm would be π^C. Naturally, the collusive profits would be greater than the Nash profits ($\pi^C > \pi^N$). Because the collusive

[8] The following remarks are based on the more detailed account in Kühn (2001).

[9] This is known as a symmetric oligopoly. The symmetry assumption made throughout is largely for expositional convenience.

outcome does not coincide with the Nash solution outcome, then each firm would have a basic incentive to change (i.e., *deviate*) from collusion. Hence, if all the rivals of a given firm play the collusive strategy in the stage game, there is a best response (best deviation) of this firm giving rise to one-shot profits of π^D for that firm, where the profits from deviating are greater than the profits from collusion ($\pi^D > \pi^C$). Hence, profits from deviation are greater than profit from collusion, which in turn are greater than the profits from the Nash solution ($\pi^D > \pi^C > \pi^N$).

Thus, this set up captures that non-coordinated profits, π^N, are lower than the profits firms could potentially attain, if they managed to collude, π^C. However, in the purely *static* setting, the collusive strategy profile giving rise to π^C would be destabilized by profit-seeking individual firms striving to attain an even higher profit, π^D.

In a *dynamic* setting, however, things may be very different because firms can use a richer set of strategies. The additional strategies are called contingent strategies because the action of a given firm in a given period may depend on the complete history of the dynamic interaction between the firms. For example, the price set by a given firm today may depend on the sequence of prices charged by rivals in the past. Thus, a firm can reward friendly behavior in the past by friendly behavior today and punish aggressive behavior in the past by aggressive behavior today.

All firms following a collusive strategy gives rise to a constant profit of π^C, and the discounted profits of a given firm are

$$V^C = \pi^C + \delta\pi^C + \delta^2\pi^C + \delta^3\pi^C .... = \frac{1}{1-\delta}\pi^C = \pi^C + \frac{\delta}{1-\delta}\pi^C,$$

where V^C is the sum of the discounted profits flows and δ is some number between 0 and 1 capturing the time discount factor of the firms. The discount factor, δ, may depend on many things, but it will be inversely related to the firm's time preference for money as measured by an interest rate or cost of capital. If the interest rate were the only factor, then $\delta = 1/(1+i)$ where i is the interest rate.

In contrast, a single firm deviating gives rise to the deviation profit, π^D, *once* followed by a *string* of non-collusive profits, π^N, starting next period (assuming the rival contingent strategies are to revert to Nash strategies). The associated discounted profits are

$$V^D = \pi^D + \delta\pi^N + \delta^2\pi^N + \delta^3\pi^N + ... = \pi^D + \frac{\delta}{1-\delta}\pi^N,$$

where V^D is the discounted profits from the strategy of deviating. The *Nash trigger-strategies* prescribe that firms start out by taking the collusive action and continue to do so as long as all firms have taken the collusive action in the past. If a single firm ever strays from the collusive path, all firms revert to the static Nash strategy from then on. The sustainability of collusion in every period, thus, requires that the discounted profits from collusion be greater than the discounted profits from deviating, that is,

$$V^C = \pi^C + \frac{\delta}{1-\delta}\pi^C \geq \pi^D + \frac{\delta}{1-\delta}\pi^N = V^D$$

or

$$\frac{\delta}{1-\delta}(\pi^C - \pi^N) \geq \pi^D - \pi^C.$$

More conveniently,

$$\frac{\delta}{1-\delta}A[dherence] \geq T[emptation]$$

or

$$\delta \geq \underline{\delta} \equiv \frac{T}{T+A}, \tag{1}$$

where $A \equiv \pi^C - \pi^N$, $T \equiv \pi^D - \pi^C$, and $\underline{\delta}$ denotes the *critical* discount factor required to sustain collusion. Thus, the temptation to deviate from collusion (the one-period gain) should be outweighed by the discounted value of the future losses. Although deviation will typically give a short-term gain for individual firms from cheating on coconspirators under collusion, when firms are sufficiently patient this gain will be wiped out by future losses resulting from the more intensive competition once the collusive understanding has been broken. Patience is captured by the discount factor, and anything that increases the effective discount factor will facilitate collusion. Hence, to combat collusion, antitrust agencies would be wise to keep a keen eye on factors such as the exchange of information, firm communication, and general market transparency which may influence the effective discount factor among oligopolists. This underlies the views on antitrust *vis-à-vis* collusion espoused by Kühn & Vives, Kühn, Halliday & Seabright, and Møllgaard & Overgaard on which the following relies heavily.[10]

The type of condition in (1) is representative of how modern oligopoly theory studies the possibility of collusion in dynamic settings. Variations in the general model developed above illustrate how information can impact the likelihood of collusion. Suppose i_f is (some "index" of) information available to firms and i_b is information available to potential buyers, where i_f and i_b are both numbers between 0 and 1. When $i_f = 1$, the market is *fully transparent* from the perspective of firms; similarly, when $i_b = 1$ the market is fully transparent to buyers. In contrast, when $i_f = 0$ ($i_b = 0$), the market is *completely non-transparent* from the perspective of firms (buyers).

The discussion of the various notions of information in the Introduction provides some possible interpretations. As far as firms are concerned, i_f may refer to how accurately and how quickly firms obtain information relevant for their business strategies. Thus, a high value of i_f (close to 1) could capture that information on the prices or quantities of rivals is obtained quickly, allowing the firm in question to respond quickly to changes in rival behavior. Similarly, a low value of i_f (close to 0) could capture that deviations by rivals from tacitly collusive behavior is only detected with a small probability (due, e.g. to the secrecy of price cutting). As far as potential buyers are concerned, i_b may capture the detail with which potential buyers are able to observe individual firm prices or product characteristics. Thus, a high value of i_b (close to 1) may signify that the prices charged by individual firms can be observed easily and at low cost (due, e.g., to the access to free and efficient online shop-bots). A low value of i_b (close to 0) could represent that it is intrinsically difficult or expensive for potential buyers to gather information on product characteristics associated with goods or services from different firms.

With these (and other) interpretations in mind, information exchange, communication, and improved market transparency either increases i_f, i_b or both. Then, in a given model, a condition on the discount factor required to sustain collusion would take the form

$$\delta \geq \underline{\delta}(i_f, i_b), \tag{2}$$

where generalized notions of "*temptation*", $T = T(i_f, i_b)$, and "*adherence*", $A = A(i_f, i_b)$, enter in the exact specification through changing the magnitudes of temptation and adherence. The temptation to cheat is dependent on i_b because, for example, when potential buyers are unable to observe the price being slashed by a particular firm the lure of deviation disappears since a deviating firm would end up selling mostly to existing buyers at lower prices. Similar arguments reveal that the temptation to cheat and the adherence to collusion depend on information available on both sides of the market.

The general model so far has been limited to the perfectly collusive outcome, a version of monopoly market sharing. The general model, however, can encompass a broader spectrum of behavior. For example, suppose that the discount factor (degree of firm-patience) is too small to allow the perfectly collusive outcome to be sustained. Does this mean that firms have to revert to the fully non-collusive outcome,

[10] *See* Kühn & Vives (1995), Kühn (2001), Møllgaard & Overgaard (2001), and Jennifer Halliday & Paul Seabright, 2001, Networks Good, Cartels Bad: But How Could Anyone Tell the Difference?, ch. 5 of *Fighting Cartels – Why and How?*, Swedish Competition Authority, Stockholm: Sweden. For an authoritative text book treatment, *see* Jean Tirole, 1989, *The Theory of Industrial Organization*, MIT Press, Cambridge: MA, ch. 6.

or is there some form of *partial collusion*, which may be sustained by the firms? Møllgaard & Overgaard find that partial collusion may sometimes be sustained even when perfect collusion is unsustainable.[11] Partial collusion could, for example, be taken to mean that rather than sharing monopoly outputs, as under perfect collusion, the firms symmetrically expand outputs to some level between monopoly outputs and the perfectly competitive outputs. The temptation to cheat for individual firms may decrease enough to sustain tacit understandings. The sustainability of partial collusion is related to the information flows on both sides of the market, in much the same way as suggested in the discussion below.

In fact, it may be shown that dynamic oligopoly interaction where firms expect (or plan) to be around indefinitely will typically allow many possible configurations, if the firms are sufficiently patient.[12] With many possible solutions, it is not immediately obvious which strategies firms will chose. In the literature, this is referred to as *strategic uncertainty*. In order to develop a sustainable behavioral pattern in the dynamic oligopoly interaction, the rival firms have to arrive at some common understanding. But how is such a common understanding to develop without some form of communication between the rivals? Communication over which strategies the firms should pursue may be referred to as *cheap talk*, but it should be evident that such "talk" (communication) may be critical to enabling a "meeting of minds". Notice how this communication relates to *future intentions*, whereas the information referred to in the general game above related to *past behavior* (prices, quantities, etc.). The upshot of this is that information about past behavior and communication about future intentions play different roles in oligopolistic coordination. Once firms have an *understanding* on acceptable collusive strategies, then information about past (and present) behavior is vital to monitor rival behavior. On the other hand, *before* an understanding on how to play the game has been reached, the ability to communicate one's future intentions appear critical to eventually developing such an understanding.

The next three subsections present more detailed commentary on the likely effects of information flows on the firm side as well as the buyer side of the market. Subsection 3.1 looks at changing information flows on the firm side, while fixing the information on the buyer side. Subsection 3.2 looks at changing information flows on the buyer side, while fixing information on the firm side. Ultimately, Subsection 3.3 brings things together. This is, of course, of utmost importance for antitrust practice because regulatory attempts to "cure" problems on one side of the market may have repercussions (positive or negative) on the other side of the market. This has sometimes been overlooked in the past, as illustrated by some of the cases discussed below.

3.1 Information Flows between Firms

Small changes to the general model above capture both detection lags and cases where rivals may or may not observe deviations. Detection lags and uncertain detection represent variations on secret price cutting. A detection lag means that cheating on an collusive understanding can be kept secret by the transgressor for some time, while a small probability of detection implies that a transgressor expects to walk away "scot free" with significant probability. Lumpy and infrequent orders have roughly the same effect as a detection lag because this is comparable to assuming that the next round for business is far into the future. Tirole makes the following general remarks.

> *"The threat of a punishment operates only if the punishment comes fairly soon after a price cut. Punishment might be delayed for two related reasons. First, a firm's price cut may be learned of by its rival only with a lag. This may happen when manufacturers contract with a few big buyers (wholesalers or downstream manufacturers). The secrecy of contracts may then be an obstacle to collusion. Indeed, if price cuts were never detected, collusion could not*

[11] *See* Møllgaard & Overgaard (2001).

[12] In the literature this is formalized by what is referred to as the *Folk Theorem*, since no one has been bold enough to claim the result, *see* Tirole (1989, ch. 6) or Drew Fudenberg & Jean Tirole, 1991, *Game Theory*, MIT Press, Cambridge: MA, ch. 5. In the present setting setting this implies 1) that anything from no collusion to perfect collusion is possible, and 2) that asymmetric profit assignments are sustainable, provided that firms are sufficiently patient.

be sustained. Second, infrequent interaction (due to lumpiness in orders, for instance) delays the punishment and makes current price cutting more attractive."[13]

Detection lags. Within the model outlined above, assuming that there is a detection lag of s periods is tantamount to assuming that deviations from some tacit or explicit understanding is observed by rival firms with a lag of s periods, which could be hours, days, weeks, months, quarters, etc., depending on the specific market under scrutiny. That is, if a firm deviates in period t, this will be detected by the rivals at the end of period $t+s$, and punishment/retaliation can start in period $t+s+1$. Thus, with this notational convention, in the basic model above without detection lag ($s=0$), the deviation is detected at the end of period t, and the punishment/retaliation can start in period $t+1$. More generally, the detection lag is related to the index of information on the firm side, $s=s(i_f)$, with no detection lag with perfect information ($s(1)=0$) and the detection lag increasing to infinity as firm side information falls to nothing ($s(i_f)\to\infty$ as $i_f\to 0$). Recall that for this subsection the information of buyers, i_b, is fixed.

For comparison with the analysis in the general model, consider again whether firms are able to collude perfectly with resulting collusive profits in every period of π^C. As above, firms are restricted to *Nash trigger-strategies*. By following the collusive path a firm still obtains

$$V^C=\frac{1}{1-\delta}\pi^C(i_b).$$

By deviating until detected, the deviating firm obtains

$$V^D=(1+\delta+\delta^2+...+\delta^{s(i_f)})\pi^D(i_b)+\delta^{s(i_f)+1}(1+\delta+\delta^2+...)\pi^N(i_b).$$

That is, by deviating a firm receives the deviation profits for $s(i_f)+1$ periods, after which the profits in every period coincide with the static Nash solution profits forever. The discounted value of this stream of profits can be rewritten as

$$V^D=\frac{1}{1-\delta}\pi^D(i_b)-\frac{\delta^{s(i_f)+1}}{1-\delta}(\pi^D(i_b)-\pi^N(i_b)).$$

Hence, to sustain perfect collusion, it must be the case that $V^C\geq V^D$, which can be written as[14]

$$\delta\geq\underline{\delta}(i_f,i_b)=\sqrt[s(i_f)+1]{\frac{T(i_b)}{T(i_b)+A(i_b)}}. \tag{3}$$

From this it is immediately clear, and not very surprising, that the *critical* discount factor, $\underline{\delta}(i_f,i_b)$, is increasing in the detection lag, $s(i_f)$, before rivals detect a deviation and start responding. In other words, a greater detection lag requires firms to be more patient and have higher discounts and lower time preferences for money (interest rates). In for a given discount factor, increasing detection lags mean that it is less likely that collusion would be the more profitable strategy. Therefore, the absence of market transparency from the perspective of firms, interpreted as long detection lags or lumpy orders, is good from the antitrust perspective because it makes collusion harder to sustain.

Uncertain detection. Next consider the case where deviations are observed with a certain probability in any give period. To capture this idea as simply as possible, assume that a deviation from a collusive understanding is detected in any period with a probability i_f, which is some number between 0 and 1. So, when $i_f=1$, which corresponds to perfect information, deviations would be detected in the first

[13] Tirole (1989, p. 248).

[14] $V^C\geq V^D$ can be written as $\frac{1}{1-\delta}\pi^C(i_c)\geq\frac{1}{1-\delta}\pi^D(i_c)-\frac{\delta^{s(i_f)+1}}{1-\delta}(\pi^D(i_c)-\pi^N(i_c))$. Rearranging, we obtain $\delta^{s(i_f)+1}\geq\frac{T(i_c)}{T(i_c)+D(i_c)}$, from which the result follows.

period as in the general model above. When $i_f = 1/2$ there would be a 50 percent chance of detection in the first period. If not detected in the first period, there would be a 50 percent chance of detection in the second period, and so on infinitely. When $i_f = 0$ deviation would never be detected. Hence, in this case the index of information on the firm side, i_f, simply coincides with the probability of detection. Again information on the buyer side at some level i_b.

As above a firm which follows the collusive path obtains discounted profits of

$$V^C = \frac{1}{1-\delta}\pi^C(i_b)$$

while a firm contemplating a deviation expects to obtain

$$V^D = \pi^D(i_b) + \delta(i_f \cdot \frac{1}{1-\delta}\pi^N(i_b) + (1-i_f)V^C).$$

Perfect collusion requires $V^C \geq V^D$, which in the notation introduced above gives

$$\delta \geq \underline{\delta}(i_f, i_b) \equiv \frac{T(i_b)}{T(i_b) + i_f A(i_b)}, \tag{4}$$

capturing that the *critical* discount factor, $\underline{\delta}(i_f, i_b)$, goes down as the probability of detection, i_f, goes up. Again, absence of transparency, interpreted as low probabilities of detecting deviation (e.g., price cuts), is bad from the perspective of antitrust, for the same reason as long detection lags.

3.2 Information Flows on the Buyer Side

When scrutinizing the effects of information flows on the buyer side, two opposing effects must be considered. On the one hand, an improvement in buyer information might be expected to increase individual firm incentives to cheat on collusive high prices (or low outputs). The more informed potential buyers are, the more sensitive are individual firm demands to changes in the strategic choice of the firm in question. So, in a static, one-shot game, increased transparency on the buyer side should intensify competition and lower the resulting static profits. On the other hand, improved buyer information would also tend to decrease the Nash solution profits; hence, punishments become more severe. So, through this effect, tacit collusion in a dynamic game may be said to be facilitated by increased transparency. The overall conclusions, thus, turn on the trade-off between the increased one-period gain from reneging and the increased severity of punishments.

These ideas may be explained in terms of the general model discussed above. For ease of exposition, assume that the market is fully transparent from the perspective of firms (i.e., $i_f = 1$) and suppress i_f for notational convenience. Let the information available to buyers, i_b, range between 0 and 1. When $i_b = 0$, then the market is said to be *completely non-transparent*, and each buyer is fully locked into a particular firm, as if he does not know the existence of the other firms. This is essentially the situation of local monopolies because the buyers of one firm are completely unresponsive to the actions of the other firms. In contrast, when $i_b = 1$ the market is said to be *perfectly transparent*, as when all buyers know the price offered by each firm. Suppose that for a given i_b, the single period stage-game has a unique Nash solution with associated profits for each firm represented by $\pi^N(i_b)$. Further suppose that the Nash profits, $\pi^N(i_b)$, fall as information to buyers, i_b, increases, which captures the idea that static competition becomes more intense the more transparent is the market from the point of view of potential buyers. If the firms managed to collude, then profits would be $\pi^C(i_b)$. As above, one would expect that collusive profits are greater than Nash prices for an given level of buyer information ($\pi^C(i_b) > \pi^N(i_b)$ for all positive i_b). Finally, there is some best deviation giving rise to one-shot profits of $\pi^D(i_b)$ to the defector, where the one-period profits from deviation are greater than the one period profits from collusion ($\pi^D(i_b) > \pi^C(i_b)$). As opposed to the Nash profits, it is reasonable to assume that the profits from deviation, $\pi^D(i_b)$, increase as information to buyers, i_b, increases. This captures the idea that

with better information of individual firm prices, for example, more buyers will know of and accept the low-price offer to buy from the firm deviating from collusion. In other words, the temptation to defect increases as buyers have more information.[15]

As before, following a collusive path gives a firm discounted profits of

$$V^C = \frac{1}{1-\delta}\pi^C(i_b) = \pi^C(i_b) + \frac{\delta}{1-\delta}\pi^C(i_b),$$

whereas deviating gives

$$V^D = \pi^D(i_b) + \frac{\delta}{1-\delta}\pi^N(i_b).$$

Sustainable collusive pricing in every period requires that

$$\delta \geq \underline{\delta}(i_b) \equiv \frac{T(i_b)}{T(i_b) + A(i_b)}. \tag{5}$$

Thus, both the numerator, $T(i_b)$, and the denominator, $T(i_b) + A(i_b)$, in (5) depend on the the measure of transparency as seen from the perspective of the potential buyers. Because the temptation to deviate and the incentive to adhere to collusion both change with respect to changes in buyer information, i_b, in general it is not possible to know how the critical discount factor, $\underline{\delta}(i_b)$, changes with changes in customer information. Nevertheless, it follows that the required discount factor to sustain full collusion, $\underline{\delta}(i_b)$, is more likely to increase as buyer information increases when the temptation to cheat, $T(i_b)$, is more sensitive to buyer information than is the incentive for adherence, $A(i_b)$. Whether increased buyer information facilitates or hinders tacit collusion would be expected to depend on the fine details of the market under scrutiny and no general policy statements result from this analysis. Accordingly, increasing buyer information could well be a mixed blessing for potential buyers.

3.3 Pulling Things Together

First consider information flows among firms. As suggested above, the traditional focus in the economics literature has been on the flow of information between rival oligopolists. At least since the seminal contribution of Stigler in 1964, it has been part of the "folklore" of Industrial Organization that oligopolists will strive towards a monopoly-like coordinated, armed truce characterized by high prices and limited quantities, but that such a state of coordination is difficult to maintain for any length of time, unless rather detailed, firm-specific information flows liberally between the firms. The firms may well have a common interest in keeping prices high, but they also have strong individual motives to undercut and steal business from each other.

Improved information flows between oligopolist rivals, through shortened detection lags, increased precision of observations, more detailed communication about future intentions, etc., have the tendency to increase the scope for coordinated behavior, whether tacit or explicit. For example, improved monitoring of the present and recent past strategic choices of rivals (such as prices, contracted quantities, and capacities) enables the detection of individual deviations from collusive understandings. This implies that "punishments" can be activated more quickly and can be made more precise, that is, they can be fitted to hit mainly the transgressor rather than at random. Thus, the punishment is more severe and therefore serves more effectively as a deterrent. Similarly, improved communication about future intentions makes it easier for the oligopolist rivals to resolve the strategic uncertainty and accept a mode of coordinated practice. In the presence of many possible solutions for dynamic oligopolies, it is important

[15] Fleshing out the details of a perfectly standard oligopoly model with the properties outlined above is done in Møllgaard & Overgaard (2001) and Peter Møllgaard & Per Baltzer Overgaard, 2002, Market Transparency: A Mixed Blessing?, *mimeo*, Departments of Economics, Copenhagen Business School & University of Aarhus.

that firms arrive at some common understanding of how to play the game. Communication about future intentions contributes to this.[16]

Thus, the exchange of information and communication between firms will often facilitate coordination (tacit collusion), and under a wide set of circumstances it will run counter to the efficiency objective of antitrust (efficient allocation of scarce resources). However, information dissemination may also serve to improve firm planning and efficiency. Finally, if the firm side includes all potential entrants, then improved information flows might also facilitate entry, in the sense that it allows potential entrants to spot profit opportunities more effectively. The latter immediately points to an important distinction from the perspective of antitrust between exchanges of information between firms which are kept proprietary and those that leak to potential competitors. Sound antitrust practice has to strike a balance between these contrasting effects of information exchange and communication between firms.

Turning to information flows on the buyer side, the most immediate effect of improved buyer information is to make individual consumers less locked into particular firms (or, less captive, in the jargon of economists). Within the framework of most static oligopoly models, the demand function facing each firm becomes more sensitive to differences between the firm's own price and those of its rivals. As a consequence, static price competition is likely to become more intense.[17] From the perspective of static modelling, it is a relatively robust result that improved consumer information tends to promote the efficiency objective. However, it remains an open question whether this qualitative result is robust to embedding the basic static models in an explicitly dynamic model of oligopoly competition. The reason for this is straight forward: if improved information on the consumer side makes it easier for a firm to steal customers from its rivals, it must also make it easier for these rivals to "steal" them back again! So, the result might just be that no one tries to steal customers from rivals in the first place.

In the abstract, it is unclear whether one effect or the other dominate. Further specializations of the theoretical model and, ultimately, empirical assessment are needed. Nilsson, Schultz as well as Møllgaard & Overgaard present different formalizations and reach somewhat different results.[18] Thus, "the Devil's in the detail", and policy statements based on a particular model seem unwarranted. Conservatively, though, it might be argued that it seems easier to write down a fully specified model in which improved information on the buyer side promotes competition (at least, in the sense of making collusion harder to sustain). Similarly, the theoretical contributions seem to indicate that increasing the number of firms makes it more probable that improved buyer information enhances dynamic oligopoly competition. With few firms (say, 2 to 5), full market transparency may not be optimal, in the sense of making coordinated behavior most difficult.[19]

In the applied and policy-oriented literature—e.g., OECD (2001) and Kühn (2001)—the consensus is that the positive effects of improving buyer information dominate. Improved buyer information without a corresponding increase in firm information tends to enhance competition. To a large extent, this forms the basis for recommendations of public intervention to facilitate price comparisons and establishment of online shopbots. In addition, the need for public intervention in information dissemination may also be motivated by the public goods elements and externalities involved in the production and acquisition of information: produced or gathered tend to spillover to others, and as a result individual agents may have limited incentives to incur the associated costs. Hence, too little or no information may be collected.

Pulling the two sides of the market together suggests that improved information flow on the firm side will likely enhance the scope for coordinated firm behavior, while improved information flows on the

[16] For more on cheap talk communication, *see* e.g. Joseph Farrell & Matthew Rabin, 1996, Cheap Talk, *Journal of Economic Perspectives* Vol. 10, pp. 103-118, for an overview and Kühn (2001) for a discussion related specifically to antitrust practice.

[17] Møllgaard & Overgaard (2001, 2002) provide fully worked-out model examples to this effect.

[18] *See* Arvid Nilsson, 2000, Transparency and Competition, mimeo, Stockholm School of Economics, Christian Schultz, 2004, Market Transparency and Product Differentiation, *Economics Letters* Vol. 83, pp. 173-178, Christian Schultz, 2005, Transparency on the Consumer Side and Tacit Collusion, *European Economic Review* Vol. 49, pp. 279-297, as well as Møllgaard and Overgaard (2001, 2002).

[19] *See* Møllgaard & Overgaard (2002).

buyer side *may* enhance competition. Antitrust has to strike a balance. Ideally, antitrust practice should attempt to promote an information regime in which potential buyers and entrants are well informed about prices, product characteristics, and contract terms while actual competitors are covered by a veil of ignorance with respect to the actions of their rivals. This regime would promote *comparison shopping* and *entry*, while at the same time provide incentives for actual competitors to *steal business* from each other through (secret) discounts and pricing near cost. This regime, of course, is largely a caricature, and it is hard to imagine how, in practice, information can flow freely to buyers and potential entrants while at the same time being inaccessible to active firms. It is difficult to change the flow of information on one side of the market, while leaving the flow on the other side unaffected. This should be kept in mind whenever regulatory intervention is contemplated.

As an example, consider an industry in which secret discounts are prevalent. Given the prevalence of discounts, a firm losing business will be in doubt as to whether this is caused by other firms charging low prices in an attempt to steal business, or whether it is due to a slump in demand.[20] Suppose that the firms in the industry are able to create an institution for information exchange. Then it will be easier for each individual firm to determine whether it is losing business to aggressive competitors or due to a decrease in demand. Such an information exchange, where individual transaction prices and quantities are registered, seems like an ideal institution to support coordinated behavior, since it enables an accurate identification of firms who might have decreased prices or increased sales. The problem for such an institution is how to verify the reported information, since individual firms have an incentive to misrepresent prices and sales. From the perspective of firms, it might be ideal if a government agency (with its authority, coercive powers, and ability to prosecute false reporting) required the publication of actual transactions prices and quantities sold.

Secret discounts make the market non-transparent from the perspective of both buyers and sellers. Therefore, coordinated firm behavior is impossible. By eliminating the secrecy surrounding individual transactions prices, (strategic) punishments can be made harsher and more precise, that is, more effective. This leaves the question: what are the possible benign effects of the information exchange? In many recorded cases, the logic of proponents seems to be that comparison shopping by the buyers is facilitated by the information exchange. Empirically, however, the effect often seems different, in the sense that firms are not prevented from using the same pieces of information to coordinate their behavior. This is explored further below.

So far the arguments have been largely theoretical. Systematic empirical study of the effects of communication and information exchange on firm behavior in dynamic oligopoly is scant, and the next section presents a sample of cases to throw some light on this. However, it should be noted that the economics literature in rich in examples of experimental studies aimed at testing the role of information exchange and communication in sustaining coordination and collusion in laboratory settings mimicking repeated oligopoly interaction. It is outside the scope of this paper to provide a comprehensive survey of the experimental evidence. Suffice it to say that the first generation (1970s and 1980s) of experiments on oligopoly interaction was largely theory driven, that is, it was aiming to test fundamental predictions of game-theory-based models of repeated oligopoly interaction. More recently, a multitude of experimental studies have taken their point of departure in problems more closely related to practical antitrust. Potters and Haan, Schoonbeck & Winkel survey, from slightly different perspectives, the experimental literature on collusion with particular emphasis on the effects of changes in the structure of information and the possibility for communication.[21] While the evidence from the wealth of experiments is inconclusive,

[20] *See* Edward Green & Robert Porter, 1984, Non-Cooperative Collusion Under Imperfect Price Information, *Econometrica* Vol. 52, pp. 87-100, for a formalization of this type of uncertainty regarding rival behavior and, thus, an explicit modelling of some of the points raised by Stigler (1964). Green & Porter explicitly tie their theoretical contribution to some early experiences from the US railroad industry. *See* also Robert Porter, 1983, A Study of Cartel Stability: The Joint Executive Committee, *Bell Journal of Economics* Vol. 14, pp. 301-314, Glenn Ellison, 1994, Theories of Cartel Stability and The Joint Executive Committee, *RAND Journal of Economics* Vol. 25, pp. 37-57, and Tirole (1989, ch. 6).

[21] *See* Jan Potters, 2005, Transparency and Collusion: Experimental Evidence, *mimeo*, Department of Economics, Tilburg

there is is strong indication that communication between firms about future intentions has a significant coordinating potential. The role of information about past behavior of rivals is less clear, even though reliable feedback on competitor prices helps police (explicit) cartels. When firms can communicate intentions, the coordinating potential is sometimes mitigated by the access of buyers to communicate back to individual firms by requesting discounts.

4 Representative Cases

Transparency and information dissemination have been an important part of quite a few antitrust landmark cases. This section briefly describes some important cases and indicates different dimensions along which they fit the modelling framework presented above.

4.1 A Concrete Case

The first case may serve to illustrate that improved transparency may, indeed, have significant anticompetitive effects by improving coordination amongst oligopolists. In the early 1990s, the Danish Competition Authority found evidence of a lack of competition in the *ready-mixed concrete* industry.[22] In particular, it was concerned that some buyers were paying too high prices because it was rumored that other customers received significant confidential discounts. Because at that time the Danish Competition Act emphasized the role of price transparency in promoting competition, the authority decided to gather and publish firm-specific transactions prices for two grades of ready-mixed concrete in three regions of Denmark. The intention was to inform buyers of bargain deals in the hope that this would lead buyers to exert stronger downward pressure on prices. Following the initial publication, however, average prices went up by 15 to 20 percent in less than six months. This compares with inflation of 1-2 percent per year and stable or decreasing costs of inputs.

Tacit collusion is the most likely explanation for the price increase. The price increase cannot be explained by an increase in demand or increasing costs. Because ready-mixed concrete can only be transported a short distance (20-30 kilometers, depending on local infrastructure), competition is local. In the relevant market around the city of Aarhus only four firms were active and pricing was reported for each. These four firms thus constitute a tight oligopoly. That improved transparency led to improved coordination of their pricing policies appears a natural conclusion from Figure 1. While prices were initially widely dispersed, after a year of publication the firms seemed to have found a mutually acceptable price level.

[Insert Fig. 1 here]

Evidence indicates that the firms stopped granting large individualized discounts because of the improved transparency, which was an implicit goal of the policy. But the authority also unwittingly assisted firms in reducing competition by providing the reliable detection of cheating that is a prerequisite for sustaining collusion. This case also illustrates that in an oligopolistic market setting if suppliers are able to react to improved information dissemination before buyers, buyers may be hurt rather than helped by transparency.

In closely related studies, Fuller, Ruppel & Bessler and Schmitz & Fuller find that contract disclosure legislation passed by the US Congress increased railroad freight rates as a direct result of the improved

University, and Marco Haan, Lambert Schoonbeek & Barbara Winkel, 2006, Experimental Results on Collusion: The Role of Information and Communication, *mimeo*, Department of Economics, University of Groningen. Kühn (2001, pp. 16 - 17) also has a brief discussion of (mainly) the early experimental literature.

[22] *See* Svend Albæk, Peter Møllgaard & Per Baltzer Overgaard, 1996, Law-Assisted Collusion? The Transparency Principle in the Danish Competition Act, *European Competition Law Review* Vol. 17, pp. 339-43, and Svend Albæk, Peter Møllgaard & Per Baltzer Overgaard, 1997, Government-Assisted Oligopoly Coordination? A *Concrete* Case, *Journal of Industrial Economics* Vol. 45, pp. 429-443, for a discussion of the legislation and a full account of the case.

scope for tacit collusion.[23] The legislation mandated disclosure of firm-specific information also in this case.

4.2 Cheap Talk in the Air and on the Ground

In the US, a price-fixing case brought by the Department of Justice against the *Airline Tariff Publishing* Company (*ATP*) involved price transparency created by eight major domestic U.S. airlines through ATP, their own joint venture.[24] ATP collects fare information from the airlines and disseminates it daily to all the airlines and the major computer reservation systems (CRSs) that serve travel agents. ATP thus allows airlines to observe and respond quickly to each other's prices. This already improves the scope for collusion; see the section on detection lags.

On top of this, ATP may have served as an efficient instrument for cheap talk, i.e. communication that does not commit the airlines to a particular action but allow them to 'negotiate' and coordinate on a collusive outcome. A suggestion to halt an unwanted discount fare could be made unilaterally by a firm by announcing a Last Ticket Day (LTD) for that fare. If other firms follow suit, they go ahead and implement it; if not, the LTD could be changed to a later date or eliminated. Since no trade is made based on the information, no sales are lost before coordination has been achieved. It is in this sense that "talk is cheap." In addition, airlines could use a First Ticket Date (FTD) to signal that they suggest a new and higher price or they could threaten a cheater with a punishment strategy of low prices to take effect in the future, if the cheater does not bring prices back in line.

The case reveals how "junk fares" were eliminated through several rounds of proposals and counter proposals that ultimately lead to an increase of junk fares by twenty dollars each way in hundreds of city-pair markets. For one airline it is estimated that this would increase revenues by $7 million per month!

The ATP case was settled through consent decrees. All airlines and ATP prohibited FTDs and LTDs so that price changes would become binding and thus potentially costly for the firms. Thus the consent decrees stipulated the end of cheap talk:

> *"By limiting the ability of the airlines to engage in extensive price negotiations, the government contends that the airlines will find it more difficult to co-ordinate on more collusive outcomes in the future. Whether the decree actually will have this effect remains to be seen, but as co-ordination becomes more costly, it seems unlikely that the airlines will be able to engage in extensive negotiations that link together dozens or hundreds of markets. Multimarket contact may still be present, but without the ability to easily define the terms of an agreement, firms may not be able to exploit their cross-market linkages as fully as before the entry of the consent decree."*[25]

In the *Ivy League* case,[26] college presidents of Ivy League Universities and MIT shared information about prospective tuition increases during their winter budget-planning process, before the public announcement. This was described by one of the involved university officials as "an informal swapping of

[23] *See* Stephen Fuller, Fred Ruppel & David Bessler, 1990, Effects of Contract Disclosure on Price: Railroad Grain Contracting in the Plains, *Western Journal of Agricultural Economics* Vol. 15, pp. 265-271, and John Schmitz & Stephen Fuller, 1995, Effects of Contract Disclosure on Railroad Grain Rates: An Analysis of Corn Belt Corridors, *Logistics and Transportation Review* Vol. 31, pp. 97-124.

[24] The following exposition draws on OECD (2001, pp. 191-193) that in turn builds on William Gillespie, 1995, Cheap Talk, Price Announcement, and Collusive Coordination, *Discussion Paper* EAG 95-3, Economic Analysis Group, Antitrust Division, U.S. Department of Justice, Washington: DC.

[25] Gillespie (1995, p. 16).

[26] See OECD (2001, pp. 193-196) for a brief account. The case resulted in consent decrees from the eight Ivy League Universities (*U.S. V. Brown University et al.*, 1991 WL 536896 (E.D. Pa.)) and a favourable verdict against MIT in district court (805 F. Supp. 288 (E.D. Pa. 1992)). On appeal the appeals court remanded the case to the district court to consider procompetitive and welfare defences for price-fixing (5 F.3d 658 (3d Cir. 1993)). Finally, the case was settled with MIT in December 1993.

intentions" – but one that would eliminate strategic uncertainty and increase prices (tuition) on average. The cases were ultimately settled with all eight Ivy League Universities and MIT. The U.S. Department of Justice notes:

> *"These complex arrangements—the Ivy Methodology, the spring meetings to negotiate uniform offers to individual students, the moral exhortations to nurture compliance from cartel members and even non-cartel members—illustrate the role that price transparency plays in a complex, longstanding cartel. It is one of an array of strategies that economize on trust, so that cartel members don't act selfishly in their own interest. Complex conspiracies impose great demands for price transparency; and legal constraints on price transparency make it more difficult to sustain complex conspiracies."*[27]

The U.S. Federal Trade Commission has also been concerned with unilateral price announcements that were perceived as *invitations to collude*. The FTC issued a complaint against Stone Container Corporation (SCC), U.S.'s largest manufacturer of linerboard, in 1998, alleging that when SCC announced a price increase of $30/ton for all grades of linerboard to take effect in March 1993, it was effectively inviting rivals to collude. The invitation was turned down since other linerboard manufacturers failed to follow suit. SCC withdrew its announced price increase and pursued other means of organizing improved cooperation.[28] In a more recent case, (indirect) communication to rivals made during presentations to security analysts have been scrutinized by the FTC. Valassis Communications, Inc., is one of two leading producers of free-standing newspaper inserts in the U.S. According to the FTC, during the quarterly conference with security analysts in July 2004, Valassis CEO invited the main rival - News America Marketing - to join a scheme to allocate customers and fix prices, in order to end an ongoing price war. According to the public announcement, Valassis would abandon its 50% market share goal, aggressively defend its existing customer base, quote above-market bids for present News America customers, monitor News America's response, and reinitiate the price war, if News America were to compete actively for existing Valassis customers.[29]

In Europe, the European Commission decided that a number of *wood pulp* producers had colluded on price announcements and by exchanging information but this decision was ultimately overturned by the European Court of Justice partly because, in contrast to the ATP and SCC cases, there were no subsequent revisions of the announced prices that, thus, were perceived to involve more commitment on the part of the parties. *See* Kühn and Vives (1995) at section 3.1.1 for an elaboration of this point.

Finally, the Swedish Market Court has recently fined five retail-gasoline chains about $20 million in a case concerning the coordinated elimination of discounts to major buyers. This case is interesting from the perspective of the present paper, since the evidence presented to the court by the Swedish Competition Authority largely turned on the communication between company representatives on their intentions.[30]

4.3 Authority at Sea

For more than a century *container shipping* has been run through a series of "liner conferences." Container shipping provides regular shuttle service in a network connecting ports all around the world. There is a fixed time table and shippers (customers) were charged standard rates that were agreed by the liner conferences. For many years container shipping has enjoyed a special treatment from cartel laws, justified by large investments in vessels and port facilities. Antitrust authorities, however, increasingly have become wary of granting such exemptions from competition law, arguing that liner conferences were essentially cartels. Thus in 1992, a number of large shipowners notified the European Commission of the

[27] OECD (2001, pp. 195-196).

[28] *See* U.S. FTC 951-0006 (available at http://www.ftc.gov/os/1998/02/9510006.agr.htm). Also *see* OECD (2001, p. 189).

[29] *See* U.S. FTC 051-0008 (more information is available at www.ftc.gov/opa/2006/03/valassis.htm).

[30] For details, *see* Swedish Market Court, 2005, *Verdict 2005:7, Docket no. A 2/03, Feb. 22*, Stockholm: Sweden (available at http://www.marknadsdomstolen.se/avgoranden2005/Dom05-07.pdf)

Trans-Atlantic Agreement (TAA). The Commission prohibited the TAA (and price fixing activities that could have the same or similar effects) in 1994. This led the parties to the TAA to notify the Commission of the Trans-Atlantic Conference Agreement (TACA) that suggested that the members could agree on the rate, charges and other conditions of carriage using a common tariff. Members of TACA had a market share of around 70 percent of the trade between Northern Europe and the United States.[31]

One of the main problems of cartelists is that cooperation tends to break down if detection is uncertain. Article 10 of TACA proposed to solve this problem by setting up the "TACA Enforcement Authority," an independent body to police the duties and obligations of the parties. The TACA Enforcement Authority could investigate any alleged breach of the terms of the agreement on its own initiative or following a complaint. It would have total unfettered access to all documents related to a carriers activity within the TACA and would be authorized to inspect records and property as well as interview and take statements from persons. It would be entitled to impose fines of $100,000 to $150,000 for any breach of the agreement, in particular for breaching the various pricing agreements. Furthermore, to support the authority, it was entitled to fine any refusal to allow access by the parties: $75,000 for the first instance, $150,000 for the second and $250,000 for each incident thereafter (within a two-year period). Recidivism, in respect of all breaches, was to be fined by up to $300,000 within any one-year period.

The effect of the TACA Enforcement Authority would clearly have been to reduce or eliminate any uncertainty as to whether the agreement is followed by all members. In this manner, it would have served to make cheating on the agreement readily observable and immediately punishable, thus supporting the price fixing agreement. For this reason, the European Commission decided in 1998 to prohibit TACA and fine the parties a total of EUR 273 million. The fine was annulled in 2003 by the European Court of Justice, arguing that the shipping companies had notified the Commission of their cooperation. However, the Court upheld the Commission's contention that the original agreement conflicted with EU competition rules.

Recently, the European Liner Affairs Association has suggested to replace the current liner conferences with an information exchange system the content of which would be to make some information (*e.g.*, monthly capacity utilization forecasts and commodity developments) available only to members of the association, while other information will be made public to shippers as well (*e.g.*, forecasts of demand and quarterly price indices for different types of cargo per trade leg). However, in September 2006, the European Council decided "...to repeal Regulation 4056/86 putting an end to the possibility for liner carriers to meet in conferences, fix prices and regulate capacities as of October 2008."[32]

4.4 Information Exchange Is Collusion: UK Tractors

Another EU case sheds light on the importance of detailed and recent information for sustaining collusion. This case is particularly interesting because it was a first, in the sense that explicit allegations of collusion did not enter, and it all turned (in a pure form) on the effects of the information exchange.[33]

In 1988, three trade associations notified the EU Commission about an information exchange agreement (the UK Agricultural Tractor Registration Exchange) that had existed since 1975. The agreement concerned dissemination of detailed information obtained from the UK Department of Transport on retail sales and market shares of eight manufacturers and importers of agricultural tractors in the UK. The market was characterized by high concentration (four-firm concentration ration of 77 percent; eight-firm concentration ration of 87 percent), declining demand and excess capacity.

[31] This case is summarized by Peter Møllgaard, 2004, TACA, *Case study*, Department of Economics, Copenhagen Business School. The complete decision is available from the *Official Journal of the European Communities* L95/1, April 9, 1999 (pp. 1-112); see also EU press release IP/98/811 (Sept. 16, 1998).

[32] *See*, press release IP/06/1249 of the European Commission.

[33] The decision is published in the *Official Journal of the EU*, 1992, L68/19. It is summarized by OECD (2001, 30-31) and subject to extensive treatment by Nikolaos Georgantzís and Gerardo Sabater-Grande, 2002, Market Transparency and Collusion: On the UK Agricultural Tractor Registration Exchange, *European Journal of Law and Economics* Vol. 14, pp. 129-150. See also Kühn & Vives (1995, pp. 96-102), Halliday & Seabright (2001, pp. 90-92) and Kühn (2001, pp. 195-196).

The Commission did not object to the availability of aggregate industry data, but rather to the dissemination of individualized sales data because it in and of itself was found to restrict competition because it prevented hidden competition in a highly concentrated market and because it was seen to increase barriers to entry for non-members:

> *"The Exchange restricts competition because it creates a degree of market transparency between the suppliers in a highly concentrated market which is likely to destroy what hidden competition there remains between the suppliers on the market on account of the risk and ease of exposure of independent competitive action. ... Uncertainty and secrecy between suppliers is a vital element of competition in this kind of market. Indeed active competition in these market conditions becomes possible only if each competitor can keep its actions secret or even succeeds in misleading its rivals. ... [T]he high market transparency between suppliers on the United Kingdom tractor market which is created by the Exchange takes the surprise effect out of a competitor's action thus resulting in a shorter space of time for reactions with the effect that temporary advantages are greatly reduced."*[34]

The firms involved opined that the exchange of information was necessary to process warranty claims and for monitoring the sales efforts of its marketing personnel, thus providing an *efficiency defense*. However, the Commission concluded that such effects could be achieved through the comparison of own company data and aggregate industry data. In general, the EU Commission is less likely to prohibit information exchange the more difficult it is to track individual firms.

This is evident from the EU Commission's *Cartonboard*[35] and *Wastepaper*[36] cases. The Commission argued that to prevent identification of individualized information, aggregation of the data of at least three, respectively, four firms would be required. See also Halliday and Seabright (2001) for a discussion of this.

5 Lessons for Antitrust

The discussion above suggests a change in focus for traditional antitrust enforcement. Antitrust historically has examined factors such as prices, output, and profits.[37] But these factors are difficult for courts to evaluate.

> *"It is typically impossible for a court to establish with any accuracy whether oligopolists have charged prices close to monopoly prices or not. In the vast majority of cases the available data will not allow making such inferences....These problems will be compounded by the lack of econometric expertise in most antitrust authorities, which creates the danger of unwarranted strong conclusions from inconclusive data in enforcement practice."*[38]

Accordingly,

> *"...[C]ompetition policy rules cannot systematically rely on the evaluation of price and sales patterns in the relevant market but have to focus instead on observed communication between firms."*[39]

[34] *Official Journal* L68, 1992, at para. 37.
[35] *CEPI – Cartonboard* [1996] *Official Journal of the EU* C310/3.
[36] *European Wastepaper Information Service* [1987] *Official Journal of the EU* C339/7.
[37] In addition to Kühn (2001), the following is based in large part on OECD (2001) and Møllgaard & Overgaard (2001).
[38] Kühn (2001, p. 5).
[39] Kühn (2001, p. 3).

Rather than primarily basing analysis on market data such as prices and quantities, the focus should be moved to other practices which are suspected of facilitating coordination. In particular, communication between market participants should be scrutinized. Such a change of focus would represent a shift from *ex post* detection and punishment (which is probably a losing battle for the authorities anyway) to *ex ante* limitation of the scope for collusion and facility of coordination.

Thus, to Kühn (2001) communication between competitors should take center stage, while the implications of this communication for potential buyers and entrants (whether direct or indirect) play a supporting role. With reference to the theoretical considerations and case material in the preceding sections, two main types of communication between firms may be identified:

1. Communication about planned future behavior and conduct.

2. Communication about past and present behavior and conduct.

Communication about planned, future conduct is *soft* and *non-verifiable* information about *intentions*. This information can relate to planned, future prices, planned production, launch of new products or services, planned capacity changes, and the like. In contrast, communication about past and present conduct is *hard* and *verifiable* information. Examples include past and present prices, contents of order book, investments made, input prices in contracts made with suppliers, and information about individual or groups of buyers. For each of these types of communication, the antitrust authority should ask the question: *what is the potential of the communication with respect to facilitating coordination or collusion?* In addition: *what are the possible efficiency-enhancing effects of the communication, and are there ways in which these can be realized without the communication?*

If the first question returns the answer that a certain type of communication has a strong coordinating potential, then a ban on this communication should be considered. If, in addition, the second question returns the answer that the communication has no possible (or probable) efficiency-enhancing effects, or that these could be attained through other means, then the ban should be placed.

For both types of communication, a distinction can be made between whether the communication is *private* or *public*. In the present context, private communication implies that it is exclusive to the firms, while public communication is transmitted also to potential buyers and entrants. Against the theoretical background painted above, this distinction is noteworthy, given that our belief is that communication between oligopolistic competitors, which does not leak to the public, has a strong coordinating potential. In particular, from the perspective of firms, the reservation of communication about planned, future behavior to a private forum would seem to have a significant potential with respect to solving problems of strategic uncertainty and would facility collusive understandings. If oligopolistic rivals are able to communicate intentions freely to each other, without simultaneously committing themselves to make offers to buyers, then the adverse efficiency effects may be grave, indeed.

As far as communication about past and present conduct is concerned, a distinction can also be made between whether the information disseminated is *aggregated* or *individualized*. The rapid communication of highly disaggregated, firm-specific or transactions-specific, data has a potentially strong effect on the scope for collusion, in the sense that recent and accurate information on the conduct of individual firms allows rivals to react quickly and precisely to changes in conduct. Aggregated information, such as an industry-level average, has a much more limited coordinating potential. With a very limited number of firms, however, aggregation does not conceal much. As a result, antitrust agencies will have to keep a keen eye on the actual loss of information through aggregation.

Paraphrasing Kühn (2001), the following conclusions suggest themselves:

1. *Private* communication between firms about *future prices* and *production plans* should be banned. This type of private communication significantly helps firms on how to play the dynamic oligopoly game to their advantage, *and* it is hard to spot the potential efficiency benefits of such a private communication.

2. If communication between firms about *future prices* and *production plans* takes place in public, and, in particular, if the communication *commits* firms to supply potential buyers to a significant extent, then the probable, positive efficiency effects are likely so great that a blanket ban would be counter-productive. Whether, in a specific case, the communication promotes or dampens competition must then rely on a more detailed analysis, but, on *a priori* grounds, the communication should be allowed.

3. The exchange of *individualized* information about past and present *prices* and *quantities* is highly suspect, in the sense that it has a very significant coordinating potential. In addition, examples in which the exchange of detailed, firm-specific information on prices and quantities is necessary for efficient planning and resource allocation seem rare. To allow an "efficiency defense", it is suggested that firms or groups of firms be given the opportunity to argue and prove that a certain exchange is benign, in order to escape a ban.

4. The exchange of *individualized* past and present *cost* and *demand data* should be handled with care, since the particulars of the market in question will determine whether positive or negative efficiency effects dominate. This suggests a *rule-of-reason* treatment with a presumption that the exchange is benign. Thus, the authority should prove its case to obtain a ban on the exchange.

5. The exchanges of *aggregated data* seem largely innocent. However, the antitrust agency must carefully check the effective extent of the aggregation. The exchange of aggregated information may have a significant efficiency enhancing potential with respect to firm planning. Cases may arise, where even the exchange of aggregated information has adverse effects, but in such cases, the authority should prove its case.

Of course, one might debate the details of these recommendations with reference to the academic literature on oligopoly.[40] But importantly these rely on a coherent theoretical frame of reference and are operative in practice, features that have not always been available in antitrust policy.

6 Final Remarks

Improved information dissemination may improve firms' ability to plan their business decisions to the benefit of society (including buyers) and allow potential buyers to make the right decisions given their preferences. However, increased information dissemination can have significant coordinating or collusive potential to the benefit of firms but at the expense of potential buyers. The balance of these effects depends on the details of the market under scrutiny, as well as how and why the information is communicated.

Antitrust agencies should take a dim view on information that is exchanged privately between firms and will ease up if the information is presented in such a way that individual firms cannot be identified. Similarly, the exchange of old information is less likely to be perceived as offensive than that of new or recent information because of the time lag thus introduced. Exchange of future plans may reduce firms' strategic uncertainty and such cheap talk is likely to raise eyebrows at competition authorities. Price announcements that are binding, however, are less likely to be anticompetitive.

Information exchange arguably has never been easier than today. It is thus an open question what competition authorities can really do about, for example, encrypted online chat rooms that substitute for the smoke-filled parlours of the past. As a result, whistle-blowers may become much more important to uncover explict collusion. As for tacit collusion, the discussion above outlines the information that likely facilitates tacit collusion and may be addressed through both *ex ante* and *ex post* competition policies.

[40] *See*, for example, Halliday & Seabright (2001). *See* also the rejoinder in Kühn (2001, pp. 20-21) and the general comments in Møllgaard & Overgaard (2001) as well as Frontier Economics (2000) and FTC (2000).

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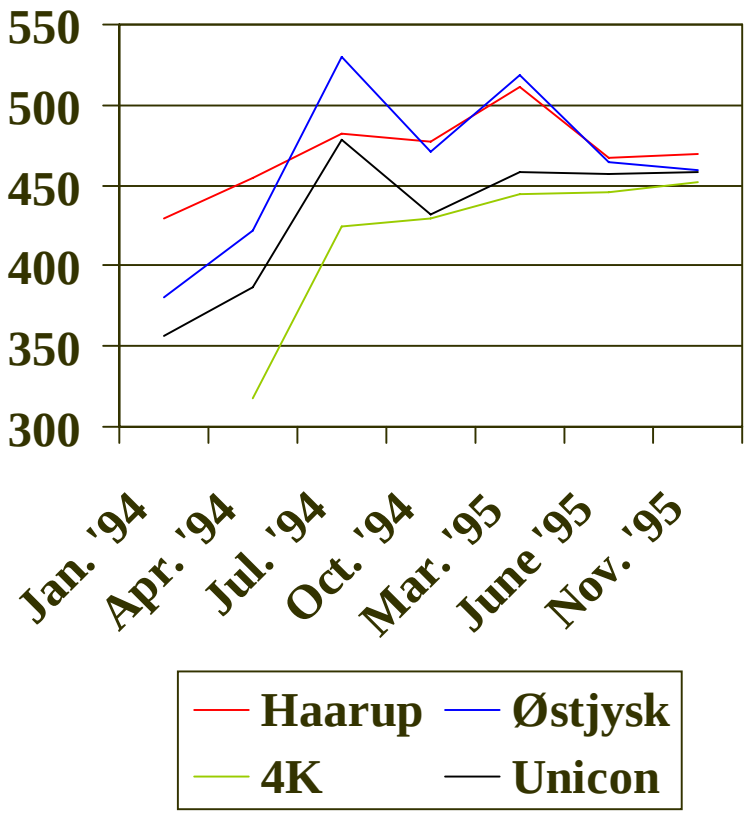

Figure 1: Average concrete prices for the four producers in Aarhus