Competitive Impacts of Information Exchange

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The European Liner Affairs Association (ELAA) has asked CRA to look at the economic implications of information exchange. In the context of DG Competition's review of Regulation 4056/86, we understand that the ELAA wishes to propose an information exchange system as a potential alternative to the current liner conferences. In this paper we review the economic literature on information exchange and investigate the likely competitive effects of information exchange.

In the past competition policy conclusions based on the economic literature rested mainly on a comparison of the effects of information exchange in static models of oligopoly and dynamic models of collusion. This work has found that the effects of information exchange in static models depend on the nature of competition. Under quantity competition, for example, information exchange improves consumer surplus and welfare but under price competition it may not. The main driver of this result is the "output adjustment effect". When firms set quantities and there is uncertainty about demand for this output, information exchange about future demand improves each firm's estimates of future demand. Thus, firms produce more (relative to the situation without information exchange) when they exchange information about future demand and future demand is high and they produce less if future demand is low. The first effect (more quantity if demand is high) is beneficial for consumers and outweighs the second effect (less quantity if demand is low), which is negative for consumers. When firms set prices the output adjustment effect is different (more quantity if demand is low and vice versa) and the negative effect outweighs the positive effect.

It has further been argued that under quantity competition firms may not have an incentive to exchange information in static models.

The economic literature on dynamic models of collusion highlighted that information exchange can improve the ability to collude.

Based on these findings it has been suggested by some economists that competition authorities should (see Kühn and Vives 1995):

- Generally not allow the exchange of individual price and quantity data;

- Allow the exchange of aggregate data through trade associations (unless there is evidence of collusion);

- Not allow information exchange about intended future pricing unless it goes along with a commitment to maximal prices for consumers.

In this paper we take into account more recent research and a broader set of effects. Our analysis has shown that the recommendations above should not be applied across the board. In particular, we find, first, that quantity-setting firms are much more likely to have a pro-

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competitive incentive to share information than believed in the past[1] and, second, we identify a number of further benefits of information exchange.

Economic literature dating back centuries identifies the generation of information as key to generating competitive outcomes. Price signals lie at the heart of the market economy. Independent actors strive to maximise their profits – to the benefit of the entire society. This idea is at the heart of the famous *invisible hand* of Adam Smith (1776). Friedrich von Hayek (1945 and 1968) describes competition as a discovery mechanism that is required to generate the information necessary for economic progress. Since then economic research has identified a large number of beneficial effects of information exchange.

Thus, the generation and use of information is traditionally seen as important for consumer welfare. In fact the ability to generate and disseminate information is seen as an important aspect for explaining the existence of the variety of institutional arrangements between market transactions and transactions within organisations. This suggests the intuition that "more information exchange is good for consumers". We discuss the following effects:

- Information exchange may improve *investment decisions*. The improvement of investment decisions has received very little formal treatment in the economic literature, but may be of considerable importance. Neglecting the role of information exchange on investment decisions implies neglecting potentially large costs for consumers leading to distortions with respect to product quality, product variety, location and the future ability to respond to demand changes.

- Information exchange improves *product positioning*. In industries with product differentiation or spatial competition (as in the liner shipping industry) coordination regarding the choice of location often is beneficial to consumers, who benefit from reduced transport cost, and increases total welfare. Moreover, information exchange may reduce sub-optimal production or pricing choices and, hence, reduce costs associated with excess inventories.

- Information exchange about the operations of rival firms is an important element of *organisational learning*. Benchmarking may lead to an improved distribution system and other improvements in productive efficiency, which ultimately benefit customers and consumers.

- Information exchange leads to better outcomes on which firm produces how much. As a result information exchange may *facilitate entry and exit* in an industry, an aspect of dynamic competition widely ignored in the earlier literature on information exchange.

- Information exchange can *lower search costs* and thereby lower costs for customers. By the same reasoning information exchange about common input variables can lower the input costs across all firms, leading to lower prices that benefit consumers.

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[1] More realistic modelling of information types has shown that in the standard quantity-setting model, first, firms do have an incentive to exchange information and, second, that this information exchange is valuable for consumers and welfare. This questions some of the previous policy conclusions that rest on the argument that when information exchange is beneficial for consumers, firms may have no incentive to exchange the information.

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- Information exchange about common value parameters can *substitute the beneficial effects of forward markets* (which will not always emerge as a market outcome) and improve the market outcome by mitigating the winner's curse, and increasing economic efficiency.

- The very coordination that may follow the exchange of information may have beneficial effects for consumers and welfare. If completely uncoordinated competition leads to market failure, then some coordination may be desirable.

However, it is well known that information can also be used to eliminate competition and information exchange can therefore harm consumers. For example, producers can use the exchange of information to coordinate their behaviour in the market in order to keep prices above the competitive level, limit production or the amount of new capacity, or share the market. The new EC Merger Guidelines provide a good summary of the environment where coordination may occur:

> *"Coordination is more likely to emerge in markets where it is relatively simple to reach a common understanding on the terms of coordination. In addition, three conditions are necessary for coordination to be sustainable. First, the coordinating firms must be able to monitor to a sufficient degree whether the terms of coordination are being adhered to. Second, discipline requires that there is some form of credible deterrent mechanism that can be activated if deviation is detected. Third, the reactions of outsiders, such as current and future competitors not participating in the coordination, as well as customers, should not be able to jeopardise the results expected from the coordination. " (EC Merger Guidelines, Para 41)*

Information exchange may facilitate the agreement, the monitoring and the punishment and may therefore lead to or stabilise collusion. This suggests the intuition "more information exchange is bad for consumers".

It follows that communication and information revelation can have pro-consumer and anti-competitive impacts depending on whether collusion is likely to be a problem or not and depending on the type and characteristics of the information that is exchanged. Since there is no general intuition with regard to the effect of information exchange, it is necessary to study the specific context for each industry.

The extensive economic literature on collusion has generated some useful conclusions on the types of information that may facilitate anti-competitive effects. Combined with the results from the static models this has lead to an assessment of different information types, concluding that, in particular, the exchange of individualised pricing and quantity data is likely to be only motivated by the intent to collude. This has lead to a critical attitude towards this kind of information exchange. More recent research has shed further light on the issue and leads to a more differentiated view on information exchange about price and quantity data. The following findings are relevant:

- Detailed case studies of collusive arrangements have shown that effective collusion requires agreement and monitoring of much more than just the "price" or the

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"quantity". Thus, it may well be possible to allow information exchange on a price or a quantity if further details are not exchanged.

- Most existing economic models are weak in explaining how a different equilibrium is achieved. If firms respond to rivals actions by imitating their behaviour, information exchange may lead to competitive outcomes. Experimental evidence provides some confirmation for these results.

- Different types of information, like demand, pricing, or quantity information, cannot always be easily distinguished. For example, often information about future prices and quantities are exchanged in order to convey information about demand. Indeed, very detailed disaggregated and individualised information exchange may be necessary in order to extract the maximum value for consumers. More recent research has stressed this point.

The requirements for collusion are cumulative as in addition to further requirements, like barriers to entry, all the following elements *need* to be fulfilled: agreement, monitoring and the ability to punish. Information about past prices, sales, cost and demand facilitates the detection of cheating which is important for the stability of collusive arrangements. Information about future prices, sales, capacities, cost, and demand is more important for reaching an agreement than for monitoring purposes. More detailed case study research shows that effective collusion requires a significant range of information. Thus, showing that collusion is impossible due to a lack of information about crucial details or as a result of other aspects of market structure is sufficient for changing the results significantly: information exchange will then have a positive effect on consumer welfare, with the possible exception of price competition.

What can be concluded about the competitive impact of exchanging different types of information? From the point of view of collusion, ignoring the beneficial effects of information exchange, we obtain the standard results that lead to the following conjectures:

- Private communication of future plans: strong negative effect

- Exchange of individual data on prices and quantities: strong negative effect

- Exchange of individual data on demand and cost: medium negative effect

- Exchange of aggregate data on any of the above: small negative effect (if any)

Given that on the one hand information exchange about individualised price and cost data raises more competition concerns than aggregated or anonymous information, and on the other hand the beneficial efficiency effects of information exchange depend on knowledge about future demand and cost, it is a relevant question how information can be aggregated and/or anonymised in a way so that the competition concerns are addressed but the benefits are retained. Here the result that disaggregated and individualised information about demand can have a significant beneficial effect on consumers is relevant and suggests a trade off. The net-effect of information exchange will depend on the circumstances in each industry.

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Generally, information exchange and transparency tends to be more valuable if:

- Market participants can learn from each other and firms have different knowledge about different parts of the market.

- The information is important for decisions which have a significant welfare effect.

- There is no/limited danger of negative market power effects (collusion or predation).

The aim of this paper is to shed some light on the different types and characteristics of information that matter for the assessment of information exchange, to understand the criteria for evaluating the settings in which information exchange may have a negative effect, and to highlight when institutions or practices that improve information exchange have a beneficial effect on consumer welfare.

2 Information exchange

Advances in economic theory have enabled economists to make competitive distinctions between different types of information exchanged between firms. Broadly, both the expected beneficial effect on consumers and the potential harmful effects for competition depend on the type and characteristics of the information that is exchanged and the nature of competition in the market. The following factors influence the results:

1. *What is the information exchange about:* firms' own prices, sales, capacities, cost, demand or other parameters? Competition authorities are usually more suspicious when information is exchanged about prices and quantities because this information is often essential for monitoring deviations from a collusive "arrangement" and hence enforcing collusion. Exchange of information on cost and demand is usually looked at more favourably. However, in practice information about prices and quantities is often used to convey information about cost or demand. For example, sharing information about past or current prices and quantities informs other players about demand and allows inferences to be made about the costs of rival firms during the relevant period. This demand and cost information is useful as current or recent demand (cost) is a central element for predicting future demand (cost).

2. *Specificity*: firm specific ("private value") or industry specific ("common value")? Does private information that can be shared pertain to "common values" or "private values"? Common values relate to information from which others could learn about their own estimates of, for instance, industry demand or common input parameters. Private values relate to information that does not convey common value information. Examples include firm-specific production costs and demand shocks.

3. *Time period*: past, present, future? Effective collusion requires coordination (which can be supported by exchanging information about future plans) and monitoring (which requires information about actual behaviour).

4. *Aggregation and individualisation*: aggregated (anonymous) information or disaggregated (individualised or anonymous) information? The level of anonymity and aggregation of the information that is exchanged (completely aggregated, aggregated by market/product category, disaggregated and anonymous, disaggregated and individualised) and the asymmetry of the value of the information to firms (e.g. whether it is valuable to know who or where a certain estimate has been made or whether it is sufficient to know the average of the private signals in the entire industry) influence the effect of information exchange:

Information exchange

5. *Availability*: private or public information? The effects of information exchange differ depending on whether information is made public or kept private within the group of firms that exchange information.

6. *What is the nature of the strategic interaction in the industry*: is there competition in quantities or capacities ("Cournot models") or competition in prices ("Bertrand models")?

7. *Substitutes or complements*: are the goods produced by the oligopolists substitutes (increasing demand for one good would reduce demand for the other) or complements (increasing demand for one increases demand for the other)?

The variety of factors that play a role in the analysis of the effects of information exchange show that it is very difficult to produce general results. The assessment of the effects of information exchange on consumers and on welfare depends on the specific industry situation.

3 Benefits of information exchange

If information exchange does not give rise to competition concerns it will almost always be positive to welfare. Indeed, the benefits from information exchange can be large (Vives 2003). In the following, we investigate a number of ways in which information exchange can increase welfare. Information exchange:

- is part of the discovery mechanism in a market economy;

- improves investment decisions and organisational learning;

- leads to output adjustments;

- lowers search costs;

- leads to an efficient allocation of goods (to those that value them most);

- helps selecting the most efficient firms; and

- mitigates the problem of a winner's curse.

For completeness we discuss each point in turn.

3.1 Discovery mechanism in a market economy

Economic literature dating back centuries identifies the generation of information as one of the central elements on which economic benefits are generated.

- The famous *invisible hand* of Adam Smith (1776) relies on the exchange of information. Independent actors can plan and conduct their economic activity to the benefit of the whole society by relying on price signals.

- Friedrich von Hayek (1945 and 1968) describes competition as a discovery mechanism that is required because of the lack of information. Competition can be perceived as a device for the *revelation and exchange* of knowledge or information about qualities and potential uses of different inputs in different potential applications. The generation of knowledge and information is one of the key tasks of the market economy. If the market fails to generate that knowledge, other institutional forms will be helpful.

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In a world without information about demand and rivals' activities, firms would have to permanently adapt to changing circumstances by a trial and error process. As a Commissioner of the US Federal Trade Commission put it with regard to pricing:

> *"Information about prices helps businesses make informed decisions about the prices at which they will offer their products and services, eliminating the need for a more costly trial and error process. Price information is useful to both consumers and businesses to inform buying decisions" (Azcuenaga 1994, p. 4).*

While a trial and error approach may be of little cost in some industries, it clearly becomes more costly when development times and investments are required for each "trial". Standardising services in order to allow meaningful price comparisons may intensify competition. Knowledge about high prices is a precondition to encouraging entry.

3.2 Investment decisions and organisational learning

Unfortunately, there is little empirical work on the benefits of information exchange due to improved coordination of investment decisions. One notable exception is Christiansen and Caves (1997) who investigate information exchange about capacity expansion in the pulp and paper industry. Noting that plenty of discussion occurs within the industry about planned investment projects they analyse the effect of these announcements on the investment rivalry, in particular the abandonment of previously announced capacity expansions. They find that if markets are not too concentrated, non-binding information exchange ("cheap talk") can help to create an environment in which more uncertain projects are likely to expire, along with those sponsored by less well-endowed firms. Solving the strategic uncertainty about the investment decisions of the rivals may therefore improve economic efficiency.

Matutes (2001) points to the beneficial effects of coordination in avoiding over-production and the costly accumulation of inventories. Novshek (1996) argues that information exchange can improve the distribution system and the marketing strategies of firms, leading to beneficial effects. Announcements about research plans and possible technological developments can lead to beneficial solutions to strategic uncertainty in research and development.

All these effects listed here have been noted in the literature but have received little formal attention, partly due to the complexities of the required formal models. As a result, the potential benefits have often been ignored in the applied literature that leads to competition policy conclusions.

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3.3 Output adjustment effects

The beneficial effect that has been most extensively discussed in the literature is the output adjustment that follows after information is exchanged. The literature up to the mid 1990s has been summarised in Kühn and Vives (1995) and the exposition below draws heavily on this report but also highlights new insights gained since this report was produced. In order to simplify the exposition we explain the effects assuming quantity competition and information exchange about common demand parameters. We then discuss how results differ under price competition and information exchange about firm specific demand parameters and cost. The primary effect of information exchange can be best understood by studying how a monopolist changes behaviour when getting access to more information. Taking into account the fact that information exchange will also benefit rivals and therefore affect the residual demand faced by firms, leads to a secondary effect, which may or may not mitigate the beneficial effect. Taking into account strategic behaviour influences the strength of this secondary effect.[2]

### 3.3.1 PRIMARY QUANTITY ADJUSTMENT EFFECT: OWN INFORMATION IMPROVES

The primary quantity adjustment effect prevails independent of the number of firms operating in the market and can be explained with reference to a monopolist. Consider first a quantity setting monopolist who takes the production decision before learning with certainty what demand is. Without information exchange output is independent of the true state of demand and prices adjust to clear the market. With information the firm produces more if demand is high and less if demand is low. Consumers benefit from information exchange because the gains from higher production in high demand states (see upper shaded area in Figure 1) more than compensates the consumers for losses if demand is low (lower shaded area).

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[2]   A number of the effects below have been shown under the assumption of constant marginal cost and linear demand.

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Figure 1: Consumer surplus effect of improved information about demand
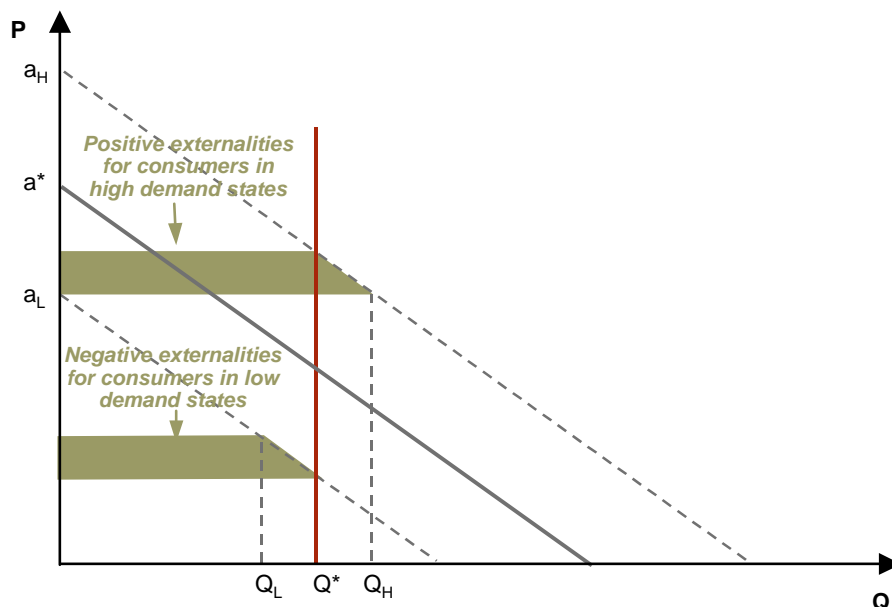
Source: Kühn and Vives 1995, p. 7

Note that the monopolist always benefits from information exchange. Indeed, the greater the uncertainty, the greater the gain from information exchange for the monopolist. Consumer surplus and welfare are higher if prices are fixed and output is variable across different states of demand.

3.3.2 SECONDARY QUANTITY ADJUSTMENT EFFECT I: RIVALS' INFORMATION IMPROVES

By analysing the effect of increasing information of a monopolist, we abstracted from the fact that in a competitive environment information exchange will, from a given firm's perspective, have two effects: first, its own information (basically leading to the effect analysed above) and, second, the information of the rivals. Moreover, with competing firms it is necessary to distinguish between firm-specific new information about (or "shocks" to) demand ("private value") or whether demand for all firms in the market is affected the same way ("common value").

In order to disentangle the different effects we first assume that firms, while having some market power, are small relative to the total market, i.e. they neglect the (minor) influence of their actions on the total output in the market (this is called "monopolistic competition").

Suppose firms set quantities and information is *industry specific*. As a result of the information exchange, the competitors will adjust their output in response to learning about a demand shock, similar to the adjustment described for the monopolist above. As a result,

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there is more output adjustment in response to the shared information, which is good for consumers.

Note, however, that this also implies that, from the point of view of a representative firm, information sharing leads to less "variable" residual demand, i.e. residual demand is less different from the original estimate, compared to a situation when the representative firm learns about the true state of demand but rivals do not. This has two effects:

- With lower variability of demand the value of the individual firm's own information is decreased.

- Moreover, the more variability of demand is reduced, the less valuable becomes the representative firm's improvement of decision making.

If products are close substitutes, the variability of the demand from the representative firm's point of view is almost zero and the loss caused by the reduced variation in demand (due to information exchange) outweighs the gains from the improved precision of the information about demand that results from the information exchange.

This may result in firms not wanting to exchange information in monopolistic quantity competition with common demand uncertainty (provided that goods are close enough substitutes). While the first effect remains, a firm benefits from the improvement of information, the fact that the rivals obtain information creates a negative externality on the representative firm.

Suppose firms set quantities and information is *firm specific*. Now sharing information increases the variability of demand from the point of view of the individual firm as before information exchange the firm's own information (or "signal") is taken as an indication of the information that the rivals received. Therefore, high own values would lead to assuming high values for the others. Thus, average output varies positively with the nature of the shock. After information sharing the average output varies less systematically with regard to the information received by the representative firm. This makes demand more variable from this firm's point of view, which leads to a positive external effect of information exchange.

More generally, the result that firms may not want to share information is crucially dependent on the fact that the uncertainty is perfectly correlated. Consider for example a multi-market setting in which each firm has superior information in a few markets, then the loss for a firm is giving up its information advantage in the markets about which it is well informed and the gain is the good information in the many other markets where others have superior information. In this setting one can find both an incentive to share information and improvements in consumer surplus and welfare (see Novshek and Thoman 1998). This finding has important implications for policy recommendations that suggest that aggregating data is competitively benign. We will return to it below.

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3.3.3 SECONDARY QUANTITY ADJUSTMENT EFFECT II: STRATEGIC INTERACTION

In industries with only a few large firms, each firm knows that they can influence market outcomes and have an impact on their competitors. This means that firms will not only act on the information about demand. They also have to consider that other firms will know about the information acquisition and change their behaviour because they anticipate that the rival's behaviour will therefore be different. Taking into account this strategic effect affects the variability of the residual demand function and thereby affect the value of the information acquired in information exchange. However, it does not change the qualitative nature of the results obtained above.

3.3.4 COMPETITION IN PRICES

If the monopolist sets prices, the primary quantity setting effect is reversed. Before information is revealed, prices will be set before all information about demand is available. Once demand is known the quantity adapts accordingly. When information is exchanged before demand is known there will be more adjustment in prices and less in quantities. Compared to the situation with low information about the true state of demand, the monopolist will produce less if demand is high (with low information prices would have been too low) and more if demand is low (with low information prices would have been too high). This leads to the opposite welfare effect than when firms set quantities and consumers would prefer no information exchange.

3.3.5 UNCERTAINTY ABOUT COST

If the uncertainty arises with regard to the monopolist's cost, price and quantity setting lead to the same result. Following information exchange a monopolist will produce more in the low cost state and produce less if costs are high. As a result, welfare increases.

3.3.6 PREFERENCE FOR VARIETY EFFECT

If products are differentiated and firms have different information about demand or common input costs, information exchange will smooth production across different varieties. This would improve the welfare of consumers that like variety and therefore lead to a positive effect on consumer welfare. This effect prevails under quantity and price setting. So it increases the beneficial effect on consumer welfare of information exchange under quantity setting and compensates (not fully) the negative effect of information exchange under price

setting. The following table summarises the effects on consumer welfare in standard static oligopoly models.[3]

Table 1: Effect on consumer welfare in standard static oligopoly models

Effect and type of uncertainty	Price competition	Quantity competition
Quantity setting effect: demand	-	+
Quantity setting effect: cost	+	+
Product variety effect: demand	+	+
Product variety effect: cost	+	+

Source: Kühn and Vives 1995; Kühn 2001; Vives 2002

3.4 Product positioning

With differentiated products or in multimarket industries the positioning of the product has important implications for consumer welfare. It is a well-known result in economic theory that without coordination competitive considerations may induce firms firms to position their products in a way that neither maximises their joint profits nor consumer welfare.[4] In many instances the product positioning that maximises joint profits is also preferable for consumers, compared to the market outcome without coordination. Experimental evidence shows that allowing communication will lead to outcomes that are much closer to joint profit maximising than without communication (Kruse and Schenk 2000). Allowing information exchange in these settings will therefore improve consumer surplus and welfare.

Note that the beneficial effects stem from increased coordination. Although firms interact non-cooperatively in setting their prices, the choice of major production decisions is coordinated.

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[3] These models do not capture collusion. We investigate potential effects of information exchange on the likelihood of collusion in Section 4.

[4] A standard example is the competitive positioning of sellers of ice-cream on a beach. Consumers and sellers would prefer if the sellers' locations are dispersed. This is not necessarily the market outcome. Consider, for example, the case of two sellers. Each seller has an incentive to position itself in the center of the beach if the rival positioned itself in the center. Without coordination both players may therefore locate in the center, which is detrimental for consumers. This reasoning can also be used for the positioning of differentiated products.

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3.5 Lowering search costs

In his seminal article on "The Economics of Information" George Stigler (1961) emphasises the importance of the search for information in economic life. Buyers need to identify sellers and their prices, investors need to detect profitable fields of investment; customers need to search for knowledge on the quality of goods. Stigler identifies the *search cost* as the causal factor for the emergence of different market institutions that improve information exchange. Stigler describes the evolution of different market institutions in order to facilitate information exchange. The emergence of markets where traders and producers sell on a centralised spot facilitate information exchange, which can benefit consumers. Revealing information about capacity shortages can guide future investment. If it is not revealed all potential investors would have to undertake initial private research in order to find out about where to allocate resources. Information exchange reduces the waste that comes with search costs. Thus, it is not surprising that the first result highlighted in an OECD research into price transparency is:

> *"As a general rule, increased price transparency will benefit buyers unless it results in considerably increased risks of collusion among sellers" (OECD 2001, p. 9).*

Unfortunately, there is little quantifiable evidence on the benefits that stem from lowering the search costs of firms and consumers.

3.6 Selecting the most efficient firms

An exchange of information will usually imply that firms with lower cost expand output and firms with higher cost reduce output. As a result inefficient firms may exit the market and more efficient firms may enter. By increasing information available to all firms, allocative efficiency is improved and consumer welfare increases.

3.7 Mitigation of the "winner's curse"

Regulators and competition authorities around the world design tendering regimes ("competition for the market") so that during the auction process information is revealed. In fact, auction design shows the trade-off between the benefits of information exchange and the increasing danger of collusion: If bidders can learn from the information of other bidders (there is a "common value"), information exchange can improve the estimate of the value of the good that is to be auctioned. If sufficient bidding competition is expected the optimal auction design entails several rounds where quantities and prices of bidders are revealed. If collusion is a concern the identities of the bidders are concealed, or, in extreme cases, information may be aggregated.

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If bidders can learn from the information of other bidders (there is a "common value"[5]), information exchange can improve the estimate of the value of the good that is to be auctioned. In most bidding situations, each bidder has some uncertainty about the true value of the items being auctioned. Bidders do not want to win by bidding "too high" or above market levels. They anticipate that if their valuation turns out to be higher than that of all other bidders (that have some knowledge about the true value of the good) they are likely to have overestimated the value. Anticipating the winners curse leads to bids below the valuation. The more uncertainty there is the bigger the negative effect. This is known as the "winner's curse effect." This leads to suboptimal auction outcomes.

Auction design therefore makes use of iterative or round-by-round bidding. This provides pricing information to bidders so they can use to bid more aggressively and closer to their true valuations without risk of over-bidding.

Evans and Mellsop (2003) investigated the beneficial effect of information exchange in such a context. They investigate information exchange among meatpacking companies in New Zealand. In meatpacking firms face considerable uncertainty about the weekly supply of livestock and about market prices for the processed product. They show that information exchange mitigates the winner's curse problem and thereby leads to efficiency gains. They also investigate why no forward market emerged, which could have resolved the information problem without recourse to information exchange. They argue that "...the transaction costs in forming such a market given the informational and locational characteristics – particularly the scattered nature of one side of the market, the need to verify quality and the costs of goods exchanged – may have outweighed the gains from trade that it would imply" (Evans and Mellsop 2003, p. 26). Thus information exchange is the best solution to resolve the winner's curse problem.

3.8 Efficient allocation of goods (to those that value them most)

One further implication of the uncertainty about the value of goods is that the goods will not necessarily be allocated to those that value it most. Given the uncertainty about the valuation of the good and the valuation of the competing bidders, bids will be shaded so much and to such varying degrees that there is no guarantee that the bidder with the highest valuation wins. This is inefficient for society.

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[5]   Loosely speaking, an item with a strong private value component is one in which one bidder's valuation of the item is not correlated with or dependent very much on the valuations other bidders have for the item. In contrast, an item with a strong common value component is one in which one bidder's valuation of the item is strongly correlated with or dependent on the valuations other bidders have.

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3.9 Policy implications

3.9.1 INCENTIVE TO EXCHANGE INFORMATION

One may question the relevance of communication leading to information exchange. On many occasions where information is verifiable it can also be gathered without communication. If it is not verifiable, it may be considered irrelevant as it is not binding or "cheap talk". There are a number of reasons why information exchange does matter, even if it is not immediately verifiable:

1. Announced plans can often be verified later and wrong announcements can be punished. In long-term relationships this may create sufficient credibility to turn cheap talk into a commitment. If information exchange is beneficial, institutions that facilitate the verification of information via "benchmarking" or the formation of trade associations that can audit and check the information reported by the members can therefore be helpful (Vives 2002).

2. One common problem in markets is that it may not be clear "what game is played". For example, in order for collusion to work, market participants need to agree on a strategy. Many game theoretic models that are used to study market behaviour rely on "common knowledge" of the strategies played by every player. Communication[6] can resolve this issue by making planned play common knowledge. This way cheap talk gains credibility because it is consistent with a situation in which no firm wishes to change behaviour given the behaviour of the rivals (Farrell 1987). The importance of non-binding communication for the sustainability of collusive outcomes has been confirmed by laboratory experiments. Communication avoids the problem of having to "signal" the adopted strategy, which may be costly. With communication it is also enough if one firm identifies the joint profit maximising behaviour and convinces the others that this is the best way to proceed (Kruse and Schenk 2000).

Another related argument, which has played an extensive role in the literature on information exchange, is that firms may not have an incentive to truthfully report information unless their objective is to collude. This view has been important for competition policy. If the firms' profits were lower when information is shared and firms continue not to coordinate, firms would not share information unless it leads to coordination. If efficiency gains for consumers are derived under the assumption that firms do not coordinate and effects for consumers are negative when firms coordinate, the observation that firms actually do exchange information can then be taken as an indication that it is only for the purpose of facilitating collusion and will therefore harm consumers. Thus, the assessment of the profitability of information exchange can have an impact on the inferences made from observing information exchange.

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6   We define communication as two-way communication, i.e. a special form of information exchange. It allows more interaction between players than pure signalling or other methods of one-way communication.

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It is noteworthy that academic research has advanced quite significantly with regard to the thinking on the private benefits of information exchange, generally with a more positive view (see Novshek and Thoman 1998; Christensen and Caves 1997, Matutes 2001, Doyle and Snyder 1999).

As we explain in Section 4 information about price and quantity data will be of greater concern to competition authorities than the exchange of aggregated information. Moreover, while the research we reported above has shown that in many theoretical instances information exchange leads to welfare improvements, this research also showed that in many of these situations it would be sufficient to exchange aggregated information and firms themselves would only wish to exchange disaggregated and individualised information in order to increase market power (ease collusion).

An influential study prepared for the European Commission argued:

> *"Indeed, it is hard to find plausible business reasons, other than collusion, that might justify the exchange of individual price and output data" (Kühn and Vives 1995, p. 115)*

This conclusion has now been found to be correct only in a very special case: it will hold if and only if the object of the uncertainty (i.e. demand shocks) are perfectly correlated, so that knowing about average demand one also knows about all the relevant private information. However, in most industries different firms will know better about different aspects of the market. By aggregating information important content is lost. As a result firms have a non-collusive incentive to share information.

This result is based on Novshek and Thoman (1998), who analyse a model in which firms sell the same product in a number of independent regions and do not coordinate. As is to be expected, they find that disaggregation of information into regions is desirable. But even within a region when the precision of information varies across firms, the average does not provide sufficient information and the information (or "signals") need to be weighted according to their precision:

> *"This means that if information is shared as a list of the members' signals, then an anonymous list is inferior to a non-anonymous list, since firms do not know the weight to attach to a signal without knowing who received the signal [...] Any other information exchange mechanism (no sharing, or anonymous disaggregated sharing, or aggregated sharing, either as an overall average or as market-by-market averages) provides less precise information to firms and is inferior in consumers' and total surplus" (Novshek and Thoman, 1998, p. 332).*

Information exchange not only allows actors to take meaningful unilateral decisions as explained above. It also allows producers to resolve coordination problems that would otherwise lead to under-investment or other forms of market failure (see Section 3.2 and 3.4).

Trade associations are created to help information exchange. They gather and disseminate information on prices, quantities, investment and closure decisions (capacity), employment

figures, wages, and product standards. This is to facilitate information exchange between firms in the respective industry and to improve communication with regulators, government and customers.

3.9.2 UNCERTAIN ASSUMPTIONS

The non-cooperative effects of information exchange often depend on whether firms set quantities/capacities (so that prices adjust) or set prices (so that quantities adjust). It has been argued that, first, it is difficult to identify the nature of competition and, second, that when effects of information exchange are positive for consumers (Cournot competition) firms may not have an incentive to exchange information. This has been used to argue for a strict anti information exchange policy (Kühn 2001). The second point is put into context by the findings of Novshek and Thomas, reported in the previous section, which show that there may well be an incentive to share information under Cournot competition.

On the issue of identifying the nature of competition there are differing views. One view is that it is impossible to identify the nature of competition: "Generally, it is not observable whether firms compete in prices or quantities and it is certainly not verifiable in court" (Kühn 2001, p. 190). Another view is that by assuming competition in quantities one can establish a "worst-case scenario" for consumers: "The Cournot outcome emerges in a range of circumstances as an upper bound to the exercise of static market power" (Vives 2002, p. 362). Yet another view is that Cournot competition can be seen as a longer run view on market behaviour as it is a way of modelling investment decisions in capacity and ensuing price competition (Kreps and Scheinkman 1983). This would lead to a distinction of a long-run perception (quantity) and a short-run perspective (price). Finally, it can be argued that one can identify the nature of competition by carefully studying the market in question.

Similar uncertainties may prevail with regard to the exact nature of the uncertainties, which could be reduced by information exchange.

3.9.3 THE TYPE OF INFORMATION

Doyle and Snyder (1999) argue that there is a strong complementarity between the planned production announcement of one firm and the future announcements of rivals in the motor vehicles industry. This may indicate that the competitors shared demand information in this way and may be an efficiency enhancing mechanism if product differentiation is high or marginal cost increases given capacity constraints.

3.10 Potential benefits: conclusions

Recent economic literature has identified various ways in which information exchange enhances welfare. There are potentially large efficiency benefits of information exchange (Vives, 2003).

The theoretical work, however, has focussed on static models, which ignore the dynamic benefits of information exchange. One key problem of this work is the lack of modelling of the dynamic benefits and the failure to model the variety of effects discussed above in an integrated model. Static models do not show the dynamic process that leads to the equilibrium. Experimental evidence has shown that information exchange can be very valuable for this process without leading to collusion.

Finally, information exchange may not only lead to efficiencies without coordination but may resolve coordination problems to the benefit of society. There are many circumstances in which such coordination (which is also "collusion") is positive.

The literature has focussed on information exchange with regard to demand or cost. With this information and knowledge about the nature of strategic interaction it is then possible to determine the rivals' choice of quantities and prices. Exchanging price and supply data is only seen as useful to the extent it improves predictions of future demand or future costs.

4 Potential economic concerns

One of the main competition concerns is that information exchange may facilitate collusion. For the analysis of collusive oligopoly, three aspects are of particular significance:

1. Collusion represents a deviation from firms' short-term profit-maximising strategy. Hence, given the behaviour of its rivals, each firm has an incentive to undercut its competitors.

2. From (1) it follows that collusion can only be maintained if the long-term profits from collusion for each firm are higher than the profits from deviating from the collusive price level, which would be followed by 'punishment' by the other firms.

3. The incentive to cheat on the other firms is larger if the market conditions do not allow firms to observe if their competitors deviate from the collusive behaviour. In such non-transparent markets, collusion usually cannot be maintained.

It follows that information exchange may help collusion if it

(A) Facilitates a common understanding on the terms of coordination.

(B) Helps the coordinating firms in monitoring whether the terms of coordination are being followed.

(C) Improves the ability or reduces the cost of punishing a deviator.

Note that for collusion to occur, all elements (agreement, monitoring, punishment) must be fulfilled. The three elements are necessary but not sufficient conditions for collusion. We discuss each point in turn.

4.1 Facilitation of coordination

This concern refers to the exchange of information on future plans. Relevant examples are the exchange of information on geographic markets one intends to cover, planned sales, future prices and the capacities one intends to build. Information exchange may also be used to agree on rules, which facilitate the detection of "cheating". For example, firms can communicate about business practices and agree that all firms publish their prices and do not give discounts. This coordination would facilitate the monitoring function.[7]

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[7] See Genesove and Mullin (2001) for a detailed description for how communication may help coordinating and resolving the monitoring problem.

Potential economic concerns

Thus, it seems that, quite generally, information exchange that concerns *future* plans regarding prices, sales, and capacities tends to facilitate coordination. Information about future demand or cost seems to be of less importance unless it is combined with information about prices, sales and capacities or allows others to infer that information.

However, information on the present or the recent past may also help coordination. If for example a market leader regularly publishes prices, this may serve as the focal point for the colluding firms to follow.

One way to address concerns about the improved ability to coordinate is to aggregate (anonymise) the data. If this method is effective (i.e. individual operators cannot be inferred), the ability to reach an agreement will usually be significantly impaired. For example it will be much less clear how a fair division of profits can be agreed if it is not known what the cost and demand situation in different localised markets are.[8]

The assessment of whether private or public information exchange facilitates coordination more depends on the intent of the inquiry. There are two opposing effects: on the one hand the publication of prices and sales data can simplify the information transmission process. On the other hand, if a private information exchange network is not too costly, it has the advantage that it will be much more difficult for other market participants or competition authorities to detect and prove the collusive behaviour. Thus, while from an ex post point of view the finding of a private information network may be a strong indication of collusive behaviour, it does not follow that competition authorities should therefore ex ante be more open to public information. The key point to investigate is whether public information would facilitate the information transmission, which would otherwise be prohibitively costly. If not, public information should be preferred from the point of view of competition authorities.

A famous example for the collusion facilitating effect of information disclosure is the Danish ready-mixed concrete case. In 1993 the Danish Competition Council decided to gather and regularly publish actual transaction prices set by individual firms. In the following years price dispersion between firms decreased and the average price level increased significantly. An academic study found that the information exchange facilitated collusion (Albaek et al. 1997).

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[8] However, Genesove and Mullin (2001) also point out that anonymising data may increase the incentive for firms to participate.

Potential economic concerns

Table 2: Information exchange that may facilitate coordination

Category	Type and characteristic of information exchange
Type	Prices, sales, capacities
Time period	Future, recent past
Aggregation	Disaggregated (individualised)
Availability	Private and public

Source: CRA

4.2 Detection of cheating

This concern refers to the exchange of information on *past* behaviour. Because of the incentive of each individual colluding party to undercut and free-ride on the high price charged by the others, one of the most difficult problems for the colluding parties is to detect secret price cuts or secret sales in addition to the collusive quantities or quotas.

Information about prices and quantities charged by the colluding firms in the past is essential for monitoring deviations. Exchange of information on cost, capacity and demand data on previous periods is usually less informative for detecting deviations from the collusive behaviour. Indeed, as we will point out below, there are considerable benefits to sharing this information as knowledge spillovers disseminate information and therefore economic progress in the market.   Trade associations and consultancy firms that do benchmarking studies commonly provide this kind of information.

In practice the requirements for effective monitoring can be quite extreme as many contractual terms could mask a price cut. This can be shown by the number of activities that were not allowed by the Sugar Institute or subject to strong disclosure rules in order to monitor adherence to the collusive behaviour in the sugar industry (Genesove and Mullin 2001):

- Discounts for water-damaged or frozen sugar;

- Favourable credit terms for customers;

- Better warehouse storage rates for customers;

- Storage services through delayed delivery;

- Favourable freight rates.

Despite these wide ranging agreements conflicts regularly arose and required resolution. The managers met once a week and discussed whether certain incidences were to be judged as deviations or not. They also used these meetings to agree on retaliatory behaviour if one member of the colluding firms has been found cheating.

Potential economic concerns

Thus, although economic models usually work with simplified models that require information about "the" prices and "the" quantities, in practice effective monitoring is much more challenging.

Another requirement is that the cheating can be detected sufficiently fast, in order to limit the gains from cheating. Thus, revealing prices that refer to the distant past may not be useful. The specific critical time period depends on the frequency of sales and the time horizon of the industry managers.

In order for collusive strategies to work it is often important to identify the prices and quantities of individual firms. An example is the Fatty Acids case (1986). The industry was dominated by three large firms and a large fringe of about 40 small producers. The industry operated with an information exchange agreement with the trade association distributing aggregate industry data. In 1979 the market leader initiated contacts with the other two large producers which led to an information exchange agreement among these producers which covered firm data on yearly sales and future four-monthly reports about total sales. This information was used to discriminate the competitive strategies: customer switches between the three main competitors were labelled "stolen sales", gains of new customers "legitimate gains". It has been argued that the existence of an individualised information exchange programme is easier to prove than collusion and therefore this type of information exchange should be disallowed (see Kühn 2001).

This example shows that competition concerns can be effectively addressed by aggregating (anonymising) the data. If this method is effective, individual operators can cheat under the shelter of total demand. Moreover, a two pronged strategy that discriminates between competitors becomes much more difficult.

Making the information accessible to all market participants would have revealed the strategy of the three dominant producers in the example above. In other cases it may just simplify the information exchange.

Thus, it is not possible to provide a general statement regarding the competitive assessment of private vs. public information.

Potential economic concerns

Table 3: Information exchange that may help detect cheating

Category	Type and characteristic of information exchange
Type	Prices, sales
Time period	(Recent) past or present
Aggregation	Disaggregated (individualised)
Availability	Private and public

Source: CRA

4.3 Ability to punish and cost of punishment

Information exchange about future and past prices and quantities may affect the ability and the cost of punishment. For example, if in a scheduled transport service collusion builds on a market sharing agreement, the announcement of a new schedule that would not be in line with the collusive arrangement could trigger a punishment response even before market entry (e.g. a price cut), this can make punishment very effective and therefore help stabilising a collusive arrangement. Information exchange may also help targeting the punishment schemes. In localised markets punishment can be targeted against the cheating party if sufficient information exists to determine who has cheated. This reduces the cost of punishing a "cheater" and so makes the threat of punishment more credible.

In passenger transport services it is often not possible to avoid publication of schedules and tariffs. However, where individual contracts are made (as in liner shipping, parcel services, etc.) it is possible to reduce the scope for anti-competitive effects of information exchange by aggregating and anonymising the data by a trade association. Transport services may also involve networks of routes (even within the same relevant market) making any disaggregated information exchange necessary for potential punishment of cheating difficult. This would alleviate the concern that information exchange may improve the ability or reduce the cost of punishment.

The arguments regarding the publication of information and the effect on punishment are the same as with regard to the role of public versus private information in the agreement and detection of collusion. The key point to investigate is whether public information would facilitate the information transmission, which would otherwise be prohibitively costly. If not, public information should be preferred from the point of view of competition authorities.

Potential economic concerns

Table 4: Information exchange that may improve the ability or reduce the cost of punishment

Category	Type and characteristic of information exchange
Type	Prices, sales
Time period	(Recent) past or future
Aggregation	Disaggregated (individualised)
Availability	Private and public

Source: CRA

4.4 Alternative behavioural assumptions and experimental evidence

Publication of data at the individual firm level may increase the competitiveness of a market if firms do not choose a best reply but imitate successful behaviour of rivals (Vega-Redondo 1997). Clearly, information exchange about competitors' actions and profits is a precondition for such beneficial learning.

Consider an example where firms set quantities and goods are homogenous. If the price is above marginal cost, the firm with the largest quantity has the highest profit. But then the rivals will imitate its quantity. Thus, total quantity increases and prices fall. If the price is below marginal cost, the firm with the lowest quantity has the highest profit. Thus, quantities approach the competitive outcome if information is exchanged.

Empirical evidence in the form of experimental evidence does not support the general intuition derived in standard models of industrial organisation but seems to resemble more the imitation results obtained by Vega-Redondo. Huck, Normann and Oechssler conducted a series of experiments to investigate the influence of information about rivals' actions and profits on the competitiveness of oligopolistic markets. They study symmetric four firm oligopolies with product differentiation. Subjects either receive aggregate information about the opponent's actions or information about individual actions and profits of their rivals. They report:

> *"In neither strategic setting we find evidence for the hypothesis that additional information facilitates collusive behaviour. In the case of strategic substitutes (quantity competition) it renders market outcomes significantly more competitive. Also in the case of strategic complements (price competition) it makes market outcomes more competitive, if however not significantly so" (Huck et al 2000, p. 52).*

Potential economic concerns

4.5 Potential competition concerns: conclusions

Effective collusion requires that the colluding parties are able to agree a collusive strategy (potentially without communication), can monitor the behaviour of the other colluding firms and in response to cheating can trigger a change in behaviour that has a deterrent effect that is large enough to remove the incentive to cheat. Each of these three conditions is necessary but not sufficient.

The analysis above shows that competition concerns arise mostly with regard to the exchange of past individual price and sales data and with regard to the announcement of future individual firm's plans, which could lead to an effective early punishment scheme.

The exchange of information about future and past demand is of no concern if evaluated in isolation. There is a policy concern only if information about past demand helps in determining the (unobservable) prices from sales, or if information about demand can be used to design more sophisticated collusive strategies. In many instances there are effective ways of addressing the competition concerns by aggregating and anonymising information. One important requirement for collusion, the detection of who is cheating, will then be more difficult.

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