

**Information sharing among firms**

Firms may have efficiency or strategic incentives to share information about current and past behaviour or intended future conduct. This article examines those incentives and the welfare consequences from the perspective of static oligopoly and monopolistic competition models. It concludes with a review of the available evidence.

Information sharing (IS) among firms has been a contentious topic in antitrust and has received substantial attention from researchers. Firms may share information about current and past behaviour of, for example, customers, orders and prices, as well as cost and demand conditions. This type of information exchange typically involves hard or verifiable information. Firms may also exchange information about intended future conduct – for example, planned prices, production, new products or capacity expansion. This typically involves soft information. Firms may have incentives to share information for efficiency or strategic reasons. The latter include influencing the behavior of rivals or sustaining collusion. We will discuss here the results of static models, leaving out dynamic models of collusion and information signaling (see for those models Vives, 1999, sects. 8.4, 8.5 and 9.1.5; Kühn and Vives, 1995, sect. 8).

Firms may exchange cost or demand information in order to better adapt their output and pricing decisions to uncertainty. From the firm's point of view, the main effects of IS are the increased precision of information to be used by itself and rivals, and the corresponding impact on firms' strategies. In general, increased precision has a positive effect on a firm's expected profits, while the effect of increased precision of rivals and the induced strategy correlation depends on the nature of competition and shocks.

Information exchange is typically modelled as a two-stage game in which firms first unilaterally decide whether to reveal their signals, and then, after receiving those

signals and possibly revealing them, compete *à la* Cournot or Bertrand. It is assumed that firms report their signals truthfully if they decide to share information. The workhorse model has quadratic payoffs and normal distributions (or distributions yielding linear conditional expectations) for signals and uncertain parameters such as demand intercepts and marginal costs. The assumptions yield linear equilibria at the second stage and explicitly computable payoffs. (See Vives, 1999, sect. 8.3.1, and Kühn and Vives, 1995, sects 2–5.) A sample of the literature is Novshek and Sonnenschein (1982), Clarke (1983), Vives (1984), Fried (1984), Gal-Or (1985; 1986), Li (1985), Sakai (1985), Shapiro (1986), Kirby (1988), Sakai and Yamato (1989), Raith (1996), and the extensions in Malueg and Tsutsui (1996; 1998). In the subgame-perfect equilibria of the two-stage game (excepting Bertrand competition with cost uncertainty) unilaterally revealing information is a dominant strategy with independent values, private values (that is, where each firm receives a signal with no noise about its payoff-relevant parameter), or common values with strategic complements. With common value and strategic substitutes, not revealing is a dominant strategy.

If firms are able to enter into industry-wide agreements, the determining factor is whether the information pooling situation increases or reduces expected profits. With the exception of Bertrand competition under cost uncertainty, expected profits with IS are always larger than without, under independent values, private values, and common value and strategic complements. With common value and strategic substitutes (for example, Cournot with substitutes), IS yields higher (lower) expected profits for a high (low) degree of product differentiation or steeply (slowly) rising marginal costs. Note that since IS often raises profits under one-shot interaction, IS cannot be taken as *prima facie* evidence of collusion.

IS agreements are usually mediated by trade associations that typically disclose an aggregate statistic of firms' private signals. Monopolistic competition, where no firm has a significant impact on aggregate market outcomes, is suitable for examining the role of such associations' disclosure rules. A firm first decides whether or not to join the association and reveal its private information. Under non-exclusionary disclosure, information is made available to everyone in the market; under exclusionary disclosure, it is provided to members only. Obviously, with a non-exclusionary disclosure rule, IS

will not ensue if the sharing is costly (by not joining, a firm, being negligible in terms of aggregate market impact, can free ride and obtain market information costlessly, with no effect on market aggregates). With an exclusionary disclosure rule, IS may occur if the membership fee is not too high (see Vives, 1990).

The impact of IS on consumer surplus and total surplus depends on the type of competition and uncertainty, and on the number of firms. Three effects operate: output adjustment to information, output uniformity across varieties (given consumer preference for variety), and selection among firms of different efficiencies. IS may allow firms to better adjust to demand and/or costs shocks (output adjustment effect). This will tend to improve welfare except if the firm is a price setter and demand is uncertain. In this case, more information will give the firm greater scope to extract consumer surplus – an insight already valid for a monopolist. In monopolistic competition, where variety must be taken into account, IS tends to make the outputs of varieties more similar with common value uncertainty and less so with private value uncertainty, thus increasing (decreasing) expected total surplus under demand uncertainty and Cournot (Bertrand) competition (Vives, 1990).

Analysis of the oligopoly case is complex, but several generalizations hold. Under demand uncertainty and Cournot competition, IS increases expected total surplus (ETS); under demand uncertainty and Bertrand competition, it decreases consumer surplus (as well as ETS, under monopolistic competition). With common values, IS always increases ETS, except under price competition, when goods are poor substitutes and/or there are many firms. (See Kühn and Vives, 1995, sect. 5.2, and Vives, 1999, sect. 8.3.3.) There are potentially large efficiency benefits from information exchange. For example, the production rationalization effect of cost information exchange under Cournot can be very large and is of a larger order of magnitude than the market power effect (Vives, 2002).

What happens when there is no trade association to provide a mechanism to share information truthfully? Assume private cost information that is exchangeable only at an interim stage, once each firm learns its own cost but does not know its rivals'. In this case, if information is not verifiable and there are no other signalling possibilities, information revelation is impossible, since all firms would like to be perceived as being low-cost. With verifiable information, full revelation ensues if disclosure is costless and it is known

whether firms have information (Okuno-Fujiwara, Postlewaite and Suzumura, 1990; Van Zandt and Vives, 2006). The lowest-cost firm will reveal its type and then all other types will unravel. Information could also be revealed through costly signalling in the form of wasteful advertising (for example, Ziv, 1993), or via dynamic competition in which production levels are observable (Mailath, 1989) or with sales reports (Jin, 1994). In the latter case, sharing sales reports eliminates the incentive to misrepresent and changes the consequences of IS. If it is possible to verify information but not whether the firm is informed, then the unravelling result need not hold, and firms can selectively disclose acquired information (Jansen, 2005).

Evidence on the effect of IS among firms is scant. Genesove and Mullin (1999) study information exchange in the Sugar Institute and find no misreporting, but some information withholding, suggesting that information can be verified. Doyle and Snyder (1999) study production plans announcements in the trade press in the automobile industry and find that a firm's announcement affects competitors' responses. Announcements of increased production are met by upward adjustments in production, which they interpret as consistent with announcements signalling a common demand parameter. Christensen and Caves (1997) study capacity announcements in the pulp and paper industry and find that unexpected announcements by rivals promote project abandonment in sub-industries with low concentration levels (and the opposite in concentrated sub-industries), which results they compare with IS models of cost information. Armantier and Richard (2003) examine exchange of cost information in the multi-market context of the airline industry. The authors account for entry decisions in a Cournot setting with complementary goods across markets, and simulate a hypothetical agreement to share cost information by American Airlines and United Airlines at Chicago O'Hare airport. They find that IS would improve airline profitability and moderately harm consumers (although, theoretically, cost IS need not necessarily hurt consumers in such a situation). The experimental results in Cason (1994) suggest that pricing behaviour is influenced by IS decisions. Ackert, Church and Sankar (2000) find that in a Cournot game with cost uncertainty, where it cannot be verified whether a firm has received information, when a firm receives information about industry-wide cost unfavourable information is disclosed but favourable information is withheld. Contrary to

theory, when information is about a cost-specific shock, disclosure is not affected by the favourableness of information.

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