

**MARKETING INFORMATION:  
A COMPETITIVE ANALYSIS**

**by**

**M. SARVARY\***

**AND**

**P. PARKER\*\***

**95/51/MKT**

\* PhD candidate, at INSEAD, Boulevard de Constance, Fontainebleau 77305 Cedex, France.

\*\* Associate Professor of Marketing, at INSEAD, Boulevard de Constance, Fontainebleau 77305 Cedex, France.

A working paper in the INSEAD Working Paper Series is intended as a means whereby a faculty researcher's thoughts and findings may be communicated to interested readers. The paper should be considered preliminary in nature and may require revision.

Printed at INSEAD, Fontainebleau, France

# Marketing Information: A Competitive Analysis

Miklos Sarvary and Philip M. Parker<sup>1</sup>

December, 1994

<sup>1</sup>Miklos Sarvary is a Ph.D candidate and Philip M. Parker is Associate Professor at INSEAD, Boulevard de Constance 77305 Fontainebleau, France. Tel: (33-1) 60 72 40 00. The authors would like to thank Luis Almeida Costa, Michael Kende, Rajiv Lal, Patrick Rey, Rafael Rob, Pedro Santa-Clara Gomes, Bernard Sinclair-Desgagné and the participants of the INSEAD business-economics seminar series for their helpful comments on earlier drafts. All remaining errors are ours.

# Marketing Information: A Competitive Analysis

## Abstract

In this paper we propose a simple framework to investigate market structures when the marketed product is information. In markets of “information products,” consumer acquisition strategies have to take into account the relations (perceived correlations) among the products sold by the different information sellers, as well as their perceived reliability in order to find the optimal number of products they wish to buy. Our paper shows that these externalities lead to interesting forms of competition. In particular, we show that under reasonable conditions a “producer” is better off facing competition than being a monopolist, and collusion in price among information sellers can increase consumer surplus as well as profits.

**(Information sales; Competitive Strategy; Complements; Substitutes)**

..[the new statistical system designed for the Information Age].. would consist of three economic sectors: goods-producing, services and information.”

“The Spawning of a Third Sector: Information,” *Business Week*, November 7, 1994, p. 48.

## 1 Introduction

In most countries the services sector has shown a rapid and stable growth over the last few decades. It is not surprising, therefore, that the marketing literature is rich in publications on the services industry (see, for example, Lovelock 1984, Zeithaml, et. al. 1990, Congram and Friedman 1991, and Palmer 1994). We tend to treat this industry as a homogeneous sector, although often this is not justified. In a recent issue, *Business Week* argues, for example, that “... with the dawn of the Information Economy, the traditional split [between goods and services] does not make sense.” The article proposes to take a new sector into consideration: information.<sup>1</sup>

Information products can take on a variety of forms: industry reports, consulting services, educational programs, and professional opinions given by medical, engineering, accounting/financial, and legal professionals, among others. The term “information product” is rarely used in the above sense in the literature. In a recent paper, Waterman (1990), for example, uses it to categorize products such as television programs, computer programs and media. In contrast, our definition follows Jensen (1991, p. 424), by referring to information that is valuable for making decision(s), e.g. expert advice. In what follows, it is more appropriate to think of a consumer who buys newspaper(s) to find information before making a decision than of someone who buys the same paper every day for distraction or entertainment. Jensen (1981) reports detailed statistics on *this* industry (see Table 1) for the period 1982-1988. The table shows that this \$17.7 billion industry is especially relevant for marketing where most of the revenues are generated.<sup>2</sup>

---

<sup>1</sup>Using a broad definition for information products, the United States Department of Commerce has recently estimated that professional fees for information-oriented products and services reached over \$375 billion in 1993. (From the U.S. Industrial Outlook 1993, United States Department of Commerce, International Trade Administration, p. 42-1, 54-1.

<sup>2</sup>Following Jensen’s definition, the information services industry includes services such

## INSERT TABLE 1 ABOUT HERE

Despite the dynamic development of the “information industry” there is relatively little academic work devoted to the subject. In this paper, we would like to propose a simple game-theoretic framework to address some, mostly competition-related, issues in information markets. Our main insight is that information products face unique competitive structures. In particular, competitive structures vary across the different regions of the perceived product-attribute space. Namely, under some conditions information products are substitutes whereas under others the same products act as complements, leading firms to follow different marketing strategies. We see the most important contributions of the paper in the following. First, we propose a first attempt to model “information markets” in a marketing context. Second, our results shed some light on a number of observed marketing strategies, including the likely fee structures for competing consultants, the benefits of sharing market-information with competitors, and possible dangers in product manufacturers setting up parallel consulting firms which serve the same industry (e.g. IBM Consulting Services). Finally, and most importantly we hope to provide managers and industry regulators with normative guidelines, especially with respect to competitive issues. Many times information is only one aspect of the product/service offered. Our model has to abstract away from other important factors, that are crucial for the understanding of observed market outcomes. As this is an early attempt to characterize such markets the implications of our model - as of most theoretical models - have to be seen with prudence.

In the next section, we provide a brief overview of the related literature and discuss how our approach departs from existing work. The third section describes the basic model characterizing consumer behavior and the product space. This is followed by an evaluation of equilibria for different situations characterizing the market. In the fourth section we briefly explore the extension of the model to a two stage game and discuss potential limitations. The

---

as Dun & Bradstreet Business Information Reports, F. W. Dodge Construction Project News, IMS International Sales Territory Reports and Consumer Reports among others. In 1988, the U.S. information services industry included some 1,500 companies (Jensen 1991).

fifth section presents some illustrations and discusses practical implications. The paper ends with a general conclusion and outlines possible extensions.

## 2 Related literature

An important stream of information economics has been mainly concerned with the effects of information asymmetries on market outcomes due to opportunistic behavior of the economic agents (see, for example, Akerlof 1970, Spence 1973, Rothschild and Stiglitz 1976, Grossmann and Hart 1983, Kreps and Wilson 1982 in economics and Basu, et. al. 1985, Lal 1990, Chu 1992, Padmanabhan and Rao 1993 in marketing).<sup>3</sup> Rather than concentrate on asymmetric information in this traditional sense, in this paper we seek to describe special aspects of markets where the marketed product is information. Information asymmetry exists to the extent that sellers hold tradeable information of value to consumers.<sup>4</sup>

Information trade in the sense used in this paper has been widely discussed in finance in the context of asset markets. In a classic paper, Grossman and Stiglitz (1980) argue that in the full revelation Rational Expectations Equilibrium (REE) model information is a public good with no private value. In a noisy rational expectations equilibrium, however, producers of costly private information can recover their costs through asset trade. In an experimental setting, Sunder (1992) shows that asset and information markets converge to the predictions of the noisy REE model. His paper is very important as it shows that even in “informative” markets with a constant supply of information (where in equilibrium traders should not rely on privately produced information) it takes time for unexperienced traders to learn to extract information from market variables. During this learning phase, traders rely on external information (i.e. information products). In markets where the price of information is fixed, no equilibrium can be reached and the information

---

<sup>3</sup>An excellent summary of the key information-related issues in the services context can be found in Holmstrom (1985).

<sup>4</sup>An interesting recent paper by Wolinsky (1993) looks at competition in a market for services offered by informed experts who also *diagnose* how serious the consumer’s problem is. His paper, however, also focuses on opportunistic behavior when the expert has an incentive to overstate the seriousness of the problem.

market remains always functional. These experimental results suggest an inherent relevance of information products in the context of industrial organization, where transactions are much less frequent than in asset markets, therefore, it takes longer - if ever - for information to become a public good. More recent work on information trade in financial markets includes important papers by Admati and Pfleiderer (1986, 1988, 1990), who study optimal selling strategies of a monopolist selling private information to traders who partially reveal the obtained information through their actions.

We depart from existing work related to information markets in two ways. First, we do not concentrate on financial markets where information revelation, ("information leakage") is the main issue. Second, the main focus of our paper is on modelling the *competition* between information suppliers. In particular, we are interested in how the properties and interdependencies (*consumption externalities*) of information products affect competitive structures. The intuition behind our model is that consumers facing important decisions may find it beneficial to consult several information sources when the reliability of information is low and/or sources of information are independent. In other words, higher correlations between information sources make information products substitutes. Uncertainty and independence among information sources, however, make them complements. Our paper is, therefore, related to the literature on substitutes and complements (see for example the paper by Matutes and Regibeau (1988) on product compatibility).

What makes information different from other goods and services is that these later are either substitutes or complements in the relevant product-attribute space, whereas information products can be one or the other depending on their position within the *same* attribute space. This space is defined by the basic characteristics of information products, namely their perceived reliabilities and similarity. The above characteristics of the product space lead to unique forms of competition among information suppliers. In particular, when information products are substitutes, competition between information suppliers is more intense than in the situation when products are complements. In fact, we show that under reasonable conditions a "producer" is better off facing competition than being a monopolist. We also find that in some situations collusion in price among information providers increases rather than decreases consumer welfare. These findings are consistent with

the general theory on substitutes and complements and may explain, in part, why some professional service providers are not adversely affected by direct competition (e.g. two consultants in the same town), and why professional fees may appear to extract higher than normal rents for the information provided.

### **3 The model**

To illustrate the model we will use the example of competing consulting companies (firms) and their clients (consumers). This illustration is analogous to a variety of other situations such as the competition between cardiologists providing medical diagnosis, lawyers giving legal advice, or stock brokers giving buy/sell recommendations. One activity of consultants or specialists in a specific industry is to sell customized reports on the status of the industry and its future prospects. Firms that belong to the industry buy the report(s) and use them when planning their business strategies. We will assume that in the “relevant” time span the acquired information is not revealed in the actions of consumers and that resale of the reports can not occur among consumers. It is not rare in practice that a firm buys and compares several reports, each from different consultants, to get a better picture of the industry. The number of reports that the client buys depends on the perceived reliability of each report (e.g. its perceived quality) as well as on their perceived similarity (e.g. their perceived substitutability). Knowing these perceptions, consultants optimally price their reports. The game between the two firms and consumers is modeled as a simultaneous, one-shot game, where firms choose prices (or output) and consumers choose the number of reports they purchase. In this simultaneous game perceptions are exogenous and fixed. Later we will discuss the case of a two-stage game where first, firms choose their positions in the perceptual space and in the second stage, the simultaneous game is played given these positions.

#### **3.1 The players and the product space**

##### **3.1.1 Firms**

Assume that the duopoly consists of two consultants selling reports. They have similar cost structures and for simplicity we assume that the marginal,

as well as fixed cost of producing a report are 0. In section 4 we will explore the implications of relaxing this assumption. We also assume that entry in the industry is not possible.

Suppose further that the information content of consultant  $i$ 's report consists of a number,  $x_i$ , that can be thought of as the predicted dollar value of total business opportunities in the industry. We assume that  $x_i$  is a random draw from a normal distribution with mean  $m$ , the true value of business opportunities and variance  $\sigma_i^2$ , which represents the inverse of the "reliability" of firm  $i$ 's report. The reports issued by different firms do not have to be independent and we suppose that the  $x_i$ -s are correlated with correlation coefficient  $\rho$ .<sup>5</sup> The value of  $m$  is unknown to all players but the  $\sigma_i^2$ -s and  $\rho$  are common knowledge. Thus, the product space can be described with a bivariate normal distribution with mean vector  $(m, m)$  and covariance matrix

$$\Xi = \begin{pmatrix} \sigma_1^2 & \sigma_1\sigma_2\rho \\ \sigma_2\sigma_1\rho & \sigma_2^2 \end{pmatrix},$$

where all parameters are exogenous.

### 3.1.2 Consumers

Suppose that consumers have different propensity to acquire information about  $m$ , measured by the taste parameter  $\theta$ . Thus,  $\theta$  refers to the consumer's "type" and it is private information. Conceptually, it can be thought of as the utility that a particular consumer gets for knowing the *true value* of  $m$ .<sup>6</sup> We assume that  $\theta$  is known to be distributed across consumers between 0 and 1 according to the cumulative density function  $\mathcal{F}$ . Thus, there is a continuum of consumers and without loss of generality we normalize their total number to 1.

---

<sup>5</sup>Positive correlation of expert opinion is supported by empirical evidence. It can result from the fact that experts share some information sources or that they have similar priors due to common education, for instance. Negative correlation is unlikely but theoretically possible.

<sup>6</sup>Consumers with high  $\theta$  values may be seen as "information seekers," although this term is used to describe a more complex concept in the consumer behavior literature (see Bearden, Netemeyer and Teel, 1989 and Thorelli and Becker, 1980 for references).

Consumers can choose to buy 0, 1 or 2 reports. If the consumer buys one report, say from firm  $i$ , her estimate for  $m$  will be  $x_i$  with sample variance  $\sigma_i^2$ . Upon buying two reports the consumer weights their content with their corresponding reliabilities<sup>7</sup>, therefore, her estimate of  $m$  will be  $\bar{x}$  with variance  $\Sigma^2$ , where

$$\bar{x} = \frac{x_1/\sigma_1^2 + x_2/\sigma_2^2}{1/\sigma_1^2 + 1/\sigma_2^2}$$

and

$$\Sigma^2 = \frac{\sigma_1^2\sigma_2^2}{(\sigma_1^2 + \sigma_2^2)^2}(\sigma_1^2 + \sigma_2^2 + 2\sigma_1\sigma_2\rho).$$

The distribution of the estimation error, ( $y = x_i - m$ , if one report is bought and  $y = \bar{x} - m$ , if two reports are bought) is also normal with mean 0 and the variance of the estimators. We assume that consumers have a quadratic loss function,  $\mathcal{L}(y) = y^2$ . Then, the expected loss of a consumer buying  $n$  reports ( $n = 1, 2$ ) is:

$$E_n\mathcal{L} = \int_{-\infty}^{\infty} y^2 f_n(y) dy$$

where  $f_n(y)$  is the density function of  $y$ . It follows that the expected loss of a consumer is equal to the value of the variance of the estimator. We assume that the *ex ante* valuation for information is separable and linear in the basic valuation for knowing  $m$  and the anticipated loss of the consumer. Thus we define the expected utility of a consumer with type  $\theta$  by:

$$\mathcal{U} = a\theta - bE_n\mathcal{L}.$$

The first term,  $a\theta$  can be thought of as the expected value of perfect information. Parameter  $b$ , in the second term, is a coefficient of risk aversion that

---

<sup>7</sup>The literature on expert resolution suggests several possible weighting schemes to combine overlapping expert opinion (see, for example Winkler 1981, Makridakis and Winkler 1983, Ashton 1986, Clemen 1987, Gupta and Wilton 1987, Morrison and Schmittlein 1989, Schmittlein et. al. 1990). A good review can be found in Clemen (1989). In addition to the above weights we have also tried several other weighting schemes, including simple average, weighting by the inverse of the standard deviations and the weights suggested by Winkler (1981) which take into account the dependence of the reports. The results are virtually equivalent to the ones presented below.

we assume to be constant across consumers. In the following discussion we will set  $a$  and  $b$  equal to 1 to simplify the analysis.<sup>8</sup>

Four additional comments should be made about the utility function defined above. First, utility does not depend on the content of the reports. As mentioned before, consumers do not know this value before making the purchase decision, so their *ex ante* utility for the information should not depend on it. Second, the separable form is adopted for mathematical tractability and is similar to that used in the literature on network externalities (see Katz and Shapiro 1985). A second paper (available upon request) develops a model based on a non-separable utility function, similar to the one used in the vertical differentiation literature (see Tirole 1992, Chapter 2). There,  $\theta$  is defined as the consumer's willingness to pay for the quality of the purchased information. Although the equilibrium conditions are different, the implications of that model are similar to the ones presented here. Third, the utility function together with the assumption on the distribution of  $\theta$  provides a natural limit to  $\sigma_i^2$ , above which it is not reasonable to believe that the information market will develop (if  $\sigma_i^2 > 1$  then a single report gives negative utility to *all* consumers). Finally, it is important to note that we do not want to explicitly model how consumers evaluate the reports. This may be specific to each client and unknown to firms. We rather seek a reasonable description of how the market behaves on the aggregate, in the eyes of the consultants. In a review on the value of information from a decision theoretic point of view, Hilton (1981) shows that unless all the details of the decision problem are specified, it is not possible to make general statements about the actual value of information. In our model, we capture the variety and complexity of the consumers' decision problems by the distribution over  $\theta$ .<sup>9</sup>

Using this utility function, the expressions for the estimator variances, and our assumptions about  $a$  and  $b$ , the net surplus of a consumer with parameter

---

<sup>8</sup>The effect of a higher  $b$  is simply equivalent to a proportional increase in both  $\sigma$ -s, i.e. a parallel shift in the parameter space.

<sup>9</sup>In Appendix C (all appendices are available from the authors upon request), we provide an alternative derivation of the above utility function based on Bayesian decision theory, where consumers are heterogenous with respect to their prior means. In this extension we also provide a detailed description of the consumers' decision problem.

$\theta$ , given that firms charge prices  $p_i$  for their reports, is:

$$U = \begin{cases} \theta - \Sigma^2 - p_1 - p_2 & \text{if both reports are bought,} \\ \theta - \sigma_i^2 - p_i & \text{if only firm } i\text{'s report is bought,} \\ 0 & \text{otherwise.} \end{cases} \quad (1)$$

The separable form of the utility function implies that for any parameter values and any vector of prices, the number of reports to be bought by those consumers who actually decide to buy as well as their brand choice, is identical. (Not all consumers will buy, however.) From expression (1), it is clear that the relevant decision variable for any consumer is the *hedonic price* of information, that is, the price adjusted for reliability (see Katz and Shapiro 1985). Let  $\phi_i$  denote the hedonic price when only 1 report is bought and  $\psi$  when two reports are bought:

$$\phi_i = \sigma_i^2 + p_i$$

and

$$\psi = \Sigma^2 + p_1 + p_2 = \frac{\sigma_1^2 \sigma_2^2}{(\sigma_1^2 + \sigma_2^2)^2} (\sigma_1^2 + \sigma_2^2 + 2\sigma_1 \sigma_2 \rho) + p_1 + p_2.$$

We derive the solution(s) to the simultaneous one-shot game as follows. Suppose that in equilibrium the optimal number of reports is  $n^*$ , ( $n^* = 1, 2$ ). This restricts the location of equilibrium prices, i.e. provides a condition that these prices have to fulfill. Given  $n^*$ , we solve the game among firms and get equilibrium prices  $p^*$ . Finally, we feed back these prices in our *ex ante* condition to make sure that  $n^*$  is still optimal for consumers. This way we delimit the parameter region where the  $(n^*, p^*)$  pair forms a Nash equilibrium in pure strategies.

### 3.2 Solutions of the game

In what follows we will distinguish three cases. First, we explore the model with a monopolist. Next, we take the case of two competing consulting firms. Finally, we examine the case when a monopolist can internalize competition by creating two marketing subsidiaries that consumers perceive as being independent (i.e. producing the reports independently).<sup>10</sup> We compare the

---

<sup>10</sup>Note that even in this case the reports may be correlated but not “more” correlated than the reports of two competing consultants. The monopolist could also pool the content

equilibria that emerge under monopoly and the different forms of competition. For the remaining discussion we will assume that  $\mathcal{F}$  is the c.d.f. of the uniform distribution between 0 and 1. We also assume that  $\sigma_i^2 < 1$  for  $i = 1, 2$ .

### 3.2.1 Monopoly

The monopolist sells a maximum of one report to each of her clients. Expression (1) becomes  $U = \theta - \phi = \theta - \sigma^2 - p$  and given our assumption on  $\mathcal{F}$ , the demand faced by the monopolist is

$$D(p) = \Pr(U > 0) = 1 - \phi = 1 - \sigma^2 - p.$$

The optimal price charged by the monopolist is  $p^M = \frac{1}{2}(1 - \sigma^2)$ . Output is  $q^M = \frac{1}{2}(1 - \sigma^2)$  and the monopolist's profit is  $\pi^M = \frac{1}{4}(1 - \sigma^2)^2$ . Given  $p^M$  and the uniform distribution of  $\theta$ , total consumer surplus is:

$$S^M = \int_{\sigma^2 + p^M}^1 \theta - (\sigma^2 + p^M) d\theta = \frac{1}{8}(1 - \sigma^2)^2.$$

### 3.2.2 Duopoly

Here consumers can decide to buy zero, one or two reports depending on the  $\sigma_i^2$ -s,  $\rho$  and the prices. First, let us consider an equilibrium in which all consumers who decide to purchase any reports buy only one each. Proposition 1 states the conditions for the existence of such an equilibrium:

**Proposition 1** *Assuming that firms compete Cournot-wise, there exists a unique Nash equilibrium in pure strategies in which consumers buy at most one report if*

$$\frac{1 + \sigma_i^2}{2} \geq \sigma_j^2 \quad \forall i, j$$

---

of the separate reports and sell a single report for a higher price. This may not be always possible if consumer perceptions are linked to the *reputation* of “brands” (see the discussion later about the interpretation of the attribute space). In such cases the monopolist may not be able to convince consumers - at least in the short run - that the “master report” is of higher quality than one of its components.

and

$$\rho \geq \frac{(\sigma_1^2 + \sigma_2^2)^2}{6(\sigma_1\sigma_2)^3} (2(\sigma_1^2 + \sigma_2^2) - 1) - \frac{\sigma_1^2 + \sigma_2^2}{2\sigma_1\sigma_2}. \quad (2)$$

*Proof of existence:* In a Cournot equilibrium where both firms have positive sales we must have  $\phi_1 = \phi_2 = \phi$ .<sup>11</sup> For consumers to buy at most one report the equilibrium prices have to fulfill

$$\theta - \phi \geq \theta - \psi$$

for all  $\theta$ , i.e. the hedonic price of one report has to be less than or equal to the hedonic price of purchasing two reports:

$$\phi \leq \psi. \quad (3)$$

We derive the equilibrium given (3) and then check for which region of the parameter space is it fulfilled. Note that if (3) holds and the hedonic prices,  $\phi_i$ , are equal, the products are perfect substitutes. Total demand is the same as in the monopoly case,  $D(\phi) = 1 - \phi$  and straightforward calculations give the unique equilibrium output,  $q_i^C = \frac{1}{3}(1 - 2\sigma_i^2 + \sigma_j^2)$ . Note that these outputs are non-negative if and only if  $(1 + \sigma_i^2)/2 \geq \sigma_j^2 \forall i, j$ . Given equilibrium outputs,  $\phi = 1 - q_1^C - q_2^C$ , from which prices can be easily calculated:  $p_i^C = \frac{1}{3}(1 - 2\sigma_i^2 + \sigma_j^2)$ . Putting these prices back into condition (3) and using the definitions of  $\psi$  and  $\Sigma^2$  results in inequality (2) of the proposition and completes the proof.  $\square$

If a Cournot equilibrium exists, profits are  $\pi_i^C = \frac{1}{9}(1 - 2\sigma_i^2 + \sigma_j^2)^2$  and consumer surplus can be calculated given  $\phi$ :

$$S^C = \int_{\phi}^1 \theta - \phi d\theta = \frac{1}{18}(2 - \sigma_1^2 - \sigma_2^2)^2.$$

---

<sup>11</sup>Assuming Cournot competition is equivalent to assuming that firms build up a capacity to produce reports that allows them to have 0 marginal cost. Every unit above capacity, however costs infinity. This assumption can be relaxed. Assuming Bertrand competition we can also derive an equilibrium where consumers purchase at most one report. Then condition (2) becomes

$$\rho \geq \frac{(\sigma_1^2 + \sigma_2^2)^2}{2(\sigma_1\sigma_2)^3} \sigma_j^2 - \frac{\sigma_1^2 + \sigma_2^2}{2\sigma_1\sigma_2},$$

if  $\sigma_i^2 \geq \sigma_j^2$ .

Now let us consider an equilibrium in which consumers who decide to purchase buy two reports. Proposition 2 states the conditions for such an equilibrium to exist.

**Proposition 2** *Suppose that  $\sigma_i \leq \sigma_j$ . There exists a unique, symmetric Nash equilibrium in pure strategies in which consumers buy zero or two reports if*

$$\rho \leq \frac{(\sigma_1^2 + \sigma_2^2)^2}{4(\sigma_1\sigma_2)^3}(3\sigma_i^2 - 1) - \frac{\sigma_1^2 + \sigma_2^2}{2\sigma_1\sigma_2}. \quad (4)$$

*Proof of existence:* In equilibrium, buying two reports is optimal for all consumers who decide to purchase if and only if

$$\phi_i \geq \psi \quad \text{and} \quad \phi_j \geq \psi. \quad (5)$$

Given this assumption, the reports are perfect complements and thus the demand faced by *each* consultant is

$$D(\psi) = 1 - \psi = 1 - \Sigma^2 - p_i - p_j. \quad (6)$$

Equation (6) is the probability that a consumer will buy from consultant  $i$ . When this is the case she will also buy from  $j$  since condition (5) is met. Note that now the consultants are competing in price. Given demand in (6), the unique equilibrium price of both consultants is given by  $p^P = \frac{1}{3}(1 - \Sigma^2)$ . Since the equilibrium prices are symmetric, given our assumption that  $\sigma_i \leq \sigma_j$ , only the first inequality is relevant in condition (5). Feeding the equilibrium price back into this condition, we get (4) and the proof is complete.  $\square$

In the above price game the output of each consultant is  $q^P = \frac{1}{3}(1 - \Sigma^2)$ , and their profit is  $\pi^P = \frac{1}{9}(1 - \Sigma^2)^2$ . Note that since both firms have exactly the same prices and outputs, their profits are equal as well, i.e. the seller with the lower quality report (higher  $\sigma^2$ ) “free-rides” on the other. Now consumer surplus is given by

$$S^P = \int_{\psi}^1 \theta - \psi d\theta = \frac{1}{18}(1 - \Sigma^2)^2.$$

In summary, if condition (2) holds then there exists a Cournot equilibrium under which some consumers buy one report. If condition (4) is fulfilled,

there exists an equilibrium to the price game in which some consumers buy two reports. Figure 1 illustrates these conditions in the parameter space  $(\sigma_1^2, \sigma_2^2, \rho)$ . The two surfaces delimit the regions defined by (2) (over surface 1a) and (4) (under surface 1b). The two regions do not intersect, which ensures *uniqueness* of the two Nash equilibria in the corresponding parameter regions. Figure 2 shows cross sections of the parameter space when  $\sigma_i = \sigma_j$ , i.e. the competitors are symmetric (Figure 2a) and when  $\rho = 0$ , i.e. their reports are independent (Figure 2b). The more the reports are correlated and the more reliable they are the more the products become substitutes and the more competitors have incentive to decrease prices (increase quantities). In the opposite case, products become complements and equilibrium prices tend to increase. There is a region in the parameter space where no competitive equilibrium exists (at least in pure strategies).<sup>12</sup>

INSERT FIGURES 1 AND 2 ABOUT HERE

Now let us compare the monopolist's profit to that of a firm operating in duopoly. If in equilibrium one report is bought by some consumers then profits are always smaller than under monopoly. If, however, the two-reports equilibrium holds under duopoly, then *the monopoly profit turns out to be smaller than the duopoly profit*. The condition for this is exactly the consistency condition (4) of proposition 2. This means that a monopolist who cannot commit to have two independent subsidiaries and that operates on an information market where the products are complements, will be better off encouraging the entry of competition. Not only the monopolist, but consumers too benefit from this move, i.e. total welfare increases unambiguously (compare  $S^M$  and  $S^P$  when (4) holds). Proposition 3 summarizes these results.

**Proposition 3** (a) *If the conditions of the one-report equilibrium hold, profits are smaller but consumer surplus is higher in the competitive equilibrium than under a monopoly regime.* (b) *If the conditions of the two-reports equilibrium are valid both profits and consumer surplus are higher in the competitive equilibrium than under monopoly.*

---

<sup>12</sup>It is likely that there is a mixed strategy equilibrium when the reliabilities of the reports are not substantially different. When the difference between the  $\sigma$ -s is high the firm with the lower quality product is driven out of the market.

### 3.2.3 Monopoly with two independent marketing subsidiaries

If under some conditions the monopolist *and* consumers are better off in a duopoly where firms charge higher prices, clearly the monopolist may be interested in creating two marketing subsidiaries which are perceived by consumers as being independent. In this case the monopolist has to decide alone about the prices of the two reports given their characteristics, thus internalizing the price competition. As mentioned earlier, this situation is equivalent to pooling the content of the two reports and sell the resulting single report for a higher price. Furthermore, one can also think of this situation as two firms producing their reports independently but colluding in price. The monopolist has to decide which strategy is feasible under the existing marketing and legal constraints.

Having two subsidiaries, the monopolist can always decide to shut down the one producing the lower reliability report. In this case the outcome is equivalent to that of a monopolist who cannot commit to have two independent subsidiaries. It is more interesting to explore the situation when both of the subsidiaries sell reports. We have to check when is this possible and when will the monopolist want to have this configuration rather than keeping a single firm. First, let us see when is it possible to sell two reports with monopoly pricing. We will see that many possible price schedules are possible. The monopolist can choose, for instance, to subsidize one of the subsidiaries. Proposition 4 establishes the relevant conditions for a specific pricing rule, where the monopolist sets the hedonic prices of the individual reports to be equal.

**Proposition 4** *Suppose that  $\sigma_i \leq \sigma_j$ . If a monopolist can credibly commit to have two independent subsidiaries and if the hedonic prices,  $\phi_i$  and  $\phi_j$  of the individual reports are set to be equal, the monopolist can sell two reports if*

$$\rho \leq \frac{(\sigma_1^2 + \sigma_2^2)^2}{2(\sigma_1\sigma_2)^3} (2(\sigma_i^2 - \sigma_j^2) + 1) - \frac{\sigma_1^2 + \sigma_2^2}{2\sigma_1\sigma_2} \quad (7)$$

*and*

$$\rho \leq \frac{(\sigma_1^2 + \sigma_2^2)^2}{6(\sigma_1\sigma_2)^3} (2(\sigma_1^2 + \sigma_2^2) - 1) - \frac{\sigma_1^2 + \sigma_2^2}{2\sigma_1\sigma_2}. \quad (8)$$

*Proof:* As in the previous proof, for those consumers who decide to purchase at all, it is optimal to buy two reports if and only if inequalities (5) hold. Then the demand faced by each subsidiary is as defined by (6). The monopolist's problem is to maximize the sum of the subsidiaries' profits by choosing  $p_i$  and  $p_j$ . In fact, the problem is over defined and the monopolist needs to choose only the sum of these prices. The optimal value of this sum is  $p_i^S + p_j^S = \frac{1}{2}(1 - \Sigma^2)$ . Given our assumption on the hedonic prices, we can calculate the prices of the reports:  $p_i^S = \frac{1}{4}(1 - \Sigma^2) + \frac{1}{2}(\sigma_j^2 - \sigma_i^2)$ . These prices are both positive if and only if (7) holds. Given these prices, condition (5) collapses to one inequality that leads to condition (8).  $\square$

Two comments should be made about proposition (4). First, our assumption on the equality of the hedonic prices is arbitrary and other price schedules are also possible. Nevertheless, if the difference between the reliabilities of the reports is not too large, this pricing scheme makes intuitive sense. Second, note that (8) is the complementary region to that defined by condition (2) of Proposition 1. Figure 3a illustrates the region where both condition (7) and condition (8) are valid. To market two reports the monopolist has to be located under both surfaces in the parameter space simultaneously. Figure 3b shows the intersection of these conditions when the correlation between the reports is 0. When two reports are sold, one by each subsidiary, output (of each) is  $q^S = \frac{1}{2}(1 - \Sigma^2)$ , total profit of the monopolist is  $\pi^S = \frac{1}{4}(1 - \Sigma^2)^2$  and consumer surplus is  $S^S = \frac{1}{8}(1 - \Sigma^2)^2$ . Both total profit and consumer surplus are higher than under competition if the monopolist can commit to have two marketing subsidiaries in accordance with the theory on perfect complements. Proposition 5 summarizes these results.

**Proposition 5** *If a monopolist with two marketing subsidiaries can sell two reports to some of the consumers, aggregate profits as well as consumer surplus will be higher than under competition.*

INSERT FIGURE 3 ABOUT HERE

This last result has important implications for regulators of information markets. In ambiguous situations ( $\sigma_i^2 \gg 0$ ), or when several experts are likely to be consulted, everyone is better off if independent information providers

are allowed to jointly decide on the price that they charge for their services. The problem of such a cartel is to convince customers that the members “produce” independently from each other, i.e. to credibly commit to the independence of the members.

Finally, we have to check whether the monopolist is always willing to keep both of the subsidiaries. By comparing monopoly profit having a single firm with that when operating two subsidiaries we get the following condition: if  $\sigma_i \geq \sigma_j$  the monopolist is willing to keep both subsidiaries if and only if

$$\rho \leq \frac{(\sigma_1^2 + \sigma_2^2)^2}{2(\sigma_1\sigma_2)^3} \sigma_j^2 - \frac{\sigma_1^2 + \sigma_2^2}{2\sigma_1\sigma_2}.$$

Note that this condition delimits the complementary region to that of a 1-report equilibrium under Bertrand competition (see footnote 11). It is easy to check that this condition is never restrictive (the constraint is never binding) in the feasibility region of the specific two-subsidiary pricing strategy in Proposition 4 (i.e. when conditions (7) and (8) both hold). This finding is summarized in the following proposition.

**Proposition 6** *Assume that the pricing rule is such that the hedonic prices of the individual reports are set to be equal. The monopolist who can commit to have two independent marketing subsidiaries always wants to keep both of them, when selling two reports is feasible.*

## 4 Extensions and limitations

### 4.1 Two-stage game with costs

Until this point, we have assumed that the perceived attributes of the reports are exogenous and the cost of producing a report is 0. In fact, the meaning of this later assumption is that the unit cost of producing two reports with different  $\sigma$ -s is the same, since  $\theta$  (the valuation of perfect information) can be always redefined as the excess of the consumer’s basic willingness to pay for knowing  $m$  over the constant per unit cost. In this section we informally explore the implications of relaxing these assumptions. Costs can be entered in the model as fixed or variable costs. We will analyze their impact separately for different interpretations of the parameter space,  $(\sigma_1, \sigma_2, \rho)$ .

### 4.1.1 Fixed costs

In our model the parameters,  $\sigma_1$ ,  $\sigma_2$  and  $\rho$  cannot be influenced by firms. One could think of an extension in which the previous simultaneous game is the second stage of a two-period sequential game. In the first period, producers choose their positions in the perceptual space at some fixed costs,  $K_i(\sigma_i)$  (see Hauser and Shugan 1983), and compete according to our previous analysis in the second stage ( $\rho$  can stay exogenous but may also be influenced by firms at some cost). This case would be analogous to situations where the experts first need to establish *reputations* and then compete accordingly. The cost of establishing a reputation can come from the costs of a “good” education, the purchase of expensive equipment or from a costly marketing campaign. The parameter space can thus be seen as a *perceptual space* describing the consumers’ (subjective) evaluations of the quality of the reports.

With fixed costs in the first period, producer  $i$  needs to maximize:

$$\pi_i(\sigma_i, \sigma_j) - K_i(\sigma_i) \quad (9)$$

with respect to  $\sigma_i$ . In expression (9),  $\pi_i(\sigma_i, \sigma_j)$  is the second period equilibrium profit given  $\sigma_i$  and  $\sigma_j$ . Note, that this profit function is not continuous in  $\sigma_i$  and we can expect the equilibrium positions in the parameter space to be very sensitive to the cost function, possibly leading to corner solutions.

In the previous sections we have seen that collusion in price may not always hurt consumers. Specifically, in the region of the parameter space where two reports are sold, consumer surplus (as well as firms’ profits) increases when producers collude in price. This is not the case, however, in the parameter region where the Cournot game is played. In a two stage game, collusion can take-on another form. Firms can collude by jointly optimizing when choosing their positions in the parameter space. Thus, in the second stage, they may play a game that is more favorable to each of them. These findings may suggest that fixed costs may in part be responsible for the differences in the overall reputations of non-regulated professions based on “information marketing” (i.e. the equilibrium positions of their members in the parameter space).

### 4.1.2 Variable costs

It is possible that better perceived reliability is acquired with higher fixed costs as well as higher variable costs. The firm may use higher quality paper in producing its reports, for instance. We can see how the results of the previous sections change when, in the second stage the marginal cost of producing a report with higher perceived reliability is also higher. Appendix A contains the equilibrium prices, outputs, profits and the consumer surplus of the games analyzed in the previous section. Here, we are more interested in the influence of costs on the validity of equilibria in the parameter space. Condition (2) of the one-report, Cournot equilibrium now becomes:

$$\rho \geq \frac{(\sigma_1^2 + \sigma_2^2)^2}{6(\sigma_1\sigma_2)^3} (2(\sigma_1^2 + \sigma_2^2) - 1 - (c_1 + c_2)) - \frac{\sigma_1^2 + \sigma_2^2}{2\sigma_1\sigma_2} \quad (10)$$

and condition (4) of the two-reports equilibrium changes to

$$\rho \leq \frac{(\sigma_1^2 + \sigma_2^2)^2}{4(\sigma_1\sigma_2)^3} (3\sigma_i^2 - 1 + c_i - 2c_j) - \frac{\sigma_1^2 + \sigma_2^2}{2\sigma_1\sigma_2}. \quad (11)$$

where  $c_i = c(\sigma_i)$ ,  $i = 1, 2$  is the marginal cost of producing a report and  $\sigma_i^2 + c_i \leq \sigma_j^2 + c_j$ .<sup>13</sup>

Simulations with three simple marginal cost functions,  $c(\sigma) = k/\sigma$ ,  $c(\sigma) = k(1 - \sigma^2)$  and  $c(\sigma) = k(1 - \sigma)$ , indicate that as the difference between the marginal costs of two producers with different  $\sigma$ -s increases ( $k$  becomes larger), the 1-report equilibrium region increases, whereas the 2-reports equilibrium region decreases, i.e. both surfaces, defined by setting conditions (10) and (11) to equalities, move downwards along the vertical axis,  $\rho$ . The region between them (where only mixed strategy equilibria exist) becomes smaller. In sum, increases in differences between the marginal costs of competitors, having different reliabilities, results in the 2-reports equilibrium being feasible when both reports have lower and lower reliabilities. The intuition

---

<sup>13</sup>The condition for a 1-report equilibrium under Bertrand competition changes to

$$\rho \geq \frac{(\sigma_1^2 + \sigma_2^2)^2}{2(\sigma_1\sigma_2)^3} (\sigma_j^2 - c_i) - \frac{\sigma_1^2 + \sigma_2^2}{2\sigma_1\sigma_2}$$

if  $\sigma_i^2 + c_i \geq \sigma_j^2 + c_j$ .

behind this result is that increasing marginal costs lead to increasing prices in both types of equilibria. Consumers are, therefore, more inclined to buy only one report. Figure 4 shows conditions (10) and (11) for the last two cost functions mentioned above, when  $\rho = 0$  and  $k = 0.5$ .<sup>14</sup> It is interesting that under some cost structures, there are more possibilities for firms with very different reliabilities to co-exist (see Figure 4). This may suggest that marginal cost structures may be in part responsible for differences in the variance of perceived quality within different types of information markets (variance in the quality of medical diagnosis versus variance of quality in the consulting industry, for instance).

INSERT FIGURE 4 ABOUT HERE

## 4.2 Potential limitations

The proposed model has made several simplifications. First, the present paper studies competition in a duopoly. In Appendix D, we show that the basic results are valid for oligopolies, at least in the case of symmetric competitors. While beyond the scope of this study, a more complete analysis of asymmetric oligopolies may be warranted. Second, our model uses a specific definition of information. In Appendix B, we examine the case where information has a somewhat different meaning. In this extension, information suppliers have different information structures (in the sense that their partitions of the state space are different) and consumers are interested in having the finest possible partition of the state space (see Milgrom (1981) and Sebenius and Geanakoplos (1983) for details). The informal analysis indicates that the results are similar to the ones found here.

Finally, our model considers a simultaneous one-shot game. This is justified in many situations. It is not uncommon that managers need to make one-shot decisions to buy from one, two or no information sources due to the lead time required to collect the data and the lack of time post delivery to order additional opinions before decision making. In reality, the purchased information is rarely a simple value as modeled here. Thus, the evaluation

---

<sup>14</sup>These cost functions follow better our model, in which everything is bounded between 0 and 1, than  $c(\sigma) = k/\sigma$ .

of the reports may be lengthy, therefore, consumers have to gather information before they have the opportunity to evaluate it.<sup>15</sup> Often, purchasing information means subscription to an on-line database. This decision may be independent from a specific application of the database.

From a modelling point of view we have chosen a static model for two reasons: First, our utility function depends only on the reliability and dependence of the reports and this is assumed to be common knowledge. A dynamic model, therefore, would provide the same results. One could consider the case where the utility for additional information depends on the value of previously purchased information (i.e. the purchase of the second report is contingent on the content of the first). Note that in this case firms would make their prices contingent on the value of their own reports. This would allow rational consumers to extract the values in the reports from the observed prices without buying the reports, i.e. the market would break down. Our model preserves the rationality of consumers and the existence of the market by assuming a simultaneous game. This approach also allows a simple way to model the empirical finding that consumers are not as sophisticated as it is consistent with Bayesian updating (see, for instance, the empirical work by McKelvey and Page 1990). Providing a dynamic model of information markets is a challenging task left for future research.

## 5 Discussion

The proposed framework specifies a separable utility function, and assumes that consumers make a unique decision to purchase from none, one or two sellers. With these assumptions as caveats, our investigation generates two surprising outcomes based on the premise that consumers face high uncertainty and maximize the expected value they receive from the information providers: (1) firms may be better off facing competition which simultaneously increases profits and consumer welfare, and (2) if competition among independent information sellers can be internalized via a monopoly with independent marketing subsidiaries, then consumer surplus is higher than that

---

<sup>15</sup>When evaluating marketing effectiveness using scanner data, for example, clients of market research companies, such as A.C. Nielsen or IRI Inc., have to order all marketing research well in advance, before seeing the result(s) of any reports.

achieved under unrestricted competition. Both outcomes have interesting marketing and public policy implications given the increasing importance of the information industry. In this section we would like to illustrate our results based on some observed market outcomes. As mentioned earlier the insights gained from our stylized model have to be interpreted carefully.

## **5.1 Entry encouragement**

### **5.1.1 Consulting fees**

It is often suggested that consultants' fees are extremely high and this despite the common belief that the output of consultants is often ambiguous. Such high fees might be justified using the following reasoning: "Managers are risk averse and are more comfortable if they can support their decisions by the written advice of a reputed consulting firm, which allows them to cover themselves. Thus, they are ready to pay a higher price to the consultants". Since consulting advice is essentially information, our model suggests an alternative explanation. By their very nature, many business decisions are very risky given the uncertainty of their outcomes. When important decisions are made (e.g. involving large capital investments, layoffs of personnel, or new product launches) and the uncertainty of the outcome is very high, firms will want to hire several experts. By hiring several consultants the firm expects to reduce this uncertainty. This is more so the higher the uncertainty of the outcome (the higher  $\sigma^2$ ). In this sense the services that the consultants offer are complements and equilibrium prices tend to increase.

Such outcomes are observed in East-bloc countries where most of the industries face fundamental reconstruction and this in a very risky economic environment. In spite of the fact that in these countries resources are thin, consulting firms are able to maintain high fee structures (despite having lower input costs by hiring locals). Since there is a lack of clear accounting standards, accounting firms in these countries also face such markets: multiple consultations reduce the uncertainty about the financial status of firms being evaluated. In such circumstances, entry may be encouraged by the monopolist.

### 5.1.2 Co-marketing arrangements

That entry can be encouraged by the single monopolist in information industries explains the apparently irrational behavior of one firm specializing in publishing industry reports for the mobile communications industry, EMCI Inc. The firm regularly swaps its client mailing lists with competitors<sup>16</sup>. This is direct evidence that reports in this industry are complements since EMCI does not expect their customers to buy competitors' reports instead of EMCI reports; the management expects customers to purchase from both.

### 5.1.3 Creating marketing subsidiaries

Entry, encouragement is more likely to occur when information sources are independent. This finding has implications for "product manufacturers", for example, which are recently diversifying into "information selling". Such is the case of computer manufacturers offering "independent consulting" or engineering services. The management of IBM, for example, has recently identified its primary competitors as the big consulting companies, instead of DEC, Apple or Unisys. In large information systems projects, consultants have recently acted as prime contractors who then purchase equipment from the manufacturers at discounted prices. Recognizing this situation, the new strategy of IBM is to create an independent consulting firm, the IBM Consulting Group.<sup>17</sup> This policy is not unique among big computer manufacturers. The idea is that the consultants of such newly created firms will carry the reputation of the manufacturers but would act as totally independent agents. In the guidelines of IBM, employees of IBM Consulting Group can propose non-IBM equipment to their clients, in fact they are told to provide the best solution for their clients regardless of whether it is based on IBM equipment or not.

Industry experts are quite skeptical about this solution. The obvious reason is that even if the agents are allowed to propose non-IBM based solutions it is difficult to believe that their approach to any problem would not be

---

<sup>16</sup>Based on a personal interview of the company chairman, September 20, 1993.

<sup>17</sup>The IBM Consulting Group was launched worldwide in October 1992 with about 1500 management and functional consultants who previously worked for IBM in various positions.

biased towards the mother firm. This can result from the mere fact that they tend to be aware of more solutions based on IBM machines. Clearly the correlation between the two information sources, IBM manufacturing and IBM consulting may be too high to make the two firms' services complements. If IBM can not convince the market that the two represent two truly different information sources, then the client is better off directly asking an IBM salesman for the IBM solution (which is free of charge).

## 5.2 Regulatory implications

Our model finds that consumer surplus as well as profits can be greater when competition among independent information sellers can be internalized. The implications of this finding is of relevance to situations where competing information providers are regularly and periodically consulted due to the high uncertainties faced by the consuming public. For example, it would seem reasonable in legal proceedings that the court system be responsible for the hiring (and, therefore, pricing) of consultations of expert witnesses, as is common practice in many European countries (rather than both parties hiring several experts representing the opposing sides). Similar arguments might be made for providers of certain health services. Planners are divided on the issue of how free a medical services market should be? While this is a complex discussion, our findings concern one subset of medical services, the provision of expert diagnoses. The last result of the previous section might be directly applied by regulators of such industries. The result implies that sometimes it is pareto optimal if a central planner sets the price for such services. In this way, the planner internalizes the effect of the price competition among experts. Such policies can be observed in France, for example, where there is an upper limit to the price a doctor can charge for various routine diagnostic visits.<sup>18</sup> This does not apply for all treatments however. Similar price controls have been set in France for certain consultations with lawyers. Again, such intervention will be optimal only in situations when uncertainty is sufficiently high and moral hazard problems related to the independence of agents can be credibly overcome.

---

<sup>18</sup>The French government has recently been forced to introduce the "Carnet the Santé", a medical record booklet which exists to discourage individuals from visiting multiple doctors for the same illness since the government traditionally reimbursed all diagnostic visits.

## 6 Concluding remarks

This paper proposes a model to explain competitive structures in markets for information. Such markets become more and more common with the development of the services industry. Our approach concentrated on modeling competition, given the interdependencies among information products. These externalities lead to counter-intuitive results regarding competitive structures which imply various policy options. Some examples in the information services, medical and legal professions are provided to illustrate these conclusions. Information is often only one aspect of the total product/service sold which suggests that the results reported here may have wider applicability than “information-only” products. It is important to realize that in these cases our results can not explain *alone* the observed market outcomes but only provide insight with respect to information-related aspects. We have also highlighted a number of interesting research directions. Besides the development of a dynamic model it would be interesting to analyze in more detail the two-period extension of the game, where competitors first choose positions in a perceptual space. One could explore the effect of different cost structures on the equilibrium positions of the competitors as well as their incentives to collude or compete. We leave these extensions to future research.

## References

Admati, Anat R. and Paul Pfleiderer (1986), "A Monopolistic Market for Information", *Journal of Economic Theory*, 39, 400-438.

——— and ——— (1988), "Selling and Trading on Information on Financial Markets", *American Economic Review, Papers and Proceedings*, 78, 96-103.

——— and ——— (1990), "Direct and Indirect Sale of Information", *Econometrica*, 58, 4, 901-928.

Akerlof, George A. (1970), "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism", *Quarterly Journal of Economics*, 48, 488-500.

Ashton, Robert H. (1986), "Combining the Judgment of Experts: How Many and Which Ones?", *Organizational Behavior and Human Decision Processes*, 38, 405-414.

Basu, Amiya K., Rajiv Lal, V. Srinivasan and Richard Staelin (1985), "Salesforce Compensation Plans: An Agency Theoretic Perspective," *Marketing Science*, 4, (Fall), 267-291.

Bearden, William O., Richard G. Netemeyer and Jesse E. Teel (1989), "Measurement of Consumer Susceptibility to Interpersonal Influence", *Journal of Consumer Research*, 15, (March) 473-481.

Chu, Wujin (1992), "Demand Signalling and Screening in Channels of Distribution" *Marketing Science*, 11, 4, 327-347.

Clemen, Robert T. (1987), "Combining Overlapping Information", *Management Science*, 33, 3, (March), 373-380.

Clemen, Robert T. and Robert L. Winkler (1985), "Limits for the Precision and Value of Information from Dependent Sources", *Operations Research*, 33, 2, (March-April), 427-442.

Congram, Carole A. and Margaret L. Friedman eds. (1991), "The AMA

- Handbook of Marketing for the Service Industries”, AMACOM, New York.
- Connor, Dick and Jeffrey P. Davidson (1990), “Marketing Your Consulting and Professional Services”, John Wiley & Sons, Inc. USA.
- Grossman, Sanford J. and Oliver Hart (1983), “An Analysis of the Principle Agent Problem”, *Econometrica*, 51. 7-45.
- and Joseph E. Stiglitz (1980), “On the Impossibility of Informationally Efficient Markets”, *American Economic Review*, 70, 393-408.
- Gupta, Sunil and Peter C. Wilton (1987), “Combination of Forecasts: An Extension,” *Management Science*, 33, 3, (March), 356-372.
- Hauser, John R. and Steven M. Shugan (1983), “Defensive Marketing Strategy”, *Marketing Science*, 2, 4, (Fall), 319-360.
- Hilton, Ronald W. (1981) “The Determinants of Information Value: Synthesizing Some General Results”, *Management Science*, 27. (January) 54-64.
- Holmstrom, Bengt (1985), “The provision of services in a market economy”, Chapter 7 in *Managing The Service Economy*, Cambridge Univ. Press.
- Jensen, Fred O. (1991), “Information Services”, in *The AMA Handbook of Marketing for the Service Industries*, eds. Congram and Friedman, AMACOM, New York, Chapter 22, p. 423-443.
- Katz, Michael L. and Carl Shapiro (1985), “Network Externalities, Competition and Compatibility”, *The American Economic Review*, 75. 424-440.
- Kreps, David and Robert Wilson (1982), “Reputation and Imperfect Information”, *Journal of Economic Theory*, 27. 253-279.
- Lal, Rajiv (1990), “Improving Channel Coordination Through Franchising,” *Marketing Science*, 9, 299-318.

Lovelock, Christopher H. (1984), "Services Marketing (Text Cases and Readings)", Prentice-Hall, Inc., New Jersey.

Made in Britain (The true state of Britain's manufacturing industry), Joint Report of IBM Consulting Group and London Business School. 1993.

Makridakis, Spiros and Robert L. Winkler (1983), "Averages of Forecasts: Some Empirical Results", *Management Science*, 29, 9, (September), 987-996.

Matutes, Carmen and P. Regibeau (1988), "Mix and Match: product compatibility without network externalities", *RAND Journal of Economics*, 19, No.2 221-234.

McKelvey, Richard D. and Talbot Page (1990), "Public and Private Information: An Experimental Study of Information Pooling", *Econometrica*, 58, 6, 1321-1339.

Milgrom, Paul (1981), "An Axiomatic Characterization of Common Knowledge", *Econometrica*, 49, 219-222.

Morrison, Donald G. and David C. Schmittlein (1989), "How Many Forecasters Do You Really Have?: Mahalanobis Provides The Intuition for the Surprising Clemen and Winkler Result", *Working Paper*, No. 195, Marketing Studies Center, UCLA.

Padmanabhan, V. and Ram C. Rao (1993), "Warranty Policy and Extended Service Contracts: Theory and an Application to Automobiles", *Marketing Science*, 12, (Summer), 230-247.

Palmer, Adrian (1994), "Principles of Services Marketing", McGRAW-HILL BOOK COMPANY International Ltd., UK.

Rothschild, Michael and Joseph E. Stiglitz (1976), "Equilibrium in Competitive Insurance Markets: An Essay on the Economics of Imperfect Information", *Quarterly Journal of Economics*, 90, 629-649.

Sebenius, James K. and John Geanakoplos (1983), "Don't Bet On It: Contin-

gent Agreements With Asymmetric Information”, *Journal of the American Statistical Association*, 78, 382, (June) 424-426.

Schmittlein, David C., Jinho Kim and Donald G. Morrison (1990), “Combining Forecasts: Operational Adjustments to Theoretically Optimal Rules”, *Management Science*, 36, 9, (September), p. 1044-1056.

Spence, Michael (1973), “Job Market Signalling”, *Quarterly Journal of Economics*, 87. (August) 355-379.

Sunder, Shyam (1992), “Market for Information: Experimental Evidence”, *Econometrica*, 60. (May) 667-695.

Thorelli, Hans B. and Helmut Becker (1980), “The Information Seekers: Multinational Strategy Target”, *California Management Review*, 23, 1, (Fall) 46-53.

Tirole, Jean (1992), “The Theory of Industrial Organization”, MIT Press. Cambridge, MA.

Waterman, David (1990), “Diversity and Quality of Information Products in a Monopolistically Competitive Industry”, *Information Economics and Policy*, 4. (1989/1990) 291-303.

Winkler, Robert L. (1981), “Combining Probability Distributions From Dependent Information Sources,” *Management Science*, 27, 4, (April), 479-488.

Wolinsky, Asher (1993), “Competition in a Market for Informed Experts’ Services”, *RAND Journal of Economics*, 24. No.3 (Autumn), 380-398.

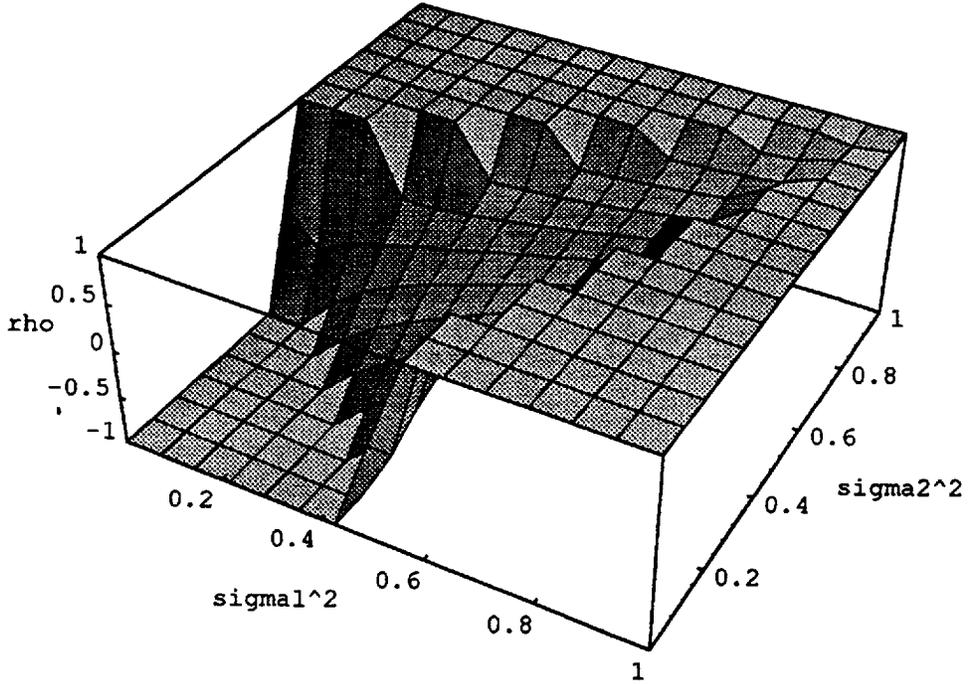
Zeithaml, Valerie A., A Parasuraman and Leonard L. Berry (1990), *Delivering Quality Service - Balancing Customer Perceptions and Expectations*, The Free Press, New York.

**TABLE 1: THE US MARKET FOR INFORMATION SERVICES IN 1988.**

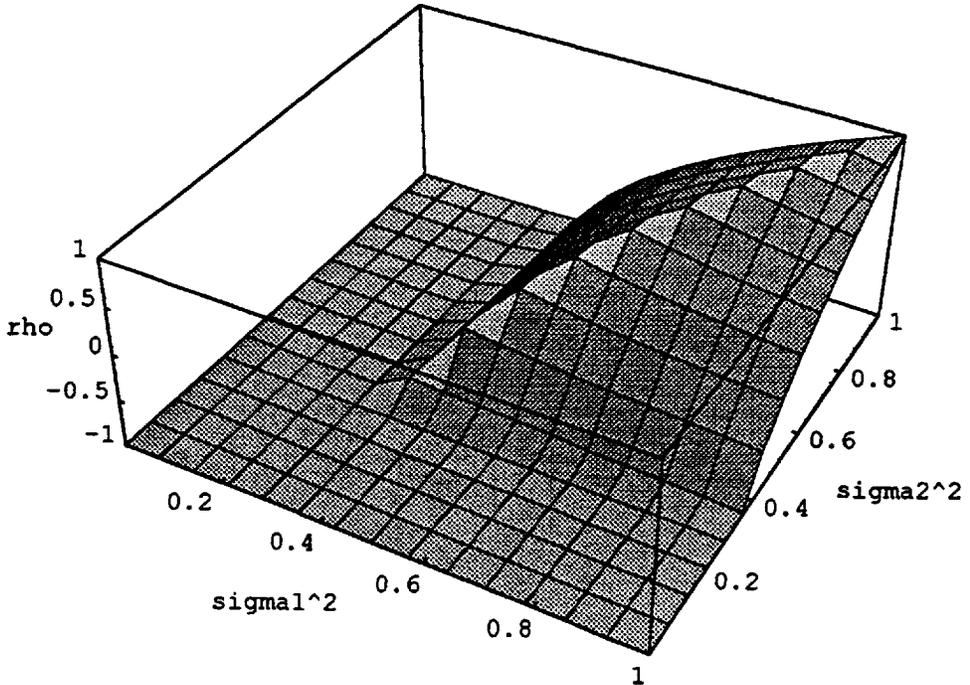
<b>Information Subject Area</b>	<b>Estimated 1988 Revenue (\$ billion)</b>	<b>Estimated 1988 Share (%)</b>	<b>Average Annual Increase in Revenue From 1982-1988 (%)</b>
<b>Market/Marketing/Media</b>			
<b>Research:</b>	6.6	37.3	13
<b>Economic/Financial/ Securities:</b>	3.9	22	16
<b>Credit/Check authorization:</b>	2.4	13.6	11
<b>Product/Price:</b>	1.5	8.5	9
<b>Legal/Regulatory:</b>	1.4	7.9	10
<b>Medical/Scientific/ 'Technological:</b>	0.8	4.5	12
<b>All others:</b>	1.1	6.2	8
<b>Total industry:</b>	17.7	100	12

Note: Adopted from Jensen (1991)

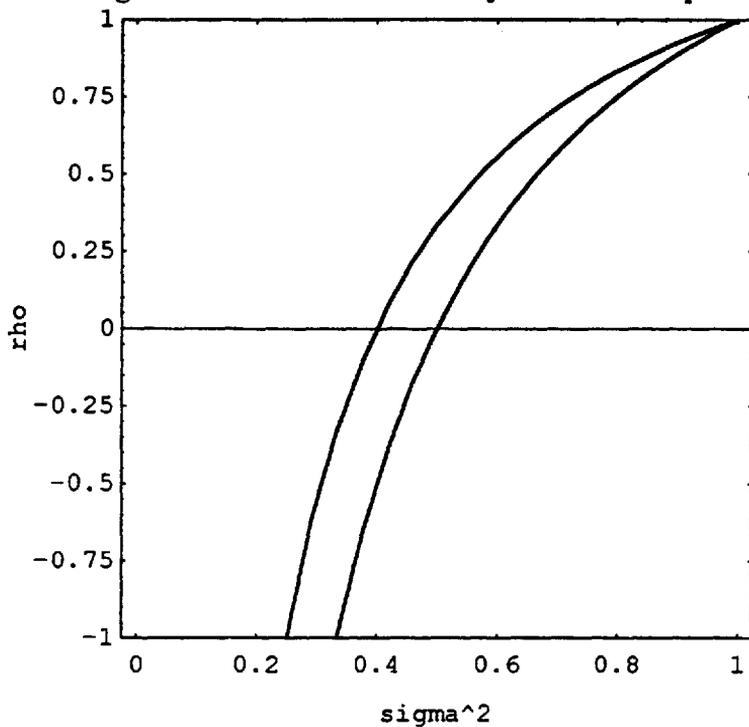
**Figure 1 a: 1-report, Cournot equilibrium**



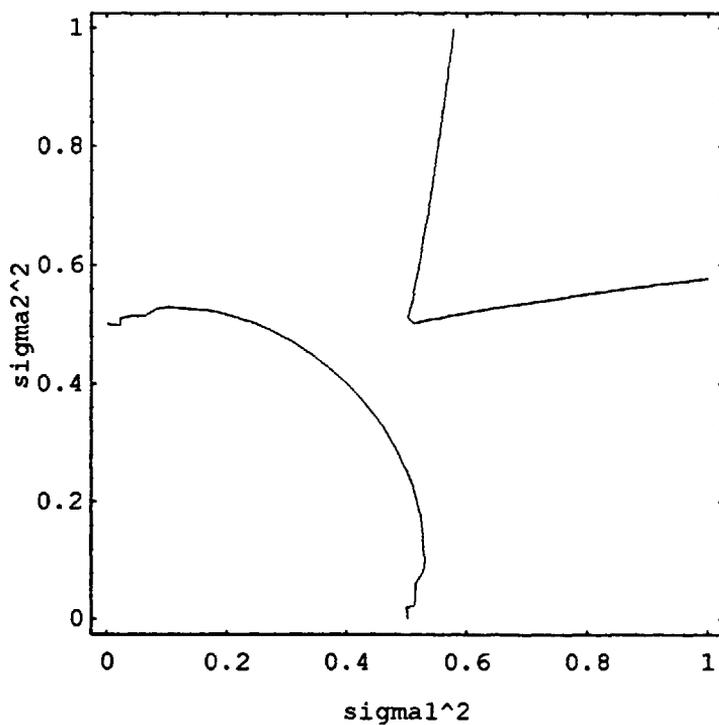
**Figure 1 b: 2-reports, Price-game equilibrium**



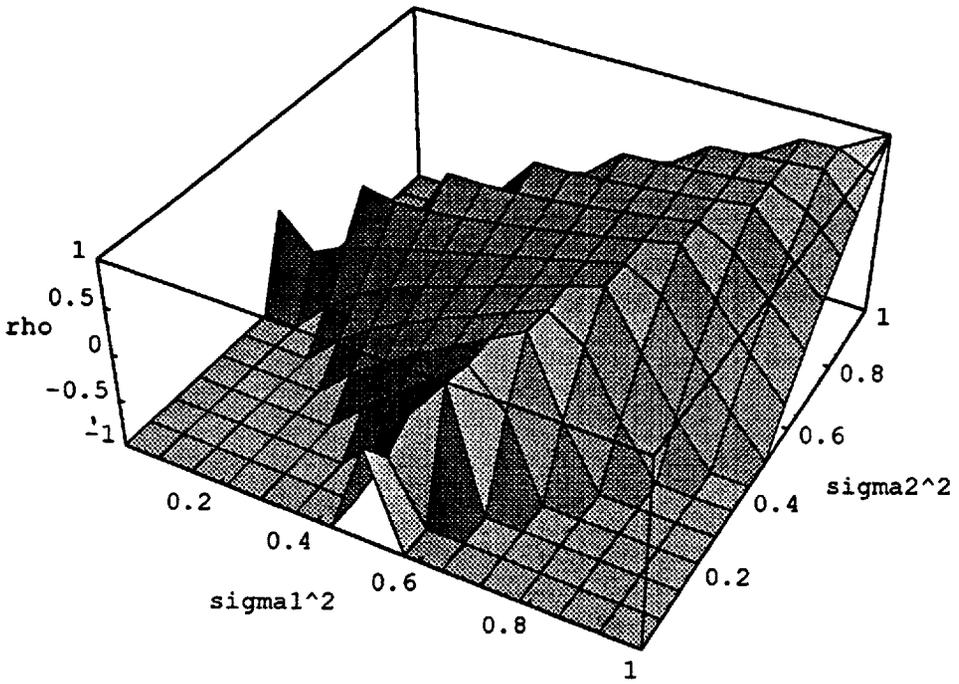
**Figure 2 a: Conditions with symmetric competitors**



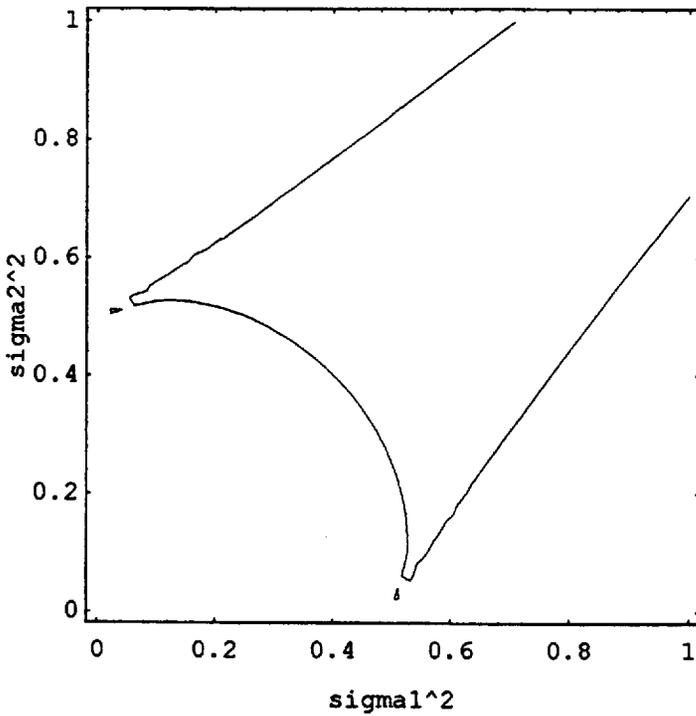
**Figure 2 b: Conditions with independent competitors**



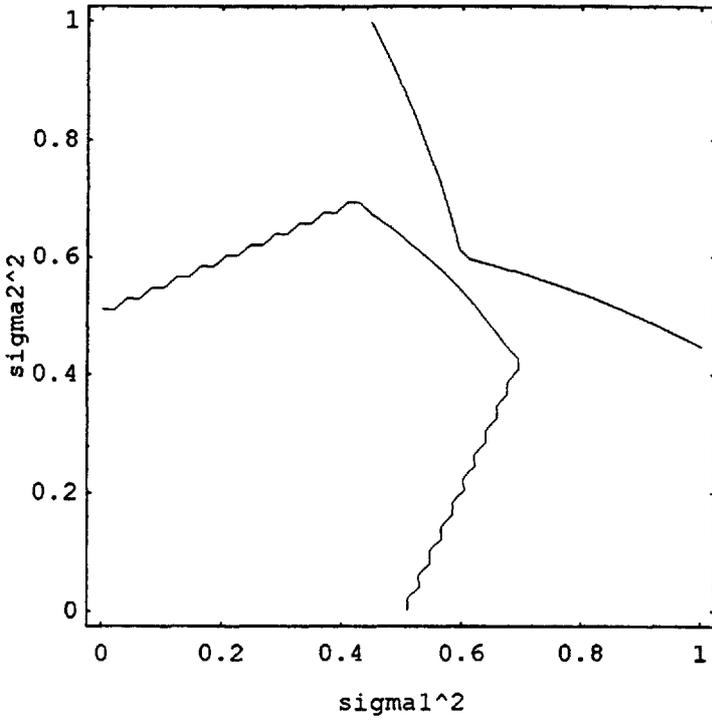
**Figure 3 a: Both subsidiaries selling reports**



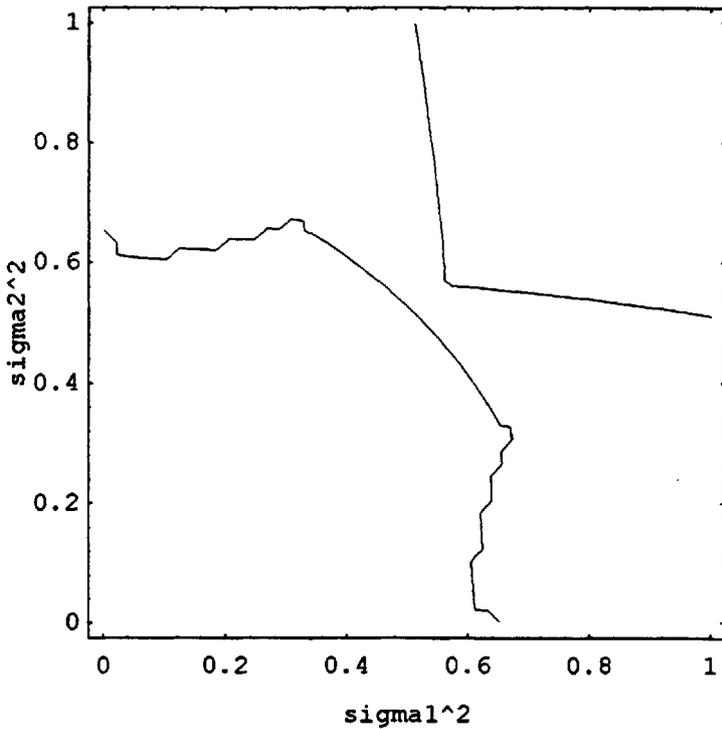
**Figure 3 b: Conditions with independent subsidiaries**



**Figure 4 a: Conditions when  $c=0.5(1-\sigma^2)$ ;  $\rho=0$**



**Figure 4 b: Conditions when  $c=0.5(1-\sigma)$ ;  $\rho=0$**



# Appendices to Marketing Information: A Competitive Analysis

December, 1994

## Appendix A: Equilibria with marginal costs

In this appendix we will list the equilibrium outcomes of the game(s) discussed in detail in the text when marginal costs are different across competitors with different reliabilities. The results are equivalent to those reported in the text when costs are assumed away. Let  $c(\sigma)$  be the marginal cost of producing a report, given technology  $\sigma$ . To ease notation define  $c_1 = c(\sigma_1)$  and  $\bar{c} = \sigma^2 + c(\sigma)$ . Note that  $\bar{c}$  can be thought of as the “effective cost” of a producer. Suppose that  $c(\sigma) = k(1 - \sigma)$ . If  $k$  is a small number, then  $\bar{c}$  is still increasing in  $\sigma$ . When  $k$  is very large,  $\bar{c}$  is decreasing and for medium  $k$ ,  $\bar{c}$  is a convex function (first decreasing, then increasing). One simple way to visualize the effect of marginal costs on our results is to say that the results are more accentuated (they are valid in a larger region in the parameter space) the more  $\bar{c}$  is increasing in  $\sigma$ .

### Monopoly

The optimal price chosen by the monopolist, her output, profit and the resulting consumer surplus are respectively:

$$p^M = \frac{1}{2}(1 - \sigma^2 + c)$$

$$q^M = \frac{1}{2}(1 - \bar{c})$$

$$\pi^M = \frac{1}{4}(1 - \bar{c})^2$$

$$S^M = \frac{1}{8}(1 - \bar{c})^2.$$

### Cournot game with one report

The equilibrium outcomes are:

$$p_i^C = \frac{1}{3}(1 + \bar{c}_1 + \bar{c}_2) - \sigma_i^2$$

$$q_i^C = \frac{1}{3}(1 - 2\bar{c}_i + \bar{c}_j)$$

$$\pi^C = \frac{1}{9}(1 - 2\bar{c}_i + \bar{c}_j)^2$$

$$S^C = \frac{1}{18}(2 - \bar{c}_1 - \bar{c}_2)^2.$$

Note that now the feasibility condition is the same as in Proposition 1 in terms of  $\bar{c}$ -s instead of  $\sigma$ -s.

### Price game with two reports

The equilibrium outcomes are:

$$p_i^P = \frac{1}{3}(1 - \Sigma^2 + 2c_i - c_j)$$

$$q^P = \frac{1}{3}(1 - \Sigma^2 - (c_1 + c_2))$$

$$\pi^P = \frac{1}{9}(1 - \Sigma^2 - (c_1 + c_2))^2$$

$$S^P = \frac{1}{18}(1 - \Sigma^2 - (c_1 + c_2))^2.$$

### Monopolist with two subsidiaries

The optimal prices, outputs and profits as well as consumer surplus are given by:

$$p_i^S = \frac{1}{4}(1 - \Sigma^2 + c_1 + c_2) - \frac{\sigma_j^2 - \sigma_i^2}{2}$$

$$q^S = \frac{1}{2}(1 - \Sigma^2 - (c_1 + c_2))$$

$$\pi^S = \frac{1}{4}(1 - \Sigma^2 - (c_1 + c_2))^2$$

$$S^S = \frac{1}{8}(1 - \Sigma^2 - (c_1 + c_2))^2.$$

## Appendix B: An alternative model for information products

Until now the information product was a random draw from a given distribution. The externalities came from the properties of the distribution and the sampling process. In this Appendix, we briefly outline the case when information has a somewhat different meaning. This outline does not present a fully developed model and should be seen as an illustration of the concept.

Suppose that  $\Omega$  represents all possible states of the world. Consumers can not distinguish between these states, i.e. their information partition is  $\Omega$  itself. Suppose also that they have a uniform prior over  $\Omega$ . Consultants, have more refined partitions that do not have to be identical. For simplicity, assume that the resolution of their partitions is the same (in the paper this would correspond to the assumption that the  $\sigma_i$ -s are identical). The information structure of all players is known by all other players. The information product in this context is the element of the partition in which the current state is. Consumers can buy information from one or two sellers and thus get a more refined partition of  $\Omega$ , i.e. a better identification of the true state of the world.

For an illustration (see Figure B) suppose that  $\Omega$  is a circle of unit diameter in the two dimensional space (two traders) and the partitions are represented by parallel lines whose distance,  $a$ , is equal ( $a < 1$  is the inverse of the resolution and corresponds to  $\sigma^2$  in the paper). The angle between the two partitions,  $\alpha$ , represents the “dissimilarity” of the consultants’ partitions. The smaller this angle, the more similar the two partitions. In the limit, when  $\alpha = 0$ , the partitions are equivalent (this corresponds to  $\rho = 1$  in the previous model).<sup>1</sup> When  $\alpha = \pi/2$  the partitions can be said to be “orthogonal” (this is equivalent to the  $\rho = 0$  case in the paper). In what follows we will use an alternative measure,  $\sin \alpha$ , for the dissimilarity of information partitions for convenience and to conform better to the previous model. This measure is bounded between 0 and 1.

INSERT FIGURE B ABOUT HERE

---

<sup>1</sup>Suppose for the illustration that the rotation is perfectly symmetric to the center of the circle. Also irregularities at the borders should be ignored.

As in the previous model we will denote the consumers' valuation for knowing the true state of the world by  $\theta$ . We will suppose that the consumers' expected loss is proportional to the measure,  $T$ , of the sets in the coarsest common refinement defined by the partitions of the sellers they have purchased from. Thus the utility of consumers can be expressed as:

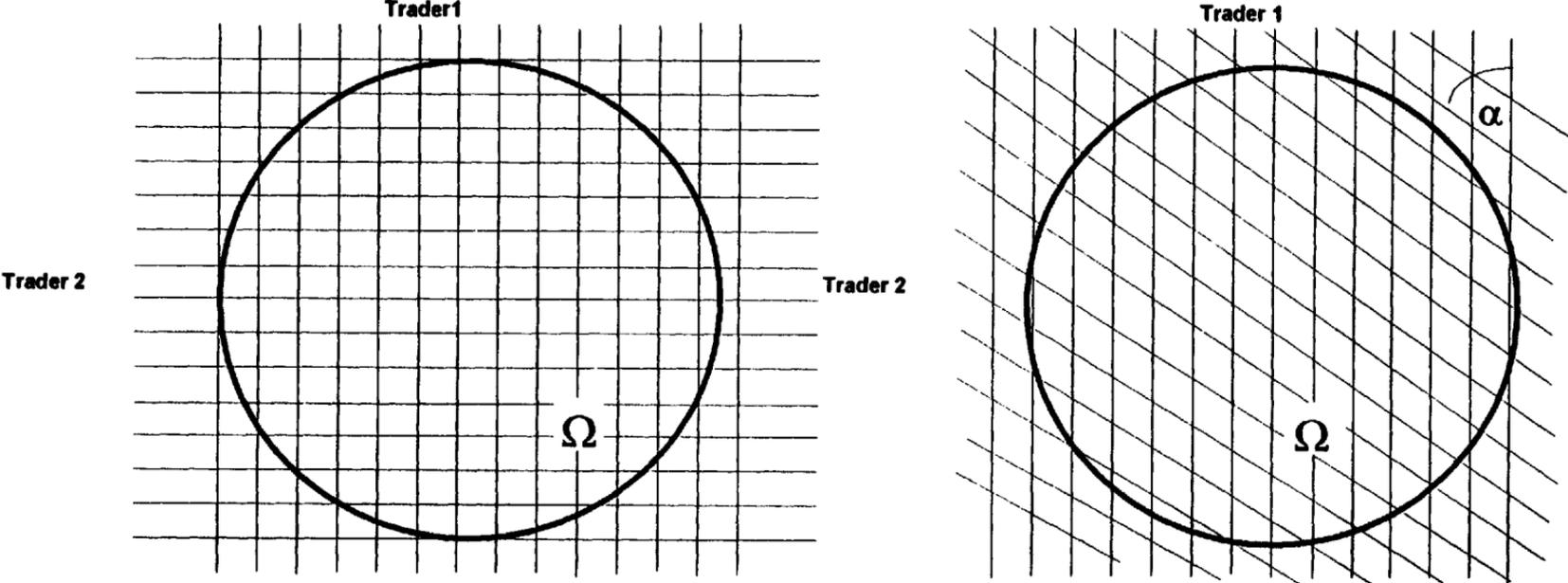
$$\mathcal{U} = \theta - E_n \mathcal{L} = \theta - T_n.$$

In our example (see Figure B),  $T = \frac{a^2}{\sin \alpha}$ .  $T_n$  can be expressed as:

$$T_n = \min\left\{a, \frac{a^n}{\sin(\alpha[n-1])}\right\},$$

where  $n = 1$  or  $2$ . The definition takes into account that the fraction above is not defined (goes to  $\infty$ ) if  $\alpha = 0$  or if  $n = 1$ . The value  $a$  is a natural limit to  $T$ , where there is no point in buying additional reports ( $T$  stays the same). This definition is not convenient and makes the formal analysis cumbersome. The point is that  $\mathcal{U}$  has similar properties to those in the previous model. Under such conditions we expect that the competition in such information markets will have similar characteristics than in the model developed in the paper. The lower the resolution of the sellers' information structures and the "more orthogonal" they are, the more the products become complements, resulting in higher equilibrium prices. In the opposite case they become substitutes and prices decrease with competition. Here, however, the value of buying from different sellers comes from the fact that they see different aspects of the decision problem (they have different expertise for instance). The externalities now come from the properties and interdependence of the information structures of the sellers.

**Figure B : Information structures of the players**



## Appendix C: Consumers with heterogenous prior means

### Restatement of the consumer model in the Bayesian framework

We assume that the information product is characterized the same way as in the paper. Suppose that consumers have a diffused prior information about  $m$  with mean,  $\theta$ , which is private information. In other words, consumers are heterogeneous in their prior “beliefs” concerning business opportunities but they do not really “trust” these beliefs. As before,  $\theta$  is known to be distributed across consumers between 0 and 1 according to the cumulative density function  $\mathcal{F}$ . There is a continuum of consumers and we normalize their total number to 1. Upon purchasing information from firms, consumers update their priors and, given our assumption that the priors are diffused they will give all weight to the sample information corresponding to the report(s).

Consumers can choose between buying 0, 1 or 2 reports. If the consumer buys one report, say from firm  $i$ , her posterior distribution for  $m$  will be  $N(x_i; \sigma_i^2)$ . Upon buying two reports her posterior distribution will be  $N(\bar{x}; \Sigma^2)$ , where the expressions for both  $\bar{x}$  and  $\Sigma^2$  are the same as in the paper. The distribution of the estimation error, ( $y = x_i - m$ , if one report is bought and  $y = \bar{x} - m$ , if two of them are bought) is also normal with mean 0 and the variance of the posterior distribution. We assume that consumers have a quadratic loss function,  $\mathcal{L}(y) = y^2$ . Then the expected loss of a consumer buying  $n$  reports is:

$$E_n \mathcal{L} = \int_{-\infty}^{\infty} y^2 f_n(y) dy,$$

where  $f_n(y)$  is the density function of  $y$ . It follows that the expected loss of a consumer is equal to the value of the posterior variance. We will assume that consumers’ valuation of sample information in general is increasing in the value of their prior mean (i.e. consumers are more interested in buying the sample if they believe that business opportunities are higher) and decreasing in the forecasted expected loss. Furthermore, we assume that the valuation for sample information is separable and linear in these two quantities. Thus we define the expected utility of a consumer with prior mean  $\theta$  by:

$$\mathcal{U} = a\theta - bE_n \mathcal{L}.$$

## Detailed derivation of the separable utility function

For simplicity we consider a single consultant who has sample information, about  $m$ . The value of the sample  $x$  is unknown to consumers but it is common knowledge that  $x$  is  $N(m, \sigma^2)$ , i.e. the consultant is known to be right on average, with some known variance.

Consumers' action set consists of  $A = \{a \in \mathfrak{R} \mid a \in [K, \infty) \cup \{0\}\}$ , i.e. consumers can choose not to invest or invest an amount above a certain threshold  $K > 0$ . Given the realization of  $m$ , the reward of consumers upon choosing action  $a$  is:

$$R(a, m) = \begin{cases} Bm - D(m - a)^2 & \text{if } a \geq K, \\ 0 & \text{otherwise.} \end{cases} \quad (1)$$

Thus, the decision is basically a "go - no go" decision where upon choosing "go" the customer still has to choose the optimal action.  $D$  is the coefficient of risk aversion. Without sample information each consumer chooses action 0, because any other action gives him reward  $R = -\infty$ . (For  $a \geq K$ ,  $E[R(a)] = E[Bm - D(m^2 + a^2 - 2am)] = B\theta - D(\infty + \theta^2 + a^2 - 2a\theta) = -\infty$ .) Upon receiving the sample,  $x$ , consumers update their priors and, given that these are totally diffused, consumers will give all weights to the sample information. Their posterior will thus be  $N(x, \sigma^2)$ . Their optimal action knowing the value of the sample can be calculated the following way. If they choose action  $a \geq K$  then their expected reward is  $Bx - D(\sigma^2 + x^2 + a^2 - 2ax)$  which is maximized if  $a = x$ . We suppose that  $BK - D\sigma^2 \leq 0$ , i.e. nobody wants to choose  $K$  if  $x < K$ . Therefore,

$$\max_a E^x[R(a)] = \begin{cases} Bx - D\sigma^2 & \text{if } x \geq K \text{ and } Bx - \sigma^2 \geq 0, \\ 0 & \text{otherwise.} \end{cases} \quad (2)$$

To evaluate the value of sample information before buying the sample, consumers have to use the predictive distribution of  $x$  to calculate the expectation of the above expression, given their prior (i.e. a priori  $x$  is a random variable). Thus, their expected reward for sample information is

$$ERSI = \begin{cases} B\theta - D\sigma^2 & \text{if } \theta \geq K \text{ and } B\theta - D\sigma^2 \geq 0, \\ 0 & \text{otherwise.} \end{cases} \quad (3)$$

Given that their optimal action is  $a = 0$  without the sample, the expected value of sample information is  $E V S I = E R S I - 0$ , which is (3).

The potential customers of the consultant are those consumers for who  $\theta \geq K$ . But not all of these will buy, since for some  $B\theta - D\sigma^2$  is still negative. Now suppose that it is common knowledge that  $\theta - K$  is distributed uniformly across the potential customers of the consultant ( $U(0, C)$ ).<sup>2</sup> Then, if the consultant sets his price for the sample to be  $p$ , the net surplus of a potential customer with prior mean  $\theta$  for buying the sample is

$$U = \begin{cases} B\theta - D\sigma^2 - p & \text{if he buys it,} \\ 0 & \text{otherwise.} \end{cases} \quad (4)$$

Assuming that potential customers maximize their net surplus the demand faced by the consultant is

$$D(p) = \Pr(U > 0) = \Pr(\theta > \frac{D\sigma^2 + p}{B}) = 1 - \frac{D\sigma^2 + p}{CB}. \quad (5)$$

If we assume that  $CB = 1$  and  $D = 1$  then we have exactly the same demand as in the paper.

---

<sup>2</sup>This does not mean that the priors of the consumers are not rational since nobody knows what is the distribution of  $\theta$ -s of the consumers who are not potential customers.

## Appendix D: The case of a symmetric oligopoly

In this appendix we would like to provide a solution for the game when there are  $N$  symmetric competing firms and the customers buy zero, one or  $N$  reports. First consider the case where it is optimal to buy only one report. For this to be true the following must hold:

$$U_1 = \theta - \sigma^2 - p > U_n = \theta - \frac{\sigma^2}{n}(1 + \rho(n-1)) - np$$

for each  $N \geq n \geq 2$ . It is easy to show, by induction, that the above condition is fulfilled for all  $n > 1$  if it holds for  $n = 2$ . So we have to have:

$$U_1 = \theta - \sigma^2 - p > U_2 = \theta - \frac{\sigma^2}{2}(1 + \rho) - 2p.$$

This leads to condition (3) of section 3 in the paper. Demand in this case is  $D = 1 - \sigma^2 - p$  and we can formulate the game as an output game:

$$p = 1 - \sigma^2 - \sum_{j=1}^N q_j.$$

Consultants maximize:

$$\pi_i = [1 - \sigma^2 - \sum_{j=1}^N q_j]q_i.$$

Using symmetry, this leads to  $q_i = \frac{1}{N+1}(1 - \sigma^2)$ . Market price is:  $p_C = \frac{1}{N+1}(1 - \sigma^2)$  and condition (3) of the paper is fulfilled if and only if:

$$(N+1)\rho > (N+3) - 2/\sigma^2, \quad (6)$$

which is equivalent to (2) in the paper when  $N = 2$  and  $\sigma_1 = \sigma_2$ .

When consumers buy  $n = N$  reports we have:

$$U_N = \theta - \frac{\sigma^2}{N}(1 + \rho(N-1)) - Np > U_k = \theta - \frac{\sigma^2}{k}(1 + \rho(k-1)) - kp$$

for all  $k < N$  to hold. One can show that it is sufficient to consider the condition for  $k = N - 1$ . This leads to:

$$p < \frac{1}{N(N-1)}\sigma^2(1 - \rho). \quad (7)$$

Demand faced by *each* consultant is  $D_i = 1 - \frac{\sigma^2}{N}(1 + \rho(N - 1)) - \sum_{j=1}^N p_j$ .  
Solving for price using symmetry we get:  $p = \frac{1}{N+1}[1 - \frac{\sigma^2}{N}(1 + \rho(N - 1))]$ .  
Condition (7) holds if and only if:

$$(N - 3)\rho > \frac{N - 1}{\sigma^2} - 2. \quad (8)$$

This is equivalent to condition (4) of section 3 in the paper if  $N = 2$  and firms are symmetric.