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SELLING INFORMATION ON THE INTERNET

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Abstract

The Internet provides a new marketplace for the sale of information. Firms who want to make profits from selling information on the Internet must succeed in reducing quality uncertainty, restricting information resale, and finding optimal price-quality combinations. This article develops solutions to each of these three problems and compares the solutions with respect to their profit and welfare effects.

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JEL classification: D82, M31.

I. *Introduction*

The Internet is the fastest growing medium of information transmission. If the current trend continues the Internet will overtake printing and television as the most important media for the sale of information. Firms who want to sell information on the Internet face a variety of problems. First of all, information producers have to overcome the information paradox (Shackle 1952, Arrow 1971): Consumers will not purchase information unless they can assess its value. In order to assess its value, consumers must know the information. Once they know the information, however, they do not want to purchase it anymore.

Secondly, information producers have to find a way to restrict information resale and redistribution in order to be able to cover production costs. Unlike traditional goods, information can be consumed and resold or redistributed because it can be copied at zero cost and does not lose its value through consumption. Since resellers do not have to cover production costs they can resell information at discount prices. Information producers will be unable to earn profits unless information resale and redistribution are effectively restricted.

Finally, information producers have to find profit maximizing price-quality combinations for their products. Standard marketing models and pricing formulas will provide little assistance. These tools have been designed for the sale of standard economic goods. Information distinguishes itself from standard economic goods by a set of unique characteristics. These characteristics cause specific problems for information producers who want to sell their product on the Internet.

This article describes the problem of selling information on the Internet and suggests

various solutions. It is organized as follows. Section 2 describes the unique characteristics of information products. Section 3 compares methods of reducing quality uncertainty. Section 4 discusses alternative methods of restricting information resale and redistribution. Section 5 analyzes the impact of price-quality discrimination on the information producer's profit. Section 6 concludes.

II. *Unique Characteristics of Information Goods*

Information products differ from standard economic products in many ways. The distinguishing characteristics of information products include the information paradox described in the Introduction, zero marginal costs, and non-rivalrous consumption.

Zero marginal costs

The cost of producing information and selling it on the Internet does not depend on quantity. Marginal costs are zero. The costs of providing information to a single customer do not differ from the costs of providing information to any other number of consumers. For a given quality q, the cost function reduces to

(1) Total Costs$=$F

where F denotes the amount of fixed costs. In this case, the standard pricing formula of choosing a price that sets marginal revenue equal to marginal cost does not maximize the firm's profit. In fact, it would result in a price equal to zero and losses equal to F.

As a result of this cost structure the efficient number of information providers in each market is one. Situations in which providers share an information market are inefficient. All information providers will be better off if one provider buys the market share of each rival provider for an amount x which is larger than the rival's profit and smaller than the rival's revenues.

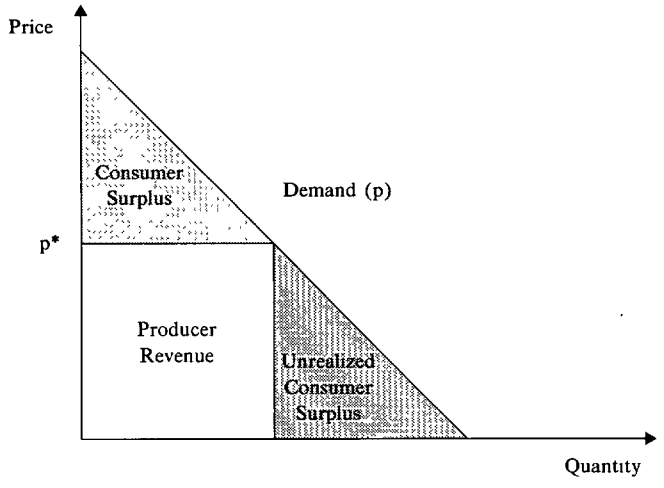
Since marginal costs are zero it is inefficient to exclude anybody who values the information from consuming it. This creates the following dilemma: in order to avoid Pareto-inefficiency nobody shall be excluded from consumption. If nobody shall be excluded from consumption information must be a free good. If information is a free good, however, information producers cannot cover their production costs F and, therefore, will not produce the information.

Non-rivalrous consumption

The use of information by one consumer does not affect the amount of information available to other consumers. Information, especially if provided on the Internet, can be consumed by an unlimited number of consumers. As long as information does not lose its value through consumption, it can be consumed *and* resold. This makes it impossible for information producers to cover their production costs F. As a result, the market for information will break down. For a description of this problem, consider the situation depicted in Figure 1.

If the producer tries to sell its information at a price p* which solves

FIGURE 1. INCENTIVES FOR INFORMATION RESALE



$$(2)\quad \max_{p} \text{Profit} = \text{Demand}(p)\, p - F$$

only those consumers who attribute a value $v \geq p^*$ to the information are potential buyers. By buying the information they will realize an aggregate consumer surplus equal to the upper (light-shaded) triangle of Figure 1.

If the information is sold at p^* there are strong incentives to resell it at a price p_1 satisfying $0 < p_1 < p^*$ to consumers who attribute a value v satisfying $p_1 \leq v < p^*$ to the information. By reselling the information at a price p_1 the reseller can capture some of the remaining consumer surplus represented by the lower (dark-shaded) triangle in Figure 1. Once the information has been resold at a price p_1 satisfying $0 < p_1 < p^*$ there are incentives to resell it again at a price p_2 satisfying $0 < p_2 < p_1$ to consumers who attribute a value v satisfying $p_2 \leq v < p_1$ to the information. This process will continue until the resale price tends towards zero. Rational consumers will anticipate this process and refrain from buying the information until the resale price tends towards zero. Since resellers can always resell the information at lower prices than producers, who have to cover production costs F, information producers will be unable to earn positive returns. The market for Internet information will break down unless producers can find a way to restrict information resale.

III. *Reducing Quality Uncertainty*

In order to establish a market for information on the Internet, information producers must overcome the information paradox, i.e. they have to reduce the quality uncertainty associated with their product. The quality uncertainty of information offered on the Internet can be reduced through signaling, reputation, and the sale of byproducts.

3.1 Signaling

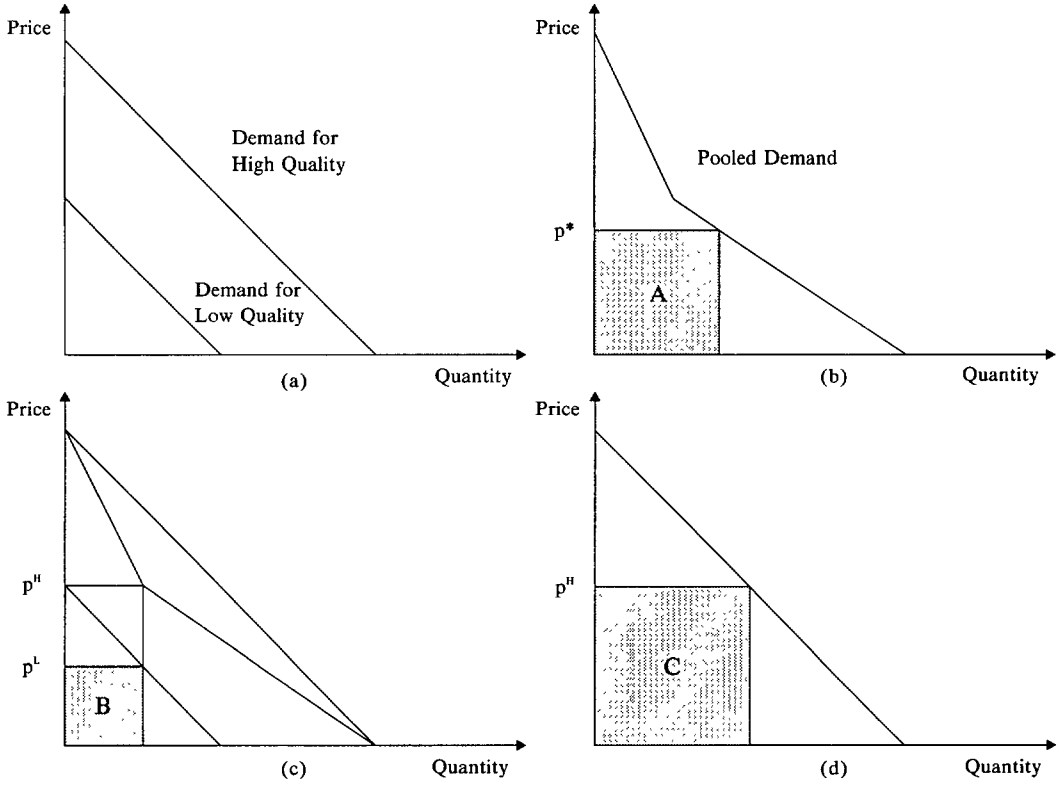
Signaling is a method of communicating information quality without revealing any information content. Instead of revealing their information, producers transmit a signal from which consumers can accurately deduce quality. Potential signals are prices, advertising, and warranties.

Price

Bagwell and Riordan (1991) have shown that high-quality producers can signal high quality by charging high prices if some consumers know the true quality. This high-price strategy works because the loss of sales volume resulting from a high-price strategy is more damaging to low-quality than to high-quality producers. If the price charged by high-quality producers is high enough it will not be profitable for low-quality producers to mimic high quality.

In information markets, high prices may signal high quality even if all consumers are uninformed. Assume that there are two producers. The first produces high-, the second low-

FIGURE 2. SIGNALING QUALITY THROUGH PRICES



quality information. Since marginal costs are zero both producers are oligopolists. Consumers are willing to pay a higher price for high quality than for low quality. The respective demand functions are depicted in Figure 2(a).

If consumers are uninformed about quality, low-quality producers will compete with high-quality producers for market share. Assuming that quality uncertainty does not affect the demand for low quality but reduces the demand for high quality by 50%, producers will face the *pooled* demand curve depicted in Figure 2(b). In this case, the profit maximizing price will be p*. Total revenue is represented by the shaded area A, with each producer's expected share equal to A/2.

If the high-quality producer charges p_H instead of p*, the low-quality producer can no longer benefit from mimicking high quality. If the low-quality producer mimics high quality by charging p_H, its revenue will equal the shaded area B of Figure 2(c). This is exactly the same revenue the low-quality producer will earn by charging p_L. If the low-quality producer charges p_L, prices will signal quality and the pooled demand will be separated into high- and low-quality demand. The high-quality producer will benefit from this separation because its revenue will increase to an amount equal to the shaded area C in Figure 2(d). If the high-quality producer charges a price slightly higher than p_H, the low-quality producer will no longer be indifferent about mimicking high quality and signaling low quality, but will strictly prefer to reveal true quality.[1]

Advertising

The idea that advertising may signal product quality has been introduced by Nelson (1974). He differentiates between *search goods* and *experience goods*. The quality of search goods can be verified by inspection. The quality of experience goods, on the other hand, can only be verified by using (experiencing) the goods. Ads for search goods are directly informative, because producers cannot benefit from misleading consumers about product quality. Producers may, however, benefit from misleading consumers about the quality of experience goods. As a result, ads for experience goods cannot directly inform consumers about product quality. These ads must convey information beyond their obvious informational content.

Basically, information is a search good. Its quality can be assessed upon inspection. Due to the information paradox, however, information is transformed into an experience good. Producers do not allow consumers to inspect the information without buying it. Consequently, advertisements cannot directly inform consumers about product quality. Producers may benefit from misleading consumers about the quality of the offered information. Ads can, however, inform consumers about the willingness of producers to incur advertising costs. If this willingness differs for high- and low-quality producers, advertising may be a credible signal of product quality.

Consider the previous example of two oligopolists producing high and low quality, respectively, and consumers who are willing to pay a higher price for high quality than for low

[1] The argumentation rests on the assumptions that (1) both producers credibly commit themselves not to reduce their prices and (2) the high-quality producer sets its price first. Then, the low-quality producer has no incentive to set its price above the high-quality producer's price given that the high-quality producer set a price of at least p_H because this would force the high-quality producer to increase its price in response.

quality (as depicted in Figure 2(a)). If uninformed consumers reduce their demand for high quality to 50%, both producers will face the pooled demand depicted in Figure 2(b). If both charge the profit maximizing price p*, total revenue will be equal to the shaded area A, with each producer's expected revenue equal to A/2. Note that A/2 is both larger than B and smaller than C, the respective revenue of the low- and the high-quality producer in case of perfectly informed consumers. If the high-quality producer incurs advertising costs of at least A/2−B, the low-quality producer will no longer benefit from mimicking high quality. The benefits of mimicking high quality, an increase in revenue of A/2−B, will be offset by the advertising costs of A/2−B. If the high-quality producer incurs advertising costs in excess of A/2−B, the low-quality producer will lose profits by mimicking high quality. As soon as the low-quality producer is deterred from mimicking high quality, the pooled market will be separated and the high-quality producer's revenue will increase from A/2 to C. Consequently, the high-quality producer will benefit from deterring the low-quality producer from mimicking high quality if the resulting advertising costs do not exceed C−A/2.

Warranties

Like prices and advertising costs, warranties can separate pooled markets based on cost-benefit differences between high- and low-quality producers (see e.g. Spence 1977). In addition, as Grossman (1981) has shown, warranties may reduce quality uncertainty in monopolistic markets where only a single seller offers a product whose quality cannot be assessed through inspection, a situation typical for many information markets.

If consumers are risk averse and the seller is risk neutral, it is Pareto-optimal to sell the product with a full warranty. Knowing this, consumers will conclude that a seller who offers less than a full warranty tries to mislead them about product quality, because a seller would only offer less than a full warranty if it made him better off. But then, the offer must make consumers worse off.

Unfortunately, these arguments cannot be applied to information markets. Information cannot be repaired or replaced in the same way as physical goods, such as cars or refrigerators. Information is primarily used to make decisions. The quality of a decision depends on the quality of the information on which the decision is based. Bad information results in bad decisions. Whether information is good or bad usually becomes apparent only after a decision had been made and its consequences are felt. At this stage, it is of little help to replace or repair the bad information. The decision cannot be reversed. To undo the damage, the information producer has to compensate consumers based on the consequences of their bad decisions. Such compensation is impossible because of prohibitively high assessment costs. Consider, for example, an investment bank which offers to predict stock market movements. A money-back-guarantee is not a credible signal of quality, because it will not deter low-quality producers from mimicking high quality. Offering full compensation of all potential losses, on the other hand, would transform the offer into a bet whose risk cannot be calculated by the investment bank. Information producers who want to signal high quality through warranties are confronted with the following dilemma: Money-back-guarantees will not deter low-quality producers from mimicking high quality. Additional guarantees, on the other hand, are too costly, because they put even a high-quality seller in the situation of a bookmaker offering non-calculable one-sided bets.

Welfare effects

Signaling may have positive as well as negative welfare effects. Positive welfare effects may result from the reduction of quality uncertainty. If this reduction leads to higher demand for Internet information, social welfare will increase because the marginal cost of satisfying additional demand for Internet information is zero. Signaling costs, on the other hand, represent a welfare loss. If quality is signaled through prices the net effect cannot be negative because signaling costs are zero. Ads and warranties, on the other hand, are costly signals. Their net effect may be positive or negative.

3.2 Reputation

If signaling is impossible, information producers may reduce quality uncertainty by building a reputation. Having built a reputation, sellers may offer their reputation as a hostage to assure consumers that the offered information is of high quality (see Williamson 1983). Since producers who sell low-quality information will lose their reputation, the offer is credible if the value of the reputation exceeds the short-term profits from selling low quality.

In order to build a reputation, however, information producers have to incur losses when they first enter the market. Since they do not have a reputation at that stage, they cannot charge high-quality prices for their information despite the fact that their information actually is of high quality. Often, they have to provide their high-quality information for free, because consumers will be reluctant to purchase information from newcomers. From the perspective of information producers, reputation is an effective yet costly instrument for reducing quality uncertainty. From a social perspective, the cost of building a reputation, i.e. profit losses, is fully compensated by gains in consumer surplus. If building a reputation eventually results in higher profits, quality reduction through reputation will lead to welfare gains.

3.3 Selling Byproducts

Companies who provide information on the Internet produce attention as a byproduct. Attention is a scarce and highly valuable product. Political parties and companies are willing to spend huge amounts in order to attract attention. The value of attention opens new doors for information providers to escape the inherent problem of quality uncertainty in information markets. Instead of selling their main product, information, producers may be better off by selling the highly valued byproduct of Internet information, attention. The quality of attention can easily be assessed by counting the hits on a site. There are no adverse selection or moral hazard problems of selling attention. The information producer has strong incentives to attract large amounts of attention. Unlike information, attention cannot be resold. Information producers may even built a reputation for providing high-quality information when selling attention instead of information.

If an information producer is better off by selling attention instead of information, society as a whole will also be better off. A producer will sell attention instead of information only if the profits from selling attention exceed the profits from selling information. Consumers are also better off if the producer decides to sell attention instead of information. If consumer surplus decreased as a result of the ads that accompany the information, the producer could increase its profit by selling attention and ad-free information. Then, consumers have the

choice of buying ad-free information or consuming free but ad-accompanied information.

IV. *Restricting Information Resale and Redistribution*

In order to be able to earn profits from selling information or its byproduct, attention, on the Internet, information producers have to find a way to restrict information resale and redistribution. There are various methods of restricting information resale and redistribution. These methods include the definition of copyrights, incorporation, specificity, and depletion.

4.1 Copyrights

Copyrights restrict unauthorized resale and redistribution by legally transforming Internet information from a public into a private good. Nevertheless, the restriction of unauthorized resale and redistribution does not automatically establish a market for Internet information. Copyrights restrict unauthorized resale and redistribution. They do not eliminate incentives for price discrimination. As shown in Figure 1, information producers have strong incentives to sell their information at a discounted price p^*-d after they sold their information at a profit-maximizing price p^*. By selling the information at a discount, producers try to capture some part of the remaining consumer surplus represented by the dark-shaded triangle of Figure 1. Since there will always remain an uncaptured consumer surplus as long as $p^*-d>0$, this process will continue until the discounted resale price p^*-d tends towards zero. If consumers will anticipate price discounts, however, the information producer cannot sell its product at p^* nor at any discount $p^*-d>0$. Again, the market will break down.

In order to establish a market for Internet information, copyrights are not sufficient. Information producers must eliminate price discrimination. However, price discrimination cannot be eliminated in perfectly competitive information markets. In perfectly competitive information markets, each producer can increase its profit by offering price discounts. As a result, perfectly competitive information markets will break down. In monopolistic information markets, on the other hand, producers will refrain from price discrimination in order to protect future rents.

Despite resulting in monopolies, copyrights will make consumers and producers better off. Protected by copyrights, monopolists will sell their information at a profit maximizing price p^* (see Figure 1). Compared to a market breakdown, consumer surplus will increase from zero to an amount equal to the light-shaded triangle of Figure 1. Profits will increase from zero to an amount equal to the quadrangle (representing producer revenue) minus production costs F. Whether society as a whole will be better off depends on the costs of defining and enforcing copyrights. If these costs are lower than the sum of consumer surplus and producer profits, society as a whole will be better off.

4.2 Depletion

Information producers often protect themselves against unauthorized resale and redistribution by producing depletive information. Basically, there are two forms of information depletion. The first kind of depletion is caused by usage. The second kind is caused by the

passage of time.

Investment recommendations provide a typical example of the first kind of information depletion. Buy or sell recommendations successively lose their value as investors act according to the recommendations and buy or sell securities. Market prices rapidly incorporate the information. As soon as market prices have adjusted to the new information it becomes worthless. Weather forecasts, on the other hand, are an example of time-based information depletion.

Information producers can protect themselves from unauthorized resale without relying on copyrights if any resale process takes longer than the depletion process. In the era of printing, for example, newspapers could earn large profits on sensational headlines without relying on copyrights. In the era of the Internet, depletion provides no protection from unauthorized resale. The instant speed of the Internet enables competitors to resell or redistribute information that is not protected by copyrights at discount prices before its value has significantly decreased.

4.3 Incorporation

Information resale and redistribution can be restricted by incorporating information into excludable and depletive goods. After incorporating the information into excludable and depletive goods, these goods can be sold at profit maximizing prices. However, this method will only be effective if the product does not reveal the information. Otherwise, competitors can sell product imitations at lower prices because they do not have to incur the original costs of production.

Leland and Pyle (1977) have shown how commercial banks sell their screening and monitoring information by incorporating it into bank accounts. Commercial banks are financial intermediaries who produce investment relevant information by screening and monitoring lenders. As a result of economies of scale, commercial banks produce screening and monitoring information at lower costs than individual lenders. The non-excludable and non-depletive character of this information prevents commercial banks from selling their information directly to lenders. Instead, commercial banks incorporate their screening and monitoring information into excludable and depletive bank accounts and, in turn, sell these bank accounts to individual lenders.

Information incorporation is a widely used method. Coca Cola, for example, does not sell its soda formula, but sells soft drinks instead. Warren Buffet and George Soros do not sell their investment recommendations, but are selling shares of Berkshire Hathaway and Quantum Fund. Commercial banks, Coca Cola, Warren Buffet and George Soros are all successfully incorporating information into products which do not reveal the information. Bank accounts do not reveal the screening and monitoring information produced by commercial banks. Coca Cola's competitors cannot reconstruct and imitate the soda formula from the final product. Holding companies such as Berkshire Hathaway and investment funds have to disclose their financial transactions. However, these transactions have to be reported periodically, not instantaneously. This time lag combined with the high volatility of financial markets precludes competitors from successfully imitating investment gurus like Warren Buffet and George Soros.

From an efficiency perspective, incorporation is Pareto-superior in comparison to copy-

rights. Both methods, incorporation and copyrights, lead to the same level of consumer surplus and profits. Contrary to copyrights, however, incorporation achieves this result without incurring any additional costs.

The disadvantage of incorporation as a method of selling information on the Internet is its limitation to situations in which the respective information can be embodied into excludable and depletive immaterial goods. Stocks, investment funds, and bank accounts, for example, can effectively be sold through the Internet. If the respective information can only be embodied into physical goods the role of the Internet will be reduced to an advertising medium. Soft drinks, for example, can only be advertised, but not be distributed through the Internet.

4.4 Specificity

The degree of information specificity k can be measured by the standardized difference of the information value to the highest-valuing (v_1) and the second-highest valuing consumer (v_2).

(3) $k=(v_1-v_2)/v_1$

Highly-specific information ($k=1$) has a resale value of zero. Only one consumer values the information and is willing to purchase it. General (unspecific) information ($k=0$), on the other hand, is equally valued by a number of consumers.

Highly specific ($k=1$) and general ($k=0$) information are the extremes of a continuum of degrees of information specificity. The danger of a profit threatening resale or redistribution increases along this continuum. General information can easily be resold whereas highly specific information has a resale value of zero. Consequently, information producers can restrict information resale and redistribution by selling specific information. Lawyers, psychics, and consultants provide examples.

From an efficiency perspective, specificity is comparable to incorporation. It restricts resale without imposing additional costs like copyrights. Unlike incorporation, however, specificity is not a method to be chosen by the information producer. It is an intrinsic characteristic of the respective information.

V. *Price-Quality Discrimination*

Producing and providing information on the Internet involves large economies of scale. Marginal costs are zero. As a result, cost-based pricing formulas, such as price should equal marginal cost, are inappropriate. Demand-based pricing is more suitable. In addition, offering only one price-quality combination may not be efficient. Price-quality discrimination may enhance profits and consumer surplus.

Subsection 3.1 analyzed situations in which high-quality producers offer a different price-quality combination than low-quality producers in order to establish a fully separating signaling equilibrium. This section focuses on situations in which a single firm offers different price-quality combinations to separate consumers according to their willingness-to-pay.

Since marginal costs are zero, an information provider will try to maximize profit by maximizing revenue. If consumers differ with respect to their willingness-to-pay for the

information, a revenue-maximizing strategy may involve price-quality discrimination. By offering different price-quality combinations, producers attempt to induce consumers to *self-select* by choosing the appropriate combination. Consumers with a high willingness-to-pay shall be induced to choose a high price-quality combination. Consumers with a low willingness-to-pay shall select a low price-quality combination.

Consider the following numerical example. There are N consumers which can be divided into two groups: a fraction α has a willingness-to-pay of $50-2q$ for information of quality q.[2] The other fraction, $(1-\alpha)$, has a willingness-to-pay of $40-2q$. For simplicity, the marginal cost of producing incremental quality shall be zero. The example can easily be modified for any non-constant cost of producing quality.

If the producer could identify ex ante, i.e. before selling, to which group a consumer belongs, it would sell quality $q_H=25$ at price $p_H=625$ to the high-willingness-to-pay consumers and quality $q_L=20$ at price $p_L=400$ to the low-willingness-to-pay consumers.[3] Total profits would amount to $(400+225\alpha)N-F$.

This kind of quality discrimination is hardly feasible when selling information on the Internet. The producer cannot identify ex ante to which group a consumer belongs. In this case, the producer can choose to produce quality $q_H=25$ and sell it at price $p_H=625$ to the high-willingness-to-pay consumers. This solution is Pareto-inefficient, because the producer and the low-willingness-to-pay consumers can be made better off by selling the same quality of information at a price $0<p_L<375$ to the low-willingness-to-pay consumers. If the producer decides to sell the same quality of information at a lower price, however, the high-willingness-to-pay consumers will no longer want to pay a price of 625.

It seems as if the producer has only two choices: (1) restrict quality to $q_H=25$, sell it at $p_H=625$ to the high-willingness-to-pay consumers, and realize profits of $625\alpha N-F$ or (2) sell quality $q_L=20$ at price $p_L=400$ to all consumers and realize profits of $400N-F$. However, there is a third choice. The producer could discriminate between consumers on the basis of their price-quality preferences by offering price-quality combinations that induce consumers to self-select the offer designed for their respective group. Offering $q_H=25$ at $p_H=625$ and $q_L=20$ at $p_L=400$ does not fulfill the self-selection requirement because the high-willingness-to-pay consumers will select (q_L, p_L) instead of (q_H, p_H). In order to induce high-willingness-to-pay consumers to purchase q_H the producer has to reduce p_H to 425. In this case, total profits will be $(400+25\alpha)N-F$.

The story does not end here. The producer may increase profits even further. By deliberately reducing the lower quality, the producer can increase the price charged for high quality information without hurting the self-selection constraints. A deliberate reduction of the lower quality from q_L to a level q_L' will reduce the surplus from sales to low-willingness-to-pay consumers by $[400-40q_L'+(q_L')^2](1-\alpha)N$ and will increase the surplus from sales to high-willingness-to-pay consumers by $(200-10q_L')\alpha N$. If the producer, for example, deliberately reduces the lower quality from 20 to 15 the price charged for high-quality information can be increased by 50 to 475 resulting in an increase in surplus of $50\alpha N$ from sales to high-willingness-to-pay consumers. Low-willingness-to-pay consumers, on the other hand, will

[2] The willingness-to-pay is the derivative of the inverse demand function.

[3] The optimal levels of q are computed by setting the willingness-to-pay function equal to zero and solving for q. The respective prices are computed by integrating the willingness-to-pay function.

demand a quality-induced price reduction of 25 to 375 resulting in a decrease in surplus of 25 $(1-\alpha)$N. The net effect of this deliberate quality reduction is $25(3\alpha-1)$N. In our example, the profit maximizing level of q_L' is $20-5\alpha/(1-\alpha)$ if $0\leq\alpha\leq 4(1-\alpha)$ and 0 if $\alpha>4(1-\alpha)$. In the latter case, the net effect of a deliberate quality reduction is negative and the producer is better off by restricting quality to $q_H=25$.

The Internet provides many opportunities for price-quality discrimination. WWQuote[4], for example, offers three price-quality combinations. Investor Premium is the high price-quality package. It is offered at $35.95/month and includes, among others, dynamically updated real-time stock quotes, real-time charting, and real-time company news. Investor Select is the medium package. It is offered at $26.95/month and includes, among others, dynamically updated real-time stock quotes and 15 min. delayed charting. Investor Basic is the low price-quality package offered at $10.00/month and including, among others, dynamically updated delayed (15−20 min.) stock quotes. ESPN[5] provides its insider accounts giving access to insider and background information at $39.95/year. Daily sports information accompanied by commercial links is provided at no charge.

The last example shows that information providers may combine the strategies of price-quality discrimination and selling byproducts. In our numerical example, this combined strategy results in higher profits if there is a quality level q_L'' at which the sum of (1) the *value* of the attention attracted by providing information of quality q_L'' at price $p_L''=0$, and (2) the revenue from selling quality q_H'' at price $p_H''=625-50q_L''+(q_L'')^2$ to the high-willingness-to-pay consumers is larger than total revenue under pure price-quality discrimination.

Internet technology enables producers to fine-tune the quality level of their information and the value of the resulting attention. Commercial links, for example, may be programmed to unfold on the screen before the actual information. This intentional delay, which is commonly used, has several effects. Its direct effects are higher attention and lower quality that may, as an indirect effect, result in lower attention. The optimal level of delay depends on the size of these effects.

Deneckere and McAfee (1996) and Varian (1997) have shown that pure price-quality discrimination does not only increase profits, but may also be Pareto-efficient. This result is counterintuitive, because one would expect that a deliberate reduction in quality resulted in welfare losses. However, this is not necessarily so. High-willingness-to-pay consumers will always be served. As a consequence, price-quality decisions only affect the distribution of the resulting social surplus from serving high-willingness-to-pay consumers. If only the high-willingness-to-pay consumers were served under flat pricing, the entire surplus from serving high-willingness-to-pay consumers would be captured by the producer. Pure price discrimination, in comparison, will transfer parts of this surplus from the producer to the high-willingness-to-pay consumers. The producer will be compensated by additional profits from serving low-willingness-to-pay consumers. Since low-willingness-to-pay consumers end up with zero surplus, the additional profits from serving low-willingness-to-pay consumers represent the welfare gain of pure price-quality discrimination compared to a flat pricing strategy which serves only high-willingness-to-pay consumers.

If all consumers were served under a flat pricing strategy, the welfare effect of pure

[4] http://www.wwquote.com as of September 1998.

[5] http://espn.com as of September 1998.

price-quality discrimination is ambiguous. Deneckere and McAfee (1996) and Varian (1997) provide conditions under which pure price-quality discrimination results in welfare gains.

A combined strategy of price-quality discrimination and selling byproducts enhances social welfare in comparison to pure price-quality discrimination and in comparison to flat pricing strategies which serve only high-willingness-to-pay consumers. A combined strategy assures that low-willingness-to-pay consumers are served and creates additional social surplus from the production and sale of attention. Under a combined strategy, even low-willingness-to-pay consumers may capture parts of the social surplus. Of course, their surplus is offset by lower profits on the part of the producer. The producer compensates this loss by additional profits from selling attention.

Compared to a flat pricing strategy which serves all consumers, the combined strategy may or may not be Pareto-efficient. However, it will always do better in comparison to a flat price strategy which serves all consumers than a pure price-quality discrimination.

VI. *Conclusion*

The Internet is a fast growing market for information. Firms that want to make profits in this market have to overcome a variety of problems. These problems include the reduction of quality uncertainty, the restriction of information resale and redistribution. Signaling, reputation, and the sale of byproducts help to reduce quality uncertainty. Copyrights, incorporation, and specificity restrict unauthorized information resale and redistribution. Moreover, firms have to find profit-maximizing price-quality combinations. In many cases, information providers can increase their profits via price-quality discrimination. By offering alternative price-quality combinations, information producers can extract larger amounts of consumer surplus as consumers self-select into the appropriate category.

Information is an economic good with unique economic characteristics. As a result, market structure and firm behavior cannot be assessed in traditional terms. Unlike traditional markets, information markets are natural monopolies. Zero marginal costs result in an optimal firm size of one. Consumers may benefit from price-quality discrimination if price-quality discrimination induces producers to serve markets that would not be served under nondiscriminatory price-quality strategies.

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