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# **The Economics of Information**

**Dennis W. Carlton and Jeffery M. Perloff**

Food Marketing Policy Center  
Research Report No. 5

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## Acknowledgements

This report is chapter 17 from the authors forthcoming (November 1989) book, *Modern Industrial Organization*. Scott, Foresman and Company, has given permission for the Food Marketing Policy Center to distribute this chapter, but no additional copies may be made without the publisher's permission. The chapter formed the basis of a talk by Dr. Perloff to the NE165 regional research committee at their November 1988 meeting.

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*There is no absolute knowledge. ... All information is imperfect.  
We have to treat it with humility.*

— J. Bronowski

Although most of the economic models discussed in previous chapters [*Modern Industrial Organization*, forthcoming] assume that consumers have perfect information, consumers often do not know which store sells a good at the lowest price or how quality varies across brands. Providing consumers with information about product prices, attributes, or quality alters their purchasing behavior and thereby affects market structure. The results of recent research on markets in which consumers have limited information are startling and contradict the strongest conclusions from the standard economic models based on perfect consumer information. In markets in which consumers have limited information, high-quality products may not be supplied, some of the desirable effects of perfect competition vanish, and firms may have an incentive to reduce consumers' information.

This chapter examines the problems that arise from limited consumer information. It begins by showing that if consumers have limited information about a product's quality, one of two serious problems occurs: either the market does not exist, or if it does exist, the quality produced is different (and usually lower) than in a world of perfect information.<sup>1</sup> For example, often only the lowest-quality products are produced. Providing information through experts, standards, and certification is socially desirable so long as the benefits to consumers outweigh the costs of collecting and disseminating the information. Warranties or guarantees may also eliminate problems due to limited information.

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<sup>1</sup>Many economists call the limited information equilibrium *nonoptimal*, inefficient, or say that it is a *market failure*. Because it is common (though perhaps confusing) terminology, we will refer to departures from perfect competition as inefficient. This terminology implies that a problem exists and can and should be fixed. It is, however, costly to provide perfect information, and the costs of providing perfect information may exceed the benefits. Thus, even though such departures from a perfect world are commonly referred to as nonoptimal, it may not be practical or even possible to correct this market failure.

Next, we show that imperfect consumer information about prices may eliminate a market, enable even small firms to set their prices above marginal cost, or lead to a variety of prices being charged for a homogeneous good. That is, with imperfect consumer information, perfect competition is impossible. In this sense, the *law of supply and demand* and the *law of a single price* do not hold in markets with limited information.

Next, we show that firms may purposely raise consumers' costs of search so as to obtain market power. For example, a firm may charge different prices for the same good at various locations or under different brand names so as to make it more difficult for consumers to find the low-priced brand.

Finally, we present some theories that show that improving consumer information can sometimes lower average price. Some empirical evidence is presented to support these theories.

## 1. Why Information is Limited

Research by psychologists, economists, marketing experts, and others show that consumers have imperfect knowledge of prices and qualities in the marketplaces where they shop. There are five chief reasons for this limited knowledge (Federal Trade Commission 1978).

First, information varies in reliability. Not all "information" is accurate, and hence a rational consumer should not rely equally on information from all sources. Information that was once correct may become dated and therefore inaccurate.

Second, there is a cost to collecting information. It does not pay for consumers to collect information beyond the point where the marginal benefit equals the marginal cost of collecting it. For example, going to several stores to determine which has the lowest price on a candy bar almost certainly does not make sense. See Example 1 in Appendix 2.

Third, consumers can remember and readily recall only a limited amount of information. (See Example 2 in Appendix 2.) They are, of course, more likely to retain and recall relatively important information. Information is easier to retain if it is easily "encoded" by the brain, and such encoding is easier if it fits into an existing pattern. Unfortunately, the prices charged by different stores for the hundreds of products a consumer typically buys are not easily arranged into mean-

ingful patterns. Moreover the typical distribution of prices for a given item is large. One survey of prices in the Boston area found that for 18 of 39 randomly chosen products, the highest price was over twice the lowest, and for 4 products, the higher price was five or more times greater than the lowest (Pratt, Wise, and Zechauser 1979).

Fourth, it is often efficient for consumers to use simplified rules to process information. That is, they rationally use only some of the information they have collected because it is costly to process it. A customer may check a restaurant bill to see if any nonordered items were included but may not check the addition. A sensible consumer processes information up to the point where the marginal benefit equals the marginal cost of processing more information. Such behavior is referred to as bounded rationality.<sup>2</sup>

Fifth, consumers do not have sufficient education or intelligence to process available information on all products correctly. For example, some quite intelligent people do not know how to determine the quality of various computers or industrial organization textbooks, the healthfulness of foods, or the probability that a given plant will survive in their yard. Others lack the math skills to compare the cost of buying a car by paying all the money at once to its cost if they pay for it in relatively small amounts each month for years. See Example 3 in Appendix 2.

## 2. Limited Information About Quality

*Lord Bowen's definition of hard work: Answering yes or no on imperfect information.*

In many markets, consumers do not know how quality varies across brands. Markets where consumers are often unsure about quality include those for professional services (doctors, lawyers, plumbers, and electricians), processed foods, used goods, and complex mechanical or electronic products. In these markets, there is *asymmetric information*: sellers know the quality of the good, but buyers do not. Asymmetric informa-

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<sup>2</sup>See Simon (1957; 1959), Cyert and March (1963), and Williamson (1964).

tion about quality can have either of two undesirable results: the equilibrium may not exist, or, if the equilibrium exists, resources are used inefficiently, compared to markets with perfect information.

## 2.1 The Market for "Lemons"

Probably the best-known study of the way limited information can disrupt a market is George A. Akerlof's (1970) classic analysis of the market for lemons. Akerlof shows that where sellers have perfect information and consumers have extremely limited information, a market may not exist or only the lowest-quality product may be sold.

Consider first the market for new cars. Neither the seller nor the buyer of a new car knows if it is a good car or bad one (a "lemon") that will break down repeatedly. An owner learns the quality of a car after owning the car for a while.

Now consider the used-car market, in which there is asymmetry of information between buyers and sellers. The sellers, who are the current owners, know the quality of the cars, but the buyers do not. At best, a potential buyer knows the probability of getting a good car. As a result, both good and bad used cars must sell for the same price, since buyers cannot tell them apart.

### 2.1.1 Bad Products Drive Out Good Products

Bad cars are overvalued and good cars are undervalued in this market. For example, suppose consumers believe that half the used cars in the market are lemons worth \$100 and the other half are good cars worth \$200. Suppose also that consumers are risk-neutral: they are indifferent between having a dollar and having something that has a 50 percent probability of being worth nothing and a 50 percent probability of being worth \$2. Then the value to a typical consumer of a randomly selected car is \$150 ( $= 0.5 [100] + 0.5 [200]$ ). A buyer who thinks that a car might turn out to be good is willing to pay more than the value of a bad car ( $\$150 > \$100$ ), but the buyer also thinks that it might turn out to be bad and thus is not willing to pay the full value of a good car ( $\$150 < \$200$ ).

A kind of "Gresham's law" for used cars occurs: bad cars drive out good cars.<sup>3</sup> Although an owner of a bad car is delighted to sell it for more than it is worth, an owner of a good car is unwilling to sell it for less than its value and hence keeps it. Thus, in a market with only two types of cars, only the bad cars are sold. Because only bad cars are sold, buyers know they are getting lemons and will only pay the value of a lemon. There is no market for good-quality used cars.

This example can be extended to many qualities of cars, but the result is the same. The lowest-quality cars eventually drive all other cars out of the market by the same sort of reasoning.<sup>4</sup>

These sorts of problems also arise in markets for insurance and for home repair. Healthy senior citizens often have problems buying medical insurance. Why don't insurance companies merely adjust the price of a policy to match the risk? The reason appears to be due to the same sort of adverse selection as in the used-car example: as the price of a policy rises, only the worst risks are interested in buying the policy. If the individual can better determine his or her own health than can the insurance company, the insurance company sells a disproportionate number of policies to the least healthy members of society. Akerlof reports that although 63 percent of a sample of people aged 45 to 54 had hospital insurance, only 31 percent over 65 had such insurance.

Similarly, suppose that some good carpenters use high-quality materials and bad carpenters use low-quality materials.

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<sup>3</sup>Gresham's law, formulated by Sir Thomas Gresham (1519-79), holds that "bad money drives out good." This is, if two monetary measures circulate at values different from their true value, then only the lower value measure survives. For example, if both gold and silver coins are used, and the face values are lower than their metal's value, the more undervalued coins will be melted down first. Akerlof points out that the analogy is not perfect, because both buyers and sellers of the coins know the relevant facts.

<sup>4</sup>Kim (1985), however, shows that if people are free to choose whether they are buyers or sellers, the results may differ. The pure Akerlof model applies better to insurance and similar markets where people cannot easily switch between being buyers and sellers.

If homeowners cannot tell the honesty of a carpenter for many years (e.g., bad materials break down in 5 years and good materials last 10 years) and must pay both types the same amount, the bad carpenters drive out the good ones costs are higher.

### 2.1.2 Asymmetric Information Lowers Quality

Although not all markets with asymmetric information degenerate so that only the lowest-quality item is sold, there is always inefficiency in these markets relative to a world with perfect information: quality levels are too low (Leland 1979a; 1979b). The inefficiencies stem from a discrepancy between private and social returns. Unfortunately, these inefficiencies relative to a perfect world usually cannot be remedied by government intervention, since providing perfect information is often prohibitively expensive.

In an equilibrium with imperfect information, the marginal firm faces a market price just equal to its opportunity cost, such as the value of the used car to the firm. That is, the marginal seller is indifferent between selling and not selling. Since the opportunity cost of higher-quality units is above the market price, the marginal seller's product is the highest quality actually observed in the market.

In such a market, the social value of a unit of the highest quality exceeds the social value of a unit of the average quality level. That is, if consumers can tell the difference in quality, they are willing to pay more for a better-quality product. Unfortunately, the private value (the amount that a buyer is willing to pay) of the highest quality is equal to the average value in equilibrium because buyers cannot distinguish good products from bad ones.

Thus, the market failure can be explained in terms of an *externality*.<sup>5</sup> When a relatively high-quality seller offers a good or service to the market, the average quality rises, and buyers are willing to pay more for all products. The high-quality

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<sup>5</sup>See Chapter 6 [*Modern Industrial Organization*, forthcoming] for a discussion of externalities. An externality arises when the benefits from a firm's actions are not completely captured by the firm.

seller must, therefore, split the benefits of its high-quality product with sellers of lower-quality products by raising the average price to all. Because marginal sellers are not recognized as providing the best available quality, they do not receive the value of their full contribution to social welfare. This wedge between social and private benefits results in quality that is too low and economic inefficiency.

In the used-car example, sellers could not vary the quality of their products; however, firms in most markets can vary the quality of their products. If firms cannot fully capture the value of producing higher-quality goods (an externality), they have an incentive to produce goods of relatively low quality.

### 2.2 Solving the Problem: Equal Information

*I only ask for information.*

— Charles Dickens

The problem of bad products driving out good ones results from the asymmetry of information. Where information is symmetric, markets are more likely to exist. There are two types of symmetric information: either both sides costlessly know the quality of a product, or neither knows.

If both buyers and sellers know the quality of used cars, prices reflect the true values of cars. Good-quality cars sell for more than bad-quality cars. There are no inefficiencies. We studied competitive markets with perfect information in Chapter 4 [*Modern Industrial Organization*, forthcoming].

If sellers know no more than buyers (as with new cars), then good and bad cars are sold at a price that reflects an average of the two qualities. That is, the price does not reflect the true value of a given car, but it does equal the expected value. Thus, where there is symmetric, but imperfect information, markets do not vanish. Whether it pays for consumers (or sellers) to obtain information, however, depends on the costs of obtaining it as well as its benefits. Where costs of obtaining information are relatively low, consumers obtain the information and markets function smoothly; if costs are high,



the information is not gathered and inefficiency results.<sup>6</sup> See Examples 4 and 5 in Appendix 2.

Consumers obtain information in at least five ways. First, by providing credible guarantees or warranties, sellers of high-quality goods credibly convey the information to consumers that their products are of high quality. By providing consumers with equal information, such firms are able to charge higher prices that reflect the higher quality of their goods.

Guarantees only convey this information if they are credible. For example, a guarantee on a used car provided by an established dealer is more credible than one from an individual. After all, a buyer only believes a guarantee is valuable if the buyer believes the seller can be found and made to honor the guarantee in the future. Thus, guarantees or warranties are only offered where the seller can establish credibility.<sup>7</sup>

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<sup>6</sup>In some markets, price may convey the information necessary for consumers to infer relative qualities of different products; in others, price is not a good indicator. See Grossman and Stiglitz (1980) and Cooper and Ross (1984). Ginter, Young, and Dickson (1987) survey studies of the relationship between price and quality in many different types of markets (clothing, cameras, shoes, food, small appliances, and others) and find that the correlation between price and quality is almost always low. In all studies, the average correlation was less than 0.29. On the other hand, price does correlate well with some major purchases of durable goods (Gerstner 1985; Tellis and Wernerfelt 1987; and Curry and Reisz 1988). Smallwood and Conisk (1979) and Chan and Leland (1982) contend that high prices should be correlated with high quality when there are informed consumers. Bagwell and Riordan (1988) show that when quality is fixed, a high price can signal high quality if higher-quality goods cost more to produce. Klein and Leffler (1981) argue that high prices signal high quality as a payoff for the repeated choice of the high-quality good by consumers. These theoretical issues are discussed in more detail below and in the next chapter [*Modern Industrial Organization*, forthcoming].

<sup>7</sup>A Federal Trade Commission study found that only 4.8 percent to 14.8 percent of consumers carefully study guarantees and warranties before purchasing; thus, in many markets, they may be provided for other reasons than to signal quality before purchase (Crocker 1986).

Typically, guarantees are only provided if the life of a product does not depend heavily on how consumers use it. Otherwise, buyers have an incentive to use the product relatively carelessly and rely on the seller to fix problems under the warranty. This incentive for a consumer to behave carelessly when the product is covered by a guarantee that the seller will fix all problems (even those caused by the consumer) is called a moral hazard.

Second, a store or manufacturer may rely on its reputation to signal that its goods are of high quality. A store that expects repeated purchases by a consumer if it provides high-quality products has a strong incentive not to provide defective products.

Third, liability laws may also serve the same function as explicit warranties. If consumers know that liability laws or contract laws force the manufacturer to make good on defective products, then the manufacturer need not provide an additional warranty. The problem with relying on legal recourse, however, is that the transaction costs are very high. Thus, manufacturers may find that explicit warranties are still necessary.

Fourth, a disinterested party, an *expert*, may be able to provide consumers with reliable information. For example, if a potential purchaser of a used car can take it to a mechanic and get it appraised, then any information asymmetry may be eliminated.

Fifth, the government, consumer groups, industry groups or others may provide information in the form of standards and certification. Standards are established for a particular good by defining a metric, or scale, for evaluating that product. For example, the R-value of insulation tells how effectively it works. Certification means that a particular product has been found to meet a standard.

Industry groups may set their own standards and get an outside group or firm, such as Underwriters' Laboratories (UL) or Factory Mutual Engineering Corporation (FEMC), to certify that their products meet these standards. Often standards are set to guarantee conformity across brands. For example, a VHS video-recorder owner is assured that a VHS tape manufactured by another firm works in that machine.

Government agencies may require manufacturers to disclose information about their products, such as the energy consumption of an electric appliance or the potentially harmful side-

effects of certain drugs. Governments may set and enforce minimum quality standards by requiring that professionals be licensed or that drugs be effective. Governments also may set fines to guarantee that firms meet standards or liability rules requiring firms to recompense consumers if products malfunction.

Consumer groups may publish comparisons of different brands, as in Consumers Union's *Consumer Reports*. Some consumer groups set their own standards, such as the National Society for the Prevention of Blindness, a prime mover in setting standards that promote eye safety (Hemenway 1975, 62). For an outside organization to provide believable the information problem, it must convince consumers that it is trustworthy and is not deceiving them. For example, Consumers Union attempts to establish its trustworthiness by refusing advertising or other payments from firms.

Objective information supplied by outside organizations is rare because information is a public good: a good that, if it is supplied to anyone, can be supplied to others at no extra cost. Information is socially valuable if it is worth more (say to consumers) than it costs to provide it. Although socially valuable information may exist, it is possible that no firm can profitably provide it because it cannot capture all the benefits. Consumers Union does not capture the full value of its information through subscriptions because subscribers to *Consumer Reports* loan their copies to friends, libraries stock the journal, and newspapers report on its findings. As result, Consumers Union does not engage in as much research as it otherwise would.

### 2.3 Standards and Certification May Help or Hurt

Unfortunately, standards and certification may either help or hurt. They are harmful if their information is degraded or misleading, or if they are used for anticompetitive purposes. Where consumers are inexpensively informed of the relative quality of all goods in a market, the information is unambiguously useful. Often, however, information is degraded. For example, although quality may vary along a continuous scale, only a high- versus low-quality rating may be used. In this case, products are likely be made so that they have either the lowest possible quality (and hence cost of manufacture) or just

barely a high enough quality level to obtain the high quality rating.

Such high-low rating schemes are often combined with the exclusion of low-quality goods or services. For example, many state and local governments license professionals, and only those meeting some minimum standards are granted licenses and allowed to practice. In most states dozens, if not hundreds, of professions and crafts are licensed, such as electricians, plumbers, dentists, psychologists, contractors, and beauticians. Licensing has two offsetting effects (Leland 1979a; 1979b). First, the restrictions raise the average quality in the industry by eliminating low-quality goods or services. Second, these restrictions raise the prices consumers pay. The number of people providing services is reduced because the restrictions screen out some potential suppliers. Moreover, consumers are unable to obtain the lower-quality and less expensive goods or services. As a result, welfare may go up or down depending on whether the increased-quality or the higher-price effect dominates. Only by setting the standard properly and changing it as necessary over time can welfare be raised. Whether such restrictions can be set properly and cost-effectively by government agencies is debatable.

A better solution than trying to set the best possible standard is to provide consumers with objective information on the relative quality of each brand or professional, and let them judge whether the price savings justifies purchasing a low-quality good or service. Restrictions may be superior to providing such information only if consumers are unable to understand more subtle grading systems or it is too costly for consumers to train themselves to use this information.

A further problem with licensing or mandatory standards and certification is that they can be used for anticompetitive purposes, such as erecting entry barriers to new firms and products. For example, many model plumbing and building codes required that pipes be made of copper or a few other types of materials and have certain dimensions (Federal Trade Commission 1978, 162-63). As a result, manufacturers of plastic pipe faced problems in introducing their products.<sup>8</sup>

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<sup>8</sup>One reason for the building-code restrictions on plastic pipes is that they can be installed more quickly and by less skilled labor than copper pipes. As a result, plumbing unions

These mandatory standards in building codes impeded the diffusion of innovations (Oster and Quigley 1977).

Many professions license themselves under government auspices. Thus, doctors, lawyers, electricians and others may set their own licensing standards. These groups may define standards that prevent entry of professionals from other states or who have just finished their education, so as to keep the wages of currently licensed professionals high. Here, licensing is very likely to be socially harmful, since it excludes qualified professionals and raises consumers' costs. Unfortunately for economists, their profession is not licensed so they cannot act in this anticompetitive manner to limit supply and raise their wages.

#### 2.4 Consumer Misperceptions

If consumers have misperceptions about product quality, such as not knowing the probability that a product will fail, a competitive market may provide less information, which forces consumers to bear more risk than they would in a world with perfect information. Spence (1977) shows that several departures from the world of complete information may occur.

He first considers the case where consumers are risk-neutral: they are willing to take a fair bet. The risk-neutrality assumption is reasonable when the loss to the consumer from a product failure is small. In this case, if consumers initially underestimate the quality (for example, safety) of a product, it is undersupplied by a competitive market. If a product-liability rule is in effect (where liability equals the loss to consumers in dollars if a product fails), then a competitive market provides a socially optimal quantity. Again, in the absence of a liability rule, firms could use guarantees to correct consumers' misperceptions about the quality of such products.

Spence next considers markets in which consumers are risk-averse: they are not willing to take a fair bet. Here, if consumers underestimate the probability of failure, the market

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supported the restrictive codes in order to increase the demand for their skilled labor.

provides below-optimal levels of insurance or guarantees.<sup>9</sup> Spence shows that a competitive market may either supply too high or too low a quality level from a social standpoint.

He also shows that if the government can perfectly determine quality, it can eliminate the market inefficiency by imposing appropriate fines on firms in the event of a product breakdown (or by providing consumers with the information).<sup>10</sup> Further, Spence demonstrates that if firms can provide information through both prices and guarantees, a market functions optimally so long as there is no moral hazard, consumers' actions do not affect the probability of failure, and consumers only suffer monetary losses in the event of a product failure (that is, they are not irreparably injured).

### 3. Limited Information About Price

Firms obtain market power from consumers' lack of knowledge about prices and quality. Limited information can lead to a monopolistic price in what would otherwise be a competitive market. For example, suppose that many stores in an area sell the same good. If one store raises its price above the level of others, *and all consumers know it*, that store loses all its business. Because the store faces a demand curve that is horizontal at the going market price, it has no market power.

In contrast, suppose that *some or all customers do not know* that other stores charge lower prices. Then the store can raise its price without losing all its sales. That is, the store faces a downward sloping demand curve and has some market power.

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<sup>9</sup>Under somewhat different assumptions, Heal (1977) shows that profit-maximizing firms overguarantee their products if they are less risk-averse than consumers and have accurate information.

<sup>10</sup>The government, of course, is not omniscient and cannot be relied upon to set standards, fines, or other regulations appropriately in all cases. For example, for a product with many quality dimensions, people of good will differ on how to set a standard or provide information in a way that is meaningful to consumers. Further, the cost of collecting the information to set the standard may be prohibitively high.

This concept is employed in a formal model developed by Peter Diamond (1971).<sup>11</sup> We call a simplified version of his model the *tourist-trap model*.

### 3.1 The Tourist-Trap Model

A typical tourist, Lisa, arrives in a small town filled with souvenir stands. Each stand sells a mug with the town hall painted on it. Lisa, by chance, wanders by one of these stands and sees the mug. For reasons better left to a sociologist or a psychologist, Lisa decides she should buy a mug for her father (and, if it is inexpensive enough, one for her mother as well). She has but a short time before her bus leaves, and she does not expect to return to this town again. Thus, she does not have time to check the prices at each souvenir stand, and she cannot use information obtained through even a limited search in the future. If there are many such tourists, what prices do the stands charge for these mugs?

To answer this question, we make four assumptions for specificity:

- All firms (souvenir stands) have the same costs and sell the identical product.
- All consumers have identical demand functions.
- A guide book provides each consumer with the general distribution of prices (how many stores charge each price) but does not give the particular price each store charges.
- The tourist's cost of going to a stand to check its price or buy is  $c$ , which reflects the tourist's time and expenses (taxi rides).

Thus, if Lisa goes to two souvenir stands, the search costs are  $2c$ . If she buys a mug at the second stand at price  $p$ , the total cost of that mug is  $p + 2c$ . The least she can pay is  $p + c$ , since she must visit at least one stand to buy a mug.

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<sup>11</sup>Probably the first paper to clearly make this point was Scitovsky (1950). Diamond (1971) was the first to present a formal mathematical analysis. Salop (1976) and Stiglitz (1979) provide excellent, relatively nontechnical surveys of this literature.

### 3.1.1 Fixed Number of Firms

Initially, assume that there are a fixed number of souvenir stands,  $n$ . How much does one firm charge for the mug? We start by considering whether each stand charges the full-information, competitive price,  $p^c$ , which equals marginal cost.

### 3.1.2 Breaking the Full-Information, Competitive Equilibrium

There cannot be a full-information, competitive equilibrium (price equal marginal cost) when consumers have limited information. Suppose all firms initially set the competitive price,  $p^c$ . Each firm has an incentive to charge a price higher than  $p^c$ , that is, each firm has an incentive to **break the equilibrium**. Thus, competitive pricing cannot persist, and competitive pricing is not an equilibrium.

If all other stands charge  $p^c$ , it pays for a deviant firm to set a higher price. Suppose the deviant firm charges a price  $p^* = p^c + \epsilon$ , where  $\epsilon$  is a small, positive number. If every consumer knows the price at every store before visiting stores, no one goes to the deviant firm, and the competitive equilibrium holds. If consumers do not know the price in each store, however, a store can charge a relatively high price and still get customers. It costs a consumer time and effort to check prices at various souvenir stands. Because foregone time spent checking the price at one more souvenir stand might be spent seeing sights or having a cool drink, our tourist values this time at  $c$ .

Lisa walks into the deviant store and sees that the mug sells for  $p^*$ . Her guide book tells her that all the other souvenir stands charge  $p^c$ . "What amazingly bad luck," she thinks to herself (or something to that effect), "I've hit the only expensive stand in town." She is annoyed and considers going elsewhere. She knows with certainty that any other store charges less. Nonetheless, she does not go to another store if the cost of search,  $c$ , is greater than the price overcharge in this store,  $\epsilon$ . That is, she does not search (go) elsewhere if the price in this store,  $p^*$ , is less than the price at another store *including* the additional cost of getting to that store or if  $p^* < p^c + c$ .

Thus, it pays for the deviant store to raise its price by an amount just less than the cost of additional search. If it pays

for this store to raise its price, though, it pays for all other stores to raise their prices to  $p^*$ . The proposed equilibrium where all stores charge the competitive price,  $p^*$ , can be broken. That is, it is in each firm's best interest to raise its price from the proposed equilibrium price.

Now suppose every store charges  $p^*$ . Can this proposed equilibrium be broken? Yes, it pays stores to raise their prices still further, by the same argument. A deviant store considers raising its price to  $p^{**} = p^* + \varepsilon = p^* + 2\varepsilon$ . Again, it is not worthwhile for a tourist unlucky enough to enter that store to search further. Moreover, if it pays one store to raise its price to  $p^{**}$ , then it pays for all to do so. This argument can be repeated, but does that mean that stores raise their prices without limit? No, they do not raise their prices above the monopolistic or profit-maximizing level,  $p^m$ .

When Lisa learns the price at the souvenir stand, she decides how many mugs to buy. If the price is set too high, the stand loses sales and hence profits (marginal revenues exceed marginal costs). Only when the price is set so that marginal revenue equals marginal cost are profits maximized. Although the store can charge a higher price without losing all its sales, it has no incentive to do so. Thus, the only possible single-price equilibrium, is at  $p^m$ .

### 3.1.3 Reducing Search Costs

Can reducing search costs lower the equilibrium price? The startling answer is that the equilibrium price does not change so long as search costs are positive and there is a single-price equilibrium. Suppose, now, that the government or a private firm sells firm-specific price information. For a price of  $c/2$ , the consumer can obtain the price at any given store.

Now repeat the previous analysis. Suppose all stores initially charge the competitive price,  $p^*$ , and a deviant considers raising its price. So long as it raises its price by no more than  $c/2$ , an unlucky consumer who goes to the deviant store does not search further. That is, at each step in the argument, the deviant store raises its price by a smaller amount, the lower are search costs; but it raises its price nonetheless. Although, the price deviation is smaller than before, any proposed single-price equilibrium at a price less than  $p^m$  can

still be broken. Again, the only possible single-price equilibrium is at  $p^m$ .

Thus, *lowering search costs has no effect on the single-price equilibrium until search costs fall to zero.* If search costs fall to zero, consumers have full information, so the only possible equilibrium is at  $p^*$ , which equals marginal cost.

### 3.1.4 Breaking the Single-Price Equilibria

Where search costs are positive, can the proposed equilibrium where all firms charge  $p^m$  be broken? The answer depends on the shape of consumer demand curves, the number of firms in the industry, and on the search costs. The following discussion first shows that, for demand curves of certain shapes, consumers buy nothing if firms charge  $p^m$ . Then it shows that for any demand curve, it may pay for a firm to deviate from a high-price equilibrium.

If the equilibrium price is  $p^m$ , a tourist may not visit even one store (Stiglitz 1979, 340). In other words, a market does not exist. Suppose each tourist buys exactly one mug so long as the price is no more than  $p^*$ . That is, the demand curve is a vertical line at a quantity of 1 up to a price of  $p^*$ . Given this demand curve,  $p^m = p^*$ . After all, once Lisa enters the shop, she is willing to pay up to  $p^*$  for one mug and buys no more mugs at a lower price.

To go to even one store, a consumer must incur a search cost,  $c$ . As a result, the full cost of a mug, the price plus the search cost, is  $p^m + c$ . Thus, the full cost of shopping for the mug,  $p^m + c = p^* + c$ , exceeds the maximum value the consumer places on the mug,  $p^*$ , so the consumer does not shop at all.

In attempting to take advantage of the tourists, the souvenir stands have set their prices so high that consumers do not find it worthwhile to shop. Thus, if consumers have this type of demand curve,  $p^m$  is not an equilibrium. Should the stores lower their prices from  $p^m$ ?

If all other stores are charging  $p^m$ , it may pay for a store to deviate by lowering its price.<sup>12</sup> As previously shown, if

<sup>12</sup>It cannot pay for a store to deviate by charging more. With the inelastic demand curves just discussed,  $p^m = p^*$ , and raising price does not attract any more customers; thus stores continue

consumers have an inelastic demand up to some maximum price,  $p^m$ , stores have no customers if they all charge  $p^m$ , so that a store might do better by lowering its price to attract customers. Even when demand curves slope down so that stores earn positive profits if all charge  $p^m$ , it may still pay a store to lower its price.

It can only pay a deviant store to lower its price if the decrease is substantial enough to induce consumers to search for this low-price store.<sup>13</sup> If search costs are  $c$  and if the store lowers its price by less than  $c$ , then consumers have no incentive to search for this low-price store. Thus the store makes less on each sale, so that its profits must fall. It may, however, pay for a store to deviate by dropping its price by more than  $c$ . If there are few stores, consumers may search for this low-price store. Although the store makes less per sale than the high-price stores, its profits may be higher due to greater volume.

The deviant does not attract the extra business, however, if it cannot easily induce search by slightly lowering its price. If there are a large number of stores, then consumers do not search for the low-price store because their chances of finding it are low. As a result, when a large number of stores makes searching for a low-price store impractical, the proposed single-price equilibrium at  $p^m$  cannot be broken.<sup>14</sup> Thus, in general, where search costs are positive and there are a large number of firms, the only possible equilibrium is a single-price equilibrium at the monopoly price,  $p^m$ .

If, however, there are few stores, price-cutting is profitable, and the high-price equilibrium can be broken. Thus, where

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to make no sales. With normally shaped demand curves,  $p^m$  is the profit-maximizing price for a store. If it raises its price further, the reduction in the number of units sold more than offsets the greater revenue from each sale, so the deviant loses profits.

<sup>13</sup>We continue to use the assumption of the model is that consumers know the distribution of prices, but not which particular store has the lowered price.

<sup>14</sup>It may be possible, however, for firms to advertise that they have low prices and thereby overcome the high search-cost problem, as discussed in the next chapter.

there are relatively few firms so that the monopoly price equilibrium can be broken, there is no single-price equilibrium. The only possible equilibrium is for various firms to charge different prices. Multiple-price equilibria are discussed after the following discussion of the effects of entry model.

### 3.1.5 Free Entry

With a small number of stores charging the monopoly price, each one earns large profits. If there are no barriers to entry, these profits attract new stores. Even though they incur entry costs, new stores enter the industry, so the number of tourists going to any one souvenir stand falls, and profits fall. Entry continues until profits are driven to zero. Depending on the shape of the demand curve, each store may continue to charge the same price even after entry occurs.<sup>15</sup> A *monopolistically competitive* equilibrium results: price is above marginal cost, but each firm's profits are zero.<sup>16</sup>

In contrast to a market where consumers have full information, the additional entry does not lower price if consumers have limited information. Additional entrants must sink some costs (buy a souvenir stand), so society is worse off with free entry here: consumers do not gain from entry, all monopoly profits are dissipated in excess entry (firms earn zero profits), and social expenditures on sunk costs rise.

Indeed, reducing the number of firms, under certain circumstances, may increase *effective* competition. For example, if several stores merge to form a chain of souvenir stands and collectively lower prices, they may be able to induce individu-

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<sup>15</sup>For example, if all customers buy one mug so long as the price is no more than  $p^m$ , the monopolistic price charges by each store does not vary with entry.

<sup>16</sup>If consumers' demand curves are downward sloping, the equilibrium resembles that of the standard monopolistically competitive industry illustrated in Figure 11.1 [*Modern Industrial Organization*, forthcoming]. Price is above marginal cost (at the quantity where marginal revenue equals marginal cost), and the demand curve is tangent to the average cost curve (so that profits are zero). This equilibrium requires that there be a fixed cost if marginal cost is constant.

als to search for one of the stands in this low-price chain (Stiglitz 1979, 340). Thus, by reducing the number of independent stores (but not necessarily the number of souvenir stands), effective competition may be increased and prices lowered.

This reasoning suggests a result that is the exact opposite of that for a market where consumers have full information. With imperfect consumer information, competition may be socially wasteful because of entry costs, so that monopoly may be superior to competition.<sup>17</sup>

### 3.2 The Tourists and the Natives Model

*A fool must now and then be right, by chance.*

— William Cowper

Our analysis of the tourist-trap model raises two questions about markets in which consumers have limited information about price. First, is a multiple-price equilibrium possible? That is, is there an equilibrium where stores charge different prices for the identical good so that there is a price dispersion? Second, if some consumers are fully-informed, even though others have limited information, can there be a full information equilibrium where price equals marginal cost?

Both questions can be examined by modifying the tourist-trap model so that there are two types of consumers. A persistent price dispersion requires that at least some consumers must be unable or unwilling to learn which stores charge the low price.<sup>18</sup> The discussions shows that where some

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<sup>17</sup>Some of the surprising results of the tourist-trap model change when there are repeated transactions. We discuss the roles of repeated transactions and reputations in more detail in the next chapter [*Modern Industrial Organization*, forthcoming].

<sup>18</sup>Stigler (1961) shows that if there is a price dispersion, consumers search for low prices, and that if the search is costly, they do not conduct sufficient searches to learn the entire price distribution. A number of papers present models where firms have different costs, and random changes affect the market so that the store with the lowest price keeps changing, and hence consumers cannot easily learn the identity

consumers are fully informed and others have limited information, either a multiple-price equilibrium (Example 6 in Appendix 2) occurs, or there is a single-price equilibrium at marginal cost.

Consider a market in which all firms have identical costs, but consumers' search costs differ. One group of consumers, the natives, who are the *informed* consumers, have zero search costs: they know the entire distribution of prices in the market. The other group, the tourists, who are the *uninformed* consumers, have search costs of  $c$ , as before. For example, natives in a town might know the prices charged by each restaurant, but a tourist has to spend the time (search cost) to visit each one to learn its price.

Even if some consumers are ignorant of the distribution of prices charged by different stores, others who are knowledgeable only buy at low-price stores, so that prices sometimes are driven to the (low) competitive-equilibrium price. Obviously, for price to be driven to marginal cost, there must be a substantial number of knowledgeable consumers. In a rigorous version of this model, Salop and Stiglitz (1977) show that with informed and many uninformed consumers, a single, competitive-price equilibrium may exist, but it is also possible that there is a single-price equilibrium at a higher price, or a multiple-price equilibrium.

To illustrate their result, suppose that of the  $L$  consumers in this market,  $\alpha L$  are informed and  $(1 - \alpha)L$  are uninformed. Each consumer buys 1 unit of the good so long as the price is no higher than  $p^*$ . There are  $n$  firms. Consider a proposed equilibrium where all stores set price equal to marginal cost, so that their price and quantity are  $(p^*, q^*)$ . If all firms set the same price, each is assumed to obtain an equal share of the consumers, so  $q^* = L/n$ .

Suppose a deviant firm raises its price to  $p^* = p^* + \epsilon$ . By the same reasoning as in the tourist-trap model, this firm obtains no informed customers, but still obtains its uninformed customers, so long as  $\epsilon < c$ . Thus, the firm's sales fall to  $(1 - \alpha)q^*$ .

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of the low-cost store in a given period. The explanation that follows assumes the firms have identical cost functions and there are no random changes. See also Reinganum (1979).

### 3.2.1 Many Informed Consumers

If there are many informed consumers, it does not pay for a firm to deviate by raising its price above  $p^c$ . As shown in Figure 1, the demand curve facing the deviant firm consists of four parts. If the firm's price is above  $p^u$ , its sales are zero.<sup>19</sup> If its price is below  $p^u$  but above  $p^c$ , its sales equal  $q^u = (1 - \alpha)q^c$ , because it loses all its informed customers. If its price equals  $p^c$ , its sales are  $q^c$ . If its price is slightly below  $p^c$  all the informed consumers shop there as well as its share of the uninformed consumers, so its sales are  $\alpha L + (1 - \alpha)q^c$ . The deviant is uninterested in charging less than  $p^c$ , because that price is below its average cost, so that it loses money on every unit sold.

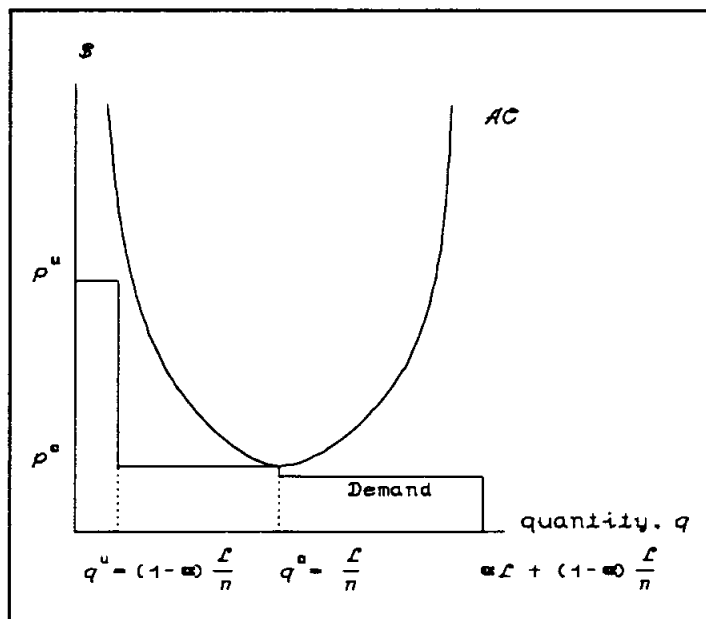


Figure 1. SINGLE-PRICE MARKET

<sup>19</sup>We assume that the deviant raises its price to  $p^u$ . As explained in the tourist-trap model, the deviant changes  $\epsilon$  more than the price other firms are charging, of  $p^u$  (the maximum price a consumer is willing to pay), whichever is less. If the deviant firm charges  $p^u$ , it must be true that  $p^c + c \geq p^u$ . That is, we are assuming that search costs,  $c$ , are large.

With the demand curves as shown in Figure 1, it does not pay for the deviant to raise its price, because it loses money. Although it makes more per sale ( $p^u > p^c$ ), it makes so few sales that its costs exceed its revenues. Profits must be negative because the demand curve is to the left of the firm's average cost at  $p^u$ .

Thus, the proposed equilibrium at  $p^c$  cannot be broken. There are so many informed consumers that a store charging more than  $p^c$  loses so much business that it loses money. Thus, if there are enough informed consumers, the price is the same as the full-information, competitive-equilibrium price, even if some consumers are uninformed.

### 3.2.2 Few Informed Consumers

In contrast, if there are relatively few informed consumers, a deviant firm can raise its price and lose relatively few customers. As shown in Figure 2, it pays for the firm to deviate because it makes higher profits: at  $p^u$  the deviant firm's demand curve is to the right of its average cost curve. The firm makes zero profits at  $p^c$ , so it has an incentive to raise its price.

Thus, if  $\alpha$  is relatively large, it does not pay for a firm to deviate from the competitive equilibrium ( $p^c, q^c$ ). That is, if there are many informed consumers, all firms charge the competitive price. In contrast, if there are relatively few informed consumers ( $\alpha$  is relatively small), it pays to deviate, and the proposed equilibrium is broken.

This reasoning shows that no single-price equilibrium exists at  $p^c$  if there are relatively few informed consumers. A firm profits by raising its price if the demand at  $p^u$  is above average cost. Let  $q^a(p^u)$  be the quantity such that the average cost equals  $p^u$ ,  $AC(q^a) = p^u$ , as shown in Figure 2. It pays for a firm to deviate so long as  $(1 - \alpha)q^u > q^a(p^u)$  or

$$\alpha < 1 - \frac{q^a(p^u)}{q^c} \quad (1)$$

and a single price equilibrium at  $p^c$  is impossible. As Expression 1 shows, the number of informed consumers needed to produce a single-price equilibrium depends on the shape of the average cost curve and the maximum price consumers are willing to pay,  $p^u$ .



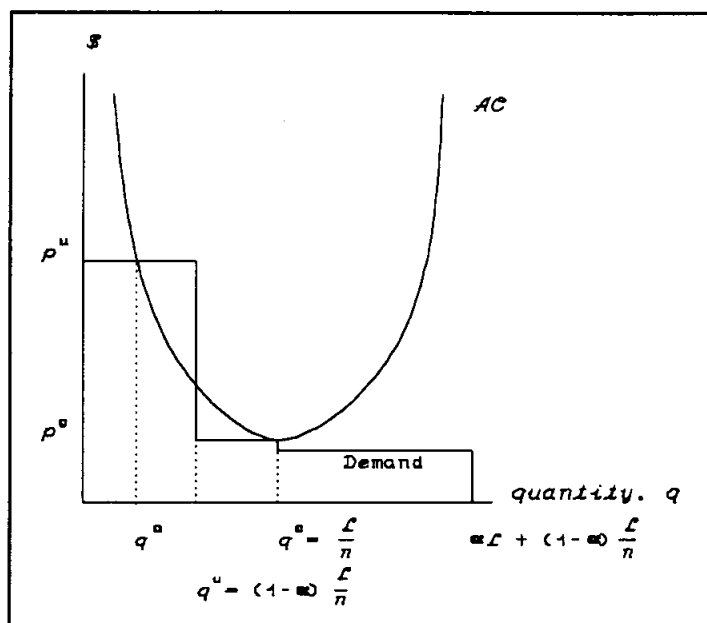


Figure 2. TWO-PRICE MARKET

Can there be an equilibrium where all firms charge  $p^o$ ? No, a clever firm can lower its price to any amount less than  $p^o$  and obtain all the informed consumers. It makes large profits if its price is only slightly below  $p^o$  because it has more sales at approximately the same price. Another firm, seeing that the first firm has captured all the informed consumers, can set its price slightly below that of the first firm and gain all the informed consumers' business. In this fashion, competition (similar to the Bertrand competition described in Chapter 10) drives the price for the informed consumers to the full-information, competitive level,  $p^o$ .

If there is a two-price equilibrium where one or more firms charge  $p^o$ , and the remaining firms charge  $p^u$ , all the informed customers shop at the low-price stores, and the uninformed consumers shop randomly. As a result, some uninformed consumers buy at the high-price stores, and others buy at the low-price stores.

Is it possible that there can be more than two prices? Suppose there is a three-price equilibrium with some stores charging  $p^1 = p^o$ ; others charging  $p^2$ ,  $p^u > p^2 > p^o$ ; and the rest charging  $p^3 = p^o$ . The stores charging  $p^2$  make no sales to

informed customers. They have, on average, the same number of uninformed customers as stores charging  $p^u$ , but they make less money than those stores. As a result, if a store charging  $p^2$  raises its price, it loses no customers and receives higher profits, so that this proposed three-price equilibrium can be broken. Thus, it does not make sense for a store to charge less than  $p^u$  and more than  $p^o$ .<sup>20</sup>

By such reasoning, we can reject three-price, four-price, and other multiple-price equilibria with large numbers of prices. The only possible multiple-price equilibrium is a two-price equilibrium.

In the two-price equilibrium, the low-price stores charge  $p^o$  and have sales of  $q^o$ . The high-price stores charge  $p^u$  and sell  $q^u$  units. The low-price stores get all the informed consumers (natives) and some of the uninformed consumers (lucky tourists), so their share of the market (sales per store divided by total sales) is greater than the proportion of informed consumers.<sup>21</sup> Appendix 1 calculates the number of firms in the equilibrium and the shares of each type of firm.

In the two-price equilibrium, all firms must make the same profits, or a firm has an incentive to change its pricing policy. The low-price stores make zero profits (because  $p^o = AC(q^o)$ ) as

<sup>20</sup>With other, less restrictive assumptions, there may be many different prices in a market. For example, if consumers know about some but not all firms, firms may charge a full range of prices (Butters 1977). Rothschild (1974) provides a good survey of search theories, which explain price distributions. Where there are many prices charged, as the number of firms increases, obtaining information may be more difficult. As a result, some firms may charge higher prices as new firms enter. A study of the prices of primary-care physicians' services in 92 metropolitan areas concludes that factors that increase search costs, such as number of providers, increase average prices (Pauly and Satterthwaite 1981).

<sup>21</sup>Thus, consumers who go to large stores and buy brands with large shares of the market may be acting rationally (Smallwood and Conlisk 1979). If uninformed consumers observe market shares, they become informed. It is possible, however, that if consumers use share as a signal, then the first entrant in a market may maintain its high share solely as a result of its historical monopoly rather than its superior product.

shown in Figure 2). Thus, in equilibrium, the high-price stores must also make zero profits. Suppose instead that they make positive profits. Then either new firms enter the market as high-price stores, or low-price stores start charging high prices. As the number of high-price stores increases, each one sells less (as the uninformed consumers are spread over more stores). The number of high-price stores increases until profits are driven to zero.

To summarize, where only a relatively small number of customers are informed, there is a two-price, monopolistically competitive equilibrium. The low-price stores charge a price equal to marginal cost (the full-information, competitive price), and the high-price stores charge the monopolistic price (the maximum consumers are willing to pay). Both types of stores make zero profits in equilibrium because of entry. All the informed consumers and some of the uninformed consumers shop at the low-price stores, so they have a disproportionately large share of the market.

#### 4. The Noisy Monopolist: Price Discrimination

*People who make no noise are dangerous.*  
— Jean de la Fontaine

As the preceding discussion shows, limited consumer information can lead to higher prices. Thus it may be in a firm's best interests to create *noise* in the market by charging different prices for nearly identical products or for the same product at different stores. That is, by creating price dispersion, they may be able to reduce consumers' information.

For example, some durable goods manufacturers sell nearly identical products under two or more brand names. For example, a product may be available under the manufacturer's own brand name at a relatively high price and be available under another brand name at a lower price.

A model by Salop (1977) shows when it pays for a firm to price discriminate in this way.<sup>22</sup> Salop points out that a firm has conflicting objectives. On the one hand, because search by consumers is costly and may lead them to drop out of the

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<sup>22</sup>The following presentation is partly based on Calvo (n.d.).

market by raising the total cost of a product, the firm wants to reduce price dispersion to eliminate unnecessary search costs. That is, because search costs raise the price to consumers but do not directly benefit the firm, they should be eliminated, all else the same.

On the other hand, when consumers have different costs of collecting information, price dispersion may benefit the firm by allowing it to price discriminate. That is, informed consumers (people who search a lot) are able to find the low-price items, but many of the uninformed consumers (people who do little search) pay the higher price. In short, this model is similar to the tourists-and-natives model.

Thus, dispersion is a costly device for sorting consumers into submarkets for the purpose of price discrimination. If search does not cost enough to drive consumers from the market and demand elasticities vary in a certain direction (as in the following example), then creating dispersion is more profitable than charging a single price.

For example, suppose that a monopolist has  $n$  retail stores and there are two types of consumers. Of the  $L$  consumers,  $\alpha L$  are natives who have no search costs and buy 1 unit of the monopolist's product if the price is no higher than  $p^a$ . The  $(1 - \alpha)L$  consumers who are tourists have extremely high search costs and buy 1 unit of the product if the price is no higher than  $p^t$ , where  $p^t > p^a$ . That is, natives are willing to pay less per meal at local restaurants than are tourists, and natives have perfect information about prices. Tourists typically choose restaurants randomly because they do not know where the low-price high-quality restaurants are located.

Imagine further that one company owns all the restaurants and that they all serve the same type of food. Does it pay for the company to vary its prices across locations. No restaurant can charge more than  $p^t$ , because, at a higher price, the restaurant draws no customers. Similarly, no restaurant should charge less than  $p^a$ , because, by assumption, natives have an inelastic demand for a meal up to a price  $p^a$ . Lowering the price from  $p^a$  does not increase the number of meals the company can sell, so its profit-maximizing price is at least  $p^a$ . If it pays for the monopolist to charge different prices at various locations, it sets a low price,  $p^a$  at only one restaurant, because natives always search for the minimum price, and tourists never go to more than one outlet. All the other

restaurants charge a higher price, because tourists discover restaurants by chance.

Suppose for simplicity that the monopolist can produce meals at zero cost. If the monopolist charges more than  $p^n$ , no native dines at local restaurants. In that case, profits on meals sold to tourists are maximized by setting price at  $p^t$ . Profits on the tourists's meals are given by

$$(1 - \alpha)Lp^t, \quad (2)$$

where  $(1 - \alpha)L$  is the number of meals sold at price  $p^t$ .<sup>23</sup>

If the monopolist charges  $p^n$  at one location and  $p^t$  at all other locations, then it sells meals to all  $L$  potential consumers. All the natives eat at the low-price restaurant, so the profits on meals sold to natives are  $\alpha Lp^n$ . Most  $((n - 1)/n)$  tourists eat at the high-price restaurants, but  $1/n$  of the tourists are lucky and find the low-price restaurant. Thus, the monopolist's expected profits are

$$\alpha Lp^n + \frac{1}{n}(1 - \alpha)Lp^n + \frac{(n - 1)}{n}(1 - \alpha)Lp^t, \quad (3)$$

where the first term is the profits from the  $(\alpha L)$  natives, the second term is the expected profits from the  $((1 - \alpha)L/n)$  lucky tourists who find the low-price restaurant, and the last term is the expected profits from the  $((1 - \alpha)L[n - 1]/n)$  unlucky tourists who pay the high price.

If the monopolist receives higher profits when it charges two prices (Expression 3) than when it charges a single price of  $p^t$  (Expression 2), it pays for the monopolist to be "noisy" and price discriminate. The difference in profits between discriminating and setting a single price (Expression 3 - Expression 2) is

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<sup>23</sup>If the monopolist is going to charge a single price at all locations, it may pay to charge  $p^n$  instead of  $p^t$  to induce natives to also patronize the restaurants. It pays to set a single price of  $p^t$  if  $(1 - \alpha)Lp^n < Lp^t$ , or  $(1 - \alpha) < p^t/p^n$ . That is, as the relative share of natives,  $\alpha$ , increases, or as the amount they are willing to pay relative to natives increases, it pays to set a high price. We do not further consider charging a single price of  $p^n$ , because price discriminating by charging  $p^n$  at one restaurant and  $p^t$  at all others produces higher profits than charging  $p^n$  at all restaurants.

$$\alpha Lp^n - \frac{1 - \alpha}{n}L(p^t - p^n), \quad (4)$$

It pays for the monopolist to price discriminate if the difference in profits between price discriminating and setting a single price (Expression 4) is positive. Since the first term in (4) is positive, and the second term is negative, price discrimination is more likely as the second term becomes small in absolute value relative to the first term. By inspection, as the share of tourists,  $(1 - \alpha)$ , falls or as the number of firms,  $n$ , increases, the second term gets closer to zero, and price discrimination becomes relatively more attractive.

As the number of tourists becomes small, it pays the monopolist to sell to natives as well as tourists. Thus, it becomes more likely that the monopolist gains by price discrimination as  $(1 - \alpha)$  shrinks.<sup>24</sup> Similarly, as the number of restaurants,  $n$ , rises, price discrimination is more likely to pay.<sup>25</sup> Suppose, for example, that the monopolist can operate extra restaurants at little or no additional cost. It can then choose the number of restaurants,  $n$ , large enough that the second term in (4) is essentially zero, and hence it pays to be noisy. That is, if the monopolist can make it so hard to find the low-price restaurant that relatively few tourists find it, it pays to price discriminate.

Thus, where there are both informed and uninformed consumers in a market, it often pays for a monopolist to create noise; that is, it has an incentive to charge different prices for a homogeneous good at various locations to make it more difficult for uninformed consumers to find the low-price store. The monopolist is able to price discriminate because search costs prevent consumers from buying at the low-price restaurants.

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<sup>24</sup>Differentiating (4) with respect to  $\alpha$  gives  $L[p^n + (p^t - p^n)/n] > 0$ .

<sup>25</sup>Differentiating (4) with respect to  $n$  gives  $(1 - \alpha)L(p^t - p^n)/n^2 > 0$ .

## 5. Providing Consumer Information Lowers Price

*It is a great nuisance that knowledge can only be acquired by hard work. It would be fine if we could swallow the powder of profitable information made palatable by the jam of fiction.*

— W. Somerset Maugham

It seems intuitively obvious that providing consumers with comparative price information should lower the average price observed in the market. Yet, as the tourist-trap model shows, lowering the cost of search has no effect so long as the cost is positive. That result may not be as perplexing as it first appears because merely decreasing the cost of search does not provide consumers with extra information. In fact, that result indicates that in equilibrium, no further searches occur when the costs of search are lowered, so consumer information does not increase.

An information program that actually provides consumers with comparative price information may, then, have an effect where merely lowering the cost of search does not. The following discussion first presents a theoretical argument that supplying more consumer information results in a lowered equilibrium price and then presents some empirical evidence that supports this conclusion.

### 5.1 How Information Lowers Prices

At least two types of models show that improving information can lower prices. First, as the tourists-and-natives model with many firms shows, either a two-price equilibrium occurs or there is a single-price equilibrium. A second model developed below shows that where information is provided that allows consumers to better estimate true prices, the average price may fall. This latter model explains the existence of a single-price equilibrium, where the price lies between the monopolistic and the full-information, competitive price (marginal cost).

Suppose a consumer wishes to shop at the lowest-price store but does not know which store has the lowest prices. Typically, consumers collect information from various sources (shopping at various stores, reading advertisements, watching

commercials, asking friends) to determine which stores are relatively inexpensive (see Example 1 in Appendix 2).

Consumers form estimates based on available information of the prices at each store and then choose the store they estimate has the lowest price (Perloff and Salop 1986). Consumers do not know the prices exactly, so a store may raise its price without losing all its customers. That is, the demand curve facing each store changes from being perfectly elastic under full information to being less elastic under limited consumer information.

Firms' demand curves are not perfectly elastic so long as consumers use their estimates of relative prices to choose the stores at which they shop. If they treat their price estimates as their best information and go to the store that they believe has the lowest price, they may make a mistake; thus a store that raises its price slightly may not lose all its customers because some of them believe (incorrectly) that other stores charge even higher prices. If consumers gain more information, or the number of stores increases, prices may fall.

### 5.2 Improved Consumer Information

The following example illustrates the effect of an increase in consumers' information. Suppose there are only two stores: Store 1 and Store 2. Store 1 charges \$10 for a given good. Consumers, however, have imperfect information, so their estimates of this price are not always correct. Consumers form unbiased estimates, so, on average, they estimate the correct price, but any one consumer may have an inaccurate estimate. Initially, suppose that one-third of all consumers believe that Store 1 charges \$9, one-third think it charges \$10, and the remainder estimate that it charges \$11.

Now, suppose Store 2 actually charges \$10.50. One-third of all consumers think it charges \$9.50, one-third believe it charges \$10.50, and the remainder estimate its price is \$11.50. If consumers form their estimates independently for the two stores, some consumers shop at Store 2 even though its price is higher. That is, some consumers estimate that store 1 charges \$11, and they estimate that Store 2 charges \$9.50 or \$10.50. If there are  $L$  consumers, each of whom buys exactly 1 unit of the good, then Store 1 sells  $(2/3)L$  units and Store 2

sells  $(1/3)L$  units if consumers shop at the first store they visit. This example is summarized in Table I.

**Table I. CONSUMER PRICE ESTIMATES**

	Price Estimates of Consumers			Share of Sales
	$(1/3)L$	$(1/3)L$	$(1/3)L$	
Store 1	\$9.00	\$10.00	\$11.00	$(2/3)L$
Store 2	\$9.50	\$10.50	\$11.50	$(1/3)L$

Now assume that the consumers obtain better information, so their estimates of the two stores' prices become more accurate, as shown in Table II.

**Table II. MORE ACCURATE CONSUMER PRICE ESTIMATES**

	Price Estimates of Consumers			Share of Sales
	$(1/3)L$	$(1/3)L$	$(1/3)L$	
Store 1	\$9.70	\$10.00	\$10.30	$(8/9)L$
Store 2	\$10.20	\$10.50	\$10.80	$(1/9)L$

If Store 2 charges 50 cents more than Store 1, as before, it loses half its customers. In the first example, one-ninth of the customers correctly estimate the price at Store 2 and overestimate the price at Store 1, so they shop at Store 2. Another ninth of the customers in the first example shop at Store 2 because they underestimate the price at store two and correctly estimate the price at Store 1. In the second example, where consumers have better information, both of these types of customers shop at Store 1. In both examples, some of those consumers who underestimate the price at Store 2 and overestimate the price at Store 1, buy at Store 2.

With better information, Store 2 loses more sales if it raises its price above that of Store 1. So long as there is some limit to consumers' information, however, Store 2 can charge more

than Store 1 and retain some customers. The amount more that it can charge varies inversely with the amount of information consumers have: the better their information, the higher the elasticity of demand facing the firm. With perfect information, each store's elasticity of demand is infinite, and a store must charge a price as low as other stores or lose all its customers.

### 5.2.1 More Firms

If firms can enter the industry without limit, then (even given imperfect information) prices are driven to the full-information, competitive price (marginal cost) under certain plausible assumptions. Suppose each consumer forms an unbiased estimate of each store's price as previously described. Then as the number of stores increases, the number of estimates increases. Suppose every existing firm is duplicated 10 times, so that the new firms charge the same prices as the original ones, and the true price distribution remains unchanged. As the number of stores increases, however, the probability that a customer thinks that another store charges roughly the same price as the one previously estimated to have the low price rises. That is, the elasticity of demand facing each store falls, and hence its price falls.

To summarize, increasing consumer information (in the sense that consumers can more accurately estimate stores' true prices) initially increases the share of low-price stores. The elasticity of demand facing stores rises, so they have an incentive to lower their prices. As a result, the average price and the spread in prices is likely to fall. Similarly, increasing the number of stores increases the elasticity of demand facing each one, so the average prices and the spread in prices is likely to fall.

### 5.3 An Example: Grocery Store Information Programs

Does providing consumers with information increase the market shares of relatively low-price stores, lower the average market price, and reduce the variance in prices across stores? A 1974 experiment by the Food Price Review Board of Canada

was designed to answer these questions for grocery stores.<sup>26</sup> There were three phases in the experiment. During Phase 1 (a 17-week period), supermarket price information was collected in both the control city, Winnipeg, and in the experimental city, Ottawa-Hull. Only during Phase 2 (a 5-week period) was the information on grocery store prices in Ottawa-Hull published in newspapers and mailed to some consumers whose behavior was monitored in detail. At no time was the information publicized in the control city, Winnipeg. In the final phase (6 weeks), prices were again collected in both cities but not disseminated.

Average food prices declined in Ottawa-Hull by 1.5 percent during the first week of Phase 2, by 3.0 percent the following week, and then remained steady for the next three weeks. During the first week following the end of Phase 2, prices dropped an additional 2.5 percent. Thus, the total decline over this 6-week period was 7.1 percent. Prices in the control market declined by 0.6 percent during Phase 2. Thus, prices in the experimental city fell relative to prices in the control city by 6.5 percent during the 6-week period that included the first week of Phase 3 (see Figure 3).

During the experimental period, prices at the higher-price stores (and chains) fell more than those at initially low-price stores. The difference in price index levels between high- and low-price stores dropped from a maximum of 15 percent during the preinformation period to a low of 5.4 percent at one point in Phase 2. The differential for chains fell from a maximum of 7.3 percent to a low of 3.1 percent. The average range of prices during the 12-week period prior to the information program was 9.71 percent compared to 7.83 percent during Phase 2.

The high-price stores had more volatile prices as measured by the index of in-store price variation. High-price stores were more common in the under-privileged areas than in the more affluent areas. Stores with the highest prices generally dropped prices to meet those of their lower-price competitors.

<sup>26</sup>Devine and Marion (1979) and Devine (1978). Lesser and Bryant (1980) critique Devine and Marion (1979), who respond in Devine and Marion (1980).

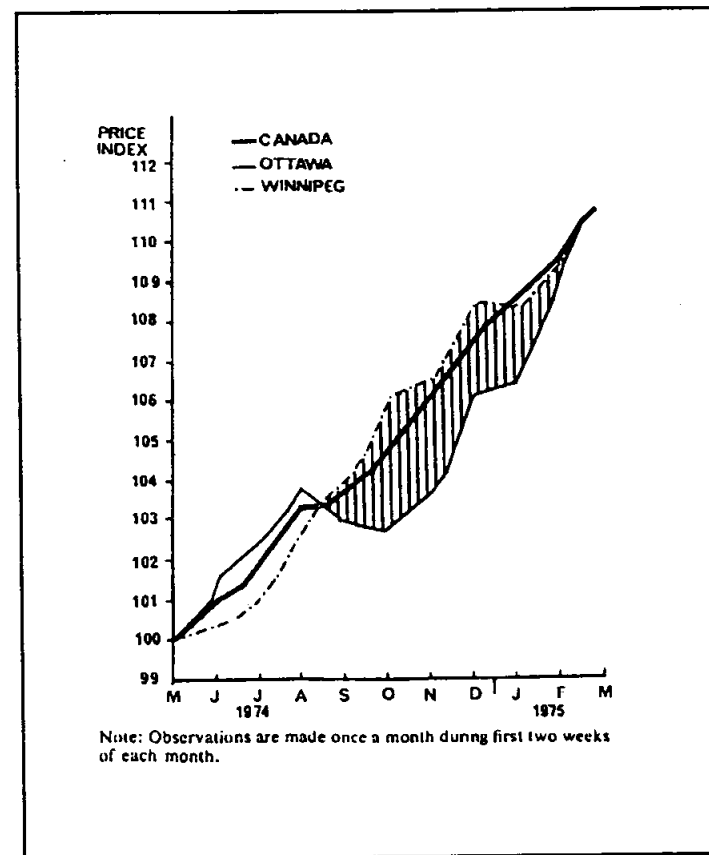


Figure 3. CONSUMER PRICE INDEX FOR FOOD CONSUMED AT HOME—MAY 1974 TO MARCH 1975 (MAY 1974 = 100) [DEVINE AND MARION, 1979]

A consumer survey found that 43 percent of the consumers in the test market indicated that they had changed stores as a direct result of the comparative price program. As a result of this shift, the top four corporate chains increased their share of the market from 74 percent to 81 percent. Lower-priced chains increased their share relative to others.

Average retail food prices in the test market began to rise within two weeks after the termination of the information program and increased 8.8 percent by the end of the research period. One interpretation of these results is that during the information period, a once-and-for-all drop in average prices

occurred. With the end of the information program, prices increased to their preinformation levels.<sup>27</sup> It appears that stores realized the experiment would be short-lived and were particularly aggressive in trying to convince consumers that they had relatively low prices while the program was in effect. Apparently, to maintain low prices, information must be continuously supplied.

A back-of-the-envelope calculation of the welfare gain (consumer surplus minus profits) indicates that it could significantly exceed the costs of collecting the information. Nonetheless, gains per family may be small. Interviewed consumers were willing to pay \$1.36 per month for this information, which implies a consumer surplus gain of approximately \$2 million per year for the city.

The basic results of this experiment were largely confirmed in another experiment conducted in the province of Saskatchewan in October 1975 to determine the long-run effects of an information program (Devine 1978). During the experiment, prices were monitored in six Saskatchewan cities and in Calgary and Winnipeg, located in neighboring provinces. The relative prices were published weekly for six consecutive months in two test markets in Saskatchewan: Regina and Saskatoon.

The price index levels in the test markets fell more than the price declines recorded in the control cities of Winnipeg and Calgary outside the province. In particular, Regina led the national decline in the Statistics Canada Consumer Price Index for Food Consumed at Home during the latter part of the publication period. Although average prices in Saskatoon declined more rapidly than in the paired control market (Winnipeg) during most of the information period, this result was reversed during the last six weeks of the program.

Prices rose rapidly with the end of the program. They increased 3.5 percent in the first week after the termination of

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<sup>27</sup>The test market basket of goods was 2 percent higher than that in the control market at the beginning of the information program. During the final week of the monitoring program, prices were 1.3 percent lower in the test market. It is possible that prices in the experimental city had not completely caught up with prices in the control city by the end of the Phase 3 monitoring period.

the publishing program in Regina. Consumers who received additional information on comparative prices reported significantly higher levels of satisfaction with food stores and prices than consumers in other Saskatchewan cities.

A similar experiment was conducted in the United States by Purdue University and the U.S. Department of Agriculture in four pairs of U.S. cities (Boynton *et al.* 1981; McCracken, Boynton, and Blake, 1982). Relative prices declined from 0.2 to 3.7 percent in the experimental compared to the control markets. In three of the four experimental cities, a statistically significant decline in the prices of the 26 items, which were individually reported, was found. In all four experimental cities, a statistically significant decline in the total (100-item) index was found.<sup>28</sup>

Thus, a number of studies have shown that providing consumers with information can lower average price. When the information programs are ended, however, the average price tends to rise to its original level. Providing information to consumers, however, does not always increase welfare: see Examples 7 and 8 in Appendix 2.

## 6. Summary

There are five major results from models in which consumers have limited information about quality or prices. First, if consumers have limited information about the quality of a product, either there is no market or, where the market exists, quality levels are usually lower than the levels produced if consumers have full information. Expert information, reputation, standards, and certification may provide consumers with information about quality and hence rectify these problems; however, standard setters can behave anticompetitively.

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<sup>28</sup>Perhaps the strongest evidence that this information program had an effect is that a number of stores covered in this study banned the price reporters (Yaeger, Don. "U.S. Price Study Goes on Despite Two-City 'Lockout.'" *Supermarket News*, 11 February 1980:1. In some cities, the indexes were challenged by the stores (Yaeger, Don. "Purdue Price Study to Be Ended Early." *Supermarket News*, 25 February 1980: 1, 34.).

Second, where consumers have limited information about prices, the markets may not exist or, if they do exist, even small firms may set prices above marginal costs. Thus, perfect competition may be impossible. Even with a homogeneous good, stores may charge different prices. In this sense, the law of supply and demand and the law of a single price do not hold. Indeed, with this type of limited information, monopoly may be socially preferable to competition.

Third, where some consumers know the prices at all stores and others must incur search costs to determine the price at any given store, two types of equilibria are possible. If there are enough informed consumers, the equilibrium price equals marginal cost. If there are relatively few informed consumers, a two-price equilibrium is likely, where some stores charge a high price and others charge marginal cost. Fourth, in such a market, a monopolist may charge different prices at its different stores in order to price discriminate between informed and uninformed consumers.

Fifth, only certain types of price information lower average prices. For example, in a single-price equilibrium, reducing search costs for all consumers may have no effect. In contrast, providing consumers with the location of the lowest-price store may lower average price.

Thus, markets with limited information differ from those with perfect information. Providing information or lowering the cost of obtaining information may not always increase welfare when the costs of providing the information or lowering the search costs are taken into account. The next chapter examines the incentives of individual firms to inform or misinform consumers by using advertising and the effects of such advertising.

## Discussion Questions

1. Under what conditions does providing consumers with extra information increase social welfare?
2. Many states and local governments license many professions. To practice those professions, one must pass a test showing a high ability level. In a few locations, the government merely tests professionals and makes that information available to consumers; low-ability workers are not excluded from the market. This latter approach is called certification. Under which circumstances is licensing preferable and under which circumstances is certification preferable?
3. In which markets do you think the government could successfully intervene to overcome problems due to inadequate consumer information? That is, in which markets do you expect the benefits to exceed the costs of intervention? How do you think the government could obtain the necessary information to provide to consumers? Can you give a real-world example of successful government intervention?
4. Is a large difference between the highest and the lowest price in a market a sign of a market failure? If so, what should or could be done about it?
5. Organizations like Consumers Union provide a valuable service. How can society encourage such organizations to provide the optimal amount of information to consumers? How should the optimal level be determined?

## Problems

1. Describe how a manufacturer could act like a noisy monopolist by using discount coupons provided to some consumers in newspapers or magazines. Under what conditions should a manufacturer use this technique?



2. Suppose that there are two types of firms. All firms have U-shaped average cost curves, where  $n$  firms have average costs of  $AC(q)$  and  $m$  firms have average cost curves of  $AC(q) + k$ . There are two types of consumers: the natives have zero search costs, and the tourists have very high search costs. Describe the resulting equilibrium.
3. Suppose two economists write a textbook. Their publisher offers them royalties on sales of the book equal to  $\alpha$  percent of the sales revenue. The economists are concerned. They believe that such a royalty system causes the publisher to sell less than the joint profit-maximizing number of copies of the book. Demonstrate this reasoning. They believe that a royalty in the form of a lump-sum payment,  $L$ , or  $\beta$  percent of profits does not cause the publisher to publish too few books. Why do they agree to the  $\alpha$  percent royalty? (*Hint*: One explanation concerns asymmetric information on the part of the publisher.)
4. Determine the equilibrium prices, quantities, and number of high- and low-price stores in the tourist-and-native model if consumers have downward sloping, linear demand curves:  $q = a - bp$ , where  $a$  and  $b$  are positive constants.
5. By reinterpreting the first model discussed in Appendix 3C (a representative consumer-spatial model) [*Modern Industrial Organization*, forthcoming] develop a model of how extra information may affect price. (*Hint*: Suppose a consumer's estimate of the price charged by store  $i$  plus an error term,  $\beta\varepsilon$ , where the mean of  $\varepsilon = 0$  and  $\beta$  is a constant. Better information could be interpreted as a smaller  $\beta$ .)

#### Terms

adverse selection  
 bounded rationality  
 break the equilibrium  
 certification

guarantees

moral hazard  
 public good

price dispersion

reputation

standards

warranties

#### Recommended Readings

In addition to the articles cited in the chapter, the following provide important background reading. Two nontechnical papers that give a good overview of many of the main issues are Salop (1978) and Beales, Craswell, and Salop (1981).

The rest of these articles are more technical. Uncertainty, information, and welfare are examined in Colantoni, Davis, and Swaminathan (1965); Allen (1981); Kahnemann, Slovic, and Tversky (1982). Important work on the value of information includes Lave (1963), Gould (1974), and Antonovitz and Roe (1986). Work on search and strategic behavior by firms includes Wilde and Schwartz (1979) and Varian (1980). The role of information in oligopolistic or monopolistic competition is discussed in Shapiro (1982), Wolinsky (1986), and Ross (1988).

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## Appendix 1: Market Shares in the Tourist-and-Native Model

In the two-price equilibrium in the tourist-and-native model, the low-price stores charge  $p^l$  and sell  $q^l$  and have  $\beta$  share of the market, while the high-price stores charge  $p^h$  and sell  $q^h$  and make up  $1 - \beta$  share of the market. The high-price stores only sell to their share of the  $(1 - \alpha)L$  uninformed consumers,  $(1 - \alpha)L(1 - \beta)$ , so each high-price firm sells

$$q^h = \frac{(1-\alpha)L(1-\beta)(1-\alpha)L}{n(1-\beta)}. \quad (\text{A.1})$$

The high-price stores' share of the market is

$$1 - \beta = \frac{q^h}{L} = \frac{1 - \alpha}{n}. \quad (\text{A.2})$$

Each low-price store sells to its share of the  $\alpha L$  informed consumers and to its share of the  $\beta(1 - \alpha)L$  uninformed consumers who are lucky enough to find a low-price store:

$$q^l = \frac{\alpha L + (1 - \alpha)L\beta}{n\beta}. \quad (\text{A.3})$$

The market share of low-price stores is

$$\beta = \frac{q^l}{L} = \frac{\alpha + (1 - \alpha)\beta}{n\beta}. \quad (\text{A.4})$$

In equilibrium the low-price stores get all the informed consumers and some of the uninformed consumers (the lucky tourists), so their share of the market is greater than the proportion of informed consumers:  $\beta > \alpha$ .

Let  $q^*$  be the quantity at which average cost equals  $p^*$ . That is,  $q^* = q^h$ , so that

$$q^* = \frac{(1 - \alpha)L}{n}. \quad (\text{A.5})$$

Similarly,  $q^*$  is the quantity at which average cost equals  $p^l$ , so  $q^* = q^l$ , and

$$q^* = \frac{\alpha L + (1 - \alpha)L\beta}{n\beta}. \quad (\text{A.6})$$

Equations A.5 and A.6 are equations in two unknowns,  $\beta$  and  $n$ . Rearranging A.5 yields

$$n = \frac{(1-\alpha)L}{q^a}. \quad (\text{A.7})$$

Substituting from Equation A.7 into A.6 and rearranging terms,

$$\beta = \frac{\alpha q^a}{(1-\alpha)(q^h - q^a)}. \quad (\text{A.8})$$

The two-price equilibrium is characterized by  $n$  and  $\beta$  (determined by Equations A.7 and A.8). The  $\beta n$  low-price stores sell  $q^h = q^l$  (Equation A.6) units at  $p^l$  and  $(1 - \beta)n$  high-price stores selling  $q^h = q^h$  (Equation A.5) at  $p^h$ .

## Appendix 2

### Example 1 Sources of Consumer Information

A national study of 2430 U.S. consumers selected randomly from the telephone directories in 1979-80 shows how consumers obtain their information about grocery stores. Two-thirds (68.8 percent) claim they read food store advertisements. The proportion of shoppers reading newspaper ads increases with family size. Presumably, the larger a family, the higher the return to finding the lowest food prices. Over half (54.1 percent) of the shoppers who read newspaper ads say that the advertisements influence where they shop. Consumers who read ads read an average of 2.5 per week.

Almost half (47.6 percent in 1979-80 compared to 40.7 percent in 1977) view food-store commercials, seeing an average of 1.8 ads per week. However, only 18.3 percent of these television viewers say the commercials influence where they shop.

Almost three-quarters of the consumers compare prices between different supermarkets (74.4 percent) compared to only about two-thirds who compared in 1977. The main method for comparative pricing is reading newspaper ads and the second most likely method is store visits.

The typical consumer shops in 2.2 different supermarkets during a one month period and 1.4 per week. To put that last figure in perspective, the average number of shopping trips is 1.4 per week (although only 26.7 percent of consumers shop more than once a week). Shopping in more than one store is more likely, the larger the family size and the more spent per week.

Shoppers tend to remain loyal to certain stores. Annually, only 18.2 percent of the respondents changed the supermarket where they did most of their shopping. The greatest switching behavior is among the younger age groups and larger families. Presumably young people are relatively sensitive to prices because of low incomes, whereas large families gain more than most from comparison shopping. The main reason (given by 36.8 percent in 1979-80 compared to 25.6 percent in 1977) for changing supermarkets is lower prices.

Thus, consumers gather information in a variety of ways. Consumers with large families, who benefit the most from the information, collect more of it and are more likely to use it.

Source: Burgoyne, Inc. *The National Study of Supermarket Shoppers*, 1977 and 1979-80.

#### *Example 2 Do Consumers Know How Much They Pay?*

Do consumers know the exact prices they pay in grocery stores? The answer is no. In a survey of 560 shoppers in four Providence and Boston area supermarkets in July 1974, consumers were asked to state the price of 44 popular brand-name and nationally advertised items. Only 24 percent of the shoppers tested knew the correct price (within 5 percent) of a specific product; the comparable figure for a similar study in 1963 was 32 percent.

The same is true in Great Britain. A random sample of housewives in Nottingham, England were asked to recall the prices they paid for seven common grocery items within the previous week. Any departure from the actual price was classified as incorrect. Across all social groups and all types of retail outlets, 57.0 percent of prices were accurate, 25.4 percent were wrong, and 17.6 percent were not known by the consumer. Thus, one-quarter of the housewives believed they knew the price but were wrong; and 4 out of 10 either did not know the price or gave the wrong one. The percent correct varied across commodities from 34.8 percent for breakfast cereal to 79.3 percent for tea.

Of those prices that were incorrect, 43.2 percent differed from the correct price by not more than 5 percent, roughly equally split between the positive and negative direction. If the researchers had classified a price as correct if the deviation did not exceed 5 percent, the percentage correct would have been 65.3 percent; with a 10 percent criterion, the number would be 73.1 percent.

Accuracy declined as wealth or the number of items bought increased. The social group with the lowest percent correct was the well-to-do, and the second lowest was the professional middle class. Thus, consumers who spend a relatively small percent of their income on food are relatively less likely to know accurately the prices they paid.

Sources: *The Progressive Grocer*, November, 1974, 39, and Gabor and Granger (1961).

### Example 3 Understanding Consumer Information

Consumers often cannot understand potentially valuable information due to lack of training or intelligence. The following four examples indicate that many consumers have difficulty understanding potentially useful information.

**Unit Pricing:** A shopper can use unit pricing information in grocery stores to determine which brand or sizes are relatively inexpensive per unit. In 300 postshopping interviews in 1975, 39 percent of shoppers claimed to use unit pricing frequently and another 32 percent occasionally. Only about 19 percent said they seldom or never used shelf tags for price comparisons and only 10 percent admitted they had never noticed the tags. Thus, over 7 out of 10 customers said they occasionally used unit pricing, whereas only 22 percent rated unit pricing as "not helpful."

One reason consumers may not use unit pricing is that they cannot process the information. One experiment found that understanding the unit price information varied with education.

Education level	Percent who understood unit pricing
Grade school	47.7
Some high school	71.1
High school graduate	75.0
Some college	80.9
College graduate	82.7

**Insurance Cost:** Surveys show that the model life insurance cost-disclosure format adopted by the National Association of Insurance Commissioners is incomprehensible to the average consumer. Only 38 percent of life insurance purchasers knew that a policy's index number could be used to compare the costs of life insurance policies. Only 21 percent knew that the lower the policy's index number, the lower its cost, and 61 percent said they did not know how to use an index number.

**Brightness of light bulbs:** Since 1970, the Federal Trade Commission has required the disclosure of brightness information for light bulbs. Five years after the rule was promulgated, most consumers did not understand the concept of "lumens," which measure brightness. In a survey of 168 people, only 1 mentioned lumens as a pertinent factor in selecting light bulbs.

**Nutrition:** The Federal Drug Administration requires that nonstandard food items must be labeled, yet many consumers (including the authors of this text) find it hard to understand the meaning of certain terms. For example, if a product is not the real thing or is nutritionally inferior to the real thing it must be called imitation. If the product is not real but is nutritionally equivalent, it may be called a substitute. The terms *salt free*, *no salt*, *no salt added*, *unsalted*, and *without salt* may be misleading to many consumers. These phrases mean that no salt has been added during processing, but the original product may be very high in salt or sodium.

Moreover, many consumers assume that food labels must provide all relevant information. Yet food that is repackaged by a store need not be labeled if the information is posted nearby. Substances that migrate from equipment or the package to a food item are not included on the label. For example, cold cereals need not list preservatives on their labels even if they are packed in boxes coated with preservatives that leach into the cereals.

Sources: *The Progressive Grocer*, October 1975: 48; McCulloch, D. and D. I. Padberg. "Unit Pricing in Supermarkets." *Search: Agriculture* 1 (1971): 18, Table 22; Federal Trade Commission (1979, 93-4); Margen, Sheldon, and Dale Ogar. "To Your Health: The Writing on Food Labels Often Confuses." *San Francisco Chronicle* 22, October 1986: FF4; and Margen, Sheldon, and Dale Ogar. "To Your Health: Labels on Our Food Don't Tell the Whole Story." *San Francisco Chronicle* 29, October 1986: FF 3.



#### Example 4 Experimental Evidence on Lemons Markets

The Federal Trade Commission sponsored an experimental study of markets where buyers have less information than sellers. College students played the roles of buyers and sellers, and two types of qualities were offered. Low-quality items were called regulars and high-quality items were called supers. The experimenters established the value of these items by announcing to the buyers that they would pay, for example, \$3.30 for a super, but only \$1.80 for a regular. Similarly, sellers might be offered supers at \$1.65 and regulars at \$.65. Thus, if a seller and buyer agreed to an exchange at \$3 for a super, the seller could obtain it from the experimenter for \$1.65 and make \$1.35 on the transaction. The buyer could sell it back to the experimenter for \$3.30 and make 30 cents.

If the seller sold a regular for \$3, the seller's profits rose to \$2.35; but the buyer lost \$1.50 (since the experimenter would only pay \$1.80 for a regular). In other words, such a buyer lost 50 cents more than the seller gained. Prices were set so that it was more efficient for the buyer and seller to trade supers, in the sense that they jointly made more money from the experimenter.

Buyers and sellers were kept in separate rooms. Bids and offers were exchanged over a CB radio and listed on a blackboard in each room. In some experiments, sellers were not identified: that is, they did not have a brand name. In other experiments, the sellers were identified by number. Here "brand names were permitted."

Sellers were allowed to advertise in some experiments by making a claim about the quality of the item offered. For example, a message might be posted saying, "Seller Number 5 offers a super at \$3." In some cases sellers were allowed to make false claims; whereas in other experiments, only true claims were allowed.

The key results were:

- Without brand names or advertising, virtually all lemons were sold. This result confirms Akerlof's prediction.
- Where only truthful claims were permitted, the market behaved almost perfectly efficiently. High-quality products were supplied whether or not brand names were allowed.

- Reputations alone were not enough to overcome the lemons problem. That is, when sellers had brand names but were not restricted to only truthful claims, lemons were still sold. When possibly false advertising or labeling was allowed along with brand names, virtually only lemons were sold.

As argued later in this chapter [*Modern Industrial Organization*, forthcoming], one would expect that reputation alone could solve the lemons problem. Hence, this last result is surprising. Perhaps the value of brand names in this experiment was not sufficient to establish a reputation for truthfulness because the long-term gain from a favorable reputation was not sufficiently high.

Source: Lynch, *et al.* (1986).

*Example 5 Empirical Evidence on Lemons Markets and a Disclosure Law*

Akerlof's lemons model raises two questions. First, does the lemons problem occur in used car markets? Second, can laws (as in Wisconsin) requiring sellers to disclose all known defects to buyers eliminate the lemons problem?

A study used Federal Trade Commission telephone survey data on used cars purchased between October 1978 and January 1980 to answer these questions. Only those who had bought, sold, or traded in a used car for more than \$25 dollars during the previous 12 months were included. Survey respondents who sold five or more cars were classified as dealers and excluded from the study.

One indirect test of the lemons problem is to see if quality varies by type of seller. If warranties, reputation, or friendship can prevent the lemons problem, then dealers or friends and relatives should provide better-quality cars than those purchased from a stranger through an ad.

To test this hypothesis, three measures of the quality of a car were used. First, survey respondents were asked to rate mechanical condition at the time of purchase on a 10-point scale, with 1 being a lemon and 10 being a gem. Presumably, since the question was asked some time after purchase, buyers had learned the actual quality. Second, respondents were asked if the car had undergone repairs. Third, the repair expenditures were recorded. Each of these measures has its strengths and weaknesses. On average, respondents rated the mechanical condition as 6.65, reported that 39 percent had repairs, and that expenditures on repaired cars were \$264.

A statistical analysis of the data controlled for various factors such as the age and mileage of used cars and repair ratings in *Consumer Reports* for the particular models of cars. For used cars 1-7 years old, few differences were found by type of seller (through an ad, friend or relative, new and used car dealer, used car only dealer, or someone of whom you have heard).

With older cars (8-15 years old), average quality differed statistically significantly by seller. (The data are inconsistent with the hypothesis that there are no differences in quality across sellers.) Cars purchased from friends or relatives were rated 0.46 points higher on mechanical condition than those purchased from an ad, and those purchased from a new and

used car dealer were rated 0.91 points higher. Cars purchased from friends or relatives were statistically significantly less likely to need a repair than those purchased through an ad. Finally, compared to cars purchased through an ad, repair expenditures were \$418 lower for cars purchased from a friend or relative, \$533 lower if purchased from a new and used car dealer, and \$449 lower if purchased from someone the buyer had heard of from others. The Wisconsin defect-disclosure law did not have a statistically significant effect on quality (compared to cars sold in other states).

Thus, there is little evidence of a lemons market problem for used cars less than 8 years old, but there is evidence of the problem for cars 8-15 years old. Apparently reputation or loyalty helps prevent the lemons problem. You can buy higher quality cars from friends or relatives or others you slightly know than through ads. New and used car dealers also provide higher quality cars, presumably to maintain their reputations.

The relatively weak Wisconsin defect-disclosure law apparently had little or no effect. One possible reason is that it only applied to car dealers, for whom the lemons problem was not severe.

Source: Lacko (1986).

### Example 6 Price Dispersion

A survey in England recorded twice a month the prices charged for nine branded goods by retailers in the same shopping area over a period of seven months. The following table gives the largest price differences as percentages of the lowest price.

Good	Number of stores	Largest % price difference
McDougall's SR Flour	4	40.0
Fairy Liquid	5	33.3
Birds Eye Frozen Pea	3	30.0
Ambrosia Creamed Rice	4	27.3
Heinz Chicken Soup	4	26.6
Nescafé	4	19.3
Heinz Baked Beans	4	17.3
Typhoo Tea	4	16.7
Pal Dogfood	5	13.3

A similar study in the United States also found large spreads. For example, out of 17 items studied, the highest price exceeded the lowest by 100 percent or more in 42 percent of the items and the highest price exceeded the lowest by 50 to 99 percent in 23 percent of the items. In only 23 percent of the items was the spread less than 30 percent. The U.S. study found that consumers' perception of the degree of price dispersion was most accurate for items with relatively small actual price dispersion, such as food items and heating oil. Consumers tended to underestimate the spread of prices for high dispersion items such as consumer durables.

Sources: Gabor (1980); Maynes and Assum (1982).

### Example 7 Warnings That Affect Markets

Although consumers routinely ignore many health and other warnings, some substantially affect markets. A dramatic example is the mid-1988 *Consumer Reports* warning that the Suzuki Samurai sports utility vehicle was prone to roll. In June 1988, 2199 were sold, compared to 7479 in June 1987 and 6074 in May 1988.

In recent years, the federal government has issued many health warnings. The Surgeon General announced that cigarette smoking could cause cancer or other serious problems. The U.S. Department of Agriculture (USDA), the Food and Drug Administration (FDA), and the Federal Trade Commission (FTC) issued health warnings concerning aflatoxin, cholesterol, sodium, potassium, saccharin, cyclamates, calories, protein levels, and other components and attributes of foods and drugs. In a few cases, the government removed certain products, such as those with cyclamates, from the market, so that the market effects did not depend on consumer reactions.

Consumers react strongly to only some of these warnings and the associated publicity. Warnings and publicity on cholesterol apparently substantially reduced U.S. consumption of meat and eggs. From 1963 to 1985, milk and cream consumption declined 39 percent and egg consumption declined 26 percent. Warnings and publicity on saccharin, cyclamates, and other sugar substitutes affected several markets. Consumers altered their relative demands for various soft drinks. Cigarette warnings and publicity greatly affected the tobacco industry: cigarette consumption per capita fell 20 percent from 1963 to 1985. A *Redbook* survey reported that 50 percent of women claimed they stopped or cut back on purchases of a food because of high sugar, 39 percent due to high cholesterol, and 29 percent because of additives.

In 1988, after the British Deputy Health Minister, Edwina Currie, made an extremely controversial statement to a television interviewer that "most of the egg production in this country" was infected by salmonella, a bacteria that may cause food poisoning, egg sales dropped 60 percent virtually overnight. This drop occurred despite public assurances by the Minister of Agriculture and the Prime Minister that they were still eating eggs. The drop in demand resulted in the destruction of tens of thousands of healthy laying hens, and farmers estimated that up to one-quarter (10 million) of the bird-

breeding stock eventually would be gassed. Indeed, the government bought eggs to prop up the market and announced that eggs were highly nutritious and good for most people.

Government warnings often lead to responses by industry groups. Currie was named in at least 11 lawsuits filed by egg producers alleging product slander and malicious falsehood. Pressure from farm groups and politicians apparently led to her resignation. The British egg industry announced that studies it sponsored failed to find a single infected egg among the 1 million eggs examined.

The conflicting claims provided by producer groups and the government may, at best, confuse consumers. For example, in response to claims that heavy consumption of eggs, which are high in cholesterol, may be dangerous to one's health (especially to people with high cholesterol levels), one employee of the California Egg Commission said, "Eggs have six times more lecithin than cholesterol. ... It emulsifies the cholesterol, breaks it down so it's not a problem." This lecithin theory is rejected by many experts.

The National Coffee Association said that coffee, which contains caffeine, "lets you calm yourself down." Many soft drinks advertised their use of NutraSweet when they also contained saccharin. Del Monte Corp advertised that its canned vegetables "are as nutritious as the vegetables you buy fresh and cook at home." Many consumers find it difficult to evaluate these various claims, which contradict widely held beliefs.

If consumers properly interpret and react to warnings, industry responses, and the resulting publicity, and if the cost of providing the warnings is low, accurate warnings may increase social welfare. Example 8, however, shows that the costs of providing accurate information may exceed the benefits.

Sources: *Commodity Yearbook*. New York: Commodity Research Bureau (various years); "Diet and Heart Disease," *Consumer Reports* 46 (1981): 256-260; "Nutrition, the Redbook Nutrition Report." *Redbook Magazine* (1976); Henderson, Nell. "What You Eat May Not Be What You Thought." *The Washington Post National Weekly Edition* 1 July 1985: 22; Bashin, Bryan Jay. "Does Anything Go with Eggs?" *San Francisco Examiner*, 8 November 1987: "This World" section, 12; Reuters. "Suzuki

Samurai Sales Plunged 70% in June." *San Francisco Chronicle*, 7 July 1988: C1 and C8. DeYoung, Karen. "British Egg Scandal Breaks—Official Quits." *San Francisco Chronicle*, 17 December 1988: A1, A20.

*Example 8 A Cost-Benefit Analysis of Providing More Accurate Information*

Providing information only makes sense if the benefits from the information outweigh the costs of providing it. A cost-benefit study was conducted concerning accurate interpretation of weights reported on chicken labels in grocery stores.

Some foods, such as meats and poultry, accumulate moisture during processing and lose moisture during packing and storage. The accumulation or loss depends on the biological characteristics of the product and handling conditions such as temperature and storage time. As a result, the actual weight of the meat purchased is often different from the weight stated on the label.

To be sure they are in compliance with labeling requirements, some firms label packages with weights less than the actual weights, a technique referred to as *overpacking* by the industry. Because different states use different standards—some use wet weights and others use dry weights—the difference between labeled and actual weight is probably substantial across the country. The U.S. Department of Agriculture examined the drained and labeled weights of packages of whole, cut-up chickens from various states. In roughly half the sample the drained weight was higher; in the other half the labeled weight was higher.

Presumably, consumers would be willing to pay more per pound if they knew that a package contained more product than was indicated on the label. One estimate of the gain from the information about accurate weights in 1978 was \$2.145 million, which is only 0.01 percent of the total expenditures on chicken. The estimated cost of providing drained-weight information is at least \$59 million annually. Thus, in this case, the costs of providing the information would easily outweigh the benefits.

Source: Sexton (1981).

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