

Asymmetric Market Information

*This note examines how **asymmetric information** and **adverse selection** affect markets, and the business strategies of **signaling** and **screening** that can improve market performance. There are two problems to prepare for class, an acquisition game on pages 4-5 and the product quality problem on pages 6-8.**

In many transactions, one party has information that the second party lacks and that is relevant to the transaction's value. We call this situation one of *asymmetric information*. Last session we discussed incentive problems created by moral hazard, which is a form of asymmetric information when one party takes a *hidden action* (e.g. a salesperson's effort away from the office). In this note we describe how a *hidden characteristic*—of a firm, a product, or whatever is being transacted—affects the way markets work.

Our main concern is a problem known as *adverse selection*. Buyers, if they do not know the quality of the particular item they are buying, will be willing to pay a price for the quality they expect. Absent any additional information, this will be their value for the average quality product. But this means that sellers with much higher quality products than the average must undertake additional (costly) efforts to distinguish their products. If they cannot credibly do this, then their high quality products will command only an average-quality price, and high quality products might not be sold at all. The products which then appear on the market will all tend to be of either average or less-than-expected quality. The market adversely selects poor quality products when buyers cannot discern the quality of a product.

This problem occurs, to varying degrees and extents, in a wide variety of settings. Perhaps the most consequential are insurance and financial markets—for instance, when a firm issues debt or equity to outside investors. The investors try to learn as much as they can about the prospects of the enterprise, but it is easy to imagine that insiders (a firm's top management) know a lot more than outsiders do.

To understand how asymmetric information and adverse selection affect markets, it is easiest to start with simpler transactions when buyers lack information possessed by sellers

* Much of this material is based on the insightful notes and examples of David M. Kreps, to whom I am deeply indebted.

of an object. The market for used cars is a nice example, and began economic research on this subject.

A Simple Story: The Market for Lemons

Imagine that a variety of used cars are “out there,” some good, some okay, and some lemons. Specifically, there are used cars worth every price from \$1000 to \$3000 to car buyers, with each price equally common. Suppose as well that a car worth $\$X$ to a new owner is worth $\$X$ less \$200 to its current owner, so there is a reason for people to buy and sell used cars. A large number of buyers are interested in acquiring used cars.

If the quality of a car were apparent to both buyer and seller, then the logic of supply equals demand implies that cars worth $\$X$ to buyers would sell for precisely that price; competition among buyers would bid the price of these cars up to that level. Every seller of a used car would be willing pocket the \$200 in surplus created by selling the car.

But the quality of a used car is rarely known precisely to a buyer. Moreover, a seller typically has a very good idea if his or her car has “hidden” problems that affect its true value to a potential buyer. Let’s suppose buyers are unaware of the true quality of a used car. Because of this, they are willing to pay for the average “quality” of cars on the market, since (absent credible information from the seller) that is the quality of car they expect to get if they buy one.

Now imagine if all cars of value between \$1000 and \$3000 are put on the market by their owners. Then the average value of cars in the market is \$2000, and that will be the price the market establishes. Seeing this, if someone has a used car worth more than \$2200 to buyers—hence worth more than \$2000 to the seller—this seller will take that car off the market. Why sell a car for \$2000 that is worth more than that to the seller?

Therefore, if the market price is \$2000, the only cars that would be on the market are those worth between \$1000 and \$2200 to buyers. But the average value of this set of cars is \$1600, so that will be the price that the market establishes (since that is buyers’ expected value of a car). And the cycle repeats: Owners of cars worth more than \$1800 to buyers—hence, worth more than \$1600 to sellers—will withdraw from the market entirely. Now the only cars on the market are those with values between \$1000 and \$1800.

So the market price drops to \$1400. Now cars of value above \$1600 drop out of the market, so the market consists of cars with values between \$1000 and \$1600, which means that the price drops to \$1300. More cars are withdrawn from the market, and the price drops again. Where does it end? If you continue this logic, it will end at a market price of \$1200. This means only cars worth \$1200 or less to their current owners—thus worth \$1400 or less to buyers—are brought to the market. Then the average value (to buyers) of cars in the market is \$1200. This is the market price and the market is in equilibrium.

What a crummy equilibrium. Think about it: A scant 20% of the used cars in existence go onto the market, even though every used car is worth \$200 more to a new buyer than to its current owner. Furthermore, this is not a random 20%, but the worst (lowest value) 20% of all used cars. This is truly a lemons market.

Of course, reality is not this bad. In practice, some owners of fine used cars are forced to sell their cars, which improves the distribution of cars in the market, raising the price and bringing more cars into the market. More importantly, buyers can often discern something of the quality of individual cars and can learn more by having the car inspected by a competent mechanic. As we'll see in a bit, the buyer or seller can do still more to signal or screen the quality of individual cars. The stark adverse selection problem of this simple story is not quite this extreme in reality.

But the effect this story illustrates is still there, hampering the efficiency of markets and requiring firms and consumers to take other actions to deal with it. The problem of adverse selection is particularly strong when (1) buyers have a hard time learning the value of the good they are buying and (2) the value of the object to prospective buyers is close to its value to prospective sellers. Here are some concrete examples.

Application: eBay, Fakes, and the “Death of a Market”

Consider the *NY Times* article “Seeing Fakes, Angry Traders Confront eBay” attached at the end of this note. It describes the death spiral of the market for authentic Weiss brooches (a type of jewelry) on eBay. Essentially all authentic brooches are now traded in off-line venues like auction houses, conferences, and through specialty dealers—depriving eBay of the revenue from handling high-value jewelry transactions. As you read it, think about two questions: Why has the trade in high-quality brooches disappeared from eBay’s online markets? What, if anything, can eBay do about it?

Other Applications: Insurance and Service Contracts

In the examples above, the seller knows more about the quality of the good than the buyer. But cases in which the buyer holds hidden information also arise, typically involving a service that the seller provides the buyer: The cost of providing the service is uncertain, and the buyer knows more about the cost than the potential service provider. Life and health insurance are classic examples. In fact, the term *adverse selection* originates in actuarial science. The cost of providing life or health insurance depends on how likely it is that the client will get sick or die. At any premium level, it is precisely the sick and soon-to-die, assuming they know this sad fact, who are most anxious to buy insurance. Therefore, in terms of expected payouts on the policy, the insurance company faces an adverse selection of the population as a whole.

This can lead to the sort of vicious cycle we saw before: Premium rates must be high, to compensate for the adverse selection problem. This leads the fairly healthy to go without insurance, and the selection of folks signing up for insurance becomes more adverse, raising premiums, worsening the adverse selection, and so forth. The cycle continues, as in the lemons problem, until it ends with a large share of people going without health insurance entirely. As you might surmise at this point, problems of adverse selection are not hypothetical.

This sort of problem arises as well in the context of outsourcing and service contracts. Suppose Corporation X requires a specific service at one of its facilities. It has the in-house capability to perform the service but has asked Contractor Y to take on the project, offering (say) \$140,000. Contractor Y is unsure what it will cost to provide the required service, and figures its cost will be somewhere between \$100,000 and \$170,000 (say).

Contractor Y should now ask itself (in true game-theoretic fashion): Why is Corporation X not using its in-house capability to provide this service? The usual answer is because Contractor Y, being a specialist, can provide the service more cheaply. Suppose that Contractor Y believes it has a \$10,000 cost advantage over what it would cost Corporation X to do this project in-house. If Corporation X is offering \$140,000 to Contractor Y, then Contractor Y should conclude that the job will cost more than \$140,000 if X does it in-house *and so the cost to Contractor Y will be more than \$130,000*. Knowing as much, the relevant range of costs to Contractor Y is not \$100,000 to \$170,000, but instead from \$130,000 to \$170,000. So perhaps Contractor Y should insist on a price of \$155,000. But if Corporation X agrees to \$155,000 as the price, then the cost to X must be more than \$155,000. That means Contractor Y should infer it will cost Y \$145,000 or more to do the job. And so forth, just as in the case of the used car market.

Am I “messing with your head” enough yet? Markets are complicated things, and who has access to what sorts of information before parties transact has profound consequences for how markets work. Here’s another example.

Problem 1 to Prepare for Class

We’ll do this as a game in class. Bring enough cash to class to cover your bid, whatever you decide that should be. I recommend you analyze this problem with others, if you wish. (Note: Scenario A is easy. Scenario B requires more thought, but not much math).

Acquiring a Company

Problems of asymmetric information are legion in the business of corporate mergers and acquisitions. The consequences of this are best illustrated by example.

You represent Company A (the Acquirer), which is considering acquiring Company T (the Target). You plan to offer cash for all of Company T's shares, but you are unsure what price to offer. The complication is this: the value of Company T—indeed, its viability—depends on the feasibility of a major technology project. In a worst-case scenario, the project would fail and Company T will be worth nothing. In the best-case scenario, Company T's value under current management could be as high as \$100 per share. For simplicity, assume all share values between \$0 and \$100 are equally likely.

You must determine the price per share that Company A should offer for Company T's shares. It is well known that, regardless of how well the technology project turns out, Company T will be worth more under the progressive management of Company A than under its current management. In fact, whatever its ultimate value under current management, Company T will be worth 50 percent more if acquired by Company A.

From all indications, Company T would be happy to be acquired by Company A for the right price. That is, Company T will accept any offer by Company A that is greater than Company T's assessment of its (per share) value under its current management.

Consider what price per share you would offer in each of the following two different scenarios:

Scenario A

Company A's offer must be made *now*, before the results of the major technology project are known. That is, neither Company A nor Company T will know anything further about the feasibility of the major technology project at the time the offer and acceptance decisions must be made.

As the representative of Company A, you are considering price offers in the range of \$0 per share (i.e., making no offer at all) to \$150 per share. What price per share should you offer for Company T's stock?

Scenario B

Again Company A's offer must be made *now*, before the results of the major technology project are known. However, now you expect Company T to delay a decision on your bid until it has completed its evaluation of the major technology project's feasibility. Thus, you (Company A) will not know the results of the major technology project's feasibility when submitting your price offer, but *Company T will know the results—that is, the company's true share value under current management—when deciding whether or not to accept your offer.*

As the representative of Company A, what price per share should you offer for Company T's stock?

Managing Adverse Selection: Signaling Strategies

There are a variety of ways that prospective buyers and sellers can act to overcome the trading hazards posed by asymmetric information and adverse selection. Two deserve explanation here. The first is *signaling* the value of a hidden characteristic, in which the informed party voluntarily provides information about the value of the good. Credibility of the information is the challenge. In product markets, things like warranties, guarantees, and reputations serve to make the information one party discloses credible.

Problem 2 to Prepare for Class

This is a discussion with a series of simple calculations for you to do along the way. It has an important point at the end. As usual, you do not need to turn in your work on class-session problems, and you may work with others if you wish.

Warranties as a Signal of Product Quality

Suppose you plan to sell a high quality product. Unfortunately, the competition can make a low-quality product that looks just like yours. Is there something you can do to signal your product is a good one and worthy of a much higher market price? One possibility is to *offer a warranty*. This can allow you to sustain a higher price if it is less costly for you to offer a warranty than it is for sellers of lower-quality products.

Let's return to our used-car market. To make matters transparent, imagine that there are only two types of used cars: lemons, worth \$2000 to buyers and \$1800 to sellers; and cream puffs, worth \$3000 to buyers and \$2800 to sellers. (In American automobile slang, a "cream puff" is a car that has been well taken-care of by its previous owner). Suppose that in the population of all used cars, three-quarters of the cars are cream puffs and that buyers learn nothing about a car's quality by driving or inspecting it. We'll assume there are lots of potential buyers and a finite supply of used cars, so that competition among buyers means the market price for a used car will equal buyers' willingness to pay. (That assumption isn't necessary for the economic conclusions to follow, by the way. But it shortens the requisite setup.)

In this market, adverse selection is a killer. Suppose all cars were brought to market. Then any single car has a 25% chance of being a lemon and a 75% chance of being a cream puff. The expected value to buyers of this "lottery" is a car worth, on average, \$2750. Competition among buyers, assuming there are a lot of them, forces the price up to \$2750. But then the owners of cream puffs would withdraw their cars from the market. The only equilibrium is for only the lemons to be bought and sold, and they sell for \$2000. Only one in four cars is traded in the market, producing a surplus of \$200.

Now suppose that sellers of used cars can, if they choose, voluntarily send a signal about the value of their car. Specifically, they can offer a 6-month warranty. Imagine that, for the owner of a cream puff, the expected cost of offering a 6-month warranty is \$300. And 6-month warranties on cream puffs are worth \$250 to buyers. But for lemons, 6-month warranties are worth \$500 to buyers and cost sellers \$1400. Warranties cost more for lemon owners than for cream puff owners because cream puffs seldom require service.

Will buyers believe that a 6-month warranty is sufficient to signal that a car is a cream puff and not a lemon? That belief will be validated by the market if lemon owners maximize their profit by not offering a warranty, and if cream puff owners maximize their profits by offering a warranty. Let's see what happens.

(a) First, the basics:

- How much is a buyer willing to pay for a cream puff with a 6-month warranty? (That is, if the buyer *knew* it is a cream puff?)
- How much is a buyer willing to pay for a lemon with a 6-month warranty? (That is, if the buyer *knew* it is a lemon?)

(b) Imagine you are the owner of a lemon, worth \$1,800 to you if you retain it. We know that if you offer it for sale without a warranty, the market price will be \$2,000 (Why? Read that "...adverse selection is a killer" paragraph above again). Now suppose that you offer it for sale with a 6-month warranty instead:

- If the buyer believes it is a cream puff, what is your expected profit (that is, what is the price the buyer will be willing to pay for a cream puff with a 6-month warranty, less your expected cost of servicing the warranty)?
- If the buyer believes it is a lemon, what is your expected profit (that is, what is the price the buyer will be willing to pay for it with a 6-month warranty, less your expected cost of servicing the warranty)?
- What is the best thing to do as a lemon owner: Sell the car with a warranty, sell the car without a warranty, or do not sell it at all?

(c) Now imagine you are the owner of a cream puff, worth \$2,800 to you if you retain it. Now suppose that you offer it for sale with a 6-month warranty:

- If the buyer believes it is a cream puff, what is your expected profit (that is, what is the price the buyer will be willing to pay for a cream puff with a 6-month warranty, less your expected cost of servicing the warranty)?
- If the buyer believes it is a lemon, what is your expected profit (that is, what is the price the buyer will be willing to pay for it with a 6-month warranty, less your expected cost of servicing the warranty)?

Let's not yet ask what you, as a cream puff owner, want to do. Rather, let's ask what *buyers should believe*.

(d) Now imagine you are a buyer. If you see a car for sale with a 6-month warranty, should you believe that it is a lemon or that it is a cream puff? Why?

(e) Now put the pieces together:

- Which cars are sold in the market: Lemons, cream puffs, both, or neither?
- Which cars (if any) sell with a warranty?
- What price(s) do these cars sell for in the market?

If you did this correctly, you will find quite a different outcome from the market's performance without the possibility of a warranty. Tallying up all the numbers, the total surplus created (that is, the direct gains from trade plus the value of a warranty to buyers with warranties less the expected cost of servicing it to sellers) is \$650 for every four cars in the population: \$150 for each cream puff, and \$200 for each lemon. This is 3.5 times the economic value created by the market without product warranties. The market works again.

About this problem. There are two keys to this sort of "separating" market equilibrium, where both qualities of goods are transacted along with a credible "signal" (e.g. a warranty) that distinguishes only the high quality products. First, the signal (warranty) must be more costly for low-quality car owners than for high-quality car owners, costly enough that low-quality car owners are unwilling to send the signal, even knowing that to do so would elicit the price appropriate for high-quality cars. Second, the signal cannot be so expensive, relative to its value to the buyers of cars, that owners of high-quality cars are unwilling to send it.

This second key—the fact that the warranty is not too expensive relative to the difference in buyers' valuations of the high- and low-quality products—makes the effectiveness of a warranty vary greatly from one market to the next. Two practical examples illustrate the contrast: Digital photography equipment and mobile phones. Nikon (a manufacturer of cameras and photography equipment) currently offers a five-year warranty on its higher-end digital SLR cameras in the United States. Professional photographers are willing to pay the steep prices that Nikon commands for these products because they can't afford to buy a product that might fail in the field, and manufacturers of less-reliable cameras cannot afford to offer a similar five-year warranty given the beating that professional photographers place on their equipment (honoring the warranties would leave them broke).

By contrast, most mobile phones come with very short warranties nowadays, sometimes only 30 days. There's not much point in competing on this basis if consumers buy new phones frequently (to switch between carriers, or to acquire new features, or whatever),

which makes the average consumer unwilling to pay much more for a highly-reliable phone than a not-so-reliable phone.

Application: Advertising Spending and Product Quality

Consider the *Economist* article “Money in the Message” at the end of this note. What characteristics of the product or firm must be true for a large advertising budget to be an effective signal of high product quality?

Managing Adverse Selection: Screening Strategies

The second means by which markets overcome adverse selection problems is called *screening*. Imagine the buyer and seller of a used car meet, in a world with 6-month warranties for high-quality cars. Does the seller take the initiative and say, “I want \$3250 for my car, and I’m offering it with a 6-month warranty”? Or does the buyer take the initiative and say “I’ll pay you \$3250 if you offer me a 6-month warranty along with it, or \$2000 for your car as it is. Take your pick.” It would not seem to matter very much to how efficiently a market operates, but the distinction is useful. We say that *signaling* occurs when the informed party takes the initiative. When the uninformed party offers the informed party a set of choices, where the choice from the set becomes the informative signal, the uninformed party is *screening* different quality goods. In essence, by making a set of contingent offers to the informed party (i.e., offering different prices for the car with and without the warranty), the uninformed party is sure not to overpay if the car turns out to be low-quality.

Screening strategies are prevalent in markets where the uninformed party provides a service for the informed party. For instance, in health, life, and casualty insurance, screens that are frequently employed include the size of the deductible, the percentage of the total loss insured, and reduced benefits for some period of time. Insurance companies collect reams of data from many clients and use those data to assess how, say, the rate of payout on a health insurance policy varies with the policy’s deductible. This allows the company to screen (that is, to separate out) the high-quality (healthy) buyers from the lower-quality (unhealthy) buyers, and ensure they are earning a profit serving both segments of the health care insurance market.

The way screening strategies actually work in practice is by employing the same concepts we started MGEC 621 with: Price discrimination using two-part prices. The firm offers a set of pricing *plans*, and a consumer picks one from among the set offered. An example will help make the economic logic for this clear.

Example. Two-Part Pricing to Screen Consumers

This worked-out example is designed to indicate why **offering consumers a choice among several two-part pricing options** is the profit-maximizing way to price most services, ranging from auto insurance to mobile phone contracts to home mortgages. Be sure you get the economic lessons of this problem at the end.

Part A. Slammin' Hammond. Slammin' Hammond has to decide whether or not to purchase insurance for his car. With some probability, Slammin' will totally wreck his car in an automobile accident. If an accident occurs, it will cost \$30,000 to replace the car. (Assume that any accident will totally wreck the car, and that the only option if the car is wrecked is to replace it.) Suppose the probability that Slammin' will have an accident with his car is 0.2.

Slammin's total wealth is \$90,000, and he is risk averse. Specifically, his utility function is given by the following formula (W stands for wealth, in dollars):

$$U(W) = (W/10,000)^{1/2}$$

How much would Slammin' pay for full insurance coverage? First, if Slammin' does not buy insurance at all, what is his expected utility and certainty equivalent?

$$EU \text{ without insurance: } EU = (.2)(60,000 / 10,000)^{1/2} + (.8)(90,000 / 10,000)^{1/2} = 2.8899$$

Slammin's certainty equivalent is the amount of wealth that solves $(W/10,000)^{1/2} = 2.8899$. Solving this equation for W gives $CE = \$83,515.10$.

Now, what is the maximum amount of money, P , that Slammin' is willing to pay to get "full" insurance? (Full insurance pays Slammin' \$30,000 if an accident occurs, and \$0 if an accident does not occur.) If Slammin' buys full insurance his wealth is $\$90,000 - P$, whether or not an accident occurs, and his utility is $((90,000 - P) / 10,000)^{1/2}$ for certain. So Slammin' will pay, at most, the price P that gives him the same utility as his next best alternative of no insurance. Solving

$$((90,000 - P) / 10,000)^{1/2} = 2.8899$$

for P gives $P = \$6484.90$. This is the most that Slammin' would pay for full insurance. Note that this could be (more quickly) obtained by subtracting from his initial wealth of \$90,000 his certainty equivalent of \$83,515.10, which again gives $P = \$6484.90$. The logic here is that paying \$6484.90 leaves him fully insured and facing no risk, and should therefore leave him with precisely the same wealth for sure (\$83,515.10) that makes Slammin' indifferent to the risk he faces.

Gentle Jim. Gentle Jim is another driver, and also owns a \$30,000 car. In fact, Gentle Jim is identical in all respects to Slammin' Hammond, except for the probability of an accident. The probability that Gentle Jim will have an accident is only 0.1.

How much would Gentle Jim pay for full insurance? For Gentle Jim,

$$EU \text{ without insurance: } EU = (.1)(60,000 / 10,000)^{1/2} + (.9)(90,000 / 10,000)^{1/2} = 2.9449$$

Jim's certainty equivalent is the amount of wealth that solves $(W/10,000)^{1/2} = 2.9449$. Solving this equation for W gives $CE = \$86,727.24$. Gentle Jim would pay up to $\$90,000 - \$86,727.24 = \$3272.76$ for full insurance.

Part B. The Dewey Cheetem and Howe Insurance Co. Dewey Cheetem and Howe (DC&H) is a risk-neutral auto insurance company. It believes that each of its potential customers is either a "low-risk" driver or a "high-risk" driver. Low-risk drivers have a 0.1 probability of having a car accident, and high-risk drivers have a 0.2 probability of having a car accident. DC&H believes that 90% of all drivers are of the "low-risk" type. Suppose that all drivers have the same initial wealth, \$90,000, and the same utility function $U(W) = (W/10,000)^{1/2}$, as Slammin' Hammond and Gentle Jim above.

Selling to only the high-risk drivers. Suppose that the insurance company offers a full insurance policy to any driver at a price of \$6400. Who will buy it? Since the high-risk types are willing to pay \$6484.90 but the low-risk types are willing to pay only \$3272.76 for it, only the high-risk types will buy this coverage. Knowing this, the insurance company's expected loss per insured driver will be

$$\text{Expected costs: } EMV = (.2)(\$30,000) + (.8)(\$0) = \$6000.$$

and DC&H's expected profit per insured driver is therefore \$400. This is just the price of \$6400 minus the expected cost of \$6000.

Selling to both types of drivers. Suppose now that DC&H wants to offer a full insurance policy that all drivers would be willing to purchase. What is the maximum price DC&H could charge for such a policy? To get both types to buy, the maximum price DC&H can charge is \$3272.76. At this price, what are the DC&H's expected profits per customer? The expected cost per insured driver is

$$\text{Expected cost: } EMV = (90\%) (.1)(\$30,000) + (10\%) (.2)(\$30,000) = \$3300.$$

In words, this is the share of low risk drivers (90%) times the expected loss of a low-risk driver (a .1 chance of a \$30,000 loss), plus the share of high risk drivers (10%) times the expected loss of a high-risk driver (a .2 chance of a \$30,000) loss. Expected profit per insured driver if DC&H sells full insurance to all drivers is therefore

$$\text{Expected profit: EMV} = \$3272.76 - \$3300 = -\$27.24$$

This is a key lesson. DC&H cannot make a profit selling insurance coverage on the same terms and conditions to everyone in this market. The reason for this is that the low-risk drivers are not willing to pay enough for insurance (knowing that they are low risk) to cover the expected losses from subsidizing the high-risk drivers. The expected profit of $\$3272.76 - \3000 from each low-risk type of driver does not cover the extra $\$6000 - \3272.76 of expected losses from insuring each high-risk driver, even though the high risk drivers are only 10% of the population. If only full-coverage insurance is available, DC&H would offer it to high-risk drivers at a high price, and the low-risk drivers would be forced to go without coverage.

Part C. DC&H meet Slammin' Hammond and Gentle Jim. Du Diligents, from McBain Consulting, suggests that DC&H should offer two contracts. One is a full insurance contract, at a price of \$5,380. The full insurance contract obligates DC&H to pay the customer \$30,000 in the event of an accident. The second is a partial insurance contract, at a price of \$1,065. The partial insurance contract obligates DC&H to pay the customer \$9,320 in the event of an accident.

What does a high-risk driver prefer? Slammin' Hammond knows that he is a high-risk driver. What does he prefer? From earlier, we have that

$$\text{EU without insurance: } EU = (.2)(60,000 / 10,000)^{1/2} + (.8)(90,000 / 10,000)^{1/2} = 2.8899$$

and now

$$\text{EU with full insurance: } EU = (1)((90,000 - 5380) / 10,000)^{1/2} = 2.9090$$

With partial insurance: With probability .8 Slammin' will not have an accident and will have wealth $\$90,000 - \1065 , where \$1065 is the price of the partial insurance contract. If Slammin' has an accident, however, his wealth will be $\$60,000 - \$1065 + \$9320$. This is his wealth after the car is totaled, less the price paid for insurance, plus the compensation received from DC&H after the accident. Slammin's expected utility is

$$\begin{aligned} \text{EU with partial insurance: } EU &= (.2)((60,000 - 1065 + 9320) / 10,000)^{1/2} \\ &+ (.8)((90,000 - 1065) / 10,000)^{1/2} = 2.9079 \end{aligned}$$

Of the three options, Slammin' would prefer the full insurance contract. He is too likely to have an accident to take partial or no insurance coverage at these terms.

What does a low-risk driver prefer? Gentle Jim is a low-risk driver, although only he knows this. What does he prefer? From earlier, we have that

$$\text{EU without insurance: } EU = (.1)(60,000 / 10,000)^{1/2} + (.9)(90,000 / 10,000)^{1/2} = 2.9449$$

and *EU with full insurance:* $EU = (1)((90,000 - 5380) / 10,000)^{1/2} = 2.9090$

Gentle Jim's EU with full insurance is the same as Slammin's because both have the same level of risk aversion and the same wealth (and car value). With the partial insurance contract, Gentle Jim's expected utility is

$$\begin{aligned} \text{EU with partial insurance: } EU &= (.1)((60,000 - 1065 + 9320) / 10,000)^{1/2} \\ &+ (.9)((90,000 - 1065) / 10,000)^{1/2} = 2.9451 \end{aligned}$$

For Jim it is a near thing between partial insurance and no insurance at all, but Jim would still prefer partial insurance. The additional coverage provided by full insurance isn't nearly worth the cost for a low-risk driver.

The logic behind DC&H's choice of prices is that it is *screening* its customers using the price structure. The drivers know what types they are (high v. low risk), but the insurer does not. The task is to identify a combination of prices that will *separate out the different types of consumers* according to their "demand" for insurance, that is, their likelihood of an accident and willingness to go without it.

What are DC&H's expected profits from offering two types of policies? Since both types of drivers are now purchasing insurance, the expected costs per insured driver are

$$\text{Expected cost: } EMV = (90\%) (.1)(\$9,320) + (10\%) (.2)(\$30,000) = \$1438.80.$$

This reflects a compensation cost of only \$9,320 for an accident by a low-risk driver choosing the partial insurance policy, and \$30,000 for a high-risk driver choosing the full insurance policy. The total revenue per insured driver is the (share-weighted) price of insurance for each policy issued:

$$\text{Total revenue per insured driver: } (90\%)(\$1065) + (10\%)(\$5380) = \$1496.50$$

DC&H's expected profit per insured driver is now \$1496.50 - \$1438.80, or \$57.70 per insured driver.

The bottom line. This is actually *much more profitable* than simply selling to one segment of the market (the high-risk drivers) at a higher price. Recall that if DC&H sells full insurance for \$6400, only the high-risk types buy it and expected profit is \$400 *per insured driver*. But that involves selling to only 10% of the population! The expected profit per driver in the population is actually only 10% of \$400, or \$40. By contrast, selling full insurance for a lower price and offering partial coverage at a price that the low-risk drivers will (just barely) purchase yields expected profit per driver in the population of \$57. This is an increase in profit of $(57 - 40) / 40 = 42.5\%$, which is a tremendous increase for simply altering a company's pricing structure.

About Separating Customers With Pricing Options

Offering two different two-part pricing policies allows for price discrimination between different types of consumers. In the last example, DC&H is using a system of *two* two-part prices. The “fixed fee” is the up-front price of insurance. The “price per use” is the driver’s out-of-pocket payment (cost to him) in the event of an accident. So Slammin’ Hammond is a high-demand type, who pays a high fixed fee (\$5380) and a *zero* price per use (since he has full coverage). Gentle Jim, who has a lower demand, pays a lower fixed fee (\$1065) but a high price per use (\$20,770, to be exact). And both prefer it that way. This system of price discrimination through a *menu of two-part prices* is the key to profits when a seller does not know how risky a customer is, *ex ante*.

Deductibles and co-pays have a great deal of value when there are problems of adverse selection (the insurer cannot tell exactly who is innately high risk and who is low risk at the start), or if there is a problem of moral hazard (the insurer cannot prevent you from driving carelessly once you buy insurance). They allow an insurer to tailor coverage to separate out the customers when adverse selection exists (via price discrimination) and to control overuse when moral hazard exists.

There are, of course, additional ways that the seller can price discriminate and screen customers of different risk (that is, demand for insurance) levels. One is to acquire information about past driving history, settlements, claims, or credit ratings from credit bureaus. These help improve the design of different two-part pricing schemes offered to each type of consumer. But they do not change the fundamental logic, nor the profitability, of designing a menu of two-part prices to screen customers that have different levels of demand for your service.

The value of pricing in this fashion is not limited to insurance, by any means. Here are a few other important examples of this.

Application: Mortgages

This economic logic applies in many other markets, too. As any of you that have purchased a home know well (or will soon), when you get a mortgage to finance the purchase of a home the mortgage will specify both *points* and an *interest rate*. Points are cash, paid up front, to the firm lending you the mortgage loan (they are expressed as a percentage of the total loan principal, so one point on a \$500,000 mortgage loan is \$5,000). And you can choose from a bewildering array of point and interest rate combinations. Figure 1 (*next page*) shows the 11 combinations of points and interest rates simultaneously available from one lender for a \$500,000 fixed-rate home mortgage with at 30-year term (this is the most common type of residential mortgage in the U.S.). When you get a mortgage, *you* tell the lender which point and interest rate combination *you* prefer.

Interest Rate	Points	Points (\$)
5.500%	3.875	\$19,375
5.625%	3.125	\$15,625
5.750%	2.500	\$12,500
5.875%	2.125	\$10,625
6.000%	1.625	\$8,125
6.125%	1.375	\$6,875
6.250%	1.125	\$5,625
6.375%	0.750	\$3,750
6.500%	0.500	\$2,500
6.625%	0.250	\$1,250
6.750%	0.000	\$0

FIGURE 1. *Interest Rate and Point Options for a \$500,000 Fixed Rate Mortgage with a 30 Year Term (Data from Countrywide Financial, October 2005).*

What are mortgage financiers doing offering consumers all of these combinations? *They are separating (that is, “screening”) consumers according to risk.* Each point, interest rate combination is a two-part tariff: The points are the “fixed fee”, paid up-front to the lender no matter how long you keep the mortgage (live in the house). The interest rate is the “price per use”: This is (literally) the price you pay for using the mortgage lenders’ money each month.

The risk that lenders are concerned with here is called *pre-payment risk*, which is the possibility that you will move (or refinance, or prepay for other reasons) and pay off your mortgage loan early. The reason asymmetric information arises about this is simple: People know how soon they are likely to move again much better than mortgage lenders do. If you plan to stay in your house for a decade or more, a combination of a high fixed fee (high points) and low interest rate (low price per use) is best for you. But if you expect to move within a few years of acquiring the mortgage, it is cost minimizing for you to pay little or no points and accept a high interest rate (since you will not be using the lender’s money for long anyway). In sum, mortgage lenders are screening potential customers to separate them out according to their pre-payment risk, and they have this so finely-tuned that it is profitable to offer (in this case) eleven different two-part prices.

Other examples abound, from the common to the subtle. Even when risk is not the principle concern per se, the economic logic of screening consumers according to consumers’ asymmetric information about how much they demand the product is compelling. The mobile phone companies figured out as much in the early 1990s, when they switched their pricing to the current system of calling plans that involve (i) a fixed monthly fee, and (ii) an allowance of “free minutes” with a higher price-per-use above the allowance. This pricing scheme screens customers according to their expected demand, which a consumer knows much better than does the mobile phone company at the time an initial contract is arranged.

More subtle are the menus of prices used by nearly all well-managed non-profit art museums and charitable institutions. The “memberships” they offer are primarily designed to screen consumers (i.e., visitors) according to their demand for visits per year, and offering various membership levels as well as a high single price-per-visit if you are not a member accomplishes this quite well.

Managerial Implications

1. Adverse selection problems arise in two settings. One is when items offered for sale are disproportionately drawn from the lower-quality end of the spectrum, because buyers cannot discern the quality of items for sale and owners of higher-quality items are therefore more likely to want to hold on to their items (or not produce them). Adverse selection also occurs in markets for “services” such as insurance or contract fulfillment, where buyers who are costly to serve know as much and are disproportionately represented in the marketplace.
2. In both types of problems, adverse selection can create a vicious cycle that results in depressed market prices for products or extremely high prices for insurance and other services. In extreme cases (private health insurance for individuals with pre-existing conditions), adverse selection can kill a market entirely.
3. Managers can take a number of actions that help overcome the problems that asymmetric information and adverse selection can pose. Leading examples in product markets include warranties, product guarantees, and other signals of product quality. Reputations are an alternative means to help solve this problem, inasmuch as a firm’s reputation serves as a signal of product quality.
4. In insurance and other “service” markets where hidden characteristics are a problem, efficiency requires the ability to price discriminate among individuals with differing levels of risk. When individuals have better information about their likelihood of incurring a loss than an insurer, offering a menu of partial insurance contracts can allow markets to function. Without price discrimination, it may be unprofitable for anyone to provide insurance.
5. The same logic can make it a profit-maximizing strategy to offer a set of two-part prices. The value of such a strategy is high when (1) customers have better information about their demand for your product or service than you do, and (2) customers are heterogeneous in their demand for your product or service.

January 29, 2006

Seeing Fakes, Angry Traders Confront EBay

By [KATIE HAFNER](#)

SAN FRANCISCO, Jan. 28 — A year ago Jacqui Rogers, a retiree in southern Oregon who dabbles in vintage costume jewelry, went on [eBay](#) and bought 10 butterfly brooches made by Weiss, a well-known maker of high-quality costume jewelry in the 1950's and 1960's.

At first, Ms. Rogers thought she had snagged a great deal. But when the jewelry arrived from a seller in Rhode Island, her well-trained eye told her that all of the pieces were knockoffs.

Even though Ms. Rogers received a refund after she confronted the seller, eBay refused to remove hundreds of listings for identical "Weiss" pieces. It said it had no responsibility for the fakes because it was nothing more than a marketplace that links buyers and sellers.

That very stance — the heart of eBay's business model — is now being challenged by eBay users like Ms. Rogers who notify other unsuspecting buyers of fakes on the site. And it is being tested by a jewelry seller with far greater resources than Ms. Rogers: [Tiffany & Company](#), which has sued eBay for facilitating the trade of counterfeit Tiffany items on the site.

If Tiffany wins its case, not only would other lawsuits follow, but eBay's very business model would be threatened because it would be nearly impossible for the company to police a site that now has 180 million members and 60 million items for sale at any one time.

Of course, fakes are sold everywhere, but the anonymity and reach of the Internet makes it perfect for selling knockoffs. And eBay, the biggest online marketplace, is the center of a new universe of counterfeit with virtually no policing.

EBay, based in San Jose, Calif., argues that it has no obligation to investigate counterfeiting claims unless the complaint comes from a "rights owner," a party holding a trademark or copyright. A mere buyer who believes an item is a fake has almost no recourse.

"We never take possession of the goods sold through eBay, and we don't have any expertise," said Hani Durzy, an eBay spokesman. "We're not clothing experts. We're not car experts, and we're not jewelry experts. We're experts at building a marketplace and bringing buyers and sellers together."

Company officials say they do everything they can to stop fraud. The company says only a minute share of the items being sold at any given time — 6,000 or so — are fraudulent. But that estimate reflects only cases that are determined by eBay to be confirmed cases of fraud, like when an item is never delivered.

Experienced eBay users say that the fraud goes well beyond eBay's official numbers, and that counterfeiters easily pass off fakes in hundreds of categories.

"EBay makes a lot of money from a lot of small unhappy transactions," said Ina Steiner, the editor and publisher of [AuctionBytes.com](#), an online newsletter. "If you've lost a few thousand dollars, you might go the

extra mile to recover it. But if you've lost \$50 or \$20 you may never be able to prove your case, and in the meantime eBay has gotten the listing fee and the closing fee on that transaction."

The Tiffany lawsuit, in addition to accusing eBay of facilitating counterfeiting, also contends that it "charges hundreds of thousands of dollars in fees" for counterfeit sales.

In 2004, Tiffany secretly purchased about 200 items from eBay in its investigation of how the company was dealing with the thousands of pieces of counterfeit Tiffany jewelry. The jeweler found that three out of four pieces were fakes.

The case will go to trial by the end of this year, said James B. Swire, an attorney with Arnold & Porter, a law firm representing Tiffany. The legal question — whether eBay is a facilitator of fraud — is a critical issue that could affect not only eBay's future but Internet commerce generally, said Thomas Hemnes, a lawyer in Boston who specializes in intellectual property.

"If eBay lost, or even if they settled and word got out that they settled, it would mean they would have to begin policing things sold over eBay, which would directly affect their business model," Mr. Hemnes said. "The cost implied is tremendous."

But eBay members like Ms. Rogers have little desire to wait for court decisions; they say that the uncontrolled flood of fakes is driving down the value of the authentic goods.

For the past few months, Ms. Rogers and three women she met on eBay who are also costume jewelry buffs have banded together to track the swindlers they say are operating in their jewelry sector. "People have faith that eBay will take care of them, but it doesn't," Ms. Rogers said. "eBay has done nothing."

Carrie Pollack, who sells jewelry from her home in Sudbury, Mass., and is part of Ms. Rogers's group, said an authentic Weiss brooch of good quality could command \$150. But she said the profusion of counterfeits had confused the market and diluted the value of such a pin to as little as \$30.

"It's a situation that's facing all of us in the jewelry world, and I suspect other decorative arts as well," said Joyce Jonas, an antique jewelry specialist in New York. "It's totally out of control."

Over the past few months Ms. Rogers and her team have reported to eBay more than a thousand jewelry listings they believe to be fakes; only a few listings have been removed.

The women say that by watching the listings they have uncovered a ring of a half-dozen or so counterfeiters, most of them living in Rhode Island within a few miles of one other. They say the sellers supply one another with fake jewelry, conceal the fact that they are buying from one another to boost their seller status, and regularly dole out positive feedback to each other to fool potential buyers.

Ms. Pollack was unaware of the abundance of counterfeit pieces on eBay when she paid \$360 for what she thought were genuine pieces of Weiss jewelry. She demanded a refund from the seller, who refused.

Ms. Pollack said it wasn't until she filed a formal complaint with PayPal, eBay's online payment system, that the seller offered to refund her money. Since then, she has sent eBay officials a raft of evidence pointing out the presence of the counterfeits, including an independent appraisal from Gary L. Smith, a gemologist in Montoursville, Pa., who declared the five brooches Ms. Pollack sent him to be unmistakable fakes.

This reporter, too, sent a butterfly brooch with "Weiss" stamped on the back, purchased for \$12.99 recently from one of the alleged counterfeiters, to Mr. Smith. He determined that there was nothing vintage about it — certainly not the very new glue used to hold in the glass stones. (In a subsequent phone conversation, the seller, Garnet Justice, who lives in Leesburg, Ind., said she had "no idea" whether the pin was authentic, and

offered a full refund.)

Antoinette Matlins, another gemologist, also purchased five vintage pieces from the sellers tracked by Ms. Rogers's group to determine their authenticity. She found them to be cheap knockoffs worth less than 10 percent of their sale prices.

But she was not surprised. Whether online or off, she said, "fraud is rampant in any venue where you are looking for a steal."

eBay's feedback system that allows buyers to post negative reviews of bad sellers is supposed to protect customers like Ms. Pollack. Yet all of the alleged counterfeiters had consistently positive ratings.

Ms. Steiner of AuctionBytes.com said this situation was not uncommon. Buyers and sellers are often reluctant to leave bad reviews, lest their own reputations suffer.

eBay does not allow members to contact other potential buyers to warn them of possible fraud. Otherwise, said Mr. Durzy, it would be too easy for someone to try to ruin the reputation of a legitimate rival.

Ms. Rogers said she had no qualms about breaking the rules by contacting buyers about fakes she spots. In November, she even put up a listing that advertised a fake Christmas tree brooch from Eisenberg Ice, a vintage costume jewelry maker, just to make people aware of the fraud.

"The reason I am doing this is because eBay won't," the listing read. "Let's stop this madness — these fakes are pushing down the price of authentic jewelry."

"The frustrating part is that eBay just stands back and lets these people make thousands and thousands of dollars" while taking a fee for each transaction, Ms. Rogers said. (The company's profits rose 36 percent in the last quarter from the year before, to \$279.2 million.)

After the spectacular case in 2000 when a fake Richard Diebenkorn painting was nearly sold for \$135,000 on eBay, the company put in place a handful of safeguards, like the PayPal buyer protection plan, an improved system for spotting eBay policy violations, and improved detection of fraud in general. But when it comes to counterfeit goods, the problem has gotten worse.

Artwork is particularly vulnerable to counterfeiting. "The majority of things that appear on eBay are fakes," said Joel Garzoli, an art gallery owner in San Rafael, Calif.

Mr. Durzy argued that "if we began to automatically pull listings for things reported to us as fake, we could be pulling listings that are legitimate." He added that the company had to rely on trademark owners to "tell us something is counterfeit." Yet trademark owners like Tiffany say they have gotten no relief.

Ms. Rogers and her team say their efforts may be working. The number of bids on the fake vintage jewelry pieces has dropped sharply since they went into action, they say. Nonetheless, the seller who sold Ms. Pollack the knockoff is still in business and recently put up for sale a "beautiful Weiss brooch with lots of sparkle and shine." Starting bid: \$9.99.

The money in the message

Economists make sense of the world by assuming that people know what they want. Advertisers assume that they do not. Who is right?

BESIDES gaining fame as the first Olympians, the ancient Greeks also excelled at commerce and the arts. If you watch the Winter Olympics in Nagano, you will see that same impressive blend of sports, creativity and the profit motive at work. For, while the world's best skiers and skaters compete heroically for medals, its best-known colas and copiers will compete ferociously for market share.

Advertising is a crucial part of that battle. Bosses at Coca-Cola, Kodak and McDonald's—three of the Olympics' biggest sponsors—believe that the huge sums they spend on advertising are an investment in their valuable brands. They are not the only ones, however, who pay close attention to advertising. To economists—the official sponsors of rational decision-making—the motives and methods of advertisers raise doubts about a fundamental claim: that people are good at making decisions for themselves.

In the economist's view of the world there is little need for firms to spend so much money cajoling consumers into buying their wares. Of course, people need good information to make good choices, and it is often too costly or time-consuming to collect it themselves. So advertising a product's features, its price, or even its existence can provide genuine value. But many ads seem to convey no such "hard" information. Moreover, most advertising firms place a huge emphasis on creativity and human psychology when designing campaigns.

Economists need to explain, therefore, why a rational consumer would be persuaded by an ad which offers nothing but an enticing image or a good laugh. If consumers are rational, they should ignore such obvious gimmicks. If producers are rational, they should not waste money on ads that consumers will ignore. The existence of such advertising thus stands out like a giant billboard, proclaiming to economists that something is amiss.

Most economists would reply that advertising is a way to deal with "asymmetric information": the fact that sellers often know more about their product than buyers. Some products are better than others in ways that are hard to detect without buying them. A product's features and ingredients do not really tell you how well it works, or tastes. And although some products' quality can be verified through trial and error, this is not always practical. A

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bad roll of film can ruin irreplaceable holiday photos; a bad burger can ruin a holiday.

Companies such as Kodak and McDonald's are thus willing to spend huge sums convincing people their products are the best around. This explanation was first developed by Phillip Nelson*, in a classic paper written in 1974. He argued that a great deal of seemingly wasteful advertising is in fact intended to send a "signal" to consumers—that even though a product's quality is hard to verify in advance, it really is one of the best on the



market. From this perspective, it does not matter what an advertisement says—so long as consumers can see the firms spending big sums on advertising. Those clever ads work because consumers understand that they are a sophisticated way for a company to signal: "We believe in our product, or we would not spend so much on advertising."

On the whole, economists find Mr Nelson's account convincing. But they believe that he had only half the story: companies need pricing as well as advertising to convey quality to consumers. However, they find it hard to agree on exactly what pricing and advertising strategies would most readily accomplish this. They have not even been able to agree how prices and advertising should be related. This state of confusion is astonishing, considering that economists have transformed the study of firms' other pricing decisions almost into an exact science.

Part of the problem is that it is extremely difficult to measure the amount

firms spend advertising "hard" information about a product's price, say, or how it works, as opposed to their spending on "signal" advertising of the touchy-feely sort. Moreover, the theory suggests that some kinds of products—those whose quality can be verified only through experience—should have more "signal" advertising. But what is quality? And can an economist tell how easily it can be verified? That depends on a product's lifespan, consumers' tastes, and the ease with which friends and consumer reports can convey what a product or service is really like.

No signal

In fact, two economists recently conducted a different kind of study[†] which suggests that the "signalling" theory may be wrong. Sridhar Moorthy, of the University of Rochester's business school, and Scott Hawkins, of the University of Toronto's, ran an experiment in which people read foreign-language magazines with ads for unfamiliar brands in several product categories: cookware, overcoats, nasal spray and yoghurt. The ads were real, but the magazines were altered to change the frequency with which they appeared.

Although they did not understand the ads' content, the subjects associated a high frequency of advertising with high quality. However, a control group saw each ad only once, with a message attached telling them how often it appeared in other magazines. Even though the control group could remember the frequency of the ads, they did not assume—as their peers had done—that more ads meant higher quality. This suggests that people do indeed associate more ads with higher quality, but not because they have a sophisticated understanding of the signal companies are trying to send. They simply see lots of ads for a product and want to buy it.

The distinction is crucial. If seeing is truly believing, then even low-quality firms may be able to create the impression of high quality by advertising, confounding the signal. Or perhaps not. People may behave differently in economists' experiments from the way they do in the marketplace, when their own money is at stake. For now, let the games continue.

* "Advertising as Information". By Phillip Nelson. *Journal of Political Economy*, July 1974.

† "Advertising Repetition and Quality Perceptions". By Sridhar Moorthy and Scott Hawkins. Working Paper, February 1998.