In a seminal article, George Akerlof (1970) argued that asymmetrical information can cause market failure, and that market participants will resort to signaling to resolve the problem and make markets work. Asymmetric information exists when one participant in a transaction (either the buyer or the seller) possesses more or better information than the other. (The principal-agent problem is one example of this phenomenon.) In such cases, the participants may make assumptions which make trade impossible unless the problem is resolved.

Akerlof described the problem in the context of the used market for used cars:

The example of used cars captures the essence of the problem. From time to time one hears either mention of or surprise at the huge price difference between new cars and those which have just left the showroom. The usual lunch table justification for this phenomenon is pure joy of owning a "new" car. We offer a different explanation. Suppose (for the sake of clarity rather than reality) that there are just four kinds of cars. There are new cars and used cars. There are good cars and bad cars (which in America are known as "lemons"). A new car may be a good car or a lemon, and of course the same is true of used cars.

The individuals in this market buy a new automobile without knowing whether the car they will buy is a lemon. But they do know that with probability \( q \) it is a good car and with probability \( (1 - q) \) it is a lemon; by assumption, \( q \) is the proportion of good cars produced and \( (1 - q) \) is the proportion of lemons.

After owning a specific car, however, for a length of time, the owner can form a good idea of the quality of this machine; i.e., the owner assigns a new probability to the event that his car is a lemon. This estimate is more accurate than the original estimate. An asymmetry in available information has developed: for the sellers now have more knowledge about the quality of a car than the buyers. But good cars and bad cars must still sell at the same price--since it is impossible for a buyer to tell the difference between a good car and a bad car. It is apparent that a used car cannot have the same valuation as a new car--if it did have the same valuation, it would clearly be advantageous to trade a lemon at the price of a new car, and buy another new car, at a higher probability \( q \) of being good and a lower probability of being bad. Thus the owner of a good machine must be locked in. Not only is it true that he cannot receive the true value of his car, but he cannot even obtain the expected value of a new car.

Gresham's law has made a modified reappearance. For most cars traded will be the "lemons," and good cars may not be traded at all. The "bad" cars tend to drive out the good (in much the same way that bad money drives out the good). But the analogy with Gresham's law is not quite complete: bad cars drive out the good because they sell at the same price as good cars; similarly, bad money drives out good because the exchange rate is even. But the bad cars sell at the same price as good cars since it is impossible for a buyer to tell the difference between a good and a bad car; only the seller knows. In Gresham's law, however, presumably both buyer and seller can tell the difference between good and bad money. So the analogy is instructive, but not complete.2

It's almost always true, then, that sellers know more than buyers. And both the sellers and buyers know it. Thus, buyers are very cautious. Maybe so cautious that they won't buy. (Caveat emptor, "Let the buyer beware.")

There are several possible partial—and I stress partial—solutions to the lemon problem.

1. Car sellers can offer warranties. Aside from protecting the buyer against loss during the warranty period, the existence of a warranty signals to the buyer that the seller has confidence in the car. Note that this can work only for dealers offering a relatively large number of cars for sale. Individuals selling their "old" car cannot take advantage of the law of large numbers. A dealer may not know which cars will develop problems during the warranty period, but he can make a good guess at how many will and therefore how much to charge for the warranty, say $50 per car. An individual sells one car which either will or will not require warranty work. If he sells the car with a warranty and adds $50 to price to cover it, either he will make an extra $50 profit (if the car develops no problems) or will lose a potentially large but unknown and inestimable amount of money if this one car develops problems. (Product warranties are essentially insurance policies; the seller agrees to pay to have the car fixed if it breaks down, just as an insurance company will pay for your car to be fixed if you have an accident. This also explains why insurance policies must be sold by relatively large companies and to relatively large numbers of buyers.)

2. Buyers sometimes have their mechanic—whom they trust, to a greater or lesser extent—inspect a car they are interested in buying, to obtain a better estimate of the car's quality. This works best if the mechanic does not know who the seller of the car is; if it is a friend or business associate of the mechanic, the mechanic might have a "conflict of interest" problem.

3. Advertising. Less effective, because talk is cheap, but sellers can point to various indicators of the car's quality. The best indicators are those than can be easily verified by the buyer, such as the car's cleanliness, condition and age of tires and battery, etc., rather than the internal condition of the engine or transmission. This explains why sellers so often stress that their car is "exceptionally clean;" prospective buyers can check this for themselves, and may often take it as a sign that the car has been otherwise well cared for. I read many years ago of a woman who, when looking for a used car, always turned on the radio and listened to the stations selected by the previous owner. If the radio played classical or easy listening music, she would consider buying the car. If it played rock and roll or country and western music, she would assume that the car had been driven hard and would move on. She said she had never bought

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2 Akerlof, pp. 489-490.
a lemon. The last used car we purchased—my wife’s Honda—had been wrecked, but not badly, and was rebuilt by a mechanic who specializes in rebuilding wrecked Hondas. I assume that lemons are no more likely to be wrecked than good cars, but that lemons are more likely to be sold by their owners than good cars. Therefore, a rebuilt wrecked car is less likely to be a lemon than the average car on a used car lot or advertised in the newspaper. By the way, the car has been an excellent one. As was the previous rebuilt Honda we bought from the same mechanic.

4. Government regulation. (Of course.) It is illegal to set back a car’s odometer or to grossly misrepresent the condition of the car. Speaking of rebuilt cars and wrecked, they are subject to a labyrinthine bureaucratic process to ensure that they have been more-or-less properly rebuilt (without stolen parts) and that prospective buyers know that the car has been wrecked.

Akerlof, however, was not really writing about used cars. His main point is that this same principle applies in other, more important, markets, and that the same methods are used to resolve those problems. The employment of minorities, credit and lending in underdeveloped countries, and fast food versus “mom and pop” restaurants, are discussed. Also, government licensing, awards, and brand names, are mentioned as solutions to the problem. The market for health insurance for the elderly, however, was his main focus. Elderly people tend to consume relatively large amounts of health care, and can consume a staggeringly large amount in a short period if a severe illness strikes. But if health insurance is offered in a free market to these people, a pricing problem arises. If the policy premium is set at a level high enough to leave the insurer with a normal profit after covering the health expenses of the average elderly person, and all, or a representative sample, of elderly persons in the market buy the insurance, then the insurer will be able to earn a profit, since the average health expense per insured person will be equal to the average expense for the entire elderly population. But this won’t happen. If we divide all elderly people into two groups; “healthy” (expected health expense less than average) and “unhealthy” (expected health expense greater than average—these are the “lemons”), many healthy people will not buy the insurance, since they will judge the premiums to be higher than their expected health expenses. It would be cheaper for them to pay out of their pockets. Many risk averse healthy individuals will still buy the insurance, since they will be willing to pay extra to avoid the chance of a catastrophic expense, but not all will. Substantially all the unhealthy individuals will buy the insurance, however, since they will recognize it as a good deal; they can pay a premium which is less than their expected health expense. As a result, the insurer will end up insuring a disproportionate amount of unhealthy individuals, and will lose money on the deal. Even if the insurer raises the premiums, the same problem will exist; no matter what premium is charged, people with expected health expenses higher than the cost of the premium will be most likely to buy the insurance, and the insurer will always lose money. Eventually, the premiums will be so high that no one will buy the insurance, and the market will cease to exist.

How can markets solve this problem? First, observe what the problem is: buyers, that is, the elderly customers, know more than the sellers (insurers) about the condition of their own health, that is, about their likely future health expenses. There are several possible, but partial, solutions. Insurance companies frequently require a prospective customer to have a thorough health examination, often by a physician selected by, and perhaps paid by, the insurer. Prospective customers are then assessed premiums based on the results. Pre-existing conditions are sometimes not covered by the policy, or not covered for a specified time. There are problems with these solutions, however. No reasonable health examination can cover all medical conditions; some can be concealed by the customer by simply lying to the physician. (Doctor: “Does this hurt?” Patient: “No, not at all,” even though the pain is excruciating.) And most of the afflictions that elderly people have are chronic problems, and are by nature “pre-existing.” If my mother, age 80, were offered health insurance that did not cover pre-existing conditions, it wouldn’t be worth buying; anything that is going to happen to her will probably result from a pre-existing condition!