Unit 8.3: Adverse Selection and Signaling

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Asymmetric information refers to any situation where different parties have different information. *Adverse selection* refers to some unobserved characteristic – for example, if a person buying health insurance has a chronic illness, unknown to the insurance company. *Moral hazard* refers to some unobserved action – for example, if a person whose car is insured takes more driving risks than he would otherwise. In either case, the informed party can potentially benefit at the expense of the less-informed party and so market failure is possible. Markets with asymmetric information can give rise to competitive equilibria that are not efficient.

1 Adverse Selection and Market Unraveling

There are two features of markets with adverse selection. First, one side of the market has some characteristic that is hidden from the other side. Second, the parties with the *worst* characteristics (from the perspective of the uninformed side) have the strongest incentives to participate in the market. In essence, one of the parties to the transaction ends up doing business with people he would rather avoid because of this information problem.

The party with the hidden characteristic can be either the buyer or the seller. Here are two examples:

- In a used car market, the *seller* has private information about the quality of the car. Furthermore, people with bad cars are more likely to want to sell them. Ultimately, buyers end up doing business with bad sellers because of the seller's private information.
- In a health insurance market, the *buyer* has private information about his health status. Furthermore, people in the worst health are the most likely to buy good health insurance. Ultimately, sellers end up doing business with bad buyers because of the buyer's private information.

Adverse selection generally reduces the size of the market. It becomes difficult to sell good used cars because there are so many bad ones on the market. Similarly, it is difficult to sell reasonably-priced health insurance to healthy people because too many sick people buy it.

Adverse selection can sometimes cause the market to completely unravel. Suppose that the average level of health care expenditures in a population is \$2000, and so health insurance is priced at the zero-profit price of \$2000. The problem is that the healthiest customers (who expect less than \$2000 in health care costs) leave the market, while the sickest ones have the strongest incentives to buy the insurance. This means that the insurance company's average payout will exceed \$2000, and so they have to raise the premium. But, once the premium is raised, again the healthier customers drop out and so the insurance company's average payout rises again and the premium must again rise. This process continues until the premium is very high, with only the sickest customers buying insurance. This is sometimes known as the *death spiral*. Even though provision of insurance to all customers might be efficient, the market unravels because of information problems.

2 Numerical Example – The Lemons Model

Suppose that half of the used cars in a market are good cars and half are bad cars (lemons). The table below shows the value to buyers and the value to sellers of both kinds of cars.

	Value to buyer	**Value to seller**
Good car	\$10,000	\$8000
Bad car	\$4000	\$2000

If there were perfect information on both sides of the market about car quality, then good cars would be sold for something between \$8000 and \$10,000, bad cars would be sold for something between \$2000 and \$4000 and the market outcome would be efficient. Notice that it is efficient to exchange both kinds of cars since both the good car and the bad car are worth more to the buyer than to the seller.

Suppose, more realistically, that the quality of the car is known to the seller but not to the buyer. Recall that half the used cars are good and half are bad. Therefore, the buyer's expectation of a used car's value is:

$$EV = \frac{1}{2}(10,000) + \frac{1}{2}(4000) = 7000$$

The problem is that, if the buyer offers \$7000 for the car, *only someone with a bad car will agree to the trade*. After all, good cars are worth \$8000 to the seller. At this point, once the buyer realizes that he is only getting bad cars, he is then willing to pay just \$4000 for the car. The good cars are completely driven out of the market because sellers masquerade bad cars as good cars and buyers are unable to tell the difference. Adverse selection has driven the good cars out of the market, just like in the health insurance case where adverse selection drove the healthy customers out of the market.

To reiterate, the resulting equilibrium is *not efficient*. Sale of high quality cars is efficient, but not possible because of information problems. If the buyer could distinguish good cars from bad cars, then there would be no problem, but adverse selection has driven out efficient exchanges of good cars.

This is the usual result – adverse selection reduces the size of the market, driving out the highest-quality exchanges.

3 Solutions

A few solutions present themselves.

- Get better information – Having a used car inspected beforehand or requiring potential health insurance customers to take a physical examination might make it possible to distinguish the good and the bad trades.
- Reputations – If a car dealer has an interest in maintaining a good reputation, then he has a long-term incentive not to sell lemons to customers. This is one justification for buying brand-name products. A restaurant with a recognizable name and branches all over the world has an interest in maintaining its reputation. A non-branded restaurant in a tourist town that only sees customers once faces fewer long-term consequences from serving bad food.
- Warranties and other consumer protections – If a seller offers a warranty on a car, this might convince the customer that the car is a good car. Otherwise the seller would not offer the warranty.
- Standards and certification – A seller that wants to convince a buyer that his product is of high quality might ask a neutral third party to certify the quality. For example, the magazine "Consumer Reports" rates car quality. Meat and dairy products are quality tested by the government.

- Mandatory risk pooling – In the case of insurance, one way to get around the death spiral is to require everyone to purchase into the same health insurance plan. This guarantees that there will be a mix of healthy and sick customers. This is a market failure rationale for universal health insurance. While arguments in favor of universal health care often rely on equity and fairness, eliminating adverse selection is an efficiency rationale for government intervention in the health care market.

- Signaling – It is difficult for a potential employer to determine whether an employee is smart and hard-working or stupid and lazy. Further, there is adverse selection since the stupid, lazy one is more likely to need a job. One way for the smart, hard-working employee to demonstrate that he is a high-quality worker is to obtain a college degree. The point is that the degree would be difficult for the low-quality worker to obtain. Many economists have suggested that this is the main reason for going to college. That is, the main purpose of getting a degree is *not* to acquire a particular set of skills, but rather to prove that you are intelligent and able to work hard. Education acts as a *signal* of intelligence and work ethic.

4 Job Signaling

Consider a simple model where high-ability workers make up fraction θ of the workforce, with low-ability workers making up fraction $1-\theta$. High-ability workers produce w_h of profit for employers and low-ability workers produce w_l of profit for employers, where $w_h > w_l$. The job market is competitive.

If there were perfect information, then competition among employers guarantees that high-ability workers would be paid w_h and low-ability workers would be paid w_l. However, worker quality is a hidden characteristic.

High-ability workers can signal that they are high-ability by obtaining a college degree at cost c. The degree is totally unproductive in the sense that it does not contribute to worker productivity. For simplicity, we assume that it is impossible for low-ability workers to get the degree (in reality, it might be possible but more costly for low-ability workers to obtain the degree than it is for high-ability workers to obtain it). Given this setup, there are two kinds of equilibria possible.

In the *separating equilibrium*, high-ability workers separate themselves by obtaining the degree. This proves to employers that they are high-ability and so they are paid w_h. Low ability workers do not go to school and are paid w_l.

Are low-ability workers picking their best option given the equilibrium structure? Well, they don't have any other choice since it is impossible for them to obtain a degree.

More importantly, we need to make sure that high-ability workers are picking their best option. High-ability workers prefer to obtain a degree in this equilibrium as long as:

$$\begin{aligned} w_h - c &> w_l \\ \Rightarrow c &< w_h - w_l \end{aligned}$$

In essence, high-ability workers will go along with this equilibrium as long as the degree is not too expensive. If the cost of the degree is higher than the wage premium to a high ability worker, then it is not worth obtaining it. Note that, if low ability workers could get degrees at cost c_l, then we would also need the inequality $w_l \geq w_h - c_l$ to guarantee that low ability workers prefer to accept the lower wage rather than to emulate high ability workers and receive the higher wage.

Another possible equilibrium is the *pooling equilibrium* where no workers go to school and, as a result, all workers are paid the same wage. Since employers cannot tell low-ability from high-ability workers in this equilibrium, all workers will be paid a salary equal to the average productivity over all workers $\overline{w}$:

$$\overline{w} = \theta w_h + (1-\theta) w_l$$

Do the low-ability workers want to deviate from this equilibrium? Again, they have no options since it is impossible for them to obtain a degree. The pooling equilibrium is a good deal for them since they get paid more than w_l on account of being averaged together with high-ability workers.

Now, the high-ability workers might find it in their interest to deviate from this equilibrium. The relevant question is whether they should accept the pooled wage $\overline{w}$ or whether they should pay the cost to signal their ability and then be paid w_h, for net benefits of $w_h - c$. Thus, high-ability workers accept the pooling equilibrium as long as:

$$\overline{w} > w_h - c$$

A pooling equilibrium is possible under a combination of two conditions:

- c is high – In this case, it is too expensive for the high-ability workers to deviate away from the pooling equilibrium by obtaining the degree.
- θ is high – In this case, the pooled wage $\overline{w}$ is close to w_h, so that the wage premium from getting the degree is low. Intuitively, if almost everyone is high-ability, then the pooled wage is very close to the high-ability wage and so there is no reason to pay for the cost of the degree.

For a specific numerical example, supppose that $w_h = 40,000$ and that $w_l = 20,000$.
A *separating equilibriun* exists as long as:

$$c < w_h - w_l \Rightarrow c < 20,000$$

A *pooling equilibrium* exists as long as:

$$\begin{aligned} \overline{w} &> w_h - c \\ \theta w_h + (1-\theta) w_l &> w_h - c \\ \theta(40,000) + (1-\theta)(20,000) &> 40,000 - c \\ \theta &> \frac{20,000 - c}{20,000} \end{aligned}$$

This last condition defines a straight line in (θ, c) space. Above this line, a pooling equilibrium is possible. The various equilibria, depending on the values of c and θ, are illustrated graphically in figure 1.

The separating equilibrium exists any time $c < 20,000$. The pooling equilibrium exists when c and θ lie above the locus $\theta > \frac{20,000-c}{20,000}$. Note that there is a region where either equilibrium can arise.

Note that, from an efficiency perspective, signaling is completely wasteful in this model. Paying to obtain the degree contributes nothing to productivity and, if information were perfect, high ability workers would have no reason to obtain it. However, even though it is wasteful, high-ability workers might prefer to signal if the wage premium they earn is high enough to offset the cost of the degree. The efficiency loss represented by the signaling cost is precisely a consequence of the information asymmetry. If information were perfect, this problem would not arise.

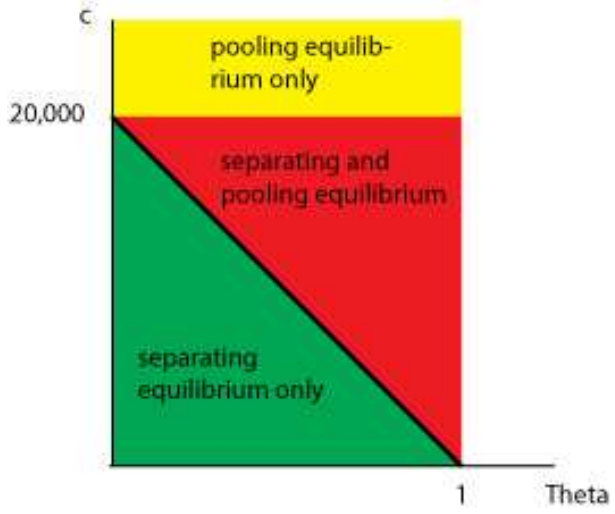

Figure 1: Equilibria in the job signaling model