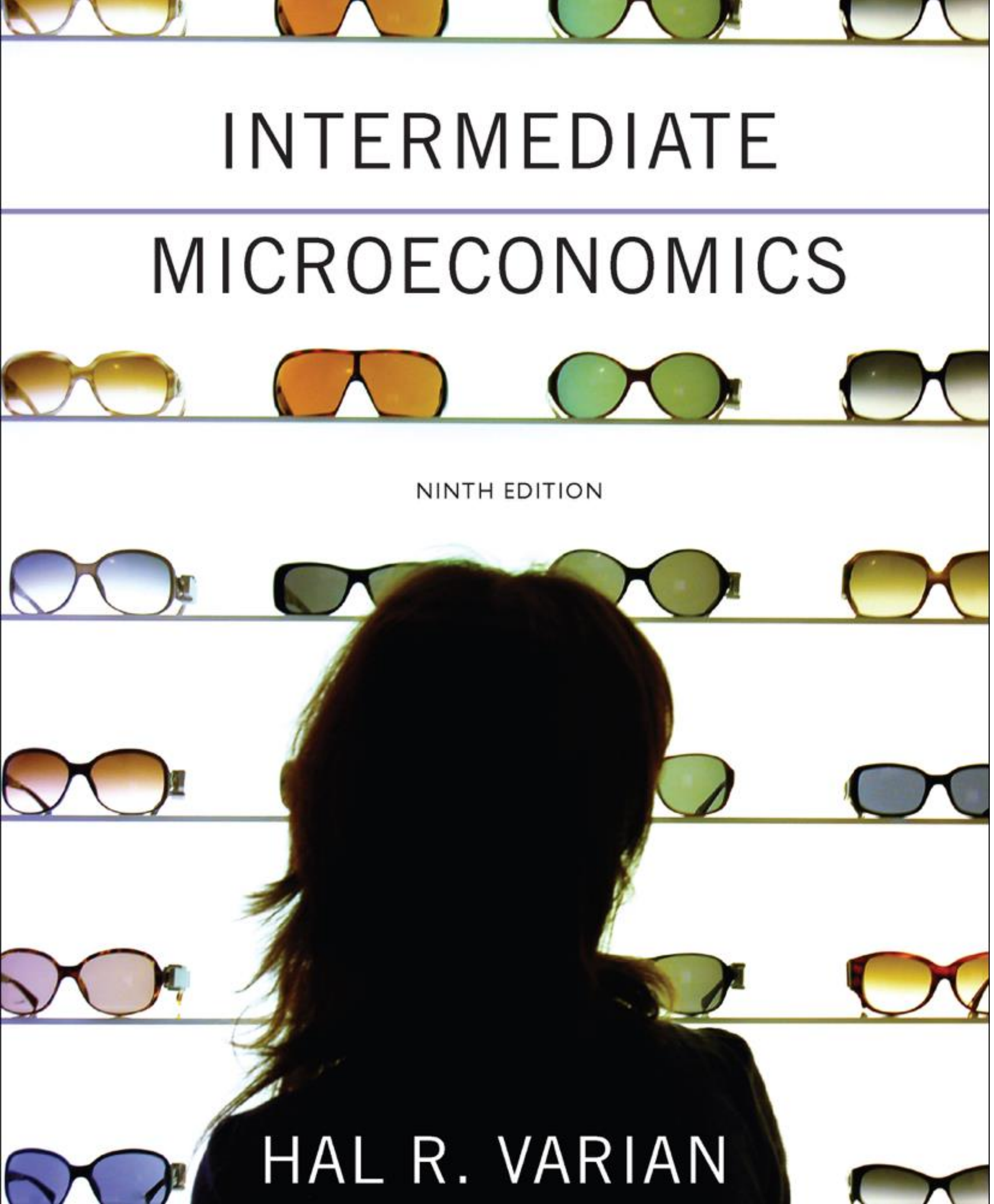

CHAPTER 38

Asymmetric Information

Information in Markets

So far, we assumed that all agents in the market are fully informed about all aspects: goods traded, prices, quality of the products, etc.

What about markets for insurance, or used cars, or medical services?

Asymmetric Information in Markets

Asymmetric information: one side in the market is better informed than the other side.

- Insurance: An insurance buyer knows more about his riskiness than does the insurer.
- Used cars: A second-hand car seller knows more about the quality of the car than does a potential buyer.
- Medical service: A doctor knows more about medical services than does the patient.

Asymmetric Information in Markets

In what ways can asymmetric information affect the functioning of a market?

Four related concepts will be discussed:

- adverse selection
- moral hazard
- signaling
- incentives

Adverse Selection

Consider a used car market.

Two types of cars: *lemons* and *peaches*.

Each lemon seller's reservation price is $1,000; each buyer's WTP is $1,200.

Each peach seller's reservation price is $2,000; each buyer's WTP is $2,400.

Adverse Selection

If every buyer can distinguish a peach from a lemon, then

- lemons sell for between \$1,000 and \$1,200, and
- peaches sell for between \$2,000 and \$2,400.

Gains to trade are generated when buyers are well informed.

Adverse Selection

Suppose no buyer can distinguish a peach from a lemon before buying, but the seller can. Hence, there is information asymmetry in the form of **hidden information**.

What is the most a buyer will pay for any car?

Adverse Selection

Let q be the fraction of lemons.

Let $1 - q$ be the fraction of peaches.

Expected value of any car to a buyer is:

$$EV = 1200q + 2400(1 - q)$$

Note that for a risk-neutral buyer, the expected utility is equal to utility of EV.

Hence, a risk-neutral buyer is willing to pay this EV. In contrast, a risk-averse buyer would be willing to pay less than this EV.

Adverse Selection

Suppose $EV > 2000$, which is the reservation price of a peach. That is, q is reasonably low.

Every seller can negotiate a price between \$2,000 and \$$EV$, no matter if the car is a lemon or a peach.

All sellers gain from being active in the market.

Adverse Selection

Suppose $EV < 2000$, which is the reservation price of a peach. That is, q is reasonably high.

A peach seller cannot negotiate a price above \$2,000 and will exit the market.

So, all buyers know that the remaining sellers own lemons only. Buyers will pay at most \$1,200 and only lemons are sold.

There is a “market for lemons” only.

Adverse Selection

Too many lemons crowd out the peaches from the market. In other words, adverse selection takes place.

Gains to trade are reduced since no peaches are traded.

The source of this **adverse selection** is **hidden information**: the buyer does not know which car is a peach or lemon, and hence is only willing to pay his *EV*, which drops with the number of lemons. If *EV* drops below the reservation price of the peach, the seller will not sell peaches.

Adverse Selection

How many lemons can be in the market without crowding out the peaches?
Buyers will pay $2,000 for a car only if

$$EV = 1200q + 2400(1 - q) \geq 2000$$

In other words, if $q \leq \frac{1}{3}$

If less than one-third of all cars are lemons, both peaches and lemons are traded. However, if more than one-third of all cars are lemons, then only lemons are traded.

Adverse Selection

A market equilibrium in which both types of cars are traded and cannot be distinguished by the buyers is a **pooling equilibrium**.

A market equilibrium in which only one of the two types of cars is traded (or both are traded since buyers can distinguish between car types) is a **separating equilibrium**.

Adverse Selection

What if there are more than two types of cars?

Suppose that

- Sellers' reservation price of cars is *uniformly distributed* between \$1,000 and \$2,000
- for a car with reservation price \$$x$, the buyer's value is \$$(x + 300)$.

Which cars will be traded?

Adverse Selection

Buyers have an $EV = 0.5*1300+0.5*2300= 1800$.

So, sellers with a reservation price above $1,800 exit the market. Now, only sellers with reservation prices between $1,000 and $1,800 remain.

The new buyer $EV=0.5*1300+0.5*2100 =1700$.

So, sellers with a reservation price above $1,700 now exit.
And so on, and so forth…

Adverse Selection

When does this unraveling of the market end? That is, what is the equilibrium?

Let v_h be the highest reservation price of any car remaining in the market.

So a buyer will pay at most:

$$EV = 0.5*1300+0.5*(v_h+300)$$

Adverse Selection

For the unraveling to stop, the EV of the buyer must be the price which the seller with the highest reservation price remaining in the market will just accept. In other words,

$$0.5 * 1300 + 0.5 * (v_h + 300) = v_h$$

This implies that

$$v_h = 1600$$

Adverse selection drives out all cars with a reservation price above $1,600.

Adverse Selection in the Health Care Market

Adverse selection: low-quality items crowd out the high-quality items because of information asymmetry.

In case of health care, for instance, the insurance company may base the premium on *average* incidence of health care in the population.

Based on these *average* premiums, only the unhealthy may want health care insurance. Adverse selection may drive out the healthy.

Potential Solution to Adverse Selection

Potential solution to adverse selection in the health care market is mandatory health care insurance (see e.g., the NL).

Potential problem of this solution is that once one has health insurance, they may change their behavior and adopt an unhealthier and riskier lifestyle.

Moral Hazard

Moral hazard: a lack of incentives to guard against risk when one is protected against its consequences. The source of such moral hazard is **hidden action**: for instance, insurance companies do not observe the insurer's lifestyle.

Examples of efforts to avoid moral hazard are:

- Deductibles: the amount you pay for health care services each year before your health insurance begins to pay
- Premium depends upon proxies for a healthy lifestyle: for instance, lower premium if one uses a smart watch to demonstrate average number of steps per day is above a certain threshold.

Signaling

Adverse selection is the outcome of an information asymmetry.

What if information can be improved by high-quality sellers **signaling** credibly that they are high quality?

For example, a car seller gives you a warranty, which signals that it is a peach instead of a lemon.

Note that this is only a credible signal for a peach if its not worthwhile to give a warranty on lemons.

Signaling in the Labor Market

Imagine a labor market with two types of workers: high- and low-ability.

Employer cannot distinguish between the two types, and so she pays an average wage.

If high types are not willing to work against this average wage, then the labor market will only consist of low types: adverse selection.

How could high types signal that they are of high ability, and hence that their wage should be higher?

Signaling

A labor market has two types of workers: high-ability and low-ability.

A high type's marginal productivity is a_H.

A low type's marginal productivity is a_L.

Where: $a_L < a_H$.

A fraction $h = \frac{n_H}{n_L + n_H}$ of all workers are high-type. $1 - h = \frac{n_L}{n_L + n_H}$ is the fraction of low-type.

Signaling

If the firm knew each worker's type, then each worker is paid his marginal productivity (that is, the labor market is competitive).

Pay each high type $w_H = a_H$

Pay each low type $w_L = a_L$

$$total\ wage\ cost = n_L a_L + n_H a_H$$

Signaling

If firms cannot know workers' types, then every employer is willing to pay the expected productivity:

$$w_P = (1 - h)a_L + ha_H$$

In this case, the firm's wage cost are identical to before:

$$\begin{aligned} total\ wage\ cost &= (n_L + n_H)w_P \\ &= (n_L + n_H)\left(\frac{n_L}{n_L + n_H}a_L + \frac{n_H}{n_L + n_H}a_H\right) \\ &= n_L a_L + n_H a_H \end{aligned}$$

Signaling

The wage for the high-type would be higher if the firm knows the type than if she does not know it:

$$a_H > w_P = (1 - h)a_L + ha_H$$

since $a_H > a_L$.

Hence, the high-type has an incentive to find a credible signal for their high ability.

Signaling

Consider that workers can acquire education. Education costs a high-ability worker c_H per unit and costs a low-ability worker c_L per unit.

With $c_L > c_H$.

Suppose that education has no effect on workers' productivities. Hence, marginal productivity remains the same after following education.

This seems a strong assumption: is education *only* signaling?

Signaling

The education-level e is a credible signal for high ability if the following two conditions are met:

(i) If high-types find it worthwhile to obtain e

(ii) If low-types do not find it worthwhile to obtain e

In case of (i) and (ii), the firm knows one is a high- (low-) type if one does (does not) have e, and the firm can set the wage equal to a_H (a_L).

Signaling

(i) High-types find it worthwhile to obtain e if net wage with education is higher than wage without education:

$$a_H - c_H e > a_L$$

This implies that e needs to satisfy:

$$e < \frac{a_H - a_L}{c_H}$$

(ii) Low-types do not find it worthwhile to obtain e if wage without education is higher than net wage with education:

$$a_L > a_H - c_L e$$

This implies that e needs to satisfy:

$$e > \frac{a_H - a_L}{c_L}$$

Signaling

Taking $e < \frac{a_H - a_L}{c_H}$ and $e > \frac{a_H - a_L}{c_L}$ together we have that

$$\frac{a_H - a_L}{c_L} < e < \frac{a_H - a_L}{c_H}$$

Hence, an education level e in between these levels is a **credible signal**: high-types want to obtain e, whereas low-types do not.

Crucial for this separating equilibrium is that $c_L > c_H$. If this is not the case, then low-types may find it worthwhile to also obtain e.

Signaling

Signaling can improve information in the market. However, in the labor market model above, total output did not change as education did not improve workers' productivity, and education was costly, so signaling decreased the market's efficiency.

Hence, **signaling need not improve efficiency**. In case of car warranties, it may, but in case of education it may not. Each case must be examined on its own merits.

Incentives Contracting

An *agent* is hired by a *principal* to do a task. There is asymmetric information: only the agent knows the effort he exerts.

The effort exerted affects the principal's payoff.

The principal's problem: design an **incentives contract** that induces the agent to exert the amount of effort that maximizes the principal's payoff.

This is often called a **principal-agent problem**.

Incentives Contracting

An agent's effort is e. There are costs of effort $c(e)$.

A principal's total revenue is $y = f(e)$.

If the agent gets a fixed wage, he does not have an incentive to exert high effort (i.e., moral hazard), and principal's profits may not be maximized.

If the agent gets a wage that depends upon total revenue, he is **incentivized** to exert high effort, and principal's profits may be maximized.

The book discusses several different types of incentives contracting.

Potential Problems with Incentives Contracting

Imagine a principal's total revenue is $y = f(e) + \epsilon$, with $\epsilon \sim \mathrm{N}(0, \sigma^2)$.

Then total revenue is (partly) random.

If the agent gets a wage that depends upon random revenue, the random variation in pay may make the job less attractive (for risk-averse agents). This is a problem for incentives contracting.