CHAPTER 17 OUTLINE

17.1 QUALITY UNCERTAINTY AND THE MARKET FOR LEMONS

- **asymmetric information** Situation in which a buyer and a seller possess different information about a transaction.

The Market for Used Cars

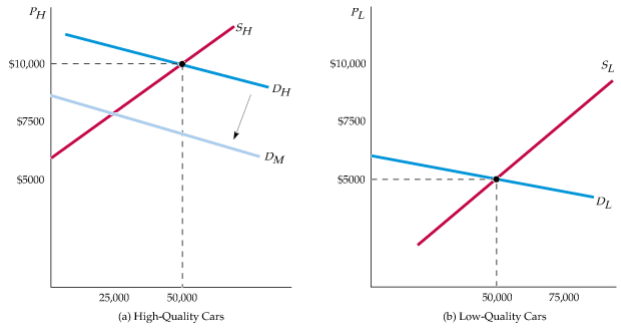
Figure 17.1

The Market for Used Cars

When sellers of products have better information about product quality than buyers, a "lemons problem" may arise in which low-quality goods drive out high quality goods.

In **(a)** the demand curve for high-quality cars is D_H.

However, as buyers lower their expectations about the average quality of cars on the market, their perceived demand shifts to D_M.



17.1 QUALITY UNCERTAINTY AND THE MARKET FOR LEMONS

- **asymmetric information** Situation in which a buyer and a seller possess different information about a transaction.

The Market for Used Cars

Figure 17.1

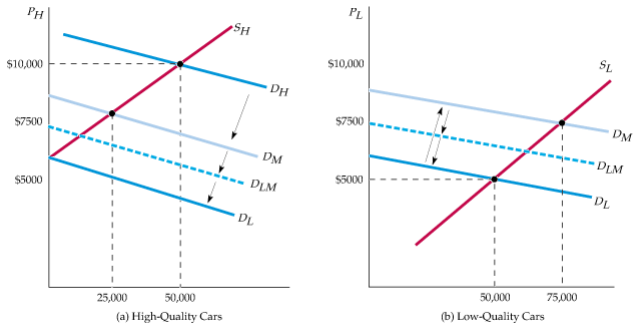
The Market for Used Cars (continued)

Likewise, in **(b)** the perceived demand curve for low-quality cars shifts from D_L to D_M.

As a result, the quantity of high-quality cars sold falls from 50,000 to 25,000,

and the quantity of low-quality cars sold increases from 50,000 to 75,000.

Eventually, only low quality cars are sold.



17.1 QUALITY UNCERTAINTY AND THE MARKET FOR LEMONS

The Market for Used Cars

The lemons problem: With asymmetric information, low-quality goods can drive high-quality goods out of the market.

Implications of Asymmetric Information

Adverse Selection

- **adverse selection** Form of market failure resulting when products of different qualities are sold at a single price because of asymmetric information, so that too much of the low-quality product and too little of the high-quality product are sold.

Chapter 17: Markets with Asymmetric Information

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A Simple Model of Adverse Selection

A **seller** supplies a good at three quality levels: $q_L < q_M < q_H$ and, for each quality level, can choose one of the following three prices: $p_L < p_M < p_H$.

For the seller there is a production cost that depends on the quality: $c(q) \in \{c_L, c_M, c_H\}$ where $c_L < c_M < c_H$.

We assume that $c_L < p_L < c_M < p_M < c_H < p_H$

There is a (representative) **buyer** that has to decide either to buy or not.

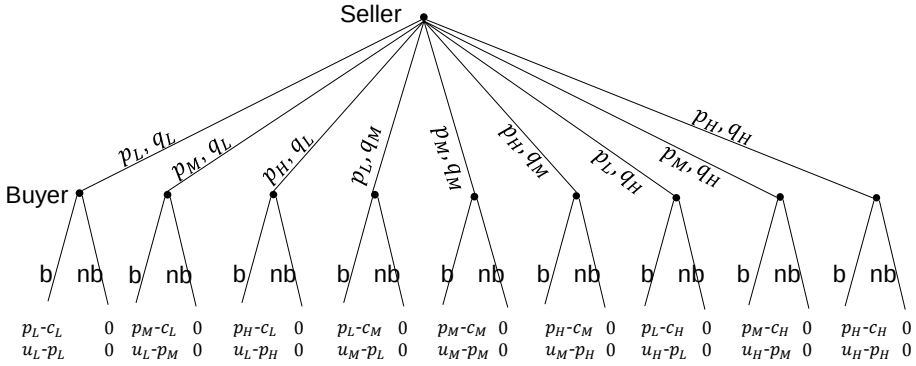
The utility he gets from this good depends on its quality:

$$p_L < u_L < p_M < u_M < p_H < u_H$$

Timing: seller chooses price and quality, then buyer observes the seller's decision and decides to buy or not

We consider two cases: i) *Perfect information* and ii) *Imperfect information*: buyer only observes prices (he does not observe quality)

Perfect information

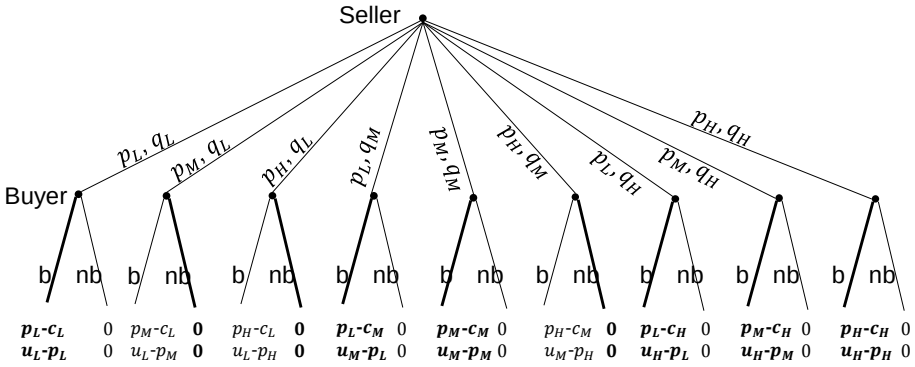


"*b*" means *buy*, "*nb*" means do *not buy*

Buyer has 9 information sets, then its strategy has to state one action for each info set

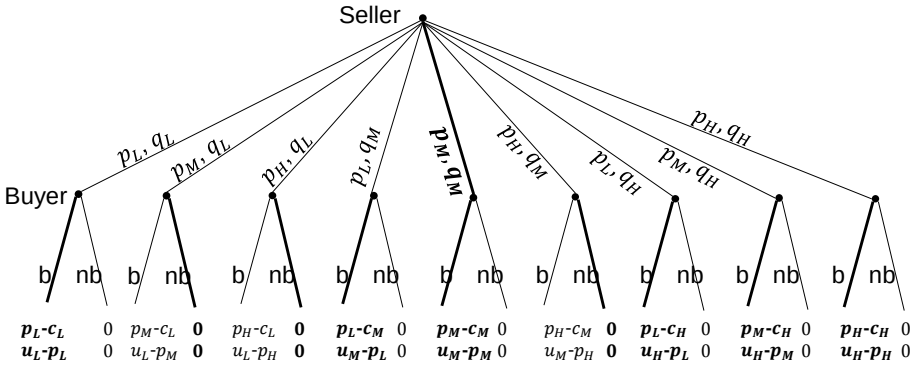
Normal form is very big, with many Nash equilibria.

Then we look for Subgame Perfect Nash Equilibria (SPNE)



Buyer' best responses are to buy when utility minus price is greater than zero

Given the strategy of the buyer, seller chooses the combination of price and quality that give him the higher profit.



Player 1's best choices are i) p_L, q_L, ii) p_M, q_M and iii) p_H, q_H

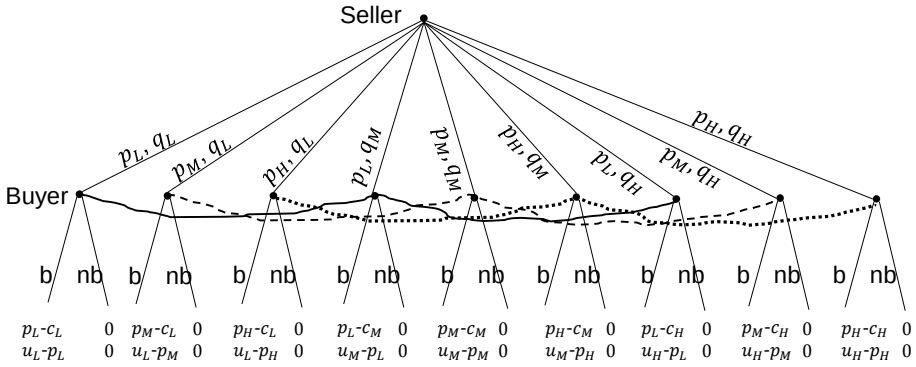
Other choices give him smaller profits

Suppose $p_M - c_M > p_L - c_L$ and $p_M - c_M > p_H - c_H$. Then the best choice for the Seller is p_M, q_M

SPNE: Seller plays strategy (p_M, q_M)

Buyer plays strategy (b, nb, nb, b, b, nb, b, b, b)

Imperfect information



Buyer has 3 information sets, then its strategy has to state one action for each info set.
Note that there is only one subgame, then all Nash equilibria are SPNE.
We use normal form

Buyer strategy states the action after p_L, then the action after p_M and finally the action after p_H. For example b, nb, b means to buy when price is low and high, do not buy at medium price.

In each cell, the upper formula denotes the seller payoff, the bottom one denotes the buyer payoff

In bold we denote the best responses

There 4 SPNE: 3 equilibria imply no trade, 1 equilibrium implies trade of the low quality good

		Buyer							
		nb nb nb	b nb nb	nb b nb	nb nb b	b b nb	b nb b	nb b b	b b b
Seller	p_L, q_L	**0** 0	$\boldsymbol{p_L}$-$\boldsymbol{c_L}$ $\boldsymbol{u_L}$-$\boldsymbol{p_L}$	0 0	0 0	p_L-c_L $\boldsymbol{u_L}$-$\boldsymbol{p_L}$	p_L-c_L $\boldsymbol{u_L}$-$\boldsymbol{p_L}$	0 0	p_L-c_L $\boldsymbol{u_L}$-$\boldsymbol{p_L}$
	p_L, q_M	**0** 0	p_L-c_M $\boldsymbol{u_M}$-$\boldsymbol{p_L}$	0 0	0 0	p_L-c_M $\boldsymbol{u_M}$-$\boldsymbol{p_L}$	p_L-c_M $\boldsymbol{u_M}$-$\boldsymbol{p_L}$	0 0	p_L-c_M $\boldsymbol{u_M}$-$\boldsymbol{p_L}$
	p_L, q_H	**0** 0	p_L-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_L}$	0 0	0 0	p_L-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_L}$	p_L-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_L}$	0 0	p_L-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_L}$
	p_M, q_L	**0** **0**	0 **0**	$\boldsymbol{p_M}$-$\boldsymbol{c_L}$ u_L-p_M	0 **0**	$\boldsymbol{p_M}$-$\boldsymbol{c_L}$ u_L-p_M	0 **0**	p_M-c_L u_L-p_M	p_M-c_L u_L-p_M
	p_M, q_M	**0** 0	0 0	p_M-c_M $\boldsymbol{u_M}$-$\boldsymbol{p_M}$	0 0	p_M-c_M $\boldsymbol{u_M}$-$\boldsymbol{p_M}$	0 0	p_M-c_M $\boldsymbol{u_M}$-$\boldsymbol{p_M}$	p_M-c_M $\boldsymbol{u_M}$-$\boldsymbol{p_M}$
	p_M, q_H	**0** 0	0 0	p_M-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_M}$	0 0	p_M-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_M}$	0 0	p_M-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_M}$	p_M-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_M}$
	p_H, q_L	**0** **0**	0 **0**	0 **0**	$\boldsymbol{p_H}$-$\boldsymbol{c_L}$ u_L-p_H	0 **0**	$\boldsymbol{p_H}$-$\boldsymbol{c_L}$ u_L-p_H	$\boldsymbol{p_H}$-$\boldsymbol{c_L}$ u_L-p_H	$\boldsymbol{p_H}$-$\boldsymbol{c_L}$ u_L-p_H
	p_H, q_M	**0** **0**	0 **0**	0 **0**	p_H-c_M u_M-p_H	0 **0**	p_H-c_M u_M-p_H	p_H-c_M u_M-p_H	p_H-c_M u_M-p_H
	p_H, q_H	**0** 0	0 0	0 0	p_H-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_H}$	0 0	p_H-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_H}$	p_H-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_H}$	p_H-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_H}$

		Buyer							
		nb nb nb	b nb nb	nb b nb	nb nb b	b b nb	b nb b	nb b b	b b b
Seller	p_L, q_L	**0** 0	$\boldsymbol{p_L}$-$\boldsymbol{c_L}$ $\boldsymbol{u_L}$-$\boldsymbol{p_L}$	0 0	0 0	p_L-c_L $\boldsymbol{u_L}$-$\boldsymbol{p_L}$	p_L-c_L $\boldsymbol{u_L}$-$\boldsymbol{p_L}$	0 0	p_L-c_L $\boldsymbol{u_L}$-$\boldsymbol{p_L}$
	p_L, q_M	**0** 0	p_L-c_M $\boldsymbol{u_M}$-$\boldsymbol{p_L}$	0 0	0 0	p_L-c_M $\boldsymbol{u_M}$-$\boldsymbol{p_L}$	p_L-c_M $\boldsymbol{u_M}$-$\boldsymbol{p_L}$	0 0	p_L-c_M $\boldsymbol{u_M}$-$\boldsymbol{p_L}$
	p_L, q_H	**0** 0	p_L-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_L}$	0 0	0 0	p_L-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_L}$	p_L-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_L}$	0 0	p_L-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_L}$
	p_M, q_L	**0** **0**	0 **0**	$\boldsymbol{p_M}$-$\boldsymbol{c_L}$ u_L-p_M	0 **0**	$\boldsymbol{p_M}$-$\boldsymbol{c_L}$ u_L-p_M	0 **0**	p_M-c_L u_L-p_M	p_M-c_L u_L-p_M
	p_M, q_M	**0** 0	0 0	p_M-c_M $\boldsymbol{u_M}$-$\boldsymbol{p_M}$	0 0	p_M-c_M $\boldsymbol{u_M}$-$\boldsymbol{p_M}$	0 0	p_M-c_M $\boldsymbol{u_M}$-$\boldsymbol{p_M}$	p_M-c_M $\boldsymbol{u_M}$-$\boldsymbol{p_M}$
	p_M, q_H	**0** 0	0 0	p_M-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_M}$	0 0	p_M-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_M}$	0 0	p_M-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_M}$	p_M-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_M}$
	p_H, q_L	**0** **0**	0 **0**	0 **0**	$\boldsymbol{p_H}$-$\boldsymbol{c_L}$ u_L-p_H	0 **0**	$\boldsymbol{p_H}$-$\boldsymbol{c_L}$ u_L-p_H	$\boldsymbol{p_H}$-$\boldsymbol{c_L}$ u_L-p_H	$\boldsymbol{p_H}$-$\boldsymbol{c_L}$ u_L-p_H
	p_H, q_M	**0** **0**	0 **0**	0 **0**	p_H-c_M u_M-p_H	0 **0**	p_H-c_M u_M-p_H	p_H-c_M u_M-p_H	p_H-c_M u_M-p_H
	p_H, q_H	**0** 0	0 0	0 0	p_H-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_H}$	0 0	p_H-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_H}$	p_H-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_H}$	p_H-c_H $\boldsymbol{u_H}$-$\boldsymbol{p_H}$

17.1 QUALITY UNCERTAINTY AND THE MARKET FOR LEMONS

Implications of Asymmetric Information

The Market for Insurance

People who buy insurance know much more about their general health than any insurance company can hope to know, even if it insists on a medical examination.

As a result, adverse selection arises, much as it does in the market for used cars.

The Market for Credit

Credit card companies and banks can, to some extent, use computerized credit histories, which they often share with one another, to distinguish low-quality from high-quality borrowers.

Many people, however, think that computerized credit histories invade their privacy.

17.2 MARKET SIGNALING

- **market signaling** Process by which sellers send signals to buyers conveying information about product quality.

To be strong, a signal must be easier for high-productivity people to give than for low-productivity people to give, so that high-productivity people are more likely to give it.

17.2 MARKET SIGNALING

A Simple Model of Job Market Signaling

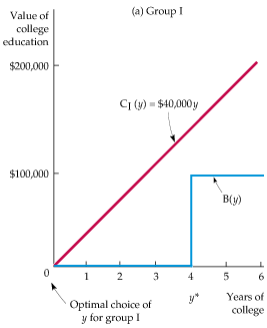
Equilibrium

Figure 17.2

Signaling

Education can be a useful signal of the high productivity of a group of workers if education is easier to obtain for this group than for a low-productivity group.

In **(a)**, the low-productivity group will choose an education level of $y = 0$ because the cost of education is greater than the increased earnings resulting from education.



17.2 MARKET SIGNALING

A Simple Model of Job Market Signaling

Equilibrium

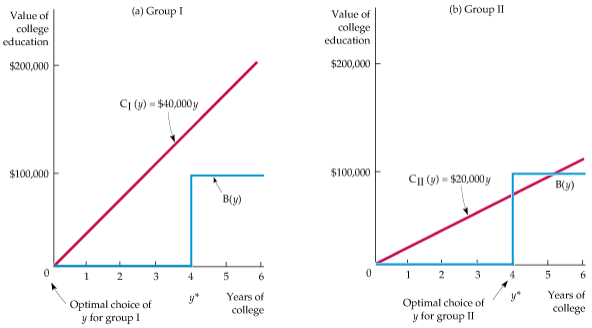
Chapter 17: Markets with Asymmetric Information

Figure 17.2

Signaling

Education can be a useful signal of the high productivity of a group of workers if education is easier to obtain for this group than for a low-productivity group.

However, in **(b)**, the high-productivity group will choose an education level of $y^* = 4$ because the gain in earnings is greater than the cost.



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A firm is looking for a worker

Workers are of two types by equal probability:

type I → low productivity p_L

type II → high productivity p_H

Type I accepts to work for a salary no smaller than w_L

Type II accepts to work for a salary no smaller than w_H $(> w_L)$

i.e. workers have an outside option (another alternative job)

Two education levels: 0 or y*

Cost of education:

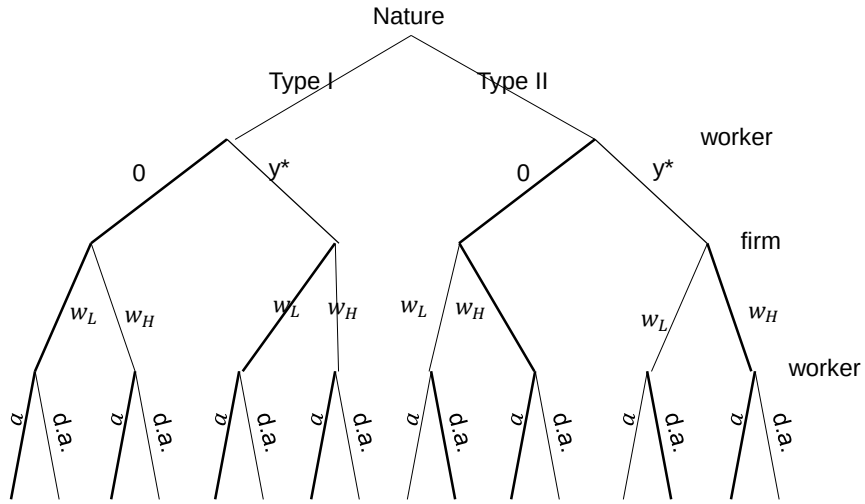
i) Level 0 costs 0

ii) Level y* costs c_L for type I, c_H for type II and $c_H < c_L$

Productivity does not depend from education level

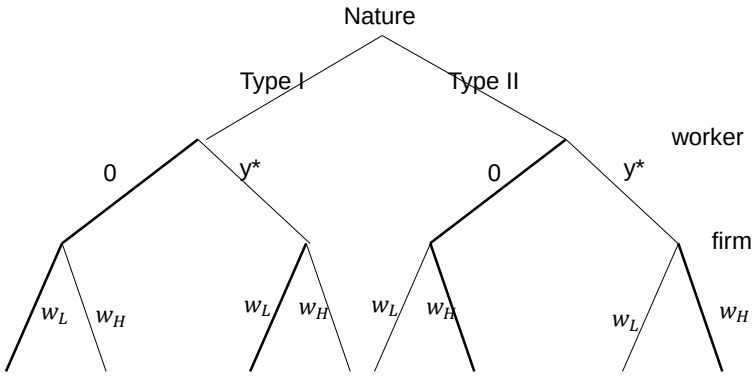
Profits of the firm are productivity of the worker minus salary:

$$p_L - w_L = p_H - w_H > 0 \; and \; p_L - w_H < 0$$



Note that in the last decision nodes, type I accepts both w_L and w_H as well as type II accepts only w_H

In the following figure we omit these nodes, assuming these strategy of the workers.

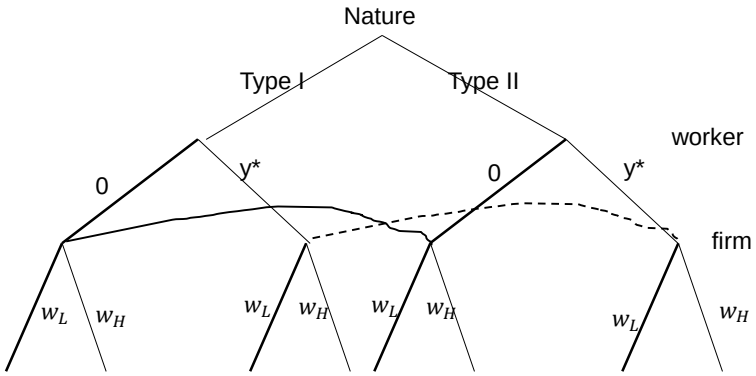


Firm observes productivity when hires a worker.

Then it offers a salary equal to the minimum acceptable salary, independent from the education level

Both type of workers gets education level 0

Note in the figure we omit the decision between accept or not



Firm is not able to observe productivity when hires a worker.

If it offers w_L only type I worker accepts, then its payoff is $\frac{p_L - w_L}{2}$

If it offers w_{H} both types of worker accept, then its payoff is $\frac{p_L - w_{\mathrm{H}}}{2} + \frac{p_{\mathrm{H}} - w_{\mathrm{H}}}{2}$ that is smaller than $\frac{p_L - w_L}{2}$

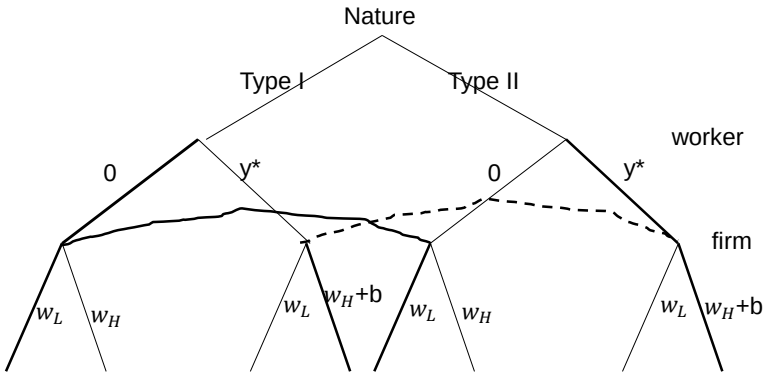
So in equilibrium firm will offer w_L, only low productivity workers are hired, and all type of workers get education 0

Firms likes to pay an higher wage to high productivity workers but is not able to observe productivity when hires a worker.

So firm decide to pay a bonus b for workers with education y* and $c_H < b < c_L$ and $p_H > b + w_H$

Note that if b is to higher, low productivity workers could take education in the hope f an higher salary.

In this case education level is not more working as a signal



For type I is optimal to take education level 0, independent from the firm's strategy.

Given the strategy of the firms, for type II it is optimal to takes education level y*

Low productivity workers are hired at salary w_L

High productivity workers are hired at salary $w_{\mathrm{H}} + \mathrm{b}$

17.2 MARKET SIGNALING

A Simple Model of Job Market Signaling

Cost–Benefit Comparison

In deciding how much education to obtain, people compare the benefit of education with the cost.

People in each group make the following cost-benefit calculation: *Obtain the education level y* if the benefit (i.e., the increase in earnings) is at least as large as the cost of this education.*

Guarantees and Warranties

Firms that produce a higher-quality, more dependable product must make consumers aware of this difference. But how can they do it in a convincing way?

The answer is *guarantees* and *warranties*.

Guarantees and warranties effectively signal product quality because an extensive warranty is more costly for the producer of a low-quality item than for the producer of a high-quality item.

17.2 MARKET SIGNALING

EXAMPLE 17.2 Working into the Night

Job market signaling does not end when one is hired. This is especially true for workers in knowledge-based fields such as engineering, computer programming, finance, law, management, and consulting.

Given this asymmetric information, what policy should employers use to determine promotions and salary increases? Workers can often signal talent and productivity by *working harder and longer hours*.

Employers rely increasingly on the signaling value of long hours as rapid technological change makes it harder for them to find other ways of assessing workers' skills and productivity. The worker will know more about his abilities than the employer.

17.3 MORAL HAZARD

- **moral hazard** When a party whose actions are unobserved can affect the probability or magnitude of a payment associated with an event.

The Effects of Moral Hazard

Moral hazard alters the ability of markets to allocate resources efficiently. *D* gives the demand for automobile driving.

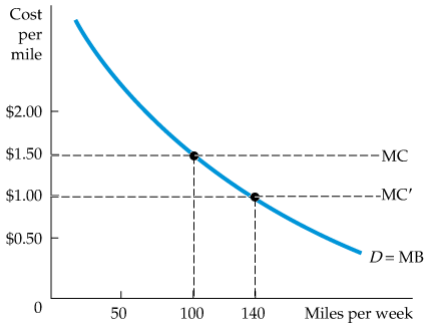
With no moral hazard, the marginal cost of transportation MC is $1.50 per mile; the driver drives 100 miles, which is the efficient amount.

Suppose that marginal cost has 2 components:

1) Use of the car (gasoline, repairs…) $1.00 per mile
2) Insurance, 0.50 per mile

If the insurance company cannot observe the number of miles traveled, a fixed cost will be charged.

the driver perceives the cost per mile to be MC = $1.00 and drives 140 miles.



17.4 THE PRINCIPAL–AGENT PROBLEM

- **principal–agent problem** Problem arising when agents (e.g., a firm's managers) pursue their own goals rather than the goals of principals (e.g., the firm's owners).
- **agent** Individual employed by a principal to achieve the principal's objective.
- **principal** Individual who employs one or more agents to achieve an objective.

17.4 THE PRINCIPAL–AGENT PROBLEM

The Principal–Agent Problem in Private Enterprises

Most large firms are controlled by management.

Managers of private enterprises can thus pursue their own objectives.

However, there are limitations to managers' ability to deviate from the objectives of owners.

First, stockholders can complain loudly when they feel that managers are behaving improperly.

Second, a vigorous market for corporate control can develop.

Third, there can be a highly developed market for managers.

17.4 THE PRINCIPAL–AGENT PROBLEM

The Principal–Agent Problem in Public Enterprises

The principal–agent framework can also help us understand the behavior of the managers of public organizations.

Although the public sector lacks some of the market forces that keep private managers in line, government agencies can still be effectively monitored.

First, managers of government agencies care about more than just the size of their agencies.

Second, much like private managers, public managers are subject to the rigors of the managerial job market.

17.4 THE PRINCIPAL–AGENT PROBLEM

Incentives in the Principal–Agent Framework

TABLE 17.2 Revenue from Making Watches

	Bad Luck	Good Luck
Low effort ($a = 0$)	$10,000	$20,000
High effort ($a = 1$)	$20,000	$40,000

The probability of Bad Luck is 0.5
The cost of high effort is $10.000

Suppose, for example, that the owners offer the worker the following payment scheme:

$$\text{If } R = \$10{,}000 \text{ or } \$20{,}000,\ w = 0$$
$$\text{If } R = \$40{,}000,\ w = \$24{,}000 \qquad \textbf{(17.1)}$$

Under this system, the worker will choose to make a high level of effort.

17.4 THE PRINCIPAL–AGENT PROBLEM

Incentives in the Principal–Agent Framework

This is not the only payment scheme that will work for the owners, however.

Suppose they contract to have the worker participate in the following revenue-sharing arrangement. When revenues are greater than $18,000,

$$w = R - \$18{,}000 \qquad \textbf{(17.2)}$$

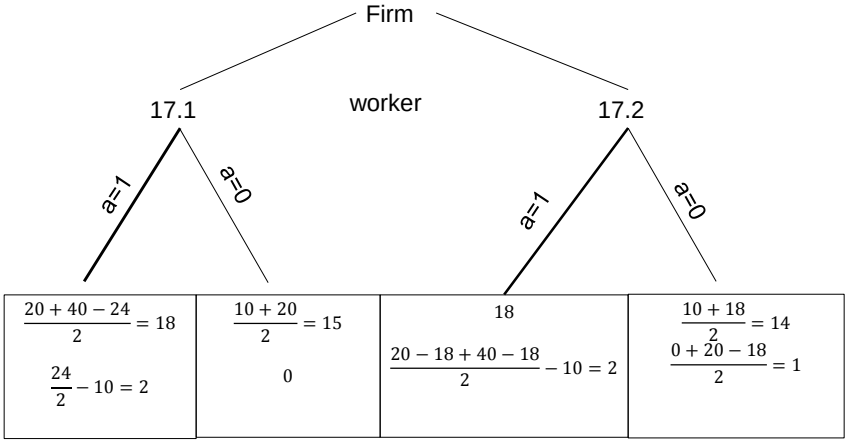
(if negative, the wage is zero.)

In this case, if the repairperson makes a low effort, he receives an expected payment of $1000. But if he makes a high level of effort, his expected payment is $12,000

*17.5 MANAGERIAL INCENTIVES IN AN INTEGRATED FIRM

- **horizontal integration** Organizational form in which several plants produce the same or related products for a firm.
- **vertical integration** Organizational form in which a firm contains several divisions, with some producing parts and components that others use to produce finished products.

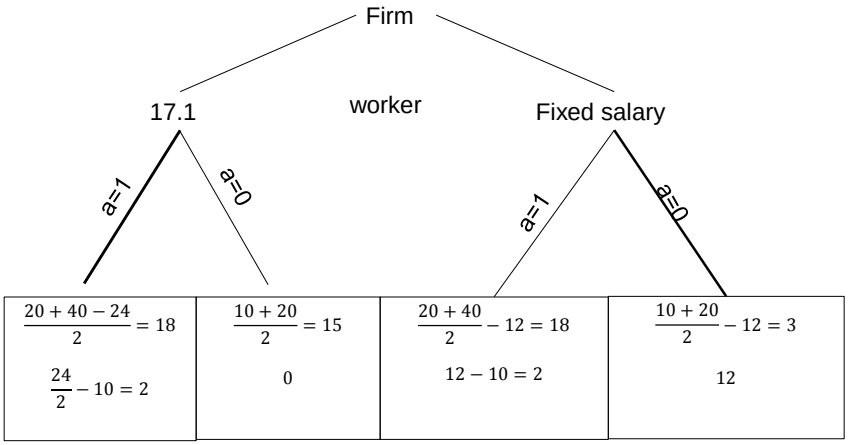
Suppose the firm has to decide between the two payment schemes, 17.1 and 17.2 (payoffs are in thousands)



Applying backward induction we find two SPNE:

i) Firm offers 17.1, workers chooses high effort (a=1) in both schemes
ii) Firm offers 17.2, workers chooses high effort (a=1) in both schemes

Suppose the firm has to decide between the payment scheme, 17.1 and fixed salary of 12 (payoffs are in thousands)



Applying backward induction we find one SPNE:

i) Firm offers 17.1, worker chooses high effort in the scheme 17.1 and low effort for fixed salary

Outcome is: salary scheme 17.1 and high effort

*17.5 MANAGERIAL INCENTIVES IN AN INTEGRATED FIRM

Asymmetric Information and Incentive Design in the Integrated Firm

In an integrated firm, division managers are likely to have better information about their different operating costs and production potential than central management has. This asymmetric information causes two problems.

1. How can central management elicit accurate information about divisional operating costs and production potential from divisional managers?
2. What reward or incentive structure should central management use to encourage divisional managers to produce as efficiently as possible?

*17.5 MANAGERIAL INCENTIVES IN AN INTEGRATED FIRM

Asymmetric Information and Incentive Design in the Integrated Firm

For example, if the manager's estimate of the feasible production level is Q_f, the annual bonus in dollars, B, might be

$$B = 10{,}000 - .5(Q_f - Q) \qquad \textbf{(17.3)}$$

where Q is the plant's actual output, 10,000 is the bonus when output is at capacity, and .5 is a factor chosen to reduce the bonus if Q is below Q_f.

We will use a slightly more complicated formula than the one in (17.3) to calculate the bonus:

$$\begin{aligned} &\text{If } Q > Q_f, B = .3Q_f + .2(Q - Q_f) \\ &\text{If } Q \le Q_f, B = .3Q_f - .5(Q_f - Q) \end{aligned} \qquad \textbf{(17.4)}$$

The parameters (.3, .2, and .5) have been chosen so that each manager has the incentive to reveal the *true* feasible production level *and* to make Q, the actual output of the plant, as large as possible.

*17.5 MANAGERIAL INCENTIVES IN AN INTEGRATED FIRM

Asymmetric Information and Incentive Design in the Integrated Firm

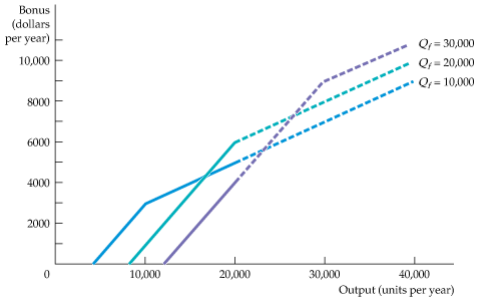
Chapter 17: Markets with Asymmetric Information

Figure 17.4

Incentive Design in an Integrated Firm

A bonus scheme can be designed that gives a manager the incentive to estimate accurately the size of the plant.

If the manager reports a feasible capacity of 20,000 units per year, equal to the actual capacity, then the bonus will be maximized (at $6000).



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*17.5 MANAGERIAL INCENTIVES IN AN INTEGRATED FIRM

Applications

Companies are learning that bonus schemes provide better results.

The salesperson can be given an array of numbers showing the bonus as a function of both the sales target chosen by the salesperson and the actual level of sales.

Salespeople will quickly figure out that they do best by reporting feasible sales targets and then working as hard as possible to meet them.

17.6 ASYMMETRIC INFORMATION IN LABOR MARKETS: EFFICIENCY WAGE THEORY

- **efficiency wage theory** Explanation for the presence of unemployment and wage discrimination which recognizes that labor productivity may be affected by the wage rate.
- **shirking model** Principle that workers still have an incentive to shirk if a firm pays them a market-clearing wage, because fired workers can be hired somewhere else for the same wage.
- **efficiency wage** Wage that a firm will pay to an employee as an incentive not to shirk.

17.6 ASYMMETRIC INFORMATION IN LABOR MARKETS: EFFICIENCY WAGE THEORY

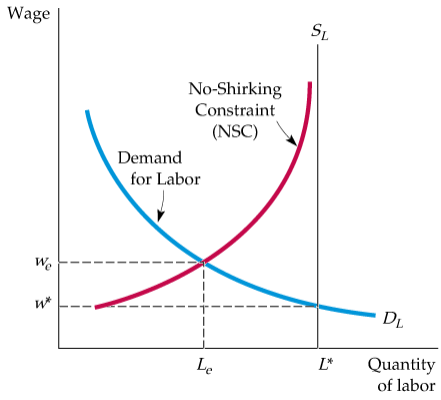
Figure 17.5

Unemployment in a Shirking Model

Unemployment can arise in otherwise competitive labor markets when employers cannot accurately monitor workers.

Here, the "no shirking constraint" (NSC) gives the wage necessary to keep workers from shirking.

The firm hires L_e workers (at a higher than competitive efficiency wage w_e), creating $L^* - L_e$ of unemployment.



17.6 ASYMMETRIC INFORMATION IN LABOR MARKETS: EFFICIENCY WAGE THEORY

EXAMPLE 17.6 Efficiency Wages at Ford Motor Company

One of the early examples of the payment of efficiency wages can be found in the history of Ford Motor Company.

Ford needed to maintain a stable workforce, and Henry Ford (and his business partner James Couzens) provided it.

In 1914, when the going wage for a day's work in industry averaged between $2 and $3, Ford introduced a pay policy of $5 a day. The policy was prompted by improved labor efficiency, not generosity.

Although Henry Ford was attacked for it, his policy succeeded. His workforce did become more stable, and the publicity helped Ford's sales.