INTRODUCTION

- Well-designed public policies can address the kinds of social dilemmas (introduced in the previous unit) to benefit all or at least most people, and to make outcomes fairer than they otherwise would be.
- Both the tragedy of the commons and a new game—the ultimatum game—illustrate the fact that policies that implement ‘efficient’ outcomes may sometimes be regarded as unfair.
- People may consider an outcome to be unfair, either because who gets what is thought to be unjust, or because the rules of the game determining this distribution are seen as unfair.
- Experiments with the ultimatum game show that people care about fairness, are willing to sacrifice their own material payoffs to avoid unfair outcomes, and are willing to punish unfair behaviour of others.
- How people respond to a change in government policy, such as a tax or a subsidy, and the effect of their responses in bringing about a new outcome, can be described as a shift in the Nash equilibrium.
- Policies will not work as expected if the intended outcome is not a Nash equilibrium.
- Models are simplifying devices that allow us to see more by looking at less.
- We use models to check for unintended consequences of policies, and use factual studies (including natural experiments) to identify the causal effects of the changes implemented by the policies.

In most countries and throughout human history, women have been underrepresented in positions of political leadership. We can argue that this affects the public policies that governments create. For example, countries in which women are more equally represented as members of parliament or heads of state have spent more to support the less well off.

But the fact that there are pro-poor policies when women are in powerful positions—as in Norway, Sweden, and the other Nordic countries—does not mean that electing women has caused these policies. It
could be that countries that have values that lead them to support pro-poor policies are also more likely to elect women. In this case, they would enact the same pro-poor policies, even if women were not elected.

This raises the difficult problem of causation, introduced in Unit 1, where we compared economic growth under capitalist West Germany and centrally planned East Germany. The data in Figure 1.13 (page 35) indicated that the difference in their economic institutions was probably a cause (not just a correlate) of the divergent economic fortunes of the two Germanies. Economists are interested in what causes what, because we would like economic knowledge to be useful. One way it can be useful is if it contributes to the design of policies that would cause better outcomes to happen.

A study of changes in women’s voting rights in the US, and the changes in public policy that followed, provides a similar opportunity to identify whether increased political power for women actually caused changes in policies. The US is a particularly useful laboratory for this kind of study because voting laws differ by state. As a result, women gained the right to vote at different times, starting in 1869 in Wyoming. In 1920, the Nineteenth Amendment to the US Constitution granted the vote to women in all of the remaining states that had not yet granted this right.

Grant Miller, an economist, has used the date at which women got the right to vote to do before-and-after comparison of the actions taken by elected officials, public expenditures related to child health, and health outcomes for children.

The key assumption for this type of research would be that the only large political difference between the state of Wyoming in 1868 and 1870 was that women had the right to vote in 1870, but not in 1868. Other aspects of the state—the social values of the citizens, or their demographic makeup, which might have influenced the policies of the state government—had mostly stayed the same.

Miller chose to focus on child healthcare policies because women had campaigned to expand health services for children. It is therefore reasonable to assume that women would have chosen different policies at this time than men would have chosen. During the nineteenth century and before, however, those who argued that only men should vote often claimed that women were represented through their husbands, brothers, and fathers. If the women were household servants, the same argument was used to say they were represented by their male employers.

Miller’s study is a ‘natural experiment’, and is similar to the case of the two Germanies:

- *It is an experiment:* The variable that interests us—the right to vote for women—was the only significant difference likely to affect public spending and child health. Other things that might have had an effect—the state’s tax base, or medical knowledge, for example—are held constant by looking at the same state, at roughly the same time.
- *It is natural:* It was not designed or conducted in a lab, but happened in the course of history.

The logic of a natural experiment is illustrated below. Each arrow represents possible causes that Miller explored.
Miller’s research asked two questions: ‘Did women’s voting rights have a causal effect on what the government did?’ (the first arrow), and ‘Did the changes in government programs have any causal effect on children’s wellbeing?’ (the second arrow).

The ‘treatment’ groups are states in which women had been given the right to vote. They are compared to the ‘control’ groups, which are the same states just before women got the vote. Note that this is entirely different from comparing across states to see if states where women had the right to vote adopted different policies and had healthier children. If we found that this was the case—and it was—then we could conclude only that women voting and child health are correlated, but not that universal suffrage causes better child health.

Here is what Miller found:

- **Social services increased**: Looking state-by-state at the date women got the right to vote, enfranchisement boosted social service spending by 24%. It had no apparent effect on public spending in other areas.
- **Spending on children increased**: Within a year of the passage of the Nineteenth Amendment, the US Congress voted for a substantial increase in public health spending aimed at children. A historian concluded that ‘the principal force moving Congress was fear of being punished at the polls … by women voters.’
- **Child deaths decreased**: In 1900, one in five children in the US did not live to the age of five. The deaths of children under the age of nine fell by between 8% and 15%. This was primarily as a result of the public programs that had been adopted, especially large-scale door-to-door hygiene campaigns.

Healthcare programs, based on the recent revolution in scientific knowledge of bacteria and disease, prevented an estimated 20,000 child deaths per year. Votes for women helped to achieve this.

In many countries today, women participate much less in political life and leadership than do men, and political systems are often less responsive to the needs of women than men. But if we want to show that it makes a difference when women gain more political power, we must always distinguish, as Miller did, between causes and correlations.

India has provided an unusual laboratory to do this. In our ‘Economist in action’ video, Esther Duflo explains what happened when the government of India mandated that randomly selected villages elect a woman to head their local council.

Reserving positions for women to head village councils:

- increased public spending on the public services that women preferred, like wells
- reduced receipts of bribes by those in power
- transformed stereotypes, so that men in villages with women leaders perceived them more as leaders, rather than solely in domestic roles
The reduction in child mortality in the US, and the changes in village council policies in India, illustrate the capacity of governments to provide solutions to problems arising in the economy.

In the US, for example, many children, particularly in poor families, no longer died from readily preventable diseases. The policies also limited the spread of communicable diseases among all members of the population.

In this case, the government provided a public good—better sanitation and public information about hygiene—that improved conditions for most Americans, and specially helped the least well off. These two objectives—promoting gains for all and correcting unfairness—are foremost among the standards by which we evaluate economic outcomes and policies to improve them.

**QUESTION 3.1 CHOOSE THE CORRECT ANSWER(S)**
According to the ‘Economist in action’ video featuring Esther Duflo:

- The reform of the panchayat (local council) was a natural experiment that enabled economists to attribute the changes in public goods investment to having women representation in the council.
- Duflo learned about villagers’ attitudes towards women as policymakers by asking them directly.
- A medium-term effect of the local council reform is that career aspirations of girls changed.
- A long-term effect of the local council reform is that girls were less likely to drop out of middle school.

**3.1 GOALS OF PUBLIC POLICY**
To illustrate these two objectives of public policy, we return to the problem of free riding, as illustrated by the tragedy of the commons introduced in the previous unit. Let’s explore how public policy might avert the tragedy.

Here is how the tragedy of the commons unfolds, according to its author, Garrett Hardin:

Picture a pasture open to all. … each herdsman … seeks to maximize his gain … [and] will try to keep as many cattle as possible on the commons. … he asks, ‘What is the utility to me of adding one more animal …?’ 1) The positive component … the herdsman receives all of the proceeds from the sale of the additional animal. 2) The negative component … the effects of overgrazing are shared by all of the herdsman [so] the negative utility for any decision-making herdsman is only a fraction of the total [negative effect].

The tragedy seems inevitable:

The only sensible course for him to pursue is to add another animal to his herd. And another. But this is the conclusion reached by each and every … herdsman sharing a commons. Therein is the tragedy. Ruin is the destination towards which all men rush, each pursuing his own best interest. Freedom in the commons brings ruin to all.

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Now think about how government policy might improve the situation.

**Cows as common property**
A policymaker might reason, as Hardin did, that the problem is that all herders have access to the pasture and they make their decisions independently. This suggests a solution. If they owned all of the cows jointly, they could decide together how many of them to put on the pasture. That way, there would be no external effects of placing too many cows on the pasture. The costs of overgrazing would be experienced by all members of the decision-making body.

If they owned the cows jointly, they would take care of the pasture. But, given that the cows are now owned by everyone, who would take care of the cows? Each of the herders would have an incentive to free ride on the others by letting somebody else tend the cattle. The tragedy of the commons has become the tragedy of the cows!

**Private property**
The policymaker tries a different approach. If one herder was given access to the pasture and the rest excluded, then this lucky herder would reason in a different way—‘If I put an additional cow on the pasture, this gives me one more cow, but less pasture for the rest of my own cows. So, I should limit the size of my herd.’

The tragedy has been averted. Converting the pasture to the private property of the one lucky herder addresses the root of the problem, which was that each herder did not consider the effects of a decision on the other herders. Now there is only one herder, and he or she will take account of the damage that overgrazing might inflict on the pasture and the cattle on it.

**Is this a fair allocation?**
But what about the herders who have been excluded from the pasture? Denying them access to the pasture hardly seems fair. An unfair outcome may not be sustainable in the long run, even if it provided an efficient solution to the initial problem.

Whether it is fishermen seeking to make a living while not depleting the fish stocks, or farmers maintaining the channels of an irrigation system, herders overgrazing a pasture, or two people dividing up a pie, we want to be able to both describe what happens and evaluate it—is it better or worse than other potential outcomes? The first involves facts; the second involves values.

We call the outcome of an economic interaction an allocation. Taking as an example the climate change game described in Unit 2, each of the four outcomes and the resulting payoffs for the two players, the US and China, is called an allocation.

In evaluating government policies and their outcomes, we ask, is the allocation resulting from a new government policy better than the status quo? Is there some other policy that would result in an outcome that is even better?
Pareto efficient An allocation with the property that there is no alternative technically feasible allocation in which at least one person would be better off, and nobody worse off.

fairness A way to evaluate an allocation based on one’s conception of justice.

últimatum game An interaction in which the first player proposes a division of a ‘pie’ with the second player, who may either accept, in which case they each get the division proposed by the first person, or reject the offer in which case both players receive nothing.

When we say better or worse, we refer to two characteristics that we value:

- efficiency
- fairness

There are many additional values that might form the basis of our evaluations of economic outcomes, including individual dignity and freedom, diversity, conformity to the prescriptions of one’s religion or other values, and many more. But here we will focus on efficiency and fairness, as shown in Figure 3.1.

### 3.2 FAIRNESS AND EFFICIENCY IN THE ÚLTIMATUM GAME

To study how the objectives of efficiency and fairness interact—sometimes in mutually supportive ways, but often in conflict—we turn to a new game, called the Últimatum game. It has been used around the world with experimental subjects including students, farmers, warehouse workers, and hunter-gatherers.

The subjects of the experiment play a game in which they will win some money. How much they win will depend on how they and the others in the game play. So, like the public goods game experiments in Unit 1, it is a strategic interaction in which the payoffs of each depend on the actions of the others.

Real money is at stake in experimental games like these, otherwise we could not be sure the subjects’ answers to a hypothetical question would reflect their actions in real life.

The rules of the game are explained to the players:

- They are randomly matched in pairs.
- One player is randomly assigned as the Proposer and the other the Responder.
- The subjects do not know each other, but they know the other player was recruited to the experiment in the same way.
- Subjects remain anonymous.

![Figure 3.1 Efficiency and fairness.](image)
The Proposer is provisionally given an amount of money, say $100, by the experimenter, and instructed to offer the Responder part of it. Any split is permitted, including keeping it all, or giving it all away. We will call this amount the ‘pie’ because the point of the experiment is how it will be divided up.

The split takes the form ‘x for me, y for you’, where \( x + y = 100 \).

- The Responder knows that the Proposer has $100 to split.
- After observing the offer, the Responder accepts or rejects it.
- If the offer is rejected, both individuals get nothing.
- If it is accepted, the split is implemented—the Proposer gets \( x \) and the Responder \( y \).

For example, if the Proposer offers $35 and the Responder accepts, the Proposer gets $65 and the Responder gets $35. If the Responder rejects the offer, they both get nothing.

This is called a take-it-or-leave-it offer. It is the ultimatum in the game’s name. The Responder is faced with a choice—accept $35 and let the other get $65, or get nothing and deprive the other player of any payoffs too.

**A game tree**

We start by thinking about a simplified case of the ultimatum game, represented in Figure 3.2 in a diagram called a game tree. The Proposer’s choices are either the ‘fair offer’ of an equal split, or the ‘unfair offer’ of 20 (keeping 80 for herself). Then the Responder has the choice to accept or reject. The payoffs are shown in the last row. In the actual experiments, Proposers were not confined to these two fair and unfair options. Instead, they could choose any split they wished, including proposing to give everything or nothing to the other.

![Game tree for the ultimatum game](image-url)

**Figure 3.2** Game tree for the ultimatum game in which the only choices open to the Proposer are an even split or to keep 80 while giving 20 to the Responder.
sequential game  A game in which all players do not choose their strategies at the same time, and players that choose later can see the strategies already chosen by the other players, for example the ultimatum game. See also simultaneous game.

The game tree is a useful way to represent social interactions because it clarifies who does what, when they choose, and the results. We see that in the ultimatum game one player (the Proposer) chooses her strategy first, followed by the Responder. This is called a sequential game because each player knows the actions of the previous player before acting (unlike the prisoners’ dilemma, for example).

A strategic interaction
What the Proposer will get depends on what the Responder does, so the Proposer has to think about the likely response of the other player. This is why it is called a strategic interaction. If you’re the Proposer you can’t try out a low offer to see what happens. You have only one chance to make an offer. How would you think this through if you were the Proposer?

1. Put yourself in the place of the Responder in this game: Would you accept (50, 50)? Would you accept (80, 20)?
2. Now switch roles and suppose that you are the Proposer: What split would you offer to the Responder? Would your answer depend on whether the other person was a friend, a stranger, a person in need, or a competitor?

We have some clues about how to answer these questions. Dividing something of value in equal shares (the 50–50 rule) is a social norm in many communities, as is giving gifts on birthdays to close family members and friends. Social norms are common to an entire group of people (almost all follow them) and tell a person what they should do in the eyes of most people in the community.

A Responder who thinks that the Proposer’s offer has violated a social norm of fairness, or that the offer is insultingly low for some other reason, might be willing to sacrifice the payoff to punish the Proposer.

EXERCISE 3.1 ACCEPTABLE OFFERS
Look again at the ultimatum game shown in Figure 3.2.

1. Suppose the Proposer received the $100 through some other means rather than being given $100 by the experimenter: For example, she might have found it on the street, won it in the lottery, received it as an inheritance, or earned it through hard work. How might the Responder’s perception of the ($80, $20) offer depend on the way that the Proposer acquired the $100?
2. Suppose that the Proposer can offer more than $50 to the Responder, and the social norm in this society is 50–50: Can you imagine anyone offering more than $50 in such a society? Why, or why not?

The problem of fairness and efficiency
If you were a Responder in the ultimatum game who cared only about your own payoffs, you would accept any positive offer, because something is better than nothing. But if you cared about fairness too, and the Proposer made you a very low offer that you considered to be unfair, you might decide to reject the offer. Neither you nor the Proposer would receive anything. This outcome—throwing away money!—cannot be efficient.
One way of eliminating this inefficiency would be to change the rules of the game so that a Responder, even one who cared very much about fairness, could not reject any offer. For obvious reasons, this is called the dictator game! There would never be money left on the table, but much like excluding all but one herder from using the pasture (in the tragedy of the commons), it would hardly be called fair.

**People value fairness in practice**

In a world composed only of self-interested individuals, in which everyone knew for sure that everyone else was self-interested, the Proposer would anticipate that the Responder would accept any offer greater than zero and, for that reason, would offer the minimum possible positive amount—one cent—knowing it would be accepted.

Does this prediction match the experimental data? No, it does not. As in the prisoners’ dilemma studied in the previous unit, we don’t see the outcome we would predict if people were entirely self-interested. One-cent offers get rejected. If it costs you just one cent to punish a selfish person—sending them away with nothing—it’s not difficult to see why most people are happy to do so!

Let’s see how Kenyan farmers and US students actually played the ultimatum game.

Look at Figure 3.3. Before playing the game, the researchers—a team of anthropologists and economists who conducted the same experiments throughout the world—asked their subjects to indicate (confidentially) the offers they would accept and which they would reject. The height of each bar indicates the fraction of Responders who were willing to accept the offer indicated on the horizontal axis. Offers of more than half of the pie were acceptable to all of the subjects in both countries, as one would expect.

Notice that the Kenyan farmers are very unwilling to accept low offers, presumably regarding them as unfair, while the US students are much more willing to do so. For example, virtually all (90%) of the farmers would say no to an offer of one-fifth of the pie (the Proposer keeping 80%), while 63% of the students would accept such a low offer. More than half of the students would accept just 10% of the pie, but almost none of the farmers would.

Figure 3.3 Acceptable offers in the ultimatum game.

Although the results in Figure 3.3 indicate that attitudes differ about the importance of fairness and what constitutes fairness, nobody in the Kenyan and US experiments was willing to accept an offer of zero, even though by rejecting it they would also receive zero.

Figure 3.4 shows another way of looking at these results. The full height of each bar in Figure 3.4 indicates the percentage of the Kenyan and American Proposers who made the offer shown on the horizontal axis when they actually played the game. For example, half of the farmers made proposals of 40%. Another 10% offered an even split. Only 11% of the students made such generous offers.

**The Proposer’s reasoning**

But were the farmers really being generous? To answer, you should think not only about how much they were offering, but also what they must have reasoned when considering whether the Responder would accept the offer. If you look at Figure 3.4 and concentrate on the Kenyan farmers, you will see that very few proposed to keep the entire pie by offering zero (4% of them as shown in the far left-hand bar). This is no surprise, given that they must have reasoned that all of those offers would be rejected (the entire bar is dark).

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**1. What do the bars show?**

The full height of each bar in the figure indicates the percentage of the Kenyan and American Proposers who made the offer shown on the horizontal axis.

**2. Reading the figure**

For example, for Kenyan farmers, 50% on the vertical axis and 40% on the horizontal axis means half of the Kenyan Proposers made an offer of 40%.

**3. The dark-shaded area shows rejections**

If Kenyan farmers made an offer of 30%, almost half of Responders would reject it. (The dark part of the bar is almost as big as the light part.)

**4. Better offers, fewer rejections**

The relative size of the dark area is smaller for better offers. For example, Kenyan farmer Responders rejected a 40% offer only 4% of the time.
EXERCISE 3.2 OFFERS IN THE ULTIMATUM GAME

In the ultimatum game shown in Figures 3.3 and 3.4:
1. Why do you think that some of the farmers offered more than 40%? Why do you think that some of the students offered more than 30%?
2. Why do you think that some offered less?

On the other hand, looking at the far right of the figure, we see that for the farmers, making an offer of half the pie ensured an acceptance rate of 100% (the entire bar is light). Those who offered 30% were about equally likely to see their offer rejected as accepted (the dark part of the bar is nearly as big as the light part).

A Proposer who wanted to earn as much as possible would choose something between the extreme of trying to take it all or dividing it equally. The farmers who offered 40% were very likely to see their offer accepted and receive 60% of the pie. In the experiment, half of the farmers chose an offer of 40%, an offer that would be rejected only 4% of the time, as can be seen from the tiny dark-shaded top part of the bar at the 40% offer in Figure 3.4.

Now suppose you are a Kenyan farmer and all you care about is your own payoff. Offering to give the Responder nothing is out of the question because that will ensure that you get nothing when they reject your offer. Offering half will get you half for sure—because the Responder will surely accept. But you suspect that you can do better. Something more than nothing but less than half would be your best bet. Given how likely the farmers were to reject low offers, you would maximize your payoffs on average if you offered 40%—this indeed was the most common offer among Kenyan Proposers.

Similar calculations indicate that, among the students, the expected payoff-maximizing offer was 30%, and this was the most common offer among them. The students’ lower offers could be because they correctly anticipated that lowball offers (even as low as 10%) would sometimes be accepted. They may have been trying to maximize their payoffs and hoping that they could get away with making low offers.

How do the two populations differ? Although many of the farmers and the students offered an amount that would maximize their expected payoffs, the similarity ends there. The Kenyan farmers were more likely to reject low offers. Is this a difference between Kenyans and Americans, or between farmers and students? Or is it something related to local social norms, rather than nationality and occupation? Experiments alone cannot answer these interesting questions, but before you jump to the conclusion that Kenyans are more averse to unfairness than Americans, when the same experiment was run with people from rural Missouri in the US, they were even more likely to reject low offers than the Kenyan farmers. Almost every Proposer in the Missouri experiment offered half the pie.

QUESTION 3.2 CHOOSE THE CORRECT ANSWER(S)
From the information shown in Figure 3.3, we can conclude that:
- Kenyan farmers place higher importance on fairness than US students.
- Kenyans are more likely than Americans to reject low offers.
- Both groups of Responders are neutral about accepting and rejecting an offer of receiving nothing.
- Just over 50% of Kenyan farmers rejected the offer of the Proposer keeping 30%.
3.3 EVALUATING INSTITUTIONS AND OUTCOMES: IS IT EFFICIENT?

How the word ‘efficiency’ is used in economics

The word ‘efficiency’ has a simple but specific use in economics—an outcome is efficient if there is no other outcome that would be preferred by everyone affected. This use of the term efficiency is called Pareto efficiency after Vilfredo Pareto, an Italian economist and sociologist who developed the idea. You will learn more about Pareto and his ideas in the ‘Great economists’ box below.

Saying that something is ‘efficient’ sounds good. But its economic use is narrowly defined. It means only that there is no waste. For example, any division of a pie between two people at all—including one person getting all the pie—is economically efficient, as long as none of the pie is thrown away.

If some people are obese while others are starving, we might say in everyday language, ‘This is not a sensible way to provide nutrition. It is clearly inefficient.’ But in economics, Pareto efficiency means something different. A very unequal distribution of food—even one that means some people will starve—can be Pareto efficient as long as all the food is eaten by a person who enjoys it even a little.

This example emphasizes that the efficiency criterion says nothing about fairness, our other important value.

Now suppose that we want to compare two possible allocations, A and B, that may result from an economic interaction. Can we say which is better? Suppose we find that everyone involved in the interaction would prefer Allocation A, or some preferred A and none preferred B (some were neutral between A and B). Most people would agree that A is a better allocation than B. This criterion for judging between A and B is called the Pareto criterion, again after Vilfredo Pareto.

Note that, when we say an allocation makes someone ‘better off’, we mean only that they prefer it. This implies only that they would choose it rather than some other option, if both options were possible at that moment. If we prefer something in economics, we can still regret the choice later (think of that 800-calorie dessert you could not resist!).

Applying Pareto efficiency to the pest control game

Figure 3.5 uses the Pareto criterion to compare the four allocations in the pest control game that we studied in Unit 2. In this example, we assume that Anil and Bala are self-interested, so they prefer allocations with a higher payoff for themselves. They each have two possible choices—use the chemical pesticide Terminator (T) or a non-chemical integrated pest control strategy (I). Recall that their payoffs describe a prisoners’ dilemma. Both would be better off if both used I than if both used T, but each would be better off by choosing T, regardless of what the other does.

The blue rectangle with its corner at allocation (T, T) where they each get 3 shows that (I, I) Pareto dominates (T, T) where they each get 1.

You can see from this example that the Pareto criterion may be of limited help in comparing allocations. Here, it tells us only that (I, I) is better than (T, T).
The diagram also shows that three of the four allocations are not Pareto dominated by any other. Any allocation with this property will be **Pareto efficient**.

We can therefore say that, if an allocation is Pareto efficient, then there is no alternative allocation in which at least one party would be better off and nobody worse off. Pareto efficiency is widely used in economics and sounds like a good thing, but this example shows we need to be careful with it:

- There is often more than one Pareto-efficient allocation. In the pest-control game there are three.
- The Pareto criterion does not tell us which of the Pareto-efficient allocations is better: It does not give us any ranking of (I, I), (I, T) and (T, I).
- If an allocation is Pareto efficient, this does not mean we should approve of it. Anil playing IPC and Bala free riding by playing Terminator is Pareto efficient, but we (and Anil) may think this is unfair. Pareto efficiency has nothing to do with fairness.
- Allocation (T, I) is Pareto efficient and (T, T) is not (it is Pareto inefficient). But the Pareto criterion does not tell us which is better.

### Figure 3.5 Pareto-efficient allocations: All of the allocations, except mutual use of the pesticide (T, T), are Pareto efficient.

1. **Anil and Bala’s prisoners’ dilemma**
   The diagram shows the allocations of the prisoners’ dilemma game played by Anil and Bala.

2. **A Pareto comparison**
   (I, I) lies in the rectangle to the northeast of (T, T), so an outcome where both Anil and Bala use IPC Pareto dominates one where both use Terminator.

3. **Compare (T, T) and (T, I)**
   If Anil uses Terminator and Bala IPC, then he is better off but Bala is worse off than when both use Terminator. The Pareto criterion cannot say which of these allocations is better.

4. **No allocation Pareto dominates (I, I)**
   None of the other allocations lie to the northeast of (I, I), so it is not Pareto dominated.

5. **What can we say about (I, T) and (T, I)?**
   Neither of these allocations are Pareto dominated, but they do not dominate any other allocations either.
Therefore, there will be many Pareto-efficient allocations that we may not like. In the ultimatum game, an allocation of one cent to the Responder and $99.99 to the Proposer is Pareto efficient, because there is no way to make the Responder better off without making the Proposer worse off. Most of us would consider this allocation unfair.

**GREAT ECONOMISTS**

*Vilfredo Pareto*

Vilfredo Pareto (1848–1923), an Italian economist and sociologist, earned a degree in engineering for his research on the concept of equilibrium in physics.

He is mostly remembered for the concept of efficiency that bears his name. Suppose that we want to compare two possible allocations, A and B, that may result from an economic interaction. Can we say which is better? Suppose we find that everyone involved in the interaction would prefer Allocation A. Then most people would agree that A is a better allocation than B. This criterion for judging between A and B is called the Pareto criterion. According to the Pareto criterion, Allocation A dominates Allocation B if at least one party would be better off with A than B and nobody would be worse off. Allocation A is called Pareto efficient if there is no other allocation that is feasible—given the available resources, knowledge, and technologies—and that dominates A.

Pareto wanted economics and sociology to be fact-based sciences, similar to the physical sciences that he had studied when he was younger.

His empirical investigations led him to question the idea that the distribution of wealth resembles the familiar bell curve, with a few rich and a few poor in the tails of the distribution, and a large middle-income class. In its place he proposed what came to be called Pareto’s law, according to which, across the ages and differing types of economy, there were very few rich people and a lot of poor people.

His 80–20 rule—derived from Pareto’s law—asserted that the richest 20% of a population typically held 80% of the wealth. Were he living in the US in 2018 he would have to revise that to 90% of the wealth held by the richest 20%, suggesting that his law might not be as universal as he had thought.
QUESTION 3.3 CHOOSE THE CORRECT ANSWER(S)
Which of the following statements about the outcome of an economic interaction is correct?

- According to the Pareto criterion, a Pareto-efficient outcome is always more fair than an inefficient one.
- All participants are happy with what they get if the allocation is Pareto efficient.
- If the allocation is Pareto efficient, then you cannot make anyone better off without making someone else worse off.
- Each economic interaction only has one Pareto-efficient outcome.

QUESTION 3.4 CHOOSE THE CORRECT ANSWER(S)
Peter, John, and James are discussing how to share three apples and three oranges. Which of the following statements regarding Pareto-efficient allocations is correct?

- If all of them like both apples and oranges, there is only one Pareto-efficient allocation.
- Assuming that Peter likes both apples and oranges, it would be Pareto efficient if he had all the apples and oranges.
- It is always Pareto efficient for Peter, John, and James to have one apple and one orange each.
- Assuming that all of them like both apples and oranges, any allocation of three apples and three oranges between them is Pareto efficient.

3.4 EVALUATING INSTITUTIONS AND OUTCOMES: IS IT FAIR?
There are many reasons why a person might consider an outcome to be unfair. Some people, for example, think that any amount of inequality can be fair, as long as the rules of the game are fair. Others would argue that a highly unequal allocation would always be unfair, even if the rules of the game were fair, because it might mean that some people were deprived of their basic needs, while others lived in luxury.

Fair shares
To help think about why some solutions to the tragedy of the commons sustain the pasture, but would nevertheless be rejected because they were unfair, consider the following situation. You and a friend are walking down an empty street and you see a $100 note on the ground. How would you split your lucky find? If you split the amount equally, perhaps this reflects a social norm in your community that says that something you get by luck should be split 50–50.

In economics, we think of people as making decisions according to the likes, dislikes, attitudes, feelings, social norms, and beliefs that lead a person to evaluate one outcome as preferable, inferior, or equivalent in value to another.
We would expect that, even if there were a 50–50 norm in a community, some individuals might not respect the norm exactly. Some people may act more selfishly and others more generously. What happens next will depend both on the social norm—a fact about the world that reflects attitudes to fairness that have evolved over long periods—and also on the specific preferences of the individuals concerned.

Suppose the person who saw the money first has picked it up. There are at least three reasons why that person might give some of it to a friend:

• **Altruism:** We have already considered this reason, in the case of Anil and Bala (Section 2.5). This person might be altruistic and care about the other’s happiness or another aspect of wellbeing.

• **Fairness:** Or, the person holding the money might think that 50–50 is fair. In this case, the person is motivated by fairness, or what economists term inequality aversion.

• **Reciprocity:** The friend may have been kind to the lucky money-finder in the past, or kind to others, and deserves to be treated generously because of this. In this case, we say that our money-finder has reciprocal preferences.

These reasons for sharing the $100 are termed social preferences. They differ from self-interest. Self-interest means taking no account of how one’s actions affect others, or how they conform to social norms or other ethical rules of behaviour.

These social preferences all influence our behaviour, sometimes working in opposite directions. For example, imagine the money-finder has strong fairness preferences but knows that the friend is entirely selfish. The fairness preferences would tempt the finder to share, but the reciprocity preferences push the finder to keep the money.

**EXERCISE 3.3 SOCIAL PREFERENCES IN THE ULTIMATUM GAME**
Consider the experiment described in Figure 3.3 (page 115).

1. Which of the social preferences discussed above do you think motivated the subjects’ willingness to reject low offers, even though they would receive nothing at all by doing so?
2. Why do you think that the results differed between the Kenyan farmers and the US students?
3. What responses would you expect if you played this game with two different sets of players—your classmates and your family? Explain whether or not you expect the results to differ across these groups. If possible, play the game with your classmates and your family, and comment on whether the results are consistent with your predictions.

**Too much inequality?**
One of the reasons inequality is seen as a problem is that many people think there is too much of it.

Michael Norton, a professor of business administration, and Daniel Ariely, a psychologist and behavioural economist, asked a large sample of Americans how they thought the wealth of the US should be distributed (http://tinyco.re/3629531). What fraction of US wealth, for example,
should go to the wealthiest 20%? They also asked them to estimate what they thought the distribution of wealth actually was.

Figure 3.6 gives the results, with the top three bars showing the distribution that different groups of Responders considered would be ideal, and the fourth bar showing the wealth distribution that they thought actually existed in the US. The top bar shows that Americans thought that, ideally, the richest 20% should own a little more than 30% of total wealth—some inequality was desirable, but not a lot.

Contrast this with the fourth bar (labelled ‘Estimated’), which shows that they thought that the richest 20% owned about 60% of the wealth. The bottom bar shows the actual distribution. In reality, the richest fifth owns 85% of the wealth. The actual distribution is much more unequal than the public’s estimate—and contrasts sharply with the lower inequality they would like to see.

Different groups largely agree on the ideal distribution of wealth. Americans with an annual income greater than $100,000 thought that the share going to the top 20% should be slightly larger than those who earned less than $50,000 thought it should be. Democratic Party voters wished for a more equal distribution than Republican Party voters, and women preferred more equality then did men, although we have not shown this information in Figure 3.6 because the differences between these groups were small. Americans, whether rich or poor, Republican or Democrat, think that the distribution of wealth should be a lot more equal than it is.

**Fair inequality or a tilted playing field?**

Not all economic inequalities are unfair. Think of the difference in income between two identical twin brothers. The first is a poet who works part-time as a primary school teacher for a low wage, while preserving enough free time for his passion (poetry). The second is an engineer who puts in 60-hour weeks at a job that he does not enjoy so he can take home a high salary that supports his love of surfing holidays in exotic locations.

Both had opportunities for a good education. The poet dropped out after two years in university, while the surfer earned a postgraduate degree. The engineer-surfer earns three times what the poet lives on, but few people would think that the difference in income is unfair. This example
shows there are more sources of inequality than the economic advantages resulting from the accidents of birth that people tend to think of as unfair.

The comparison of the brothers highlights the role of the choices made by two individuals who started at the same point on a level playing field. By making different choices, they end up with different incomes. Luck could also play a role. People will differ in their judgement about whether inequality arising from chance is fair or not.

Suppose we accept the idea that the kind of inequality that occurs between identical twins is not unfair. After all, they have the same parents and thus they win a similar prize in the lottery of accidents of birth. In our example, they grow up in the same neighbourhood, experience the same upbringing, share an identical genetic inheritance from their parents, and go to the same school.

The same reasoning applies to economic differences among identical twin sisters—but not between brother and sister twins because brother–sister differences in income could be the result of gender discrimination.

Christina Fong, an economist, wanted to know if people in the US think this way when it comes to their political support or opposition to policies to raise the incomes of the poor, financed by general taxation. An unusual survey from 1998 provided the data she needed; respondents were asked the usual questions about their economic situation, but also their opinion on why some people get ahead in life and succeed while others do not, and whether the government should introduce ‘heavy taxes’ to redistribute income to the poor.

She found that a person who thinks that hard work and risk-taking are essential to economic success is much less likely to support redistribution to the poor than a person who thinks that the key to success is inheritance, being white, your connections, or who your parents are.

The results of her study are in Figure 3.7. Notice that white people who think that being white is important to getting ahead strongly support redistribution to the poor—evidently because they think that the process that determines economic success is unfair.

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tax A compulsory payment to the government levied, for example, on workers’ incomes (income taxes) and firms’ profits (profit taxes) or included in the price paid for goods and services (value added or sales taxes).

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Figure 5.3 in Samuel Bowles. 2012. The New Economics of Inequality and Redistribution. Cambridge: Cambridge University Press; Christina Fong, Samuel Bowles, and Herbert Gintis. 2005. ‘Strong Reciprocity and the Welfare State’. In Handbook of Giving, Reciprocity and Altruism. Serge-Christophe Kolm and Jean Mercier Ythier (eds). Amsterdam: Elsevier.
EXERCISE 3.4 USING EXCEL: YOUR IDEAL INCOME DISTRIBUTION

Download and save the spreadsheet (https://tinyco.re/3355915) containing the data for Figure 3.6.

1. Using the columns provided, fill in the row labelled ‘Your own’ according to your ideal income distribution for your own country. (For example, if you think the top 20% in your country should have 40% of the income, type 40.0 into cell B7).

2. Plot your ideal income distribution alongside the other income distributions as a stacked bar chart in Excel. Follow the walk-through below on how to do stacked bar charts in Excel. Is your ideal income distribution similar to or different from the Americans’ ideal distribution (top three bars in Figure 3.6)?

**Figure 3.8** Making a stacked bar chart.

**1. The data**

We will be using this data to create a stacked bar chart. Each row contains a particular income distribution, and each column contains a particular group of society. The last row (cells shaded blue) contains an example of how you could fill in your ideal income distribution.
2. Draw a stacked bar chart
The stacked bar chart will look like the one shown above. If you selected the labels in Row 1, your legend would be labelled correctly. Otherwise, you have to change the labels manually.

3. Change the legend and horizontal axis labels
The bars corresponding to the quintiles are currently named 'Series 1', 'Series 2' and so on. We need to edit their names to correspond to those in Figure 3.6.
4. Change the legend and horizontal axis labels
After step 6, ‘Series 1’ will now be renamed as ‘Top 20%’.

5. Change the legend and horizontal axis labels
After completing step 7, the bars in the chart legend will be labelled correctly.

6. Change the legend and horizontal axis labels
After completing step 9, the vertical axis will be labelled correctly.
7. Move the legend to the top of the chart
After step 10, the legend will now be at the top of your chart, as in Figure 3.6.

8. Add axis titles and a chart title
After step 14, your chart will look similar to Figure 3.6, but with the bars in a different order.

QUESTION 3.5 CHOOSE THE CORRECT ANSWER(S)
Figures 3.6 (page 123) and 3.7 (page 124) indicate that:

☐ In the US, people think there is less income inequality than there actually is.
☐ Aside from the ideal income of the top 20%, all Americans’ ideal income distributions are quite similar.
☐ Aside from the allocation of income, people also care about the process by which that income is earned.
☐ Americans who believe that economic success depends on risk-taking are less likely to support redistribution, compared to those who believe that economic success depends on hard work.
3.5 WHAT’S WRONG WITH INEQUALITY? PROCEDURAL AND SUBSTANTIVE JUDGEMENTS OF FAIRNESS

When people express the view that there is too much inequality, they usually refer to differences among people in one or more of the following dimensions:

- **Income**: The reward in money (or some equivalent measure) of the individual’s command over valued goods and services.
- **Hourly pay**: The income reward for a given amount of work.
- **Health status**: For example, longevity
- **Happiness**: Economists, psychologists, and others have developed indicators by which subjective wellbeing can be measured.
- **Freedom**: The extent that one can do (or be) what one chooses without narrow socially imposed limits.
- **Respect, dignity or social status**.

The two studies of Americans’ attitudes towards fairness that we looked at in the previous section make a basic point about how people judge differences in these dimensions. Allocations can be judged unfair because of:

- **How unequal they are**: In terms of income, for example, or subjective wellbeing or the distribution of wealth, in Figure 3.6. These are **substantive judgements of fairness**.
- **How the inequalities came about**: For example, by force or racial discrimination, by competition on a level playing field, or by hard work, as in Figure 3.7. These are **procedural judgements of fairness**.

**Substantive judgements**

These are evaluations of the allocation itself—how the pie is shared. We know from the behaviour of experimental subjects that many people would judge as unfair an allocation in which the Proposer took 90% of the pie. To make a substantive judgement about fairness, all you need to know is the allocation itself. However, for procedural evaluations we also need to know the rules of the game and other factors that explain why this allocation occurred.

Two people making substantive evaluations of fairness about the same situation need not agree, of course. For example, they may disagree about whether fairness should be evaluated in terms of income or happiness. If we measure fairness using happiness as the criterion, a person with a serious physical or mental handicap may need much more income than a person without such disabilities to be equally satisfied with his or her life.

**Procedural judgements**

These are theories are ideas of fairness based on how the inequality came to be that focus not on how poor or rich someone is, but instead on why the person is poor or rich.

The rules of the game that brought about the inequality may be evaluated according to aspects such as:

- **Voluntary exchange of private property acquired by legitimate means**: Were the actions resulting in the allocation the result of free choices by the individuals involved? For example, did each person buy or sell things

that they had come to own through inheritance, purchase, or their own
labour? Or was fraud or force involved?
• *Equal opportunity for economic advantage:* Did people have an equal
opportunity to acquire a large share of the total, or were they subjected
to some kind of discrimination because of their race, sexual preference,
gender, or who their parents were?
• *Deservingness:* Did the rules of the game that determined the inequality
take account of the extent to which individuals need, or for some other
reason deserve, the amounts they get?

**Using judgements to evaluate an outcome**

We can use these differing judgements to evaluate an outcome in the
ultimatum game. The experimental rules of the game will appear to most
people’s minds as procedurally fair:

• Proposers—who can expect to receive not less than half of the pie, and
will probably receive more—are chosen randomly.
• The game is played anonymously, so who a person is (her name, or title,
or some other aspect of her identity) cannot matter.
• All actions are voluntary. The Responder can refuse to accept the offer,
and the Proposer is typically free to propose any amount.

These rules of the game are (procedurally) fair. But, as we have seen, the
actions of Proposers are often seen as (substantively) unfair.

Now imagine that the person selected to be Proposer was based on
ethnic origin and gender—therefore only males of European origin can be
the Proposer. The game would be procedurally unfair by awarding the
position that has the greatest income-earning prospects using a rule that
discriminates against women and non-Europeans.

This suggests that, for many people, the question, ‘How much inequality
is too much?’ cannot be answered unless we know why a family or person is
rich or poor. Many people think it is unfair if income depends substantially
on accidents of birth, such as your race, your sex, or your country.
Inequalities based on hard work or taking risks are less likely to be seen as
unfair.

Many people also object to economic inequalities—especially extreme
disparities—whatever the source, on the grounds that:

• *People should have second chances:* Mistakes made early in life—not
working hard in school, for example—should not consign an individual
to a lifetime of low income.
• *Economic inequalities may undermine democracy.*
• *Dignity and respect matter in society:* Large economic differences among
people make it make it more difficult to achieve this.

**Evaluating fairness using the veil of ignorance**

The American philosopher John Rawls (1921–2002) devised a way to clarify
our own ideas of fairness that can sometimes help us to find common
ground on questions of values. We follow three steps:

1. *Fairness applies equally to all people taking part in the interaction:* Whatever
the rule for dividing up the $100 is, it cannot involve the identity of one
or the other of the players. (This principle, for example, would reject as
unfair the rules of the game of a monarchy, in which a named person, say George III, is head of state; democratic constitutions specify how the head of state is to be selected, not who this will be).

2. Imagine a veil of ignorance: Since fairness applies to everyone, including ourselves, Rawls asks us to imagine ourselves behind what he called a veil of ignorance, not knowing the position that we would occupy in the society we are considering. We could be male or female, healthy or ill, rich or poor (or with rich or poor parents), in a dominant or an ethnic minority group, and so on. In the $100 on the street game, we would not know if we would be the person picking up the money, or the person responding to the offer.

3. From behind the veil of ignorance, we can make a judgement: For example, the choice of a set of institutions—rules of the game that will determine who gets what—imagine that we will then become part of the society we have endorsed, with an equal chance of having any of the positions occupied by individuals in that society.

The veil of ignorance invites you, in making a judgement about fairness, to put yourself in the shoes of others quite different from yourself. You would then, Rawls argued, be able to evaluate the constitutions, laws, inheritance practices, and other institutions of a society as an impartial outsider.

A video of economist Helen Miller speaking to students at Manchester University in the UK in 2017 outlines some of the issues of tax fairness, starting with the question, 'What would be a fair tax rate for George Harrison?'. (George Harrison was lead guitarist for The Beatles during the 1960s and 1970s. The Beatles were the world’s most famous pop group at the time, and so he was a high earner when the highest income tax rates in the UK were set at 95%.)

Neither philosophy, economics, nor any other science, can eliminate disagreements about questions of value. But economics can clarify:

• How the dimensions of unfairness may be connected: For example, how the rules of the game that give special advantages to one or another group may affect the degree of inequality of income.
• Trade-offs between the objectives of fairness and efficiency: For example, are some kinds of unfairness essential for achieving efficient outcomes? Does unfairness (as in the ultimatum game) sometimes lead to inefficient outcomes (remember that the money is thrown away if the offer is rejected).
• Public policies to address concerns about unfairness: How can unfairness be reduced by the actions of governments and other bodies?
• The effects of the introduction of new policies: Economics can measure this once businesses, individuals, and other private economic actors have responded to the opportunities and constraints imposed by the new environment, and then use this information to make better policies in future.

The last bullet point poses our next challenge—how do we know how the intended outcomes of a government policy will result once we take account of not only government actions, but also the reactions of private actors?
EXERCISE 3.5 SUBSTANTIVE AND PROCEDURAL FAIRNESS, AND THE VEIL OF IGNORANCE

Consider the society you live in, or another society with which you are familiar.

1. To make society fairer (according to the substantive judgement of fairness), would you want greater equality of income, happiness, or freedom? Why? Would there be a trade-off between these aspects?
2. Are there other things that should be more equal to achieve greater substantive fairness in this society?
3. How fair is this society, according to the procedural judgement of fairness?
4. Suppose that, behind a Rawlsian veil of ignorance, you could choose to live in a society in which one (but only one) of the three procedural standards for fairness (voluntary exchange of property, equality of opportunity, and deservingness) would be the guiding principle for how institutions are organized. Which procedural standard would you choose, and why?

QUESTION 3.6 CHOOSE THE CORRECT ANSWER(S)

Which of the following statements regarding substantive judgements of fairness is correct?

- Fairness may depend on the individual’s freedom to choose without socially imposed limits.
- If all individuals receive an equal income, then this allocation cannot be made fairer.
- Since happiness cannot be objectively measured, it cannot be used to evaluate the fairness of an allocation.
- Two people making substantive judgements of fairness about the same situation must necessarily agree.

QUESTION 3.7 CHOOSE THE CORRECT ANSWER(S)

Which of the following statements regarding procedural judgements of fairness is correct?

- Consider an ultimatum game where only those with university degrees can be the Proposer. As the Proposer is free to propose any amount and the Responder’s choice of response is voluntary, the game is procedurally fair.
- A transfer system where income earners are taxed to provide benefits to the unemployed may or may not be considered to be procedurally fair.
- Procedural fairness implies substantive fairness.
- Substantive fairness implies procedural fairness.

3.6 IMPLEMENTING PUBLIC POLICIES

Giving women the vote reduced child deaths in the US. Requiring randomly selected Indian villages to be headed by women changed spending priorities in ways that benefited women. But policies don’t always work as intended.

There is a limit to the extent that governments can order people around, and this is a problem for government policymakers. Even something simple, like imposing a speed limit on a highway, does not prevent people from driving fast. It just changes the environment in which the driver’s decision about how fast to drive occurs.
For this reason, the outcome of a government policy is not something the government can dictate. Instead, it is the result of an interaction between the government’s actions and the privately chosen actions of those affected.

In many countries, some actions (stealing, for example) can be effectively prohibited, and other actions required (such as sending your children to school). But for the most part, governments alter outcomes in the private economy by changing:

- **Incentives**: A policy changes the benefits or costs of alternative courses of action open to the individual.
- **The information available**: People can use all available information when they make decisions about which actions to take.

To understand how government policies can change economic outcomes by changing what actions people decide to take, we will use game theory and the idea of a Nash equilibrium, introduced in Unit 2.

**Fairness and efficiency in averting the tragedy of the commons**

Let’s return again to the tragedy of the commons and make things concrete (if somewhat unrealistic at this stage). The tragedy of the commons—as you saw in Unit 2 (Section 2.1)—can be represented as a prisoners’ dilemma in which overgrazing is the dominant strategy, even though restricting the amount of grazing would support higher payoffs for both players.

Let’s say there are just two herders, and that they may each put either 10 or 20 cows on the communal pasture. The payoff table for their interaction is shown in Figure 3.9.

You can confirm that this is a prisoners’ dilemma by noticing that whatever B does—restrict the cows she places on the commons to 10 or not—the highest payoff for A is to place 20 cows on the pasture. By pasturing more cows, she gets 12 rather than 10 if B has restricted his cows to 10, or 8 rather than 6 if he has pastured 20 cows.

The same is true of B. Whatever A does, the best for him is to put 20 cows on the pasture. Yet both A and B would be better off—getting 10 rather than 8—by both restricting the number of cows they put to pasture. Overgrazing is the Nash equilibrium.

Figure 3.9 Overgrazing the commons.
An effective government policy might alter this situation by changing the Nash equilibrium. But how can this be done?

**A tax on overgrazing the commons**

We saw at the beginning of this unit that one solution would be to give A access to the pasture and exclude B. This alters the game fundamentally. She would then pasture all 20 of her cows there, B would pasture none, and A would get a payoff of 20 (and B would get zero). While this solved the problem of overgrazing, it seemed unfair to B.

But the government could pursue a more even-handed approach. The problem of overgrazing, remember, arises because each herder, when deciding on how many cows to keep, thinks only of his or her own payoffs. Thus, when A compares pasturing 20 cows as opposed to 10 where B is pasturing only 10, she looks at how her own payoff is affected, rising from 10 to 12 as she adds the extra cows. She does not look at the fact that B has just seen his payoffs drop from 10 to 6. A has ignored the costs that her action imposed on B.

If A were altruistic, she might be concerned about the harm she caused B, and not overgraze. If the two were close friends or relatives, this might be enough to prevent overgrazing. Instead, let’s imagine they are complete strangers and do not care at all for each other. As we saw in Unit 2 in the game with Anil and Bala, if there were really only two people involved, they probably would not be complete strangers, but we are using the two-person case as a simplification to understand what happens when there are dozens or even hundreds of herders, among whom many would be unknown to each other.

The government, however, could address the problem by adopting a policy that imposed a tax of 0.4 for any cow beyond 10 that a herder sent to pasture. We assume that the government uses the tax revenues for some purpose unrelated to the problem of overgrazing. This just means we do not have to think about what the tax is spent on. Under this new tax policy, for example, either herder would pay a tax of 4 if he or she sent 20 rather than 10 cows to pasture. The ‘overgrazing tax’ changes the payoff matrix, as shown in Figure 3.10.

The effect of the tax is to displace the Nash equilibrium from each herder putting 20 cows on the commons to both of them putting only 10. You can check that protecting the commons is now a Nash equilibrium—when one is putting only 10 cows on the commons the best response of the other is to also put only 10 cows on the commons.

The overgrazing tax has three valued features:

- *It treats both herders equally:* It averts the tragedy without introducing inequality among the herders and so, in this sense, it is both efficient and fair.
- *Each herder must take account of the cost that their overgrazing imposes on the other:* Note they do not have to care about the other herder because the cost is a tax on each herder.

We assumed both herders are the same. There is an additional feature of the tax that would occur if some are better at cattle raising than others.

- *The better herders will find it more valuable to put their cows on the pasture:* Those less skilled at raising cattle will not find it worth paying the tax. As a result, the better herders will have greater access to the pasture.
1. The original situation
In Figure 3.9, overgrazing occurred because each herder ignored the cost of their actions on the other herder. The Nash equilibrium is (Do not restrict, Do not restrict).

2. An overgrazing tax
Imposing the overgrazing tax reduces the payoffs for ‘Do not restrict’ by 4, making (Restrict, Restrict) the Nash equilibrium. The commons is protected.

This solution is efficient—those who can make the best use of the land are using it. Any decision about whether this is fair or not would depend on additional facts that we have not discussed, for example, whether the not-so-good herders are better at something else, and whether they can make their living without herding.

But often it is more difficult to fashion a policy that will achieve its objectives, as the examples in the next two sections show.

**Question 3.8 Choose the Correct Answer(s)**
Which of the following statements about the tragedy of the commons shown in Figure 3.10 is correct?

- The overgrazing tax changes the preferences of the herders, so that they now care about the costs they impose on each other.
- The overgrazing tax is only efficient and fair in certain situations.
- The amount of the tax is exactly equal to the cost that one herder imposes on the other.
- The overgrazing tax works by changing incentives and information available.

**3.7 Unintended Consequences: Policies Affect Preferences**
The tools we are developing are useful in many settings, not just so that governments can design policies. Consider the policy of an organization—a daycare centre—rather than a government.

Sometimes it is possible to conduct experiments ‘in the field’; that is, to deliberately change the economic conditions under which people make decisions.
There are two quite distinct uses of the term. One is the observed negative effect when economic incentives displace people’s ethical or other-regarding motivations. In studies of individual behaviour, incentives may have a crowding out effect on social preferences. A second use of the term is to refer to the effect of an increase in government spending in reducing private spending, as would be expected for example in an economy working at full capacity utilization, or when a fiscal expansion is associated with a rise in the interest rate.

It is common for parents to rush to pick up their children from daycare. Sometimes, a few parents are late, making teachers stay extra time. What would you do to deter parents from being late?

Two economists ran an experiment that introduced fines in some daycare centres but not in others (these were used as controls). The ‘price of lateness’ went from zero to ten Israeli shekels (about $3 at the time). Surprisingly, after the fine was introduced, the frequency of late pickups doubled. The top line in Figure 3.11 illustrates this.

Why did putting a price on lateness backfire?

One possible explanation is that before the fine was introduced, most parents were on time because they felt that it was the right thing to do. In other words, they came on time because of a moral obligation to avoid inconveniencing the daycare staff. Perhaps they felt an altruistic concern for the staff, or regarded a timely pick-up as a reciprocal responsibility in the joint care of the child. But the imposition of the fine signalled that the situation was really more like shopping. Lateness had a price and therefore could be purchased, like vegetables or ice cream.

The use of a market-based incentive—the price of lateness—had provided what psychologists call a new ‘frame’ for the decision, making it one in which self-interest rather than concern for others was acceptable. When fines and prices have these unintended effects, we say that economic incentives have crowded out social preferences. Even worse, you can also see from Figure 3.11 that, when the fine was removed, parents continued to pick up their children late.

Figure 3.11 Average number of late-com ing parents, per week.
**QUESTION 3.9 CHOOSE THE CORRECT ANSWER(S)**
Which of the following statements about the field experiment shown in Figure 3.11 are correct?

- [ ] The fine can be considered as the ‘price’ for collecting a child.
- [ ] The introduction of the fine successfully reduced the number of late-coming parents.
- [ ] The crowding out of the social preference did not occur until the fines ended.
- [ ] The graph suggests that the experiment may have permanently increased the parents’ tendency to be late.

**EXERCISE 3.6 USING EXCEL: THE EFFECT OF DAYCARE CENTRE FINES**

As in science experiments, we can think of the daycare centre experiment in terms of a ‘treatment’ and a ‘control’ group. Daycare centres who received fines were in the ‘treatment’ group, and those who did not were in the ‘control’ group.

Download and save the spreadsheet ([https://tinyco.re/3355915](https://tinyco.re/3355915)) containing the data used to create Figure 3.11. You can see that Centres 1–6 are the ‘treatment’ group, while Centres 7–10 are the ‘control’ group.

Follow the walk-through below to help you do this exercise.

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**Figure 3.12** Making a line chart with labels.

**1. The data**
This is what the data looks like. Column A contains time periods, Columns B to G contain the number of late arrivals in centres where fines were introduced, and Columns J to M contain the number of late arrivals in centres where fines were not introduced.
2. Calculate averages for each group and time period
We will use Excel’s AVERAGE function to calculate the average number of late arrivals for both groups, and put them in the shaded blue cells.

3. Draw a line chart
After completing step 6, your line chart should look like the one shown above.
4. **Add dotted lines to show when fines were introduced and removed.**

Using Excel’s ‘Insert Shapes’ option, you can add lines to your chart. To make a line dotted, you need to change its ‘Dash type’ using the options in the right-hand menu.

5. **Add text boxes to label the dotted lines.**

Using Excel’s ‘Insert Shapes’ option, you can add also text boxes and other shapes to your chart.
6. Add axis titles and a chart title
After step 15, your chart will look like Figure 3.11 (page 136).

1. Fill in the columns ‘Average (treatment)’ and ‘Average (control)’ by taking the average separately for each group, for each period.
2. Plot a line chart of the ‘Average (treatment)’ and ‘Average (control)’. Your chart should look similar to Figure 3.11. Label the lines as in Figure 3.11.
3. Calculate the difference in average lateness in Period 5 and in Period 17 (‘Average (treatment)’ minus ‘Average (control)’). Relate these numbers to what you see in your chart or in Figure 3.11.
4. One explanation for the observed difference in Period 17 is that the treatment and control groups were initially different. Based on your answer to Question 3 and your Excel chart, do you think this explanation is plausible? What other aspects of the treatment and control groups do you think should be similar before the fines were introduced in order for us to infer that the fines ‘caused’ the increased lateness?
5. Why do you think that, after the fine was removed, parents in the treatment group still continued to pick up their children late?

3.8 UNINTENDED CONSEQUENCES OF A REDISTRIBUTIVE TAX
Suppose that a newly elected government wants to raise taxes on the profits of firms in order to fund high-quality public education and other new programs that will benefit middle- and lower-income voters. At the current moderate tax rate, firms are making high after-tax profits. The new finance minister introduces a higher tax rate, calculating that it will raise revenue by 50%. Then he sets about planning how to spend the additional tax revenues, announcing popular improvements in primary schooling.

The finance minister is not surprised when firm owners protest against the new tax rate. But he is dismayed when the head of the tax collection agency reports that tax revenues are falling. She estimates that the revenue from the profits tax will be 10% lower than it was the previous year. What has gone wrong?

The head of tax collection explains that when the tax rate went up, firms began hiring tax lawyers to exploit loopholes in the tax laws. The finance
The minister has failed to consider that a change in the tax regime may cause firms to change their strategies too.

The firms’ response to government policy—hire lawyers to exploit tax loopholes—is commonly adopted in real life. Recall that George Harrison objected to the taxman saying, in his words, ‘One for you, 19 for me,’ in the 1960s. The Beatles hired an accountant who explained that if they formed a company, they would not have to pay the 95% income tax, because company income was taxed at a lower rate than personal income. This is what they did.

**Why firms hire tax lawyers**

To understand the misjudgement made by our finance minister, we can model the interaction between government policy and the strategies of firms as a game, which we will call the tax avoidance game, played by two hypothetical people—the ‘Government’ who will levy taxes and direct their uses, and the ‘Firm owner’ who will pay taxes on the profits accruing to the firm.

The Government would like taxes (and therefore its ability to improve schools) to be greater, and the Firm would like profits after the payment of taxes (‘after tax profits’) to be greater. Those who will benefit from the expenditure of the tax revenue—on improved pre-primary centres, for example—are not players in the game as their role is entirely passive. Their actions do not affect the payoffs of the two players.

We will assume that each of the players has just two choices. In the games we studied before, the two players had the same two strategies to choose from—plant cassava or plant rice; use integrated pest management or use the Terminator pesticide; use C++ or use Java. Here, we recognize that the actors differ—the actions open to the Government are not the same as the actions open to a private citizen or the owner of the Firm:

- **The Government**: May levy either moderate taxes or high taxes on the Firm owner’s profits.
- **The Firm**: Can either pay taxes at the statutory (government-intended) rate, or hire tax lawyers to exploit loopholes in the tax laws—finding accounting methods that will allow the Firm to ‘earn’ its profits in some other lower tax country, for example—so as to minimize its tax obligations.

The strategies available and the payoffs associated with each strategy are given in Figure 3.13. Consider first what happens when the owner pays tax at the statutory rate:

- **When the tax rate is moderate**: $100 million in tax is collected and the Firm’s profits are $500 million (the upper left cell, A).
- **At the higher tax rate**: $150 million in tax is collected (lower left cell, B) and profits fall to $450 million. This is what the finance minister had expected to happen.

Now suppose that hiring legal advisors to find tax loopholes costs $20 million; the lawyers will be able to save the firm $15 million when the tax rate is moderate, and $60 million at the high tax rate. We can calculate the payoffs in cases C and D, as shown in Figure 3.13.

Figure 3.14 shows a useful way of representing the payoffs in this game. The Government’s payoff (tax revenue) is shown on the horizontal axis, and the Firm’s payoff (profits after taxes and lawyers’ fees) on the
vertical axis. Each of the four cases A, B, C and D in Figure 3.13 is marked as a point in this diagram.

Figure 3.14 tells the story of the newly elected government’s redistributive tax policy. Initially, having ‘inherited’ the tax policies of the previous government, it finds itself at point A. Work through the steps in Figure 3.14 to see what happens next.

Can the game help us understand the challenge facing the Government? Notice first that, at the initial moderate tax rate, the Firm is not tempted to hire lawyers. It is better off at point A, paying tax at the statutory rate, than it would be at point C. But the strategies at point A are not a Nash equilibrium; given that the Firm is not hiring lawyers, the Government does better by raising taxes, taking it to point B.

But—and this is the key point—the strategies leading to outcome B, which the Government wishes to implement, are not a Nash equilibrium either! Given the higher tax rate, the Firm does better hiring tax lawyers. And so the outcome spirals downwards from point A to B to D—where they finally reach a Nash equilibrium. At this point, both players are doing the best they can, given the strategy chosen by the other player.

**Figure 3.13** Payoffs in the tax avoidance game.

1. **Cases A and B: No lawyers involved.**
   If the Firm pays tax at the statutory rate, raising the tax rate from moderate to high increases the Government’s revenue from $100 million to $150 million. The Firm’s profits fall from $500 million to $450 million.

2. **Case C: Avoiding taxes when the rate is moderate.**
   When the tax rate is moderate, lawyers could reduce the tax paid by $15 million, to $85 million. But the Firm has to pay $20 million to the lawyers, so overall its profits would fall by $5 million, to $495 million.

3. **Case D: Avoiding taxes when the rate is high.**
   At the higher tax rate, lawyers could reduce the Firm’s tax bill by $60 million—it falls from $150 million to $90 million. Taking into account the $20 million paid to the lawyers, the Firm’s net gain from hiring lawyers would be $40 million. Its profits would therefore be $490 million rather than $450 million.
Point D is dominated by point A. Sadly, both players are worse off at the Nash equilibrium D than they would have been if they had remained at A, with moderate taxes and no lawyers. Because of their decisions, after-tax profits are lower and tax revenues are lower too.

Figure 3.14 Payoffs in the tax avoidance game: How higher taxes may lead to less redistribution.

1. **The payoffs in the four possible cases**

The Government’s payoff is shown on the horizontal axis, and the Firm’s payoff on the vertical axis. The four points show the payoffs in each of the possible outcomes of the game.

2. **When the Government comes into office, the tax rate is moderate**

Initially the tax rate is moderate and the Firm pays the tax intended. The payoffs are shown by point A—100 for the Government and 500 for the Firm.

3. **With a moderate tax rate, the Firm does not want to hire lawyers**

Point C shows the payoffs if the Firm hires lawyers when the tax rate is moderate. Profits are lower at C than at A, so the Firm prefers to pay tax at the statutory rate.

4. **Comparing payoffs**

The pink-shaded area shows points where both players are better off than at point C. Point A lies inside this area—both the Government and the Firm are better off at A than C.

5. **The Government raises the tax rate**

The Government sets a high tax rate, hoping to move from A to B. At B, the Government is better off, but the Firm is worse off.

6. **With a high tax rate, the Firm prefers to hire lawyers**

Now that the tax has risen, the Firm re-evaluates the benefits of legal advice. Hiring lawyers would change the payoffs from B to D, where profits are higher. The Firm decides to hire lawyers.

7. **In the end, both players are worse off**

The decisions of the Government and the Firm have changed the payoffs from point A to point D. Both players have lower payoffs than they had at the beginning.
A successful policy must be a Nash equilibrium
We are not arguing that increasing tax rates never works when governments want to raise tax revenue. When government officials raise tax rates, the policy often succeeds. But our analysis illustrates that the outcomes of policies are determined by the decisions of private actors as well as those government officials. The outcome that the government wants must be a Nash equilibrium. Otherwise, like point B in Figure 3.14, it will not last.

This means that once the policy is implemented—say, a new tax—the intended outcome must be the result of everyone doing the best they can, given what everyone else is doing under the new tax. If that is not the case, then people will change what they are doing, and the intended outcome of the policy will not occur.

If the policymaker ignores how people will respond to its actions, this policy is unlikely to have its intended effect.

Sections 3.7 and 3.8 illustrate some essentials of the policymaker’s toolkit that will help to avoid unintended consequences. A good policymaker must make sure that:

• The policy does not change people’s preferences in unintended ways: A change in preferences might mean that behaviour changes too, which may mean the policy fails to hit its target. This is what happened in the daycare centres in Israel.
• The intended outcome is a Nash equilibrium: Under the new policy, people must be motivated to act in ways that are consistent with the objective of the policymaker.

QUESTION 3.10 CHOOSE THE CORRECT ANSWER(S)
Which of the following statements about the tax avoidance game in Figure 3.14 is correct?

☐ The outcome due to the policy is a Nash equilibrium and is Pareto efficient.
☐ In Figure 3.14, there are three Pareto-efficient outcomes.
☐ If lawyers became more expensive to hire, then outcome B might be the final outcome.
☐ If the government closed the tax loopholes, then outcome B might be the final outcome.

3.9 HOW DO WE FIND OUT IF A POLICY WILL WORK?
We have seen that a policy works when it is a Nash equilibrium. In other words, it works by changing people’s behaviour when they are doing the best they can, considering the new policy and what everyone else is doing (including the policymaker). Thus, the policymaker faces another real-world policy design problem. When the policymaker pulls the policy lever, how do we work out the effect on outcomes? So far, we have simplified by assuming that our policymaker knows the possible futures with certainty—how the policy will shift the Nash equilibrium, and so what the outcome will be. This helped our model, because we could fill in the payoffs in the payoff matrix.

Policymakers sometimes talk of policy ‘levers’ or ‘dials’, but implementing a public policy is not like dialling up the thermostat in your home to raise the temperature. It’s rarely the case that the connection
between the policy chosen and the intended effect is as simple as these mechanical terms suggest.

If the policy makes an action illegal, such as banning the use of lead in petrol, we can assume it will (broadly) be obeyed. But, in most cases, we do not know with this level of precision what the impact of a policy would be. If a tax is imposed on sugary drinks to discourage obesity and prevent diabetes, how do we know if people will drink tomato juice instead, or just switch to eating more chocolate to get their sugar? We also do not know how the effect might differ among, say, rich and poor.

This is a challenge because the effect of a policy often depends on the actions taken by millions of people. We could ask each of them, ‘If a soft drink were to cost you an additional euro per can, how would that change the amount you drink in a week?’ But we should not be confident that we would get a reliable answer.

There are ways of narrowing the range of uncertainty about the effects of policies. Rather than asking people, economists typically look at what people do. First, we can examine the effects of similar policies adopted in the past, or by other bodies. This is why policymakers in India assumed that having women in political leadership in Indian villages would affect the decisions that were made.

But it is often difficult to distinguish between the effects of the policy under consideration, and the effects of other things that happened to take place at the same time. For example, see Figure 3.15.

![Figure 3.15 Identifying the causes of reduced consumption of sugary drinks: Prices or information.](image)

Before introducing a sugar tax, a government may consult medical evidence about the problem of diabetes and its links to sugar consumption, and use it to explain to the public why it is considering the tax. Now imagine that sugary drink consumption falls following the tax. This might have happened because the drinks are more expensive. But it might also be because the public has new information about the effect of sugar, and this had the effect, not the higher price.

In this case, the correct policy would have been to provide information, not to impose the tax.

Here are three cases illustrating how researchers have estimated the effects of policies, starting with food taxes designed to reduce obesity.

1. **Taxes on food**
   Taxes on food will raise its price. The ability to measure how the amount sold varies in response to a change in price is essential for policymakers.
The effect of the tax will depend on what is termed the **price elasticity of demand**. This is the percentage change in demand divided by the percentage change in price, made into a positive number (it will be negative, because demand goes down when prices go up).

- **If demand is highly elastic**: A small increase in price will cause a large reduction in sales, and the number is high (even greater than 1 in some cases). Typically, luxury or fun foods have elastic demand, because they are easier to do without.
- **If demand is inelastic**: Food which we consider essential for our diet has low elasticity of demand, meaning that we continue to buy it in similar quantities when the price goes up. When demand is inelastic, the percentage change in demand is very low, and so elasticity is close to zero.

Note that policies applied to taxes on food (and all other goods that we buy, such as alcohol and petrol) have different effects depending on the price elasticity of demand:

- **Taxes on inelastic demand mostly raise government revenues**: A government wishing to raise tax revenue should choose to tax products with inelastic demand, because we will continue to buy them. For centuries, governments around the world—including France, Russia, China, and the British Empire (in India)—have taxed salt. Consumers do not cut back much on their salt consumption. Its demand is highly inelastic, so substantial revenues could be collected.
- **Taxes on elastic demand mostly change consumer behaviour**: A government wishing to change our food choices should choose to tax those foods and drinks with the most elastic demand. This is the reasoning behind a sugar tax.

**Anti-obesity taxes in practice**

Several countries, including Mexico and France, have introduced taxes intended to reduce the consumption of unhealthy food and drink. A 2014 international study found worrying increases in adult and childhood obesity since 1980. In 2013, 37% of men and 38% of women worldwide were overweight or obese. In North America, the figures were 70% and 61% respectively, but the obesity epidemic does not only affect the richest countries—the corresponding rates were 59% of men and 66% of women in the Middle East and North Africa.

Matthew Harding and Michael Lovenheim used detailed data on the food purchases of US consumers to estimate elasticities of demand for different types of food, to investigate the effects of food taxes. They divided food products into 33 categories and used a model of consumer decision making to examine how changes in their prices would change the share of each category in consumers’ expenditure on food, and hence the nutritional composition of the diet, taking into account that the change in the price of any product would change the demand for that product and other products too. Figure 3.16 shows the prices and elasticities for some of the categories.

You can see that the demand for lower-calorie milk products (category 31) is the most elastic. If their price increased by 10%, the quantity purchased would fall by 19.72%. But demand for snacks and candy is quite
inelastic, which suggests that it may be difficult to deter consumers from buying them simply by imposing taxes.

Harding and Lovenheim examined the effects of 20% taxes on sugar, fat, and salt. A 20% sugar tax, for example, would increase the price of a product that contains 50% sugar by 10%. A sugar tax was found to have the most positive effect on nutrition. It would reduce sugar consumption by 16%, fat by 12%, salt by 10%, and calorie intake by 19%.


**EXERCISE 3.7 FOOD TAXES AND HEALTH**

Food taxes intended to shift consumption towards a healthier diet are controversial. Some people think that individuals should make their own choices, and if they prefer unhealthy products, the government should not interfere. In view of the fact that those who become ill will be cared for at some public expense, others argue that the government has a role in keeping people healthy.

In your own words, provide arguments for or against food taxes designed to encourage healthy eating.

### 2. Super Bowl advertising

Marketing managers are interested in the causal effect of advertising on demand for their products—does demand increase, by how much, and why?

As we have already seen earlier in this unit and in Unit 1, we want to make causal statements in economics—to understand why things happen, or to devise ways of changing something so that the economy works better. This means making a causal statement that policy X is likely to cause change Y.

<table>
<thead>
<tr>
<th>Category</th>
<th>Type</th>
<th>Calories per serving</th>
<th>Price per 100 g ($)</th>
<th>Typical spending per week ($)</th>
<th>Price elasticity of demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fruit and vegetables</td>
<td>660</td>
<td>0.38</td>
<td>2.00</td>
<td>1.128</td>
</tr>
<tr>
<td>2</td>
<td>Fruit and vegetables</td>
<td>140</td>
<td>0.36</td>
<td>3.44</td>
<td>0.830</td>
</tr>
<tr>
<td>15</td>
<td>Grain, pasta, bread</td>
<td>1,540</td>
<td>0.38</td>
<td>2.96</td>
<td>0.854</td>
</tr>
<tr>
<td>17</td>
<td>Grain, pasta, bread</td>
<td>960</td>
<td>0.53</td>
<td>2.64</td>
<td>0.292</td>
</tr>
<tr>
<td>28</td>
<td>Snacks, candy</td>
<td>433</td>
<td>1.13</td>
<td>4.88</td>
<td>0.270</td>
</tr>
<tr>
<td>29</td>
<td>Snacks, candy</td>
<td>1,727</td>
<td>0.68</td>
<td>7.60</td>
<td>0.295</td>
</tr>
<tr>
<td>30</td>
<td>Milk</td>
<td>2,052</td>
<td>0.09</td>
<td>2.32</td>
<td>1.1793</td>
</tr>
<tr>
<td>31</td>
<td>Milk</td>
<td>874</td>
<td>0.15</td>
<td>1.44</td>
<td>1.972</td>
</tr>
</tbody>
</table>

**Figure 3.16** Price elasticities of demand for different types of food. (See the ‘Calories per serving’ column to compare high- and low-calorie groups of each food type.)
Advertising expenditure and product sales may be positively correlated, but that alone doesn’t prove a causal link unless we can rule out the effect of other variables. For example, toy companies increase advertising expenditure in the weeks leading up to Christmas, and also sell more products before Christmas. We can’t immediately conclude that advertising caused this increase in sales, because it could be due to seasonal spending patterns, which would affect both product demand and advertising expenditure.

To establish a causal link between advertising and sales, we need to find a case where there are differences in exposure to advertising that are unrelated to sales. One example is the Super Bowl, the (American) football championship that regularly sets records for the most watched television broadcast event in the US. In 2012, a record 54% of US households watched the game.

This large-scale event provides an advertising opportunity that can be large enough to affect demand, even for established brands. Also, Super Bowl advertisements are shown nationwide and are purchased months before marketing managers know which teams will play, so they cannot target their advertisements to specific regions or control the amount of exposure their advertisement will receive in a given city.

Economists have used this Super Bowl natural experiment to estimate the effect of advertising on product demand. The key point allowing these researchers to identify the causal impact of advertising is that differences in the exposure to the advertising on the day of the Super Bowl among cities is the result of something that cannot possibly have affected consumption patterns in the cities. Advertising exposure depends on the teams that play in the Super Bowl, because there are proportionally more viewers in the cities associated with these teams.

The difference in sales of advertised products in the cities of teams who qualify for the Super Bowl, compared to sales in cities whose teams nearly qualified, can therefore be attributed to advertising exposure.

**Measuring advertising in practice**

Seth Stephens-Davidowitz, Hal Varian, and Michael Smith looked at the effect on movie ticket sales of movie advertising during the Super Bowl, and found that, on average, spending $3 million on Super Bowl advertisements increased release-week ticket sales by 21% ($8.4 million) compared to similar movies that weren’t advertised.

In another study, Wesley Hartmann and Daniel Klapper looked at advertisements of established soda brands, and found that Super Bowl advertisements increased sales per household by between 10% and 15% in the eight weeks following the Super Bowl. But when two major soda brands both advertised in the Super Bowl, each experienced less than half of this gain.

This suggests that Super Bowl advertising may be a prisoners’ dilemma. If two brands compete, the best revenue outcome for each brand may be for neither to advertise. But if one advertises and the other does not, the one that doesn’t advertise may experience a decrease in revenue per household. Therefore, the Nash equilibrium is for both brands to advertise, despite the fact that this head-to-head competition will be much less cost effective.
EXERCISE 3.8 ADVERTISING AS A PRISONER’S DILEMMA GAME

Think about the situation of two major soda brands advertising (call them Brand A and Brand B) described above.

1. Draw the payoff matrix to illustrate this situation, and explain why the Nash equilibrium is (Advertise, Advertise). (Hint: As in the climate change game of Section 2.10, you can use descriptors such as ‘good’ or ‘bad’ to represent payoffs, instead of numbers.)
2. How could the firms or the government change the Nash equilibrium to a more cost-effective outcome?

3. Intellectual property rights

Governments use intellectual property rights (IPR)—most often patents and copyright—to establish time-limited private monopolies for inventors or creators over the use of their ideas and inventions. This type of monopoly can mean greater profits for the inventor, as long as the protection lasts, because the government prevents others from copying the idea. In theory, this policy increases the incentive to innovate.

**IPR in practice**

We can use historical data to learn whether IPR has actually boosted innovation. When Petra Moser, an economic historian, studied the number and quality of technical inventions shown at mid-nineteenth century technology fairs, she found that countries with patent systems were no more inventive than countries without patents. Patents did, however, affect the kinds of inventive activities in which countries excelled.

But Moser came to a contrasting conclusion in another one of her studies. In our ‘Economist in action’ video, she explains that copyright protection for nineteenth-century Italian operas led to more and better operas being written, as long as the protection is not too broad, and not too long term.

In her research into the quantity and quality of operas, we can be pretty sure that Moser had identified copyrights as the cause (not just a correlate), because she was able to use a natural experiment—some provinces in Italy had copyright protection because they had been invaded and ruled by Napoleonic France, and others that had not been under French rule did not have copyrights. As a result, what determined which provinces had intellectual property rights had nothing to do with how creative or music loving their populations were, but instead were accidents of geography and strategic priorities of the French forces.

EXERCISE 3.9 EFFECTIVE POLICYMAKING FOR INTELLECTUAL PROPERTY RIGHTS

Watch the ‘Economist in action’ video, in which Petra Moser discusses copyright protection for nineteenth-century Italian operas.

1. Outline Petra Moser’s research question, and her approach to answering it.
2. What were Petra Moser’s findings about patents and copyrights?
3. What factors should governments consider when deciding on the effective time period of IPR protection laws, such as patents and copyrights?
Models come in many forms. You have seen three of them already in Figures 1.15, 2.1, and 2.14.

**Policy evaluation**

These three case studies highlight challenges economists face when seeking to evaluate the likely effect of a policy. This always involves the difficult problem of identifying causes rather than simply finding correlations.

- **Sugar tax**: Because detailed data on patterns of consumption is available, it is possible to design a well-targeted tax that would lead to a fall in obesity.
- **Advertising strategy**: The natural experiment provided by the Super Bowl enabled researchers to find out how effective advertising was in causing an increase in market share.
- **Intellectual property rights**: Modern governments can use natural experiments in history to find out whether patents and copyright encourage innovation, and how best to design these policies.

### 3.10 Economic Models: How to See More by Looking at Less

What happens in the economy depends on what millions of people do, and how their decisions affect the behaviour of others. It would be impossible to understand the economy by describing every detail of how they act and interact. We need to be able to stand back and look at the big picture. To do this, we use models.

To create an effective model, we need to distinguish between the essential features of the economy that are relevant to the question we want to answer, which should be included in the model, and unimportant details that can be ignored.

#### Types of model

Models come in many forms—you have seen three of them already in Figures 1.15 (page 41), 2.1 (page 66), and 2.14 (page 102). For example, Figure 2.14 illustrated that economic interactions involve flows of goods (for example, when you buy a washing machine), services (when you purchase haircuts or bus rides), and also people (when you spend a day working for an employer). You have encountered still more models in the public goods game, the climate change game, and other games, as well as in our use of the Nash equilibrium concept to study the effects of public policy.

Figure 2.14 is a diagrammatic model illustrating the flows that occur within the economy, and between the economy and the biosphere. The model is not ‘realistic’—the economy and the biosphere don’t look anything like it—but it nevertheless illustrates the relationships among them. The fact that the model omits many details—and in this sense is unrealistic—is a feature of the model, not a bug.

Some economists have even used physical models to illustrate and explore how the economy works. For his 1891 PhD thesis at Yale University, Irving Fisher designed a hydraulic apparatus (Figure 3.17) to represent flows in the economy. It consisted of interlinked levers and floating cisterns of water to show how the prices of goods depend on the amount of each good supplied, the incomes of consumers, and how much they value each good. The whole apparatus stops moving when the water levels in the cisterns are the same as the level in the surrounding tank. When it comes to rest, the position of a partition in each cistern corresponds to the price of
each good. For the next 25 years he would use the contraption to teach students how markets work.

**How models are used in economics**

Fisher's study of the economy illustrates how all models are used:

1. **What matters?** He built a model to capture the elements of the economy that he thought mattered for the determination of prices.
2. **How do these elements interact?** Fisher used the model to show how interactions between these elements could result in a set of prices that did not change.
3. **What can we learn?** He conducted experiments with the model to discover the effects of changes in economic conditions. For example, if the supply of one of the goods increased, what would happen to its price? What would happen to the prices of all the other goods?

Irving Fisher's doctoral dissertation represented the economy as a big tank of water, but he wasn't an eccentric inventor. On the contrary, his machine was described by Paul Samuelson, himself one of the greatest economists of the twentieth century, as the 'greatest doctoral dissertation in economics ever written'. Fisher went on to become one of the most highly regarded economists of the twentieth century, and his contributions formed the basis of modern theories of borrowing and lending that we will use in later units.

Figure 3.17 Irving Fisher’s sketch of his hydraulic model of economic equilibrium (1891).
Fisher’s machine illustrates an important concept in economics—the equilibrium. An equilibrium is a situation that is self-perpetuating, meaning that something of interest does not change unless an outside or external force for change is introduced that alters the model's description of the situation. Fisher’s hydraulic apparatus represented equilibrium in his model economy by equalizing water levels, which represented constant prices.

Note that equilibrium means that one or more things in the model are constant. It does not need to mean that nothing changes. For example, we might see an equilibrium in which GDP or prices are increasing at a constant rate.

Although it is unlikely that you will build a hydraulic model for yourself, you will work with many existing models on paper or on a screen, and sometimes create your own models of the economy.

When we build a model, the process follows these steps:

1. We construct a simplified description of the conditions under which people take actions.
2. Then we describe in simple terms what determines the actions that people take.
3. We determine how each of their actions affects each other.
4. We determine the outcome of these actions. This is often an equilibrium (something is constant).
5. Finally, we try to get more insight by studying what happens to certain variables when conditions change.

A good model has five attributes:

- **It is clear:** It helps us better understand something important.
- **It identifies important relationships:** We need to have accurate information about these to evaluate alternative courses of action.
- **It predicts accurately:** Its predictions are consistent with evidence.
- **It improves communication:** It helps us to understand what we agree (and disagree) about.
- **It is useful:** We can use it to find ways to improve how the economy works.

Economic models are only occasionally tanks of water. They often use mathematical equations and graphs, as well as words and pictures. Mathematics is part of the language of economics, and can help us to communicate our statements about models precisely to others. Much of the knowledge of economics, however, cannot be expressed by using mathematics alone. It requires clear descriptions, using standard definitions of terms.

A model starts with some assumptions or hypotheses about how people behave, and often gives us predictions about what we will observe in the economy. Gathering data on the economy, and comparing it with what a model predicts, helps us to decide whether the assumptions we made when we built the model—what to include and what to leave out—were justified.

Governments, central banks, corporations, trade unions, and anyone else who makes policies or forecasts use some type of simplified model.

Bad models can result in disastrous policies. In this unit have seen examples of unintended consequences of policies arising from poor
models. To have confidence in a model, we need to see whether it is consistent with evidence.

We will see that the economic models used in later units pass this test—even though they leave many questions unanswered.

**EXERCISE 3.10 DESIGNING A MODEL**

For a country (or city) of your choice, look up a map of the railway or public transport network. When designing this model, how do you think the modeller selected which features of reality to include?

**causality** A direction from cause to effect, establishing that a change in one variable produces a change in another. While a correlation is simply an assessment that two things have moved together, causation implies a mechanism accounting for the association, and is therefore a more restrictive concept. See also: natural experiment, correlation.

**public policy** A policy decided by the government.

**allocation** A description of who does what, the consequences of their actions, and who gets what as a result.

**fairness** A way to evaluate an allocation based on one’s conception of justice.

**Pareto efficient** An allocation with the property that there is no alternative technically feasible allocation in which at least one person would be better off, and nobody worse off.

**Pareto dominant** Allocation A Pareto dominates allocation B if at least one party would be better off with A than B, and nobody would be worse off. See also: Pareto efficient.

**substantive judgements of fairness** Judgements based on the characteristics of the allocation itself, not how it was determined. See also: procedural judgements of fairness.

**procedural judgements of fairness** An evaluation of an outcome based on how the allocation came about, and not on the characteristics of the outcome itself, (for example, how unequal it is). See also: substantive judgements of fairness.

**tax** A compulsory payment to the government levied, for example, on workers’ incomes (income taxes) and firms’ profits (profit taxes) or included in the price paid for goods and services (value added or sales taxes).

**patent** A right of exclusive ownership of an idea or invention, which lasts for a specified length of time. During this time it effectively allows the owner to be a monopolist or exclusive user.

**sequential game** A game in which all players do not choose their strategies at the same time, and players that choose later can see the strategies already chosen by the other players, for example the ultimatum game. See also: simultaneous game.

**ultimatum game** An interaction in which the first player proposes a division of a ‘pie’ with the second player, who may either accept, in which case they each get the division proposed by the first person, or reject the offer in which case both players receive nothing.

**price elasticity of demand** The percentage change in demand that would occur in response to a 1% increase in price. We express this as a positive number. Demand is elastic if this is greater than 1, and inelastic if less than 1.

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**3.11 CONCLUSION**

This unit has looked at how we can determine the causal effect of public policies. This is a difficult task, as it depends on the behaviour of millions of people and because there may be other factors that affect the outcome at the time the policy is introduced.

In our evaluation of economic outcomes, also called allocations, we have focused on the concepts of efficiency and fairness. An allocation is called Pareto efficient if there is no other feasible allocation that Pareto dominates it. In other words, there exists no other attainable outcome where at least one person would be better off and nobody worse off.

Substantive judgements of fairness consider how unequal an allocation is (based, for example, on income, wealth, or subjective wellbeing), whereas procedural judgements of fairness are concerned with how these inequalities come about (an uneven playing field due to discrimination, for instance).
Examples of institutions and policies we have looked at include women’s suffrage and child health programs, anti-obesity taxes, and intellectual property rights in the form of patents. Yet we have also seen how incentives such as fines or paying people to do things may produce unintended results in behaviour, in which case they are said to crowd out social preferences.

We have expanded our game theory toolkit by introducing a game tree to model sequential games. Specifically, we have encountered two new games:

- The ultimatum game: In which the Proposer must consider how the Responder will react to the take-it-or-leave-it offer.
- The tax avoidance game: In which the government must consider the response of the private firm owners when deciding whether to levy moderate or high taxes.

While payoff diagrams are useful in visualizing whether allocations are Pareto efficient, the Rawlsian veil of ignorance is a concept that helps us evaluate the fairness of an allocation as impartial outsiders, not knowing the position we would occupy in the society we are considering.

The price elasticity of demand is useful for measuring how responsive consumers are to changes in prices of products, for instance as the result of an increase in taxation.

With the aid of various models, economics can clarify how the rules of the game affect the degree of inequality in allocations and can help us design effective public policies that take into account potential trade-offs between the twin objectives of efficiency and fairness.

3.12 DOING ECONOMICS: MEASURING THE EFFECT OF A SUGAR TAX

In Section 3.9, we asked ‘how do we find out if a policy will work?’ One of the examples was the use of taxes on food as an anti-obesity policy.

In Doing Economics Empirical Project 3 we provide a step by step guide through the process of finding out the effects of the tax on sugar-sweetened beverages introduced in Berkeley in California in 2014. The introduction of the tax provides a natural experiment and we show how to construct treatment and control groups to test for the effects of the tax.

The project addresses two questions:

1. How did sellers change their prices for sugary beverages in response to the tax?
2. What was the effect of the tax on consumers’ spending on sugary beverages?

Go to Doing Economics Empirical Project 3 (http://tinyco.re/3451308) to work on this problem.
Learning objectives
In this project you will:

- use the differences-in-differences method to measure the effects of a policy or program, and explain how this method works
- create summary tables using Excel’s PivotTable option
- use line and column charts to visualize and compare multiple variables
- create summary tables to describe the data
- interpret the p-value in the context of a policy or program evaluation.

3.13 REFERENCES


