



Collective Action: Government Policies and Programs

6.1 PUBLIC GOODS AND SOCIAL CHOICE: PROPERTY RIGHTS, TAXES AND SUBSIDIES

6.1.1 *Motivation and Guiding Questions*

The story so far has been about individuals interacting with each other in voluntary transactions, under a variety of market conditions. We have seen how a benchmark perfectly competitive market would deliver the most economic surplus, providing a framework in which to diagnose each real-world market failure away from that benchmark such as externalities, monopolies, hidden quality differences and other societal objectives not met by existing markets in the real world. Now we turn to policy remedies for those market failures. What determines the extent and impact of policy interventions? Can we use economic principles to understand government policies and programs?

Previously in this textbook we treated government interventions as external factors that influenced market outcomes. Here we address the role of government directly, introducing the toolkit of *public economics* and the *political economy* of how policies and programs arise and persist. This reveals how missed opportunities for societal gains can arise from both too little and too much government intervention. When public-sector activity is insufficient, we observe persistent market failures due to collective inaction or inattention. In other settings, we observe opportunities for societal gains by reducing or removing government-mandated obstacles to transactions whose benefits would outweigh their costs. Both kinds of policy failure coexist as the public-sector counterpart to private-sector market failures. *Social choice* is the process by which communities obtain the mix of government and market activities that determine their collective wellbeing over time.

Governments are sovereign entities with authority over a specific geographic region. There may be disputes over the borders of their jurisdiction, and limits to the extent of their control within those borders, but the distinction between governments and markets derives from the potential for a single entity to gain ultimate authority over all people within their territory. The instruments used by each national or local authority to create and govern markets include policies that establish property rights and enforce laws to regulate private activity, and programs that directly provide public goods and services. Private voluntary groups also take *collective action* to govern their members, but membership in a non-governmental organization is a choice and each person can join or help create multiple nonprofit groups and associations, just as we form new commercial enterprises.

Governments come to power in many ways, and may or may not act in the best interests of the people in each place. The history of each population shapes its governance, and there is abundant research focusing directly on politics, law and other aspects of how governments operate. Economics about government, known as public economics or political economy, focuses on the relationship between governments and markets in the places they control.

By the end of this section, you will be able to:

1. Define and use the concepts of non-excludability and non-rivalry to distinguish between private and public goods, and the role of common property or gated club goods in society;
2. Identify how a population's willingness to pay for a public good affects the quantity that would lead to the highest possible level of economic surplus;
3. Describe how each person's gain or loss from public action, including their expectations about what others will do, affects their incentives to engage in collective efforts; and
4. Describe and provide examples of policy processes that influence government choices in the food system.

6.1.2 *Analytical Tools*

The government of a country is a singular entity, typically subdivided into sub-regional and local governments with authority over distinct parts of their territory, and also subdivided into branches and agencies with control over distinct aspects of government. Democracies use elections and other mechanisms to make government officials more accountable to the people of their country, with diverse levels of success in having their government serve the public's interests.

Economists typically use the term *public sector* to mean all activities of government, while the *private sector* consists of both commercial enterprises and nonprofit organizations as well as individual activities. The two sectors

are intertwined from the start, when governments create the legal framework for each enterprise to be formed and governed with specific rights and responsibilities. For example, in the U.S. about ten percent of private-sector employment is in nonprofit organizations whose registration status entitles them to pay fewer taxes, governed by boards that elect their successors. In contrast, commercial enterprises have owners who elect or appoint the directors and managers of the enterprise, or self-employed people such as many farmers who work independently as an individual or a partnership.

Terminology about both government and private-sector enterprise varies around the world, but in this book, we use the term *policies* to mean rules and institutional arrangements that govern other activities, while *programs* deliver goods and services to conduct those policies. For example, a country's agricultural authorities might have diverse programs to implement and enforce their policies about land use, irrigation and water rights, and the country's food and nutrition services might have diverse programs to implement and enforce policies about school meals or product labeling.

Decisions about each policy and program are a *collective action*, also known as a *social choice*, in the sense that one choice affects a whole community. Collective actions occur at every scale and in all kinds of social organization, from a small partnership to a global enterprise, but we are especially interested in choices that involve governments due to their potential *monopoly of force*, meaning their ability to make and enforce rules that apply to everyone within their territory.

Government decisions in agriculture and food systems often involve flows between countries, for example to govern international trade, migration and investment, or foreign aid. Governments also undertake regional or global collective actions through *international organizations*, whose member states agree to the organization's rules in exchange for the benefits of participating. The largest grouping is the United Nations (UN) whose specialized agencies such as the Food and Agriculture Organization (FAO), the World Food Program (WFP) and World Health Organization (WHO) implement programs on behalf of member countries.

The UN and its agencies are not a global government, because they operate in each place only at the invitation of that country's national authorities. Country governments have also created various international groupings alongside the UN such as the World Trade Organization (WTO), the Organization for Economic Cooperation and Development (OECD), the World Bank and others that play major roles in global agriculture and food systems. International organizations jointly owned by multiple governments are known as *multilateral* agencies, in contrast to *bilateral* programs of one country's agencies working elsewhere such as the U.S. Agency for International Development (USAID) or the Japan International Cooperation Agency (JICA).

Governments and their various agencies often work through *implementing partners* that receive grants and contracts to provide public goods and services on the governments' behalf. For example, in the fiscal year ending

October 2023, USAID used contracts, grants and other arrangements to award about \$37 billion for its implementing partners around the world, managed by agency staff and operational expenses costing less than \$2 billion. Implementing agencies may be international or local non-governmental organizations licensed to operate in each country where they work.

Collective actions are the result of political processes in and between countries, influenced by the extent to which individuals and organizations join together in groups that invest their time and efforts in pursuing their common interests. These interest groups may try to influence elections by contributing time and money to candidates or advocacy groups, and participating directly in outreach, activism and lobbying of government officials. The economics of public decision-making, often known as *political economy*, concerns the incentives for people to devote time and resources to influencing government.

Economics about government seeks to understand policies in terms of peoples' choices among limited options, doing two kinds of analysis in parallel: *positive* political economy seeks to explain and predict government actions, and *normative* political economy that seeks to assess the degree to which government actions help people reach their goals. Positive analyses are descriptive about *what is*, while normative analyses are prescriptive about *what should be*, and in economics both rest on the same framework as described in this chapter.

To begin our analysis of political economy and policymaking, we return to the four types of goods and services that we introduced in Chapter 4. At that point we introduced externalities, which are *non-excludable* and often also *non-rival* costs or benefits affecting people as an unintended side effect of market activity. Here we focus on collective action to manage things that are done insufficiently or excessively by voluntary private activity, shaping the market through public-sector intervention.

Public Goods are Non-excludable, and May Also be Non-rival

One role of governments is to provide *public goods*. These are goods or services that would be provided insufficiently or not at all by the private sector, because sellers cannot capture a sufficient fraction of the benefits to cover the cost of supplying those goods and services. An agricultural example is the underlying data and methods used for weather forecasts. Meteorological information is of immense value to both end-users and the media companies that repackage and deliver weather forecasts for specific audiences. Once someone creates the underlying information, its value is *non-rival* because additional people can use it at the same time without reducing its value to others, and also *non-excludable* if the provider cannot stop people from copying the information. The two attributes create the four-way classification of all goods and services shown in Fig. 6.1.

The top-left and bottom-right corners of Fig. 6.1 show the two extreme cases, with purely private goods in the top left and purely public goods in the bottom right. Private goods can be exchanged in markets without government intervention, as in the example of Alphabet Beach fish market. Public goods

	Demand is <i>rival</i> (if one person uses it, they displace other users)	Demand is <i>nonrival</i> (if one person uses it, other people can use it too)
Supply is <i>excludable</i> (provider controls who can use it)	<i>Private goods & services</i> such as food & fuel	<i>Gated goods & services</i> such as software & content
Supply is <i>non-excludable</i> (once provided, anyone can use it)	<i>Common property</i> such as public roads	<i>Public goods & services</i> such as climate & air quality

Fig. 6.1 Definition of four types of goods and services, from private to public

are like the information behind weather forecasts, or more importantly the actual weather and air quality that affects everyone. Those are the cases where private provision is minimal, and if the government does not do something then it is not done.

The other two corners of Fig. 6.1 are intermediate cases, with important roles for collective action to influence the extent and impacts of market activity. The top-right corner shows examples of things that are non-rival but potentially excludable, such as software and media content. These ‘gated’ services include the media companies that repackage government weather forecasts in distinct ways, for example with more entertaining meteorologists or customized versions of the public data. The bottom-left corner shows things that are non-excludable but may be subject to congestion when too many people use them at once such as public roads, sidewalks and other facilities. Everyone in a given area could potentially try to use that common property at the same time, reducing its value for everyone. In these settings governments can improve market outcomes by allocating property rights, regulating use and taxing or subsidizing market activity.

We introduced the role of property rights to address externalities in Chapter 4, where the government’s role in allocating rights to people was shown to be a major determinant of how income and wealth are distributed, as well as the efficiency of resource use. Earlier in Chapter 3, we also saw the same thing for regulations or taxes and subsidies, which have big impacts equity as well as the total economic surplus available for each society. To achieve more efficient as well as more equitable outcomes, collective action to address each kind of market failure is needed such as antitrust policy to limit monopoly power.

In discussions of public policy observers often use shorthand descriptions of a country’s economy as being more or less market-oriented, with more or less focus on public goods. The term *capitalism* typically refers to governments giving greater property rights for owners of commercial enterprises, who are ‘capitalists’ in the sense of using financial investments and physical assets as ‘capital’ in the production of things for sale in private markets along the top row of Fig. 6.1. The opposite term *communism* typically refers to governments giving more limited rights to enterprise owners, so that people buy and sell fewer things in private markets. Ideological debates around capitalism and

communism were influential in twentieth-century politics, but other shorthand descriptions of policy orientation are more common today. Policy debate in the twenty-first century is more often described as between a conservative movement that wants things to be as they were, and a progressive movement that wants change towards something new. Other axes of debate focus on the demographic composition and origins of interest groups, the role of government in enforcing morality and cultural norms or the personalities of political leaders.

Over time, modern economics research has become increasingly empirical, using the increasing availability of data and computing power to focus research efforts on the challenge of making accurate predictions and providing practical advice. Economists test, adapt and apply the models presented in this book for both positive description and normative prescription. The interests of economists themselves undoubtedly play a role in their work, driving topic selection and choice of methods towards the kind of research that people want to have done. Researchers who are interested in the benefits of something are more likely to look for and find evidence of gains, while researchers who are interested in the harms from something might look for and find its costs. Schools of thought emerge around specific questions, for example the prospects for plant-based alternatives to animal-sourced foods, but modern economics involves a diverse set of debates about different topics instead of polarization between two political ideologies.

Economics about the public sector uses the market models presented earlier in this book to show how government intervention affects private-sector activity, and adds methods designed specifically around the supply and demand of public goods and services. Economists explain the resulting models with the analytical diagrams shown in this section, and apply them to practical questions using the empirical methods in the second section of this chapter.

The Scale and Scope of Public Goods Provision: Local, National and Global

Governments deliver a variety of goods and services, providing nonmarket complements to market activity. What determines the scale and scope of decision-making by each public sector institution?

Data and analysis of public-sector policies typically starts with national governments. As of 2023 the world had about eight billion people governed by the 193 member states of the United Nations, ranging in size from China and India to microstates like the city of Monaco or the island of Palau. Whatever the country's size, its national policies and programs cover their entire territory for example trade policy implemented at the country's borders and monetary policies affecting the macroeconomy, while other kinds of intervention are decided upon by local or regional governments within countries, or by international organizations.

When comparing countries economists usually focus on data per person in each territory, but that can be ambiguous. Borders may be disputed and

can change over time, and the population of each place may include travelers, migrants and displaced people. International agencies often revise their statistics to account for changes in how people are counted, and country governments do the same for subnational data.

The highest level of decision-making for most policies and programs is the country's national government. They routinely delegate local decisions to subnational authorities such as towns and regions, and countries also participate in international organizations such as UN agencies or the World Bank. Every institution has a history of its own, as for example city governments may have been formed by people who lived there well before the establishment of the national government, and accidents of history often dictate geographic borders.

Economists use non-rivalry and non-excludability to help explain the scale and scope of many government functions. The *subsidiarity principle* of delegation suggests that public-sector decisions are typically most cost-effective when made at the geographic scale within which their costs and benefits are contained. In some cases, the actual scale and scope of government functions follows that principle. For example, food safety and licensing of restaurants is usually run by local governments, because the costs and benefits of that service are mostly contained within their jurisdiction. In contrast, food safety and licensing of food manufacturers is usually done by state or national governments, because those products are bought and sold throughout their territory.

The principle of subsidiarity provides only very loose guidance about the most cost-effective scale and scope of each agency, and factors other than cost-effectiveness influence their operations, but the geographic area within which effects are contained provides useful insights into the evolution of many public institutions. Irrigation systems in agriculture, for example, may have been built through collective action of a few farmers and their local governments, but then changing scarcity drives demand for water management over a larger geographic area, leading to intervention by the state or national government. Similarly, transboundary disputes over irrigation water have traditionally been settled through negotiation between two countries, but larger regional initiatives are increasingly used to monitor river basins and lakes, and global agreements increasingly govern the use of the oceans and the atmosphere.

The Value of a Public Good Is the Sum of Willingness to Pay at Each Quantity

The value of public goods and services cannot be shown using a market demand curve, because each unit provided benefits multiple people at the same time. Every person in the population potentially experiences the same quantity provided, so that quantity's value to society is the vertical sum of each individual's willingness to pay as illustrated in Fig. 6.2.

In the example shown in Fig. 6.2, we can return to Alphabet Beach village and imagine that Ana, Bob and Cat want to use some of the shoreline for a public park. Again, we can imagine that Ana has the highest willingness to pay

Where use is non-rival, each person can use the same thing at once so willingness to pay is added vertically. Congestion effects introduce rivalry, and in the case of private goods and services all demands are added horizontally.

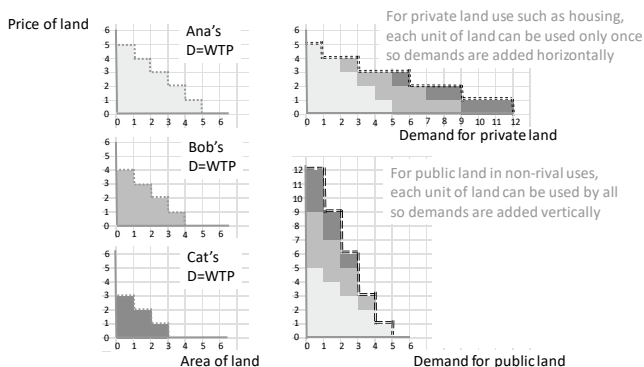


Fig. 6.2 The value of public goods to a community is a vertical sum of private demands

for land to be used as a park, perhaps because she really loves the idea and would like the park to be as big as possible. Bob has intermediate demand, and Cat has the lowest willingness to pay because she cares about other things, while others in this community might have no desire at all for a public park.

In this context, the value to each person could be scaled in different ways depending on how we are using the term 'value'. If we want to compare the value of parkland to other public services such as a new sewage system that would cost money, we might want to use a concept like economic surplus. We would count each person's monetary willingness to pay for land in the park, and differences between people might be partly due to their income or wealth. We might also want to make comparisons using another metric such as time use, measuring their willingness to invest time in creating the park or using it afterwards. We could also assign to Ana, Bob and Cat a metric of value that is derived from observations of other people, for example if studying parks elsewhere revealed that each additional unit of parkland yielded the number shown of additional life years for other people like Ana, Bob and Cat.

Whatever measure of willingness to pay we might use, the sum of Ana, Bob and Cat's valuation of land in the park is shown in the bottom-right corner of Fig. 6.2. The first unit of parkland would have a total value of twelve for the community as a whole, composed of five for Ana, four for Bob and three for Cat. The next unit would be worth only nine and then six to the three of them. The fourth unit of land in the park is of value only to Ana and Bob, and the fifth unit helps only Ana. In contrast, when land is used as private property, quantities are added horizontally as shown in the top right of Fig. 6.2. Because each unit can be used privately by only one person or household, a much larger total area of private space is needed, while total willingness to pay for the small area of public parkland is very high.

In real-life valuation of public goods and services, analysts might take account of congestion and rivalry in the use of the public amenity, modeling how each person's willingness to pay is modified by the number of other people using it. Many other challenges arise for measurement and comparison of cost-effectiveness among public activities, but the basic contrast shown in Fig. 6.2 remains the central distinction between public and private goods.

When collective action can mobilize resources to provide public goods, each unit provided can have extremely high total value when many people have high willingness to pay, and additional quantities have lower value to the community due to diminishing marginal value for each person. Empirical modeling can estimate the socially optimal level of public good provision, based on a corresponding study of the fixed and marginal costs of government provision. The highest possible level of total or average value created per person would be where the marginal social cost of providing one more unit meets its marginal social value, but providing public goods at any level is challenging due to the difficulty of collective action.

Barriers to Collective Action: Inattention, Free Ridership and Voting

Using the example of Fig. 6.2, we can imagine how Ana, Bob and Cat might hold meetings and pool their efforts to obtain a public park for Alphabet Beach. They might be able to hire people to persuade others that the community needs the park, for example by conducting studies and forming advocacy groups. They could proceed within the private sector as a philanthropic initiative, forming a nonprofit organization to achieve their goals, but could they persuade their whole community to create the park? More generally, what determines the quantity of public goods provided by governments?

Who has what influence over government decisions is the topic of political science, and also studied in law schools and by policy specialists in diverse fields. Those researchers use the economics toolkit and add details about the options available in each setting, focusing on how policymaking differs from the market for private goods. In the markets seen earlier, outcomes follow from individual transactions between sellers and buyers. Each transaction is motivated by the opportunity to close a gap between price received and marginal cost (for sellers) or between price paid and willingness to pay (for buyers). Markets emerge whenever transaction costs are low enough for individuals to act on their own interests. Collective actions are much more difficult to obtain. The economics toolkit about collective action is often framed in terms of three concepts that had long been understood intuitively but were formalized for empirical research purposes in the mid-twentieth century.

A first constraint on collective action is the problem of *inattention*, stemming from the fact that political effort depends on the stakes per person, not just the number of people, and many people have such low stakes that even learning about the issue is not worthwhile for them. We have already seen the issue in action when discussing trade policy, where producers who sell large

quantities are very attentive to policy and invest heavily in persuading people to restrict imports and thereby raise price, with little pushback from consumers each of whom buys a small quantity and often has an insufficient stake to even bother learning about the issue. In our toy model, there are three people who want the park (Ana, Bob and Cat) and we know that the village has at least five other residents (Deb, Ed, Fio, Gio and Hijo). The three advocates could potentially pool their efforts and obtain a park, even if all five of the others are indifferent or potentially opposed, simply because the five are focused on other issues and inattentive to the question. More importantly, even Cat may have an insufficient interest in the park to justify any effort at all.

Using time as the unit of valuation in Fig. 6.2, Cat's willingness to pay for the first unit of parkland was 3 hours of work. If she expected that advocating for the park would cost 3 or more hours, she would realize that acting on her interest in the park is not cost-effective for her. She might still work on the issue, but that would be for some other reason such as altruism towards Ana and Bob, and economists analyzing that motivation would want to have included altruism in Cat's estimated willingness to pay. More generally, learning about any issue is itself costly, and Cat would realize that even learning about an issue would not be cost-effective for anything whose value to her ultimately turns out to be below the cost of advocating for it. The time cost of political action ensures that for most individuals it is not worthwhile to even learn about the issues they might care about, so only those with a high stake in the matter will pursue it. The inattention constraint was formalized in the book *An Economic Theory of Democracy* by Anthony Downs, published in 1957, showing how the cost of political engagement and of acquiring information can pose big barriers to having collective action, leading to advocacy groups formed only by people with high stakes in that specific issue, and more effective public goods provision in settings that have low costs of political engagement and easy access to accurate information about each policy.

A second big constraint on collective action is *free ridership*, popularized in a book entitled *The Logic of Collective Action* by Mancur Olson published in 1965. Free ridership is the same mechanism as the Tragedy of the Commons and limits collective action even when people know that they care enough about an issue to take action. In our toy model the total value to Ana, Bob and Cat of a one-unit park is 12 hours of fun, and if it costs each person 3 hours of work to obtain it, Cat might decide to drop out of the effort. If Ana and Bob succeed, they would have a net gain of 3 and 1 respectively, but they would also know that Cat is getting the park for free. Bob might then realize that Ana really wants the park and will pursue it no matter what, leading Bob to drop out leaving Ana to pursue the effort alone. The incentives for people to free ride on others' efforts depend on each person's expectations about the behavior of others, and strongly rewards efforts to establish social norms and other mechanisms to enforce participation of each person likely to gain from the collective action.

The economic obstacles of inattention and free ridership both limit the incentives for each individual to contribute their full willingness to pay in pursuit of public goods, but even among those who do invest there is an important limitation to the concept of a socially optimal level of public goods. That obstacle was first formalized by Kenneth Arrow in his doctoral dissertation published in 1950, using an *impossibility theorem* to show that aggregating preferences among people cannot produce the kind of consistent ranking that characterizes an individual person's preferences. In other words, there is no voting scheme that can prevent preference reversals such as a community having voted for a park instead of a library, a library instead of a garden and then also for a garden instead of a park. Even if each individual in the community has consistent preferences between the three options, the community as a whole may have inconsistent preferences. The Arrow impossibility theorem does not mean that voting is ineffective. To the contrary, the study of voting systems shows how different electoral systems have very large impacts on the way in which popular preferences are represented, including the relative influence of interest groups in agriculture and food policy.

The three economic limits to collective action described here all refer specifically to the way that economics compares benefits to costs as a guide to decision-making. Many other factors outside the economics toolkit affect public-sector decisions. In fact, a core implication of inattention, free ridership and Arrow's impossibility theorem is that successful collective action involves not just economic incentives for individuals but also social psychology, political institutions and attention to accidents of history. Keeping both economic and non-economic influences in mind can be helpful to understand the dynamics of collective action in any given setting. The problem of inattention leads us to focus on the gains and losses per person, relative to the cost of political participation and obtaining accurate information. The problem of free ridership leads us to focus on social norms about participation, and the study of voting leads us to focus on how public interests are aggregated to guide public policy.

Agricultural and food policies have long provided big opportunities for initiatives that overcome obstacles to collective action and improve outcomes. In the 1960s and 1970s, a professor of political science named Elinor Ostrom built a research program to record how people around the world have in fact created social norms and institutions that successfully overcome the tragedy of the commons, free ridership and costly information, and come closer to socially optimal levels of public goods provision over time. Ostrom's most influential book, *Governing the Commons: The Evolution of Institutions for Collective Action*, published in 1990, was almost entirely about how groups of farmers, herders and others manage natural resources and develop governments literally from the ground up, as small self-governing communities who develop commitment devices to elicit cooperative behavior around local public goods like irrigation and grazing. Ostrom was awarded the Nobel Prize for

economics in 2009, recognizing her achievements in expanding the toolkit of economic analysis from individual to social action.

Policy Processes: Veto Players, Rent-Seeking and Median Voters

Each policy or program that governments actually implement must pass through a long sequence of political processes, each of which imposes a different political constraint. Useful terminology about policy processes includes the role of *veto players* who can stop things and *rent-seeking* by actors who see opportunities to influence policy in ways that restrict competition and make their activities more profitable. Advocacy groups pursuing their own preferred outcomes must overcome opposition by potential veto players, and to limit rent-seeking by those who might alter policies to their advantage.

Policy processes often include steps where voting occurs. The general public may elect its leaders, often through a sequential processes that lead to policies by votes among those representatives. When elections or other voting specifies that actions require a majority vote, a change needs only 50% plus one vote to pass, giving political leaders strong incentives to adjust policies until they are just sufficient to reach that threshold. When voters are arrayed on a scale from strongly opposed to strongly in favor of the change, so majority-rule decisions rest on persuading the *median voter* to switch sides. Similarly, in elections that require a supermajority such as two-thirds (66%) of the voters to approve, the deciding vote would be at the 66th percentile of those voting. Most political processes evolve such that the outcome of voting comes down to the marginal or 'swing' decision-maker favoring or opposing the change.

Observed policies are those for which leaders were able to build coalitions with just enough support to pass through each step of the political process, navigating through veto players and rent-seeking efforts to stop or modify the policy, and attracting the median voter at each stage of policymaking. Economic principles can help us understand how a given set of political institutions shapes the policies that decision-makers will actually enact. Decision-making at each stage depends not only on whether or not a person favors a change, but the intensity of their preferences and their willingness to sacrifice other things to attain that goal.

6.1.3 Conclusion

Public policy and programs for agriculture and the food system operate at diverse scales, with varying scope to address each kind of market failure and achieve societal goals for sustainability, equity and health.

This section introduces the economics toolkit to understand how public action differs from private transactions. Economic analysis of the public sector begins with the costs and benefits experienced by individuals, and the incentives they must engage in collective action to obtain government-provided goods and services. For example, a small group of farmers might build a shared irrigation system, while another group of herders might set rules for

grazing. The governing bodies of those local institutions might then collaborate with others over a larger geographic area, expanding to address regional issues like watershed management and animal disease control. Their scope of operations can also vary to combine different kinds of public goods, such as joint governance of crops and livestock to improve all of agriculture.

Economic analysis of the public sector typically begins with national governments. Countries are the main unit of analysis due to their sovereignty over all the people in the territory they control. Each government has branches and specialized agencies for each public function, with nested subnational governments of states or regions, counties or districts, and towns or cities to provide public goods and services at each scale of operation. Many aspects of agriculture and food systems cross country borders, so national governments often join international organizations with specialized regional or global agencies to perform public functions of varied scale and scope. The principle of subsidiarity calls for tailoring the scale and scope of each governing body to the problems it solves, making organizations as small as possible to maintain accountability, while achieving the economies of scale and scope needed to provide the nonmarket public goods and services that can overcome market failures in each situation.

Priorities for change and opportunities for collective action evolve over time, requiring each successive group of people to work together in new ways. Incentives for individuals create dilemmas where cooperation can help others but be costly for oneself, leading to the intentional creation of social norms and commitments to sustain cooperative behavior and overcome free rider-ship. Groups can then build institutions with low cost of participation and easy access to accurate information, overcoming the problem of inattention and allowing government to take costs and benefits into account when setting policies and providing programs. The following section describes how data on those costs and benefits are obtained and used in the actual practice of government for agriculture, food and health.

6.2 COST-EFFECTIVENESS AND NONMARKET GOALS IN FOOD AND AGRICULTURE

6.2.1 *Motivation and Guiding Questions*

The previous section showed how economists use each person's incentives to understand collective action, helping government agencies and other large organizations meet goals that individuals cannot achieve through market transactions. These nonmarket goals drive policy interventions that shape the economy, potentially providing remedies for market failure and delivering public goods and services. What determines which interventions would best help each population meet its goals? In other words, how can we know if an intervention is cost-effective?

Government decisions can be seen as yes/no choices, often among multiple options. Each choice will help or harm different people in different ways. Economics can help decision-makers predict those impacts and compare their relative magnitudes. As we will see, the cost-effectiveness of each policy or program depends not only on what it does, but also the extent or magnitude of each action. Helpful interventions can become harmful when they are too much of a good thing. Some policy actions involve choices like the menu at a restaurant with predetermined portion sizes, while other decisions are like a grocery store where people choose between things first, and later decide how much to use.

For each decision, economic analyses compare costs to benefits. As we have seen, net gains or losses for each person help explain individual choices, market outcomes and our own willingness to spend time and money on collective action, but incentives for each individual do not fully determine what governments do. The actual policies and programs we see were created in the past, influenced accidents of history, and ongoing changes are driven by social norms and beliefs about other people. Those beliefs can be self-perpetuating, as we saw in the example of a two-person strategic game where expecting others to act nicely makes it in each person's interest to do so. Social activists and political leaders shape common narratives and beliefs, while policy decisions change actual payoffs to the options among which people can choose, potentially aligning costs and benefits so that outcomes improve over time.

The role of history and beliefs in collective action ensures an ongoing need for creative leadership, whenever individuals in society see opportunities for improvement. Throughout human history, governments have sometimes done too much, taking actions whose costs exceed benefits, and sometimes done too little, or what they have done is too late for the populations that could potentially have been helped with actions whose benefits exceed their costs. Public-sector actions or inactions that harm the public interest are known as *policy failures*, in the same way that private interactions' failure to achieve a population's full potential are known as *market failures*.

Economists use the same kind of cost-effectiveness analysis to assess both policy failures and market failures. In each case, understanding the value of each option calls on subject-matter knowledge about the environmental conditions, available technologies and human factors that determine production possibilities and consumption needs, as well as economic techniques to add up and compare costs and benefits. Professional economists sometimes craft policy proposals, but more often they volunteer or are employed to analyze options proposed by others, and economic techniques can readily be used by anyone to assess the net gains or losses from any initiative.

By the end of this section, you will be able to:

1. Explain how to convert market prices and monetary values from one time and place to another, accounting for inflation and differences in purchasing power;

2. Describe how economic and social valuation of something is affected by how far in the future it will occur, as well as risk and uncertainty about whether it will occur, using interest rates and discounting;
3. Describe how economists elicit a population's valuation and willingness to pay for things that they are not currently buying; and
4. Explain how cost-benefit and cost-effectiveness analysis can be used to inform decisions relating to agriculture, food and nutrition.

6.2.2 *Analytical Tools*

The previous section showed how the benefits of a change in public goods or services can be added up over the population it serves, drawn as the vertical sum of each person's valuation. In this section we turn to how those benefits can be compared to their costs. Both benefits and costs can be counted in their natural units, for example hours of time or kcals of energy or years of life lost. Monetary comparisons refer to things that could be bought and sold and therefore valued at market prices, in terms of economic surplus based on whatever currency units are used for transactions. Other things are counted in natural units and can be compared to each other only in that same unit of measure.

In this section we use the term *cost-effectiveness analysis* broadly, to include all comparisons of gains and losses experienced by a population that might be attributed to changing a policy or program. Specialized terminology can be helpful to identify the technique used to quantify gains or losses. For example, *cost-benefit analysis* usually refers to comparisons between different things that are measured in monetary terms. When studies focus on probabilities, they are often called *comparative risk assessments*, or risk-benefit analysis. This section introduces the economic principles used for these cost-effectiveness studies, for both market and nonmarket objectives of policy.

Comparing Monetary Values: Adjusting for Inflation and Purchasing Power

Comparing monetary costs or benefits such as economic surplus requires adjusting currencies for inflation and differences in purchasing power. The *nominal prices* that are observed at each place and time, and also the *real prices* that adjust for inflation, refer to what money can buy in terms of all other goods and services. Nominal prices are also known as prices in 'current' terms, while real prices are in 'constant' terms.

Inflation over time is typically measured and reported as the average rate for an entire country, so that real prices have constant buying power for the quantities of all goods and services that people report buying in nationally representative surveys. Similarly, international comparisons are made in *purchasing power parity* terms, with constant buying power for average of all goods and services available in each country. Subnational comparisons are

also possible, for example with separate inflation rates and purchasing power comparisons for rural or urban populations.

Adjusting for inflation and purchasing power can be very confusing and is a common source of misleading information about costs and benefits. To avoid errors, it is helpful to do the *analysis of units* that was introduced in Section 3.2 on elasticities. In an analysis of units, the descriptive name of each number's measurement units, for example 'pesos in 2024' is used as a variable in a mathematical expression to confirm that numerical conversions are done consistently. Nominal data might show a value of 20 pesos in 2023 and 21 pesos in 2024.

Consumer price indexes to monitor inflation are typically shown as one hundred in the base year to see percentage differences since then and might have shown that the national average level of prices rose from 100 in 2023 to 105 in 2024. Analysis of units reveals how the real value of the 21 pesos in 2024 must be divided by $1.05 = 105 \text{ in } 2024 / 100 \text{ in } 2023$, because that divides 'in 2024' by itself so those words cancel out. The result in this case is that 21 nominal pesos in 2024 equals 20 real pesos in 2023 terms.

Similar analysis of units can be used to ensure that any other unit conversion is done accurately, to avoid misleading comparisons of costs and benefits. Logical consistency can be checked by using variable names in a sentence, or using variable names in an equation to confirm that ratios cancel, or using numerical examples to verify magnitudes. In each case it is helpful to remember the original definition of each term. For example, when monetary values in Japanese yen or Mexican pesos are converted to real purchasing power parity terms in U.S. dollars, by definition each real dollars should have the same average purchasing power over all goods and services in Japan as in Mexico, and only the relative prices of different things within Japan and Mexico would differ.

When we introduced externalities in Section 4.2, we showed their costs and benefits in monetary terms. Using a common denominator such as real dollars is needed whenever cost-benefit analyses seek a common unit of measurement. Comparing market and nonmarket benefits using economic surplus, expressed in real monetary terms, is helpful to make comparisons in terms of all things that money can buy.

The material requisites of wellbeing sometimes have an observable price, for example in the form of higher rents and house prices near public amenities like a park, or lower rents and house prices in places with more pollution. Analyses could use those monetary values to quantify questions of environmental justice and efficiency, adding up gains and losses from parks or pollution for different populations. Similar analyses could potentially be done for social conditions such as worker protections and occupational safety, but analysts may also prefer to use natural units such as years of life lost from disease or disability, or biophysical measures of change in the environment.

Risk and Uncertainty: Use Values, Option Values and Existence Values

Environmental and natural resource economists study how people interact with the ecological and geographic conditions around us. Ecosystem services are the benefits provided by the natural environment such as carbon sequestration, clean air, pollination, education and recreation. Many cost-benefit studies involving ecosystem services focus on their *use value*, based on the average level of each attribute employed by people in production or consumption.

Risk ensures that people place an additional value on environmental attributes or ecosystem services they might need, which is known as an attribute's *option value*. Option values are computed based on known probabilities, for example the option value of groundwater might be calculated based on historical risks of low rainfall leading to the probability that groundwater will be needed. Systemic shifts such as climate change alter those probabilities, and different people will have different ideas and models in mind about what the environment is worth to them. *Risk assessment* is the standard term for estimating probabilities, and *risk aversion* is a person's willingness to pay to avoid riskier things.

Adding up the population's subjective valuation of potential needs or intangible benefits of environmental attributes or ecosystem services is known as their *existence value*. As we have seen, all valuations in economics are ultimately subjective, capturing how much people value each thing for their overall wellbeing. Nonmarket valuations are contentious in part because of limited data about both quantities and values, especially for option values and existence values. But economists can elicit those valuations using a variety of techniques, and often find somewhat predictable patterns. For example, diminishing returns ensures that existence values depend greatly on the level of something, and the risk that it will be lost forever, leading to very high valuation of species at risk of extinction or rare natural amenities.

Comparing Costs and Effects over Time: Interest Rates and Discounting

Many studies involve projects whose benefits are felt long after the costs are incurred. Decisions today often have consequences at different points in the future, for example after one month, one year, one decade or one century.

People reveal their relative valuation of things that are experienced sooner rather than later in many ways. For things that people can buy with money, *interest rates* reflect the price paid or received for delaying costs and benefits, and economists use *discount rates* to mean a person's willingness to pay for that delay. A higher rate means more discounting of future benefits and costs. For example, something now worth a hundred dollars but received after ten years would now be worth about \$82 today at a discount rate of 2% per year, or about \$56 at a discount rate of 6% per year. Longer time periods greatly increase the importance of interest and discount rates, for example after twenty

years the difference between 2 and 6% per year is a present value of \$67 or \$31.

Because delays involve risk, interest rates and discount rates are always affected by differences in risk assessment and risk aversion. For example, private lenders offer lower interest rates for auto loans than for student loans, in part due to less risk that the loan will not be repaid when lenders can repossess the vehicle and sell it if loan payments are missed. The value created by student loans is more difficult for lenders to capture, and those externalities help explain government support for educational investments.

Adding up a whole population's discount rate for public goods in the future leads to very different results than the discount rates revealed by individual transactions today. Many people have discount rates for long-run benefits experienced by a whole community or the global population that are much lower than the rates we apply to the short-term needs of individuals today. These differences are revealed by both nonmarket behavior and thought experiments, for example when people borrow or lend for short-term loans at high interest rates that imply a high degree of impatience, even as we all protect land and resources for our children and grandchildren at near-zero discount rates. The difference arises in part because overlapping generations create a potentially infinite time horizon for the group, and population growth means that collective assets like land or public goods could potentially be shared among a larger number of people.

Potentially larger population sizes over potentially long time horizons lead many people to place a much higher value on the future of their whole community than on their own future consumption. But attitudes towards the future are also shaped by beliefs about future living standards. If people expect or arrange for incomes to grow over time, then diminishing returns in consumption make an additional dollar in the future less valuable than it is today. On the other hand, if people expect or fear that living standards might be lower in the future, we all would be more willing to sacrifice things today. These beliefs are difficult to quantify but have a very large effect on people's discount rates and willingness to save and protect resources for the future. We will return to each person's risk assessment and risk aversion in Chapter 7, and then to our intertemporal comparisons in Chapter 8, to keep the focus in this chapter on collective action among groups of people.

Social Welfare and Inter-personal Comparison of Costs and Benefits

Any decision about collective action involves adding up impacts among people. Cost-effectiveness analyses usually aim to count each gain or loss equally, without regard to other attributes of that person. One reason is the practical difficulty of making those distinctions, because we often know the magnitude of total gains or losses but we do not know which person in society experienced how much gain or loss. For example, economic surplus is defined relative to supply or demand curves and then measured using observed prices,

total quantities and elasticities of response, usually with no way of knowing which person sold or bought each unit of the product.

Even if a cost-effectiveness analysis had data on which person experienced each gain or loss, counting them differently based on a person's observed characteristics would require a weighting scheme that decision-makers would find attractive. For example, a study of health impacts might count gains only when experienced only by people in certain demographic groups, but the centuries-old trend in many societies has been towards counting all people equally. For the English-speaking world, a first step in that direction was the Magna Carta adopted over 800 years ago in 1215 granting a very limited set of rights for each citizen, and then almost 250 years ago in 1776 another step was the U.S. Declaration of Independence from Britain which claimed additional rights because 'all men are created equal'. That was followed eventually by the Emancipation Proclamation of 1863 ending the U.S. government's enforcement of slavery, the 19th Amendment to the U.S. constitution adopted in 1920 granting women the right to vote, and similar steps towards equal counting of all people when making collective decisions. Not all societies aspire to counting people equally, and each step towards greater equality is often followed by steps back, but the effort to count gains and losses more equally over time is a deeply rooted tradition.

An important use of cost-effectiveness analysis that counts each person equally is to identify how actual policy decisions favor some groups over others. For example, we have seen how import restrictions and licensing arrangements favor producers over consumers. Economic surplus analysis can then show which groups gain or lose, revealing the relative strength of each group when influencing policy. Similarly, comparative effectiveness studies in health service provision can show which groups gain more from an intervention, and which gain less. In other words, equal counting often reveals unequal treatment, in ways that would not be possible if the cost-effectiveness accounting used differential weights on gains and losses of different groups.

Counting each person equally does not mean that each person experiences equal costs and benefits. Different metrics count different impacts, so their magnitude differ in systematic ways. For example, comparative effectiveness in health can be calculated based on either lives saved, or years of life saved. An intervention saving a child might extend their life by many years, while an intervention saving an older adult might contribute only a few additional years. Further weighting is often done by *quality-adjusted life years* (QALYs) or *disability-adjusted life years* (DALYs) which account for improvements in living standards. When counting disability, improving vitamin A status through better diet, supplementation or fortification often ranks as one of the world's most cost-effective health interventions because it reduces blindness (which has a high weight in QALYs and DALYs), and often does so for preschool children (and hence many years per life).

Selection of the outcome metric in each cost-effectiveness study typically aims to reflect both the kind of data available for the study and the policy

or program questions being asked. Environmental policies and projects often involve a wide range of outcomes that are compared in cost–benefit terms, whereas health programs all target human longevity and years of disease-free life, so they are evaluated using cost-effectiveness methods in units such as QALYs or DALYs. In some cases, health programs are compared to each other without cost data, which is known as *comparative effectiveness*. In health care, efforts to standardize and improve the metrics and methods chosen often make use of *reference case* guidelines, a term coined in the 1990s to help adapt the economic principles of cost-effectiveness analysis to the needs of health care providers.

Ecosystem Services and Environmental Analyses of Costs and Benefits

The climate crisis has made greenhouse gas emissions the single most important environmental outcome of recent years, but ecosystem services are extremely diverse in whether and how they can be measured. To facilitate comparison, the European Environment Agency defines and characterizes different ecosystem services in a uniform way, regularly updating the Common Classification of Ecosystem Services (CICES) as illustrated in Table 6.1.

Table 6.1 Types of ecosystem services

Category	Type	Ecosystem service examples	Benefit received by humans
Regulation and maintenance	Biotic	Decomposing and filtering of wastes, noise reduction, reducing smells, disease control	Mitigation of the effects of daily life on the environment
	Abiotic	Diluting chemicals, filtration, sequestration, storage, flows of gases and liquids	Dissolving silica in soil runoff, reducing the cost of disposal of chemical wastes
Provisioning	Biotic	Cultivated and wild plants and fibers, livestock for work or food for humans, wild animals for food or materials	Sources of fuel, food, clothing, medicines, building materials
	Abiotic	Water for energy, drinking, and lubrication; minerals; wind energy, solar energy, geothermal energy	Hydration, cleaning, energy production, manufacturing capabilities
Cultural	Biotic	Direct outdoor interactions, education about nature, research about ecology	Happiness, mental and emotional wellbeing, a feeling of purpose
	Abiotic	Geological features, rocks	Recreation, exercise, identity

Source Authors’ adaption of definitions and examples from the European Environment Agency, whose updated infographics are at https://www.eea.europa.eu/ds_resolveuid/INF-169-en

The actions that government take to improve ecosystem services sometimes use regulation that restricts what people can do. Compliance can be costly so restrictions are resisted, and it may be easier for governments to use incentive payments instead. For example, the U.S. Clean Water Act of 1972 sharply reduced pollution into navigable rivers from identifiable point sources such as industrial factories but did not cover surface water through which agricultural runoff often flows. In 2015 the government proposed a new regulation that would extend Federal protection from navigable rivers to seasonal streams and wetlands, known as the Waters of the U.S. (WOTUS) rule. That proposal would have limited what many farmers and others could do, prompting counter-pressure that was ultimately resolved in 2023 by restricting protection to year-round streams and lakes with surface connection to navigable rivers that cross state boundaries.

In contrast to the difficulty of implementing WOTUS, since 1996 the U.S. Federal government has run a popular Environmental Quality Incentives Program (EQIP), which generally pays for up to 75% of farmers' costs of actions to reduce runoff and provide other ecosystem services. Farmers apply for cost-sharing of investments for changes in crop residue management and cover cropping, irrigation and nutrient management or other improvements to their farm. Much of EQIP aims to reduce negative externalities, using payments for voluntary actions instead of regulations like WOTUS, providing additional support shaping how production occurs to complement other payments to help farmers such as subsidized crop insurance.

Cost-Effectiveness of Optimal, Second-best and Politically Feasible Actions

Economic principles provide helpful guidance for using cost-effectiveness to improve collective action. As shown in Chapters 2, 3 and 4, attaining the highest possible level of wellbeing requires that actions are adjusted until their social marginal costs just equal their social marginal benefits. Marginal costs and benefits differ from average or total costs and benefits, and scale effects imply that analysts must consider different scales of intervention to find the highest level of wellbeing. Adjusting until marginal costs just equal marginal benefits is known as *the first equimarginal principle*. The same idea also applies to equalizing marginal costs among different resources used, and equalizing marginal benefits among different benefits created, which is known as the *second equimarginal principle*.

The optimality conditions needed to maximize societal wellbeing imply that different strategies would be pursued in a coordinated manner. For example, regarding fertilizer use and other runoff into public water supplies, there might be a combination of actions like WOTUS and EPIC, each of which would be pursued until the overall gains reached their maximum. Decision-makers would keep expanding helpful actions and reducing harmful ones until the marginal social cost of each change just equals its marginal social benefit.

Economic models provide guidance about the direction and magnitude of changes that would improve outcomes, but this chapter also shows the political economy constraints on collective action. Economists use the term *second-best* to mean the most cost-effective policies and programs given political constraints. Second-best interventions differ from socially optimal actions in systematic ways. For example, in U.S. agricultural policy, extending Clean Water Act protections to smaller streams through WOTUS has been more difficult to implement than payments to farmers through EQIP, so the second-best policy is to do more EQIP than would be socially optimal if the two policies were equally easy to implement.

Eliciting Willingness to Pay and to Accept in Market and Nonmarket Settings

Goods and services that are traded in markets can be valued at their social opportunity cost, meaning the best available alternative. The social opportunity cost of traded products is typically the price paid by or received in trade, while nontraded goods have social opportunity costs that depend on both supply and demand. Opportunity costs can sometimes be estimated based on computerized models, but estimating a population's willingness to pay for a given change requires specialized set of economic or *nonmarket valuation* techniques.

The methods used to elicit willingness to pay begin with *revealed preferences* shown by actual choices. As seen in Chapter 3, for market transactions economists use can estimate demand systems from the population's variation in supply, but for nonmarket goods and services economists must use artificial experiments to elicit willingness to pay. In some settings researchers also elicit *stated preferences*, which are surveys that might include hypothetical choices designed to capture how much a person would value each good or service.

A central challenge for preference elicitation is to obtain robust estimates of willingness to pay that can predict observed behavior over time. As we know from Chapters 2, 3 and 4, each person's willingness to pay and hence the society's demand curve depends on what else is available or needed, at what price. A person's willingness to pay for health interventions, for example, can range from their entire wealth when faced with an immediate life-or-death choice, to almost nothing when the benefits are uncertain and long delayed. How an analyst frames each question can also affect preference elicitation. A purely hypothetical question such as 'how much would you be willing to pay' is unlikely to predict actual future behavior, but specialists in preference elicitation have developed a large toolkit of empirical methods used to guide both private-sector marketing of new products and economic valuation of public-sector actions.

We will return to the psychological factors that influence individual decisions in Chapter 8, but for cost-effectiveness of collective actions a particularly

important aspect of decision-making is known as *status-quo bias*, also known as *loss aversion*. That idea creates a gap between a person's willingness to pay (WTP) to acquire something and their *willingness to accept* (WTA) compensation for giving up that same thing when they already have it. People consistently put a higher value on things they have, so a population's WTA for something is consistently above its WTP for that same thing. A typical example involves land use, where individuals and communities place a very high value on avoiding change. The entire toolkit of preference elicitation includes both WTP and WTA, using methods like those listed in Table 6.2.

The methods listed in Table 6.2 aim to overcome a variety of challenges in eliciting a population's valuation of nonmarket goods and services. These concerns may be common to all surveys, starting with problems of *selection bias* in who is contacted and who is willing to respond. Careful sampling and testing for differences between respondents and the target population is an essential starting point, along with appropriate use of rewards to ensure that a representative sample completes the survey.

Even if people agree to start a survey, results are often influenced by respondents choosing the most convenient way to finish. Respondents' inattention or fatigue during the survey can be addressed to some degree with careful questionnaire design, and testing to detect various systematic biases. For example, survey responses are subject to *heaping* on round numbers, to *priming* when the sequence of questions influences responses, and to *framing* effects when people choose intermediate values in any range because they expect that to be the appropriate preference. There can also be important selection bias within the survey, when respondents skip questions that they prefer not to answer.

An important kind of risk in valuation research is that respondents will answer in accordance with preferences they want to project or believe they should have, instead of the preferences they actually have. That *social desirability bias* appears in all kinds of survey responses, reflecting how people want to be seen. Social desirability bias can arise even with real stakes and when responses are anonymous, helping a person see themselves as they want to be. A related problem is *strategic response bias*, when a respondent wants to influence the survey result. Social desirability bias and strategic responses can be seen as kind of hypocrisy, but there can also be genuine differences between what a person wants for their community and what they do for themselves.

One example of differences between valuation for collective action and for individual choice concerns the effect of food system regulations that alter the cost of production, such as animal welfare rules. Survey results consistently show populations placing higher value on animal welfare than their purchase behavior suggests. The survey data could be misleading due to social desirability or other biases, but purchase behavior could also be affected by market failures such as asymmetric information when buyers don't trust animal welfare labels, or by free ridership when buyers are not willing to be the only people who pay higher prices, in which case it is survey responses that are closer to the population's true willingness to pay for public intervention.

Table 6.2 Examples of methods for preference elicitation and economic valuation

<i>Method</i>	<i>Description</i>	<i>Benefits</i>	<i>Drawbacks</i>	<i>Typical use</i>
<i>Revealed preference methods</i>				
Demand system estimation	Uses market prices and quantities to estimate elasticities	Corresponds to actual decisions in the real world	Limited to observed markets, estimates may be confounded by unobservable factors and fail to forecast out of sample	WTP and WTA for existing products such as foods or farm inputs
Market experiments	Uses bidding in auctions or choices among discrete options	Can be made to simulate actual choices, with high predictive value	Can be expensive to run when conducted with real-life choices in real-life settings	WTP for new or different products or services, often including environmental or health attributes
Hedonic valuation	Uses prices paid for things with different combinations of attributes	Can be used with either real-world market prices or experiments with new products and services	Limited to attributes of things with which buyers have enough experience and different options to reveal their needs and preferences	WTP or WTA for environmental or health attributes that affect the value of homes, vehicles, wages or other things
Travel cost and wait times	Uses data on time and travel cost to an amenity or to obtain a service, such as parks or health care	Corresponds to actual decisions in the real world	Difficult to isolate valuation for different attributes of the amenity or service, and many other factors also influence time use	WTP or WTA for recreational sites and amenities, or things that are rationed through wait times such as some health services

(continued)

Table 6.2 (continued)

<i>Method</i>	<i>Description</i>	<i>Benefits</i>	<i>Drawbacks</i>	<i>Typical use</i>
<i>Stated preference methods</i>				
Contingent valuation (CV)	Asks people about their choices under alternative conditions	Low cost, and can vary how questions are asked to reflect many scenarios of interest	Hypothetical answers without consequences often do not predict actual behavior	WTP or WTA for changes in water quality, outdoor recreation, wildlife preservation, biodiversity, climate and air quality
Choice experiments (hypothetical)	Asks people to state their preferences between described alternative scenarios or goods	Low cost, and can vary the options between which people are asked to choose	Hypothetical choices may not predict behavior, unless there are actual things at stake	WTP for new or different products or services, often including environmental or health attributes and label changes
Inferred valuation	Asks people to predict how much <i>others</i> would value a nonmarket good or service	Focus on another's utility rather than one's own may reduce bias in responses	Hypothetical choices may not predict behavior	WTP for new or different products or services, often including environmental or health attributes and label changes

A personal example of the difference between valuation for collective action and one's individual choices would be William's interest in gardening. He worked on farms and enjoyed home gardening earlier in his life, and in surveys or choice experiments, when asked about his willingness to pay for a new community garden, or his willingness to accept the loss of a community garden than exists, he would place a high value on those investments. But when actually faced with a choice to do some gardening, the opportunity cost of doing other things with that time is usually sufficient to keep him away. William's high valuation of gardening for others but not himself could be a form of hypocrisy due to social desirability bias (he wants others to think he likes gardening) or free ridership (he wants others to do the work, while he enjoys the result), but there are also option values involved (he genuinely wants gardens to exist in case he might use them in the future), as well as existence value and altruism (he genuinely believes others might benefit from having gardens, as he did in the past). Different kinds of real-stakes preference

elicitation might be able to distinguish among those motivations, and similar analysis for other community members might help guide public investment in community gardens.

Comparing Costs to Benefits: Net Present Value and Cost-Effectiveness

To count the effects of a policy, analysts must compare costs to benefits. When analysts can count both in monetary terms, they can compute the two as ratios or a sum over time in a *cost-benefit analysis*. For other questions, analysts use monetary units only for costs and measure impacts in natural units for *cost-effectiveness analysis*. Analysts typically focus on the *incremental cost-effectiveness* of the decision, at a given level of everything else in society. For example, if we are studying the incremental cost-effectiveness for health of a voucher for fruits and vegetables, we should do that analysis in the context of the existing markets and other government programs that might exist for the population of interest. How analysts estimate the incremental cost of an initiative can drive the results, with important variables including the opportunity costs assigned to resources used for the initiative, based on what other things the people involved might be doing with those resources instead.

Once researchers have estimated the initiative's total costs and its total effects or benefits for the population of interest, analysts can present costs and effects in terms of absolute levels or relative ratios. The absolute level of gains for a population are often expressed in monetary terms, subtracting costs from benefits to obtain the *net present value* (NPV) of the change. For the NPV to accurately represent the net gains from a policy or program, all costs and benefits must be in comparable 'present value' terms representing all else that money can buy. This requires appropriate unit conversions and discount rates for each element of the initiative's costs and benefits. Similarly, a comparative effectiveness study might show net changes in the absolute level of various outcomes, such as total CO₂-equivalent gases in the atmosphere from different environmental policies or programs, or DALYs lost to various diseases from different health interventions.

When the effects of an intervention remain in natural units such as life years saved, then costs must be compared to effects in the form of an *incremental cost-effectiveness ratio* (ICER). The same kind of ratio can be used when effects are measured in monetary terms, which yields a *cost-benefit ratio* (CBR) for the change, and there is no difference in results when ratios are inverted, for example to show life years saved per dollar invested, or benefit-cost ratios. Benefits relative to costs can also be presented in percentage terms as the initiative's *internal rate of return* (IRR), which is the implied interest rate offered by the future benefits in return for investment of the costs.

Comparing policies and programs using the absolute level of their impacts (such as NPV or DALYs) versus relative ratios of cost-effectiveness (such as ICER or CBR) leads to different rankings whenever there are differences in the scale of the policy or program. For example, a school breakfast program

that reaches only some children could have a higher cost-effectiveness ratio but smaller total impact than changes in school lunch that affect every child. In some cases, program scale is fixed by its demographic or geographic limits, but cost-effectiveness ratios are often used to guide decisions about which programs should be replicated or scaled up from initial trials to the entire population they could serve.

The difference in impact between small and large programs is important because some interventions have economies of scale, where the full program is more cost-effective than the smaller version. These increasing returns arise to the extent that the intervention has high fixed costs of setup and low marginal costs of delivery, or network effects where each additional participant makes the program more valuable for other participants. In practice, initial trials and pilot programs are sized to take advantage of most such scale economies, and expansion to reach the entire potential population is subject to the same diminishing returns that limit supply of other things.

Even when small trials of pilot programs aim to be done under representative conditions, the initial steps taken to implement a given policy or program are typically the most cost-effective actions, and scaling up requires additional steps that are often increasingly costly or less effective than what can be done on a smaller scale. For example, the cost-effectiveness ratio of adding fruits and vegetables to school meals might be high in a pilot program where the participating staff are interested in the idea, school facilities are suitable and local supplies of attractive products are available, but then expansion brings in staff with other interests, at schools with less favorable kitchen and classroom layouts, and less attractive local supplies of fruits and vegetables.

Amelia had the opportunity to work in school food service in 2021. One of the rules is that children participating in the National School Lunch Program (NSLP) are offered at least five components for lunch: grains, meat/meat alternatives, fruit, vegetable and fluid milk. While a student is offered five items, they are required to take three items, one of which must be a fruit or a vegetable. The school food service staff consistently worked at preparing fruit and vegetable servings that the children would enjoy, including by cutting fresh vegetables in nice ways and presenting them with contrasting bright colors and alternating available options as often as possible.

Part of the motivation for Amelia and the staff to prepare vegetables carefully was for the children to benefit directly from eating that day's meal, but they also saw the work as educational. They wanted the children to talk with their friends about what was on offer that day, to build understanding and expectations about what meals would be desirable for themselves later in life. The educational value of each meal extends beyond nutrition to community building with local farmers or the health teacher. Nonmarket effects like these are difficult to measure and call for close attention to the short- and long-term goals of each program.

Cost-effectiveness ratios are generally lower for scaled-up programs than for their initial pilot or trial versions, but even at the larger scale they may have

higher value than other public investments at population scale. All programs are subject to some version of diminishing returns. Applying economic principles to cost-effectiveness analysis allows us to anticipate how the costs and effects of trial-sized programs might differ from full-scale results, and thereby guide public-sector decisions towards the set of all interventions that can help the entire population achieve their highest potential level of wellbeing.

6.2.3 *Conclusion*

Cost-effectiveness analysis can help guide government policies and programs, informing decision-makers about the best ways to address market failures and overcome previous policy failures through new collective actions. This section introduces the toolkit used to improve outcomes for both environmental sustainability and population health, in ways that address the distribution of gains and losses and impacts on equity of each change in policies or programs. Successful use of cost-effectiveness analysis to improve outcomes for each population calls for tailoring the economic principles seen in Chapters 1 through 5 to the specific needs of public-sector decision-makers.

A fundamental economic principle underlying cost-effectiveness is that each decision involves increments of change from the baseline alternative situation. The increments of change may be large, for example the national rollout of a new agricultural or food policy, but useful analyses focus on the difference between one scenario and another. We can then rank two or more options and help decision-makers choose based on their incremental cost-effectiveness ratios, or the total change in each outcome such as its net present value, relative to the alternative of no change in current policies and programs.

The practical work of cost-effectiveness analysis, like other applications of economic principles to agriculture and food systems, involves careful measurement of changes in the natural environment as well as human health, taking account of how people respond to intervention and how much the population values each change. Much of the work consists of careful accounting, ensuring that all units of measure consistently work as intended. Monetary values should measure real purchasing power for the average of all goods and services used by the population, and natural units should be converted to whatever measurement scale reflects the purpose of intervention.

Economic analysis of cost-effectiveness can help citizens, activists and decision-makers of all kinds understand why existing policies were chosen and help improve those choices in response to new challenges. This chapter focused primarily on improving average or total outcomes for entire populations, which depends critically on variation among people and over time as discussed in the next chapter.

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