

Chapter 18

Global public goods

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1 Introduction

Euro uncertainty ‘undermining recovery’

BBC News 2012

World Bank’s Jim Yong Kim:
‘I want to eradicate poverty’

Guardian 2012

Lagarde: Huge legacy of public debt could
sink [global] recovery

Guardian 2012

Threat of US-China trade war hangs over
dealings of century’s superpowers

Guardian 2012

Oceans on brink of catastrophe

Independent 2012

While governments make decisions about how to run their own economies, some of the most worrisome problems affecting our societies and economies these days cannot be solved within the borders of each country. Their impacts are global and have far-reaching consequences. Failing to stabilise the euro and public debt in developed countries affects the global economy. Failing to preserve fish and fauna and their reproduction will eradicate a natural resource for future generations, and create worldwide starvation and inflation. Failing to establish trade policies that allow countries to find demand for their products will reduce worldwide output and create imbalances, poverty and instability, affecting all countries, even exporting countries,

adversely. This book ends with an appraisal of the limits and opportunities that these global problems impose on governments: how can they cooperate in seeking solutions to these problems, and what are the difficulties in doing so?

One of the recurring themes throughout both books is the question: what can governments do? In Parts 2 and 3, you examined how governments use fiscal and monetary policy to influence unemployment, inflation and economic growth. In Part 4, you saw how government policy influences the actions and performance of firms and markets; and in Part 5, you have seen how government policy shapes international trade, income inequality and the distribution of public goods. This chapter moves beyond thinking about what governments can do, towards a position of what governments can do, or should do, together, and why they have to.

With constant advances in technology, communication and transportation, there is increased interdependence between economies. It will be argued that solutions to many current economic problems require a more collective response through governments cooperating with each other; or perhaps on a gloomier note, solutions cannot be found without this cooperation.

To examine the possibilities for such cooperation, I use the notion of public good to develop what is meant by a global public good, and I use game theory to represent economic situations where global public goods are at stake. I will therefore develop the material on public goods and game theory that was initiated in Chapter 17 in order to understand better some of the greatest challenges faced by national economies today.

The learning outcomes for this chapter are:

- to understand global public goods and global commons problems as applications of the prisoners' dilemma
- to know and be able to identify global public goods and the free rider problem
- to develop further understanding of the notion of Nash equilibrium, and use it in solving games
- to understand collective action games as games with many players
- to understand how outcomes may change when players interact more than once

- to recognise that outcomes and payoffs may vary when games are played by different players with their own cultures, experiences, beliefs and norms.

2 Understanding global public goods

What is at stake ... is not the stability of Greece. It's not the stability of the Eurozone. It's not the future of the Euro. It's actually the stability of the global economy. Because, if things go south, all economies will be affected.

(Lagarde, 2011)

Chapter 17 distinguishes between private goods and public goods. It explains that the distinction between private goods and pure public goods rests in two properties of public goods: non-rivalry and non-excludability. Public goods tend to benefit everyone, and preventing people from using them can be very costly, if this is even possible. At the same time, this means that each individual person's benefit cannot exclude others or reduce the benefit of others. Every Eurozone country is connected, through trade, investments, charities or migration, so every Eurozone country is affected by financial instability. But the Eurozone does not exist in isolation – an unstable euro and a financially unstable Eurozone can cause spillovers to other countries: demand for Eurozone exports may decrease, Eurozone imports may decline, and tourists, investors and migrants may go elsewhere. What happens in the Eurozone affects many countries far beyond its borders. The Eurozone's connectedness and the global nature of the financial crisis is the essence of Christine Lagarde's (2011) message: the collapse of Greece or the disruption of the financial stability of the Eurozone has far-reaching implications. The Eurozone's connectedness makes financial stability a global public good – a public good that is non-excludable and non-rival on a global scale. As the Nobel laureate Paul Samuelson once described global public goods:

What great blessings or scourges have befallen humanity? Consider issues as disparate as greenhouse warming and ozone depletion, the Internet and William Shakespeare, terrorism and money laundering, the discovery of antibiotics and nuclear proliferation. Each is an example of a complex system whose effects are global and resists the control of individuals and even the most powerful governments. These are examples of global public goods, which

are goods whose impacts are indivisibly spread around the entire globe.

(Paul Samuelson quoted in Nordhaus, 2005)

Activity 18.1

The Samuelson quote highlights several important features of global public goods. List the ones that you can identify.

Answer

Samuelson gives examples of public goods that are global in their impact: though they may arise from the actions of individuals they affect everyone across the world. His examples include public ‘bads’, such as global warming, and public goods that are beneficial, such as the decline in deaths from infections after the invention of antibiotics. Because public goods like these are non-excludable, cannot be appropriated or owned, their provision or control cannot rely on any single group of countries or people, but must emerge from collective awareness and effort that crosses national borders. These dynamics lead to the main difference between a public good that has local or national effects, as discussed in Chapter 17, and a global public good. While national policies and government incentives can lead societies to produce or consume the right level of national and local public goods, they are much less successful when it comes to global public goods. These goods are global not just in their effects, but also in the solutions that they require.

Debates rage over whether the solution to some of today’s global public goods problems should be left for countries with a historical responsibility to solve, or whether Coase’s theorem (which you met in Chapter 17) should be applied and countries who benefit the most from public goods be left to negotiate with others to sustain the global public good. In this chapter, I steer clear of the long debate about the ethics of public good provision. However, the debate highlights one of the fundamental problems in providing global public goods: who should contribute to their provision, and are incentives in place to ensure that countries contribute? I turn to this problem next.

3 Revisiting the prisoners' dilemma

If costs of a global public good are borne by a few, but benefits remain non-excludable, then those who bear the costs will see their own benefits decreased by having to pay for its provision. But if they don't bear the costs, then there is a chance that the global public good does not get produced. You came across this problem when you analysed the prisoners' dilemma in Chapter 17.

Recall the game between Robin and Cal where they have to decide whether or not to contribute to a public good. The rules are simple: as long as one player contributes, the public good is provided to both players. The contributor bears the whole cost of the public good if the other does not contribute, and being the only one bearing the whole cost is the worst possible scenario for either player. No player wants to be the 'sucker'. Each player's most preferred scenario is the opposite: to free ride and benefit from the public good while the other player foots the bill. The best outcome for society is when both players contribute. The payoff matrix analysed in Chapter 17 is reproduced in Figure 18.1.

		Cal	
		Contribute	Refuse
Robin	Contribute	2, 2	-1, 3
	Refuse	3, -1	0, 0

Figure 18.1 A prisoners' dilemma game demonstrating the problem of resourcing public goods

I will start from the socially optimal scenario where both players contribute. As discussed in Chapter 17, this cannot be an equilibrium of this game because, individually, both players would want to change their strategy and avoid contributing. Consider what Robin would do. Robin's payoffs show up first in each cell (the red player, with red payoffs). The payoff received by Robin depends on what Cal does. So when Cal is contributing (first column), Robin gets 2 if she contributes, but she gets 3 (bottom left cell) if she moves away from the socially optimum scenario and tries to free ride. If you now look at what Cal will want to do (the blue player, with blue payoffs, after the comma), you can see that it works in the same way. When Robin contributes (first row), Cal gets 2 when he contributes but 3 (top right cell) if he tries to free ride.

So both players would want to unilaterally change their strategies and would not end up in (Contribute, Contribute).

3.1 Finding the Nash equilibrium of a game using best responses

The example in Figure 18.1 shows that the temptation to free ride can undermine socially optimal outcomes, but it does not reveal the solution of the game. In Chapter 17, Section 4, you learned how to solve the game by checking for each cell whether either player (or both) wants to unilaterally deviate. If not, then the combination of strategies related to that cell is a Nash equilibrium. You also learned that when both players have a dominant strategy, there is one and one only Nash equilibrium, which is when players choose their dominant strategy.

Activity 18.2

Is (Refuse, Refuse) an equilibrium in dominant strategies?

Answer

An equilibrium in dominant strategies occurs when each player's strategy does not depend on what the other player might do. This means that each player will always do the same thing, regardless of what the other player is doing. Consider what that means for the payoff matrix here. Robin will have a dominant strategy if she always prefers to contribute, or always prefers to refuse, whether Cal chooses to contribute (first column) or to refuse (second column). So to find out what Robin will want to do, I have to concentrate on how Robin strategically responds to Cal (what is Robin's best response to each of Cal's actions), and see if these responses are the same regardless of what Cal does.

If Cal contributes, then Robin prefers to refuse (Robin prefers to free ride), getting 3 instead of 2. When Cal refuses, Robin prefers to refuse too, getting 0 instead of -1. The red numbers corresponding to these two responses (3 and 0 along the bottom row) are underlined in Figure 18.2 to show they are both in the same row, namely Robin's Refuse row. Visually, I have established that the way Robin's strategy depends on what Cal does is given by best responses along the same row. This is how one identifies dominant strategies: the row player has a dominant strategy when the best responses are along the same row. Correspondingly, the column player has a dominant strategy when the best responses are in a column. In fact, Cal will also prefer to refuse no matter what Robin does. This can be seen in Figure 18.2 by the

underlining for the column player of the blue payoffs corresponding to Cal's best responses.

		Cal	
		Contribute	Refuse
Robin	Contribute	2, 2	-1, <u>3</u>
	Refuse	<u>3</u> , -1	<u>0</u> , <u>0</u>

Figure 18.2 Solving a prisoners' dilemma, underlining best responses

So (Refuse, Refuse) seems to be the dominant strategy equilibrium of this game, because that is what both players will do no matter what.

You can see that (Refuse, Refuse) is also a Nash equilibrium. To show this, I will check whether Robin or Cal will want to unilaterally change strategy at (Refuse, Refuse). If Robin changes to contribute, her payoff will drop to -1 , and the same is true for Cal. So the dominant strategy equilibrium is also a Nash equilibrium, as you saw in Chapter 17. You can see that the Nash equilibrium of the game is also found when both payoffs in the same cell are underlined: both players' best responses intersect at points of equilibrium from which neither player wants to deviate. This suggests another way of identifying Nash equilibria:

- Find the best responses of each player to what the other is doing, and underline the payoffs of these best responses.
- Check which cells have both players' payoffs underlined.
- *All* cells with *both* payoffs underlined are Nash equilibria.

This method of finding Nash equilibria applies to all games that are played simultaneously and only once. It can be used when players do not have a dominant strategy, when there is more than one equilibrium in the game, or to find that there is no equilibrium at all. Throughout this chapter, I will use this method of solving games to illustrate the difficulties in sustaining and preserving some important examples of global public goods. The three examples of free trade, fisheries and financial stability will be used.

Activity 18.3

To what extent do you think free trade, international fisheries and financial stability are global public goods?

Answer

All of these examples could be argued to be global public goods, but with different characteristics and different problems. Free trade has the characteristics of a global public good because free trade can promote growth worldwide with the potential for all to benefit. Countries that are open to trade can expand the markets for their products and their economies can grow; and, due to comparative advantage, resources can be used more efficiently worldwide when countries specialise in the production of goods and services in which they have a comparative advantage, and import goods where they do not. Apart from the direct benefits from trade, by stimulating growth in trading countries, trade generates more output and income worldwide (despite the difficulties regarding effective redistribution of the gains from trade across countries, discussed in Chapter 15).

International fisheries are a different type of a global public good. Because fishing and the use of the sea is a non-excludable good, all individuals can catch as much fish as they want. Fish is, however, a rival good: the fish caught by one fishing boat prevents another fishing boat catching that same fish. This type of public good is called more precisely a common resource good or commons.

Financial stability could also be argued to be a global public good. At the level of an individual bank, its actions lead to profits (or losses) for that institution, yet a bank's actions can also affect others outside its trading network. In a financial system that is globally connected, there are significant negative externalities when individual banks collapse, and these negative externalities take the form of public 'bads' – as one bank does worse, it calls in the loans that it gave to other banks, which means that other banks must call in their loans, and so on until a systemic banking collapse may result and no-one can avoid the effects. In recent years, many of us have experienced first-hand the troubles of interconnected banks and financial instability, or of individual banks undermining global financial stability.

There are other global public goods that present more fundamental challenges to governments, such as maintaining peace and eradicating hunger and preventable disease, as well as reducing global poverty.

However, the focus in this chapter is on these three examples – a less ambitious aim, but nevertheless very challenging, as each case has its own particular features that need to be explained in the context of global cooperation.

3.2 Free trade

In the final decades of the twentieth century and early decades of the twenty-first century, the insight that free trade is beneficial is at the heart of the EU's internal market. The member states of the EU have each committed not to impose tariffs on the other member states of the union. Free trade in the internal market is a good – a public good – that provides benefits to all the member states of the EU. Each member can access the markets of the other states without tariffs impeding their trade.

Worldwide, a majority of countries are currently members of the World Trade Organization (WTO). At the time of its creation, the WTO's predecessor body, the General Agreement on Tariffs and Trade (GATT), had succeeded in reducing worldwide tariffs by one-third, had made some progress at reducing agricultural subsidies in developed countries, and had succeeded in having Japan and South Korea agree to lower barriers on rice imports (Wydick, 2008, p. 240). The WTO was created with the following five principles in mind:

- Trade would not discriminate between domestic- and foreign-produced products.
- Freer trade is ultimately better for the world.
- There should not be any uncertainty in the terms of trade and trade policy.
- Trade should foster competition.
- Priorities of developing countries can allow for privileges in setting trade agreements.

With the WTO having 157 members in 2012, and all decisions being agreed unanimously, it is impressive that there are still several success stories in reducing barriers to trade. But not all initiatives have been successful. As discussed in Chapter 15, governments have strong national interests in protecting some of their producers and their own labour force from worldwide competition. Countries will more likely be net importers if world prices for goods consumed domestically are lower than domestic prices, and more likely to be net exporters if world

prices for goods consumed domestically are higher than domestic prices. Reducing barriers to trade means that consumption can occur at lower world prices rather than at higher domestic prices.

As Chapter 15 discussed, freeing trade can therefore raise global social welfare, but there are major redistributive effects within and between countries. As Figure 15.5 in Chapter 15 showed, when world prices are below domestic prices, consumers benefit from free trade through lower prices. However, domestic producers lose out, as sales fall. If producers do not improve productivity or find new markets, unemployment may rise.

The political pressure in import countries to protect domestic producers is often the main argument leading countries to implement protectionist measures and undermine free trade. But the response to this incentive, by compromising trade flows between countries, will dictate how open to trade all countries decide to be. Trade policy thus involves a strong element of strategic behaviour. These strategic choices in trade policy can be explained using a payoff matrix, such as the one shown in Figure 18.3.

		USA	
		Low tariffs	High tariffs
China	Low tariffs	400 , 400	200 , 500
	High tariffs	500 , 200	300 , 300

Figure 18.3 China and the USA choosing tariffs (payoffs in billions of dollars)

In this hypothetical example, China and the USA could raise tariffs on each other's traded goods. Let each country have the option of keeping low tariffs or imposing high tariffs on the other country. The outcomes for the two countries are interdependent because the best action for each one depends on what the other country does. There are four possible outcomes in Figure 18.3, with payoffs to each country in billions of dollars. You can think of these payoffs as the social welfare gained by each country in each situation.

When both countries choose low tariffs, this is the socially optimum free trade scenario with benefits in both countries. However, each country will have an incentive to free ride and unilaterally impose high tariffs. If one country imposes high tariffs and the other does not, then

the country that keeps its tariffs low will be in the worst possible scenario. When both countries impose high tariffs, they both lose the benefits from free trade.

Activity 18.4

Find the Nash equilibrium or equilibria of this game.

Answer

The easiest way to look for a Nash equilibrium is to find each player's best responses to each of the other player's actions and see which cells, if any, have both payoffs underlined. So starting with the row country, China, I will look at what it prefers when the USA keeps tariffs low (comparing first red payoffs in the first column) and when the USA imposes high tariffs (comparing first red payoffs in the second column). In both cases, China prefers to impose high tariffs. To impose high tariffs is therefore China's dominant strategy. Similarly, to impose high tariffs is the USA's dominant strategy (comparing second blue payoffs first in the first row, then in the second). It turns out that the only cell where both payoffs are underlined is when both countries play their dominant strategy (High tariffs, High tariffs). Thus to impose high tariffs is each player's best response to their opponent. (High tariffs, High tariffs) is therefore the Nash equilibrium of the game. The best responses of each player and the equilibrium of the game are presented in Figure 18.4.

		USA	
		Low tariffs	High tariffs
China	Low tariffs	400 , 400	200 , <u>500</u>
	High tariffs	<u>500</u> , 200	<u>300</u> , <u>300</u>

Figure 18.4 China and the USA choosing tariffs – best responses and Nash equilibrium

The choices that China and the USA face in the tariff game mirror the structure of the prisoners' dilemma. In games that have the structure of a prisoners' dilemma, players can choose to Cooperate or to Defect. In the public good game that you saw above and in Chapter 17, players cooperate if they contribute to the public good and defect if they don't.

In the tariff game, 'Low tariffs' is equivalent to Cooperate, and 'High tariffs' is equivalent to Defect. The socially optimal outcome where both countries keep tariffs low (cooperate) cannot be reached because individually each country has an incentive to raise tariffs (defect) and try to free ride. If the other country is imposing high tariffs, then there is also an incentive to choose high tariffs to avoid being the sucker bearing all the costs of doing the right thing. In games with the prisoners' dilemma structure, these two forces – the free-riding incentive and the sucker payoff – lead to very gloomy outcomes in which global public goods are not provided and global cooperation is undermined.

3.3 Fisheries

The discussion of free trade as a global public good led to a conclusion that the likely outcome was that free trade would be undersupplied. A variation on public goods is that of commons goods or a commons. A commons is a good that no one individual owns, and consequently that many people have access to and can use. Commons goods are non-excludable and so share some properties of public goods. However, their benefits are rivalrous because as one person, state, firm or organisation consumes a common good, the benefits to others or the total stock of the good decreases. So even though commons can benefit anyone, whoever benefits from consuming the good reduces the benefit of others. Commons are like private goods that anyone can access.

Commons problems have a long history in political philosophy and economics. During the twentieth century, these problems were made notorious by Garrett Hardin in his 1968 paper 'The tragedy of the commons'. Hardin was an ecologist. He argued that if many people all used the same common resource, then the resource would deplete over time. Where the dynamics of public goods like free trade would lead to undersupply, commons goods would lead to overuse.

Hardin's original example involved a common resource – land – where herders could take their cattle to graze because the land was non-excludable. A herder receives private benefits from his cow grazing on the common land because his cow is fed and feeding the cow on the common land costs the herder nothing but time – he does not incur a cost to produce the grass on the common land. But common land is rivalrous, so when a herder allows his cow to graze the common land, he decreases the amount of grass available to others for their cattle, therefore decreasing the potential benefit to other herders. Eventually,

given how tempting it is to use a common land for cow grazing, all herders will do so, overgrazing the land and deteriorating the quality of the land for future use until the grass no longer grows and the commons good disappears. Hardin argues that overgrazing on common land highlights a problem of overexploitation more generally:

[T]he inherent logic of the commons remorselessly generates tragedy ... Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.

(Hardin, 1968)

The international waters of the large oceans of the world offer a different example of a resource that no one owns, but which fishers from every country can exploit if they so choose. Fisheries in international oceans are common property and non-excludable, but as explained above they exhibit rivalry. As more and more fishers catch the fish, the total stock of fish decreases. Identifying the global commons and analysing the incentives that people face – the costs and the benefits – shows the ways in which over-fishing can emerge as a consequence of each fisher following their self-interest. Though no individual fisher plans to over-fish, over-fishing emerges on aggregate from the incentives faced by all fishers.

For example, as Vidal (2012) argues in *The Guardian*, for many years the seas off the coast of Mauritania in West Africa have provided local fishermen with the resources that they need to sustain their daily lives: enough fish for their families and some to be sold at local markets. But the number of boats on the seas has begun to change. Trawling the Mauritanian waters are massive Russian, Chinese, Korean, Japanese and EU fishing boats. These international fishing boats scour the Mauritanian seas for fish to be sold on international markets. The Mauritanian government reassures its people that as the international fishing fleets trawl deep waters, they cannot affect the fish caught by the locals. The local fishermen, however, claim that they are catching fewer and fewer fish as the number of international fishing boats increases. The challenge that a country like Mauritania faces is a consequence of the tragedy of the commons – the destination of ruin that Hardin



describes when property is common and society permits free access to all.

According to the United Nations Environment Programme (UNEP) report *Towards a Green Economy* (2011, p. 85), the top five fishing countries are Russia, China, the USA, Japan and Taiwan. As shown in Figure 18.5, the amount of fishing along the coasts of China, Japan and Korea is incredibly large and has been intensifying over the decades.

The UNEP (2011) report argues that in order for there to be any kind of concerted control of fisheries, the 'top fishers' must be involved. Game theory and the prisoners' dilemma can illustrate why cooperation between these countries will not happen unless additional mechanisms are put into place. Consider a game between two of the world's top five fishing countries, Japan and China. In estimates from data in 2005, China and Japan 'land' the most valuable fish, at \$15.2 billion (China) and \$14.4 billion (Japan) in 2005 US dollars.

But, as also discussed in the UNEP (2011) report, because so much fishing goes on in the areas close to Japan and China, the risk of the fish populations along those coastlines 'crashing' is very high. When a fish population crashes, the population suddenly disappears and the likelihood that it will recover in the near future is very low. So China and Japan need to choose whether or not to adopt sustainable fishing policies, i.e. choose between the two actions 'Limit fishing' and 'Over-fish'. Because the outcome depends on whether or not populations will

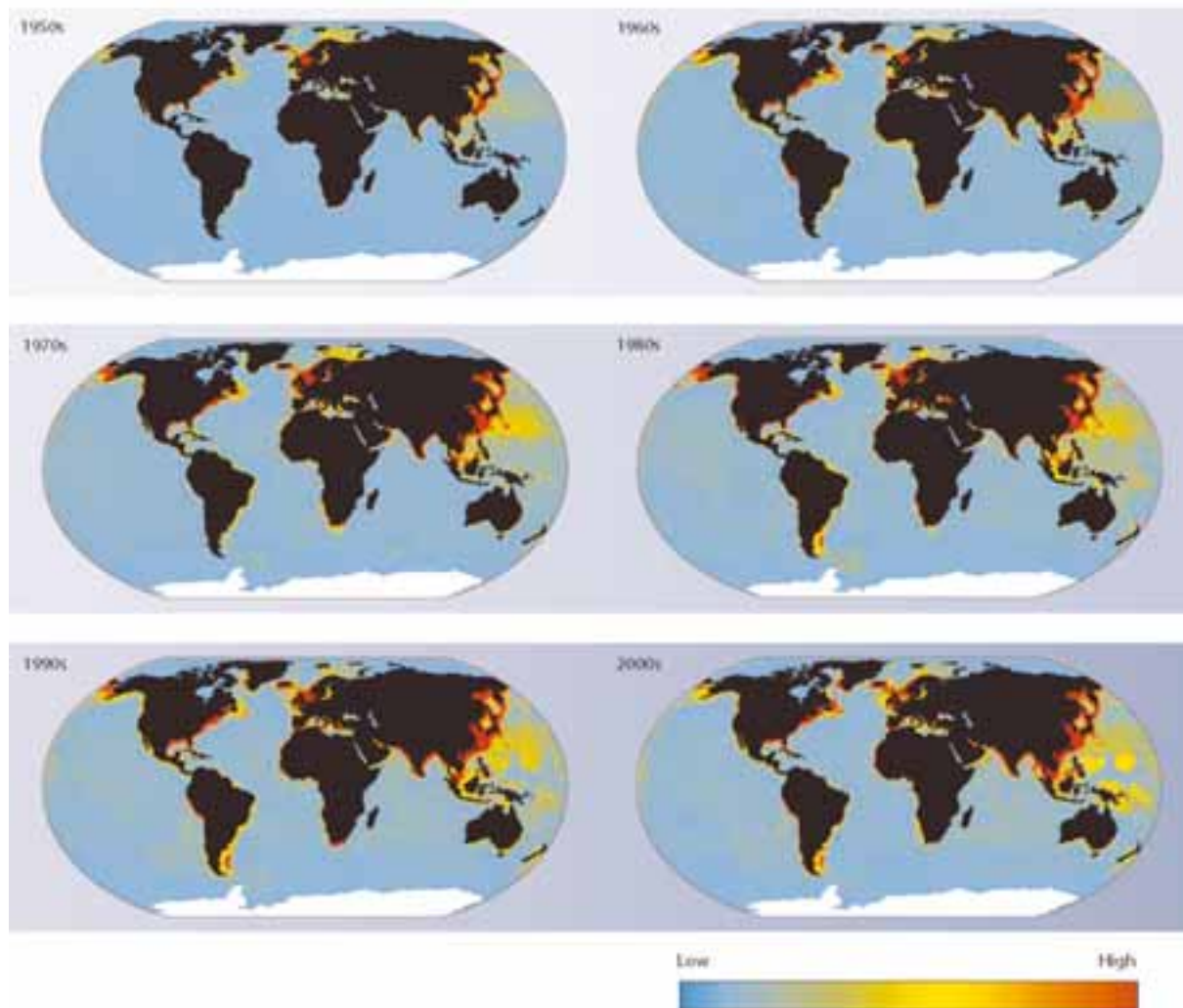


Figure 18.5 The distribution of the value of fish caught internationally, 1950–2010

(Source: Sumaila, 2011, Figure 2)

crash, I will consider a simplified game for the sake of illustration. Suppose that it is known that the fish populations on the coasts of China and Japan will crash if both countries continue to over-fish. If one country limits fishing and the other does not, then the country that limits fishing will lose the profit of not having fished more, and it will lose its own fish population because the other country will take over its coast. If both countries limit fishing, then they will make lower profits in the present, though their profits might be more sustainable and

therefore higher over the long run. So the payoffs of this game might be as shown in Figure 18.6.

		China	
		Limit fishing	Over-fish
Japan	Limit fishing	8 , 8	2 , <u>10</u>
	Over-fish	<u>10</u> , 2	<u>3</u> , <u>3</u>

Figure 18.6 Japan and China fishing game (US\$ billions)

This game also has the structure of a prisoners' dilemma. The social optimum occurs when both countries adopt sustainable fishing policies and limit fishing, but there is an incentive to unilaterally deviate from this optimum and try to free ride by choosing to over-fish. Over-fishing, no matter what your opponent does, is the dominant strategy for both countries, which leads to an outcome where countries continue to fish to the tragic end of fish commons.

3.4 Financial stability in the Eurozone

You have seen examples that explain why free trade may be undersupplied and international oceans over-fished. A third example refers to the global public good that collapsed in 2008 – financial stability. At the time of writing, the Eurozone has been caught in a crisis of its own, which several critics consider to be self-created:

The crisis 'is having tremendous impact in the state of affairs, it is pushing the EU into a lasting depression, and it is entirely self-created,' Soros, Chairman of Soros Fund Management, said at a luncheon hosted by the National Association for Business Economics.

(Wearden, 2012)

When countries joined the Eurozone, they signed a pact that required low public deficits. With the crisis of 2008, a lot of countries saw their public deficit pass the threshold, and several countries were finding it hard to pay off the debt. Greece and Portugal were two of the first countries that showed signs of unsustainable structural deficits and thus

high levels of debt. For the sake of financial stability across the whole Eurozone, a dominant view was that a country should reduce its deficit and pay off its debts; then it would regain its reputation in the financial world and contribute to the Eurozone's financial stability. However, if a country were to adopt 'austerity measures' and pay off its debts too quickly, then doing so might initiate a recession or even a depression, with consequent unemployment and lower provision of social services. The country's government would find it very difficult to decrease unemployment without further public spending, which would once more contribute to increasing the country's deficit, overall debt and threaten Eurozone stability. But high unemployment and decreased access to social services could trigger social upheaval and political unrest. So while the global public good of financial stability (and the terms of the Eurozone agreement) would require a country like Greece or Portugal to endure economic hardship while paying its debts, the country may experience political and socio-economic pressures within its own borders to avoid paying the debt.

To illustrate the dilemma faced by these countries and their difficulties in paying their debts, consider another game with two players, Greece and Portugal, where each player has two actions to choose from: to pay debts or to not pay debts. It is assumed that the failure to pay its debt could be sufficient to trigger a Eurozone crisis but probably falling short of total collapse. If neither pays, then the Eurozone collapses and financial markets worldwide are affected. If both countries pay, then they do what is socially optimal and preserve financial stability, the integrity of the Eurozone. The stability of the Eurozone will help them to recover from the economic sacrifice of having paid. In the meantime, the countries have to deal with political unrest and social upheaval. If only one country pays, then the paying country has the worst possible outcome, with social upheaval within its own borders and financial instability just the same, which prevent quick recovery. The free rider, however, is in its best position, because it avoids internal problems and the Eurozone does not collapse completely.

The payoffs shown in Figure 18.7 provide a simple illustration with numbers that are ranked consistently with the economic situation. This game still has a prisoners' dilemma structure, with a free-riding incentive to defect, and the sucker effect of being cooperative when the other player is not.

		Portugal	
		Pay debt	Don't pay debt
Greece	Pay debt	1, 1	-3, <u>2</u>
	Don't pay debt	<u>2</u> , -3	<u>-1</u> , <u>-1</u>

Figure 18.7 To pay or not pay your debts

So as long as countries weigh the consequences of their actions in the way described, both countries would always choose not to pay, regardless of what the other country does. The Eurozone collapses.

4 Strategies for cooperation

People often think: ‘I don’t behave like that – I cooperate with my family, friends and even people I don’t know.’ This section discusses some of the reasons why you may indeed cooperate, and strategies that may help to get governments and communities working together.

4.1 Rewards and punishment

Governments, societies and families all come up with ways to reward and punish people playing everyday games or complicated and politically important games. You may ask why the punishments and rewards that you have experienced are relevant to economics. The answer is that rewards and punishments change the payoffs and rules of the game, and can increase the appeal of outcomes that are better for society.

Returning to the problem of international over-fishing, Khan et al. (2006) discuss subsidies in fishing industries, saying that there are ‘good’, ‘bad’ and ‘ugly’ subsidies. Subsidies can act as rewards for the players in a game: good subsidies create incentives to enhance cooperation, while poorly designed subsidies can jeopardise cooperation.

Subsidies are not the only method by which government can change the incentives that fisheries and players in other prisoners’ dilemmas face. For example, with fisheries, many governments have instituted systems of fines for fishers who are caught with too many fish or fish that are protected. These kinds of penalties are meant to reduce the free-riding incentive, and to discourage fishers from over-fishing.

Activity 18.5

Recall the Japan and China fishing game. What would be the equilibrium or equilibria of this game if fines of US\$5 billion were subtracted from the payoffs of countries that fish beyond their quotas? The payoff matrix is shown in Figure 18.8.

Answer

If fines are subtracted from the payoffs, then the payoffs from fishing over quota are much lower.

Now, when China remains within the quota, Japan also prefers to remain within the quota because the incentive to free ride disappears when the fine is high enough. When China breaches its quota, Japan continues to

		China	
		Limit fishing	Over-fish
Japan	Limit fishing	8, 8	2, 5
	Over-fish	5, 2	-2, -2

Figure 18.8 Japan and China fishing game with fines (US\$ billions)

prefer to stick to the rules. China will want to respond in the same way and stick to the rules by limiting fishing. The game is not a prisoners' dilemma any more because there is no longer an incentive to free ride. The players have a different dominant strategy, which is to always cooperate and remain within quotas. So the game has a unique Nash equilibrium (Limit fishing, Limit fishing), and that equilibrium is socially optimal.

You might wonder who would administer a system of fines like those described in the activity above. Typically, when two agents play a game like this within national borders, it is the state – the police, judiciary, etc. – that enforce fines and punishment. Globally, the problem is more complex and requires multilateral institutions like the UN and the WTO. International organisations like the WTO, by not responding to the interests of a single country, and by having interests that transcend national borders, can more easily enforce fishing quotas and punish countries that breach them. As long as an institution like the WTO can credibly enforce punishment, countries may come together and achieve the socially optimal outcome.

4.2 Collective action

The problem with penalties and rewards, or fines and subsidies, is that the regulatory bodies – often the government or international institutions – have to spend lots of money on the subsidies and on monitoring, detecting and meting out the rewards or punishment. In this subsection, I want you to reflect on the generic strategies of the prisoners' dilemma game: Cooperate and Defect. As you saw in Section 3.2, the strategies Contribute and Refuse used in the public good game can be interpreted as Cooperate and Defect. Contribute is renamed Cooperate in order to convey the sense that there exists an

agreement to cooperate between the players, but from which players can choose to defect. Defection undermines cooperation, rather than players simply refusing to contribute to a public good. If you are one of many players in a game, then it can be very difficult to detect when one of your opponents defects. In global commons problems there are many, many players who are simultaneously trying to monitor each other and understand each player's behaviour. In this context, what might help to solve the commons problem? In this subsection, I discuss some *decentralised* solutions for when centralised institutions like the WTO or UN are unable to monitor all the players all the time to ensure that all players cooperate. The centralised institutions recognise that there are many factors outside of their control, and that sometimes delegating control to local communities can help to solve commons problems.

Activity 18.6

Read the following extract from a *New York Times* article. Explain what certain countries are trying to do to create a 'win-win' scenario to overcome the problem of over-fishing.

How to catch fish and save fisheries

The good news is that many large commercial fisheries are already benefiting from the improved management of the last decade. The harder problem is with smaller-scale fisheries that local communities rely on for food and income. The fact is that small-scale fishers – who fish within 10 miles of their coast – account for nearly half of the world's global catch and employ 33 million of the world's 36 million fishermen, while also creating jobs for 107 million people in fish processing and selling. Mostly poor, they live mainly in areas lacking fisheries management, monitoring and enforcement. No one is in a position to formally declare their fisheries 'disasters.' They must just endure their situation. Or – take control of it.

A rising tide of local communities is doing just that. Here's the emerging recipe proposed in [a study in the journal *Science*]: Give local fishers exclusive access to their fishing grounds in the form of territorial use rights, or TURF.

In exchange for the privilege of exclusivity, local fishermen agree to establish and protect no-take zones. Results include increased

fish populations, richer marine habitats, and coastlines less vulnerable to climate change – and more food for people.

Unleashing the self-interest of local fishermen to advance both conservation and economic development can create one of those rare win–win scenarios.

A growing body of research shows that fish populations inside a no-take zone can more than quadruple. Fish numbers outside the reserve can double. And, exclusive access enables investment and better management, increasing the catch's value.

It works. We've visited several local fisheries in Mexico and the Philippines this year – with heads of leading research institutions, NGOs [non-government organisations] and government agencies – and in each case, we witnessed increasing fish populations, increased catch value and better-protected reefs.

TURF reserves are not a silver bullet. They might, however, be the silver buckshot. With nearly one billion people reliant on the ocean for their primary source of protein, stakes are high. If the most fish-dependent nations adopted widespread networks of TURF Reserve, they can potentially create enough fish recovery to feed hundreds of millions of people.

(Source: Safina and Jenks, 2012)

Answer

The start of the *New York Times* article says that in order to face the disastrous evolution of fisheries head on, many communities are adopting local institutions of monitoring and punishment. These institutions – called TURFs – delegate to each community the ability to monitor and evaluate their own fisheries, while also allocating to them the rights of control and 'residual claimancy' over the products of their local fisheries. A residual claimant on production is entitled to the profits on the output of that production process. Hence the name TURF – territorial use rights fisheries. Already seeing success in Mexico and the Philippines, TURFs help local communities to take control of their own destinies, while also aligning their incentives with preserving global populations of fish.

Why might a solution like this work? I discuss the problem in general below, and also describe why the proposed solutions seem to be succeeding.

The communities that took control of their local fisheries had to agree to a condition: to establish and protect ‘no-take’ zones in which the local fishers would not fish. Consequently, it would be in the local fishers’ interests to maintain the no-take zones and ensure that the local fisheries did not get over-fished. In maintaining no-take zones, the local fishers would be able to maintain the rights over local fisheries. The no-take zones are occasionally checked by third party observers. These third parties judge whether or not the zones have been adequately cared for. If the no-take zones are not cared for, then the third parties revoke the local fishers’ rights to fish. The study published in the journal *Science* (Costello et al., 2012) concluded that local fish populations have grown, richer marine habitats have flourished, and the coastlines appear to be less vulnerable to climate change. If only all commons problems could have so simple a solution.

Commons problems and global public goods problems tend to be more complex than our example of fisheries and TURFs. For instance, global commons and global public goods problems tend to involve many countries, many governments, or many organisations. In these cases, often called collective action games, it is more difficult to achieve a socially optimal solution. The collective nature of the outcome means that the accountability of each player to the final outcome decreases as the number of players increases. When there are more players, it is easier for players to defect and for their defection to go unnoticed, which makes the problem all the more challenging. A solution like the TURFs described above makes sense because a third party decentralises the challenge that it faces by delegating the solution to communities. In small communities, people can monitor each other more easily and defection is much more likely to be noticed. Internationally, if lots of communities monitor themselves, then society will be more likely to obtain a win–win outcome. No third party by itself can monitor everyone, so if each community self-monitors, then the third party’s job is a lot easier.

Consequently, in collective action games, players may invest in technologies to detect players who defect so that the players who cooperate can punish the players who defect. Alternatively, when players are unable to detect defection, the players may delegate the role of policing and enforcing cooperation to a third party. International

institutions such as the International Maritime Organization, which monitors international fishing, aim to police member states. Similarly, the WTO, which monitors and tries to regulate multilateral trade agreements, uses the Dispute Settlement Mechanism to examine situations in which one government claims that another government has contravened the rules of the organisation – for example, by imposing an unfair tariff on a foreign country or by allowing firms to dump subsidised goods at low prices in foreign countries. In all of these organisations, being a member state requires the members to adhere to judgements made by the enforcement arm of the organisation. For cooperation to succeed, enforcement must involve punishing players who defect (or rewarding those who cooperate). Within society, citizens delegate enforcement to third party institutions – like the police and the judiciary – because the players themselves are unable to sustain cooperation without these institutions.

4.3 Changing beliefs and norms

Did you know?

Harambee is a Swahili word denoting a project to which everyone – originally everyone in a rural Kenyan village – ought to contribute. Consequently, many Kenyans view public goods as harambee – as something that they should support.

In contrast to the large third party monitoring and enforcement operations of the WTO and the UN, TURFs in communities in the Philippines and Mexico exemplify how people in communities can come together and agree on the ‘rules of the game’ that will govern their behaviour when it comes to common or global public goods. Such agreement often occurs when communities are homogeneous and composed of people who are similar in the way they perceive the problem and its challenges. For many Kenyans, the notion of free riding on the contribution to a public good is not part of their language, and therefore is not likely to be part of the way they would respond to the challenges faced worldwide about sustaining global public goods with individual contributions. In such societies, cooperation is more likely to occur, and to be ensured by social norms that condition the way people want to behave.

Similar norms appear in many societies, from who gets to graze their sheep and how long they may do so in villages in the Swiss Alps, to the Amish raising barns in rural North America, to the division of meat among the Lamalera whale hunters in Indonesia. Institutions can play a role in supporting cooperation by influencing the evolution of social norms.



The trade and tariff example of China and the USA – two countries with a long, antagonistic history – provides a different set of problems. Political scientists and historians might say that interactions between China and the USA cannot be understood only as a prisoners' dilemma; they must be understood in the political and historical context that shaped current norms of behaviour. Similarly, norms play a role in how people in each country believe they ought to act, and how politicians on either side need to maintain a reputation in the context of these histories. No cultural, historical or political details are captured in the concise but clear model of the prisoners' dilemma.

4.4 A credible leader

The example of China, a major export country, and the USA, a major import country, also highlights a problem with which economists still grapple: what happens when the costs and benefits in an interaction are different? That is, what happens when some groups get large benefits while other groups get smaller benefits, or when some groups incur high costs while others incur low or no costs? What happens when

groups have different incentives? It is easy to see how this problem is magnified when the costs and benefits of many countries have to be considered. The negotiations between Eurozone members over the sovereign debt crisis at the beginning of the second decade of the 2000s were drawn out in part because the different members faced different costs and benefits of finding solutions. The European Commission or the European Central Bank (ECB) acting as a third party could monitor and set rules that member states should abide by, but individually countries could not agree on a solution. Each country's interests were not reconcilable in a way that allowed the countries to negotiate a solution.

The Eurozone example also illustrates an alternative solution to encourage a cooperative outcome: the nomination of a country or a group of countries to act as leaders. Leaders typically bear more of the costs of cooperating while others may gain more of the benefits. In the Eurozone, it might be argued that Germany is such a leader when it comes to stability of the euro and of the Eurozone economies.

As the economic powerhouse of the Eurozone, Germany is the source of much of the Eurozone's wealth. But as a leader, it must also shoulder the responsibility of sustaining the euro currency when other countries are either unwilling or unable to bear the costs of cooperation. For example, in the case of countries like Greece, Ireland, Italy, Portugal and Spain that did poorly during and in the aftermath of the financial crisis, their sovereign debt problems at the time of writing were at the core of the instability in the Eurozone, and in global finance. As the leader, Germany has had to help to 'bail out' the finances of countries with sovereign debt problems. Why would Germany bail out other countries? Germany might do so because the overall financial stability of the euro, from which Germany benefits greatly, requires the cooperation of the Eurozone's largest producer.

A similar argument about leadership can be made about the ECB's declaration of the Outright Monetary Transactions scheme. The scheme guaranteed that the ECB would buy unlimited amounts of European debt in order to ensure the monetary stability of the euro and therefore the economic stability of the Eurozone. Unlike Germany, the ECB does not have an economy producing final goods, but the ECB's continued existence depends on the Eurozone remaining financially stable.

The idea of leadership – like that of Mario Draghi for the ECB or Angela Merkel in Germany – also illustrates the idea that sometimes

players' payoffs may not be symmetric, like they have been in most of the examples used in this chapter. Sometimes, the payoffs may be structured so that the benefits and costs received by one player may be very different to those received by other players. In the case of the Eurozone, the benefits from having a stable euro received by Germany may be greater than those received by Greece. Consequently, Germany may be more willing than Greece to incur costs to maintain the large benefits of financial stability. Greece, however, might even be willing to drop the euro as its currency if the costs of retaining the euro become too high. It is a delicate balance of costs and benefits for each country, with each country recognising that the eventual outcomes are not dependent on any one of them alone. The countries of the Eurozone acting in concert are more likely to cooperate and produce a stable euro than each country trying to maximise its own national interests and undermining cooperation.

5 Conclusion

In his book *The Logic of Collective Action*, Mancur Olson (1965) argues that large groups attempting collective action will likely fail. However, since the book's publication, we have seen many examples of situations in which people in dire circumstances can join together and overcome public goods problems. Yes, public goods problems and commons problems present challenges to the most stalwart and generous of countries and people; but with rewards and punishments, monitoring and collective action, norms and leadership, people, organisations and countries can join together to overcome problems that, were they divided, isolated and merely self-interested, they might never have hoped to defeat.

Kofi Annan, former Secretary-General of the UN, provides an optimistic thought that is perhaps an apt end to this book:

It is not beyond the powers of political volition to tip the scales towards more secure peace, greater economic well-being, social justice and environmental sustainability. But no country can achieve these global public goods on its own, and neither can the global marketplace. Thus our efforts must now focus on the missing term of the equation: global public goods.

(Kaul et al., 1999)

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