PART I

Non-Intervention

CHAPTER 4

The Polycentric Production of Global Public Goods

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Introduction

What should be done to defend the Earth from asteroid impacts? How should we mitigate climate change and its consequences? How should we protect the ozone layer and prevent its destruction? What should be done to avert nuclear war? How can we maintain a peaceful, liberal international order? On the concrete level, these questions deal with disparate topics. Yet at the level of economic theory, all of them involve the question of providing public goods at a global scale (Kaul et al. 1999; Buchholz and Sandler 2021).

In Samuelson's classic formulation, a public good is non-rivalrous and non-excludable (Samuelson 1954). Let's consider each of these characteristics in turn. A good is non-rivalrous in consumption if one user's use or consumption of the good does not reduce the amount available for others. For instance, if the world is protected from a global catastrophic

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risk, the fact that I am protected does not render you any less protected. As for excludability, for some goods it is quite costly to exclude potential beneficiaries. For instance, if an organization successfully prevents nuclear war, catastrophic asteroid impacts, or catastrophic climate change, then everyone on Earth benefits, whether they paid for the protection or not. For these types of global catastrophic risks, it is not easy to protect some while leaving others vulnerable. The difficulty of excluding non-payers creates a "free rider problem." If I know that protection will be provided regardless of whether I contribute, then I have an incentive to spend my resources on other goods, and simply "free ride" on the contributions of others. As a result, many argue that coercion is necessary to force people to contribute to the provision of public goods.

For public goods that have a local, subnational, or national scale, the proposed means of coercion is typically a local government, state or provincial government, or national government. For global public goods, the problem is more challenging. If the United States government implements policies to reduce greenhouse gas emissions and thereby help mitigate climate change, then the governments of other countries may have an incentive to free ride off American efforts. Many international relations theorists characterize the international arena as "anarchic" (see Lechner 2017). There is no global government that can force us all to contribute to global public goods. While a global government seems infeasible, some advocate other binding, one-size-fits-all solutions to global public goods problems. Some such solutions involve nations agreeing to binding treaties. Others involve one nation-state acting as a global hegemon, exercising imperial domination over others to guarantee that global public goods are provided (Lal 2004; Ferguson 2004).

Are these the only viable options for providing global public goods? Are they the best available options? I argue that they are not. Instead of these relatively monocentric approaches, I suggest that polycentric approaches to providing global public goods are both feasible and more desirable than relatively monocentric approaches. I emphasize *relatively* monocentric because it is important to clarify that in a sense "all international-level policies are inherently polycentric because there is no world government, meaning that the international community of sovereign countries has always constituted a polycentric order" (Lofthouse and Herzberg 2023, 2). However, a set of policies that are established and enforced at the global level, whether via a treaty or a hegemonic empire, are *more* monocentric than policies that involve a

multiplicity of formally independent organizations pursuing diverse solutions at multiple scales. Among these relatively monocentric policies, a hegemonic empire is more monocentric than a treaty. The treaty arises from agreements among a multiplicity of states and non-state actors, whereas an empire involves the imperial hegemon using force to impose the plans of a narrow group of political decision-makers around the globe.

Advocates of one-size-fits all solutions, such as Lal (2004) and Ferguson (2004), may fear that more polycentric approaches to providing global public goods will fall short due to the free rider problem. However, there are a surprising number of ways that individuals and organizations within polycentric systems manage to cooperate from the bottom-up to overcome social dilemmas. This is a key insight throughout the scholarly work of Elinor Ostrom. Her work on polycentric systems began with studies of local public goods such as municipal policing, as well as various small and medium scale common-pool resources such as local water resources. However, later in life Ostrom turned her attention to global issues, arguing that polycentric approaches to addressing climate change were more promising than one-size-fits-all solutions (Ostrom 2009, 2012). This spawned a growing literature on polycentric approaches to providing the global public good of climate change mitigation (Cole 2011, 2015; Hamilton and Lubell 2019; Lofthouse and Herzberg 2023). I argue that the lessons from this literature apply to global public goods more broadly, including peace, security, and the mitigation of global catastrophic risk. Polycentricity therefore presents a viable alternative to both imperial hegemony and waiting for one treaty to solve global problems. Note that many scholars in international relations, political science, and political economy already recognize the promise of polycentric international governance, even if they do not explicitly use the word "polycentric." For instance, Lisa Martin (1999) explains that a substantial literature explores how nation-states can form self-enforcing agreements among themselves that remain incentive-compatible even in the absence of a central enforcer. In order to make these agreements work, international organizations help provide information and knowledge that aligns expectations and thereby enables cooperation. Non-governmental organizations and epistemic communities also play a role in providing the knowledge that makes international cooperation in an anarchic world possible. Martin builds on a broad literature, including Kenneth Oye's edited volume. *Cooperation Under Anarchy*

(1986) and scholars advancing a contractual theory of international cooperation (e.g., Krasner 1983; Keohane 1984; Goldstein 1996). Keohane (1984) is especially relevant to critiquing hegemony, as he points out ways that international cooperation can be sustained even when a hegemon's power wanes. In this chapter, I show that the Bloomington school literature on polycentric governance complements the contractual theory literature, enabling us to better understand possible modes of cooperation to provide international and global public goods. While these complementarities are underappreciated, there is already some crossover between these literatures (see Keohane and Ostrom 1994).

The chapter proceeds as follows. First, I explain the core features of polycentric systems and the social scientific literature on polycentricity. Second, I discuss theoretical nuances of the theory of public goods, and their implications for the feasibility of polycentric provision of purported public goods. Third, I analyze the case of climate change, and the benefits of polycentric approaches to addressing climate change. Fourth, I argue that the lessons from climate change are more broadly applicable to global public goods.

Polycentricity

A polycentric system is characterized by "many centers of decision-making that are formally independent of each other" (Ostromet al. 1961, 831). This can be contrasted with a monocentric system, in which power is "vested in a single decision structure that has an ultimate monopoly over the legitimate exercise of coercive capabilities" (Ostrom 1972 in McGinnis 1999, 55–56). There are many examples of polycentric systems. A federalist system is polycentric, because multiple, independent governments are part of the federation. This creates room for experimentation, as well as interjurisdictional competition in which citizens move to jurisdictions they prefer. A free, competitive market is polycentric because there are multiple firms that compete to satisfy consumers, and free entry into the market creates opportunities for entrepreneurship and contestation. Scientific communities are polycentric, because scientists organize into different research labs, academic disciplines, and scholarly societies. Processes such as peer review enable scientists to check one another's work, and scientific conversation is characterized by contestation, learning, and error correction. Civil society is likewise polycentric, a tapestry of informal social groups, formal non-profit organizations,

churches, neighborhood groups, social movement organizations, and more.

These polycentric systems can interact in a "meta-polycentric" order, "in which power and decision making is divided among various levels of governments, markets, and civil society" (Lofthouse and Herzberg 2023, 2). Just as scientists check other scientists, private firms compete with one another, and different centers of government provide checks and balances, the interaction of these polycentric systems can provide a useful check against the fragilities of each.

When market failures occur, they may sometimes be solved by entrepreneurs within the market. But they may also prompt actors within civil society or government to organize and act in ways that alleviate market failure. When governments fail to serve some groups, civil society groups and market entrepreneurs can fill the gap. When governments or businesses exercise power in unwanted ways, then social entrepreneurs in civil society may organize movements to contest or resist their power (Novak 2021). Meanwhile, commercial entrepreneurs within markets may provide goods such as encryption technologies or social spaces like cafes that enable citizens to resist or evade that power (Alshamy et al. 2023).

Both polycentric orders and meta-polycentric orders have several advantages, several of which we have already alluded to. One major advantage is that by dispersing power they limit the abuses and tyranny associated with concentrated power. A polycentric system is therefore conducive to liberty in a way that a monocentric hierarchy is not. An additional advantage is that polycentric systems are more resilient, because they lack a single point of failure. In a monocentric system, an error or abuse by the leader can be catastrophic, as it is imposed throughout the entire system. However, in a polycentric system one center's errors can be alleviated by another center of decision-making that tries a different approach. There will be errors in any system, and polycentricity is not a panacea. Rather than eliminating error, polycentricity provides a system that is more resilient to errors.

This resilience is related to another major benefit of polycentricity, namely that polycentric orders have *epistemic* advantages over monocentric systems. A single, hierarchical center of authority must rely upon the knowledge possessed by those at the top of the hierarchy. Individuals who are subordinate within the hierarchy may have incentives not to pass information to the leaders if that information would be embarrassing, unwanted, or could provoke retaliation (Scott 1990). Even when

there are incentives for subordinates to share information with leaders, there are limits to the knowledge that the leaders of a monocentric hierarchy can possess. The advantage of a polycentric system is that it allows people throughout society to act on their local knowledge, which enables processes of social learning in which dispersed knowledge is effectively used. Such processes of social learning are particularly well understood within polycentric market processes, in which exchanges give rise to price signals, which then help generate profit and loss feedback that tells entrepreneurs whether consumers value their products more than alternative uses of the inputs (Mises 1920; Hayek 1945; Lavoie 1985). However, processes of social learning occur within other polycentric systems as well. For instance, in scientific communities, we see different scientists and research teams pursue distinct research programs, contest one another's findings, and check one another's errors. This enables processes of learning and error correction that would not occur if science were a monocentric system where a single leader or laboratory held monopoly power and authority over all others.

Local governance, whether governmental or part of civil society, likewise enables greater use of local knowledge than centralized, monocentric governance does. By empowering those with local knowledge who are close to the relevant community and problem, polycentric self-governance allows for more contextual knowledge to be incorporated into governance decisions. Moreover, the fact that citizens can move to jurisdictions allows them to use their knowledge of their own preferences to find a community or jurisdiction that offers a mix of services and rules that they prefer.

A closely related benefit is that polycentric systems are more likely to promote *coproduction*. While many goods can be produced without direct participation by the consumers, some goods rely on consumer participation to be effectively produced (Ostrom 1996; Goodman 2017). For instance, education tends to be worse when students do not participate in their class. If students are disengaged, then even excellent lectures, lesson plans, or assignments may fail to provide a good education. Similarly, the effective enforcement of rules often relies on buy-in and coproduction from the general population. Police cannot be everywhere, so ordinary citizens will often have relevant local knowledge of rule violations. Their actions and values also shape the social norms in the community, which can be complementary or antagonistic to formal rule enforcement. Coproduction is therefore crucial to the viability of rules and their

enforcement. Given that individuals and communities often have heterogeneous values, a one-size-fits-all monocentric hierarchy is likely to clash with at least some communities, thereby impeding coproduction. Polycentric order is therefore better suited to promoting coproduction than monocentric hierarchy.

An additional reason that polycentric order promotes coproduction is that it involves space for face-to-face cooperation and collaboration at multiple scales. This creates opportunities to build trust and practice engaging in collective action. This type of cooperation can help people develop skills and relationships that empower them to resolve social dilemmas, including the types of dilemmas involved in the production of public goods.

Providing Public Goods in a Polycentric System

Some may fear that public goods, at least those with a scale above the level of the largest decision-making center, will be underprovided in a polycentric system. The fear here is that absent a single organization with the power to exercise coercion over all beneficiaries, there will be incentives to free ride on the efforts of those who do contribute to efforts to provide the public good. The game theoretic logic of this situation is that of a prisoner's dilemma. To discern whether this logic must undermine the provision of public goods in a polycentric context, it is worth examining the theory of public goods in more detail.

As discussed earlier, Samuelson (1954) defined public goods as non-excludable and non-rivalrous. He contrasted public goods with private goods, which he defined as both excludable and rivalrous. But these were the only two types of goods that he discussed. Since then, additional nuances have been discussed. These include additional types of goods, such as club goods, common-pool resources, and contribution goods (see Buchanan 1965; Ostrom and Ostrom 1977; Ostrom 2009; Kealey and Ricketts 2014, 2022; Rayamajhee and Paniagua 2021).

In addition to noting that the categories of goods are more varied than private and public goods, scholars have explained that the nature of a good is *institutionally contingent*. Tyler Cowen argues that "Nearly every good can be classified as either public or private depending upon the institutional framework surrounding the good and the conditions of the good's production" (1985, 53). The institutional framework and the conditions of production can impact the levels of excludability and rivalry.

For instance, radio broadcasts have historically been public goods. Once radio waves are broadcast, anyone with a radio can listen to the broadcast. However, satellite radio technology has introduced excludability to this type of broadcast medium. While a traditional radio broadcast is a public good, a satellite radio broadcast is a *club good*. That is, it is excludable but is not rivalrous in consumption. This enables companies like Sirius XM to charge their customers subscription fees to listen to satellite radio stations.

Astute readers will note that, even prior to the invention of satellite radio, competing private firms produced radio broadcasts. A monocentric public bureaucracy was not required to produce these public goods. How was this possible? While the radio stations did not have the ability to exclude *listeners*, they did have the right to control what was said on their broadcasts. This meant that they could bundle entertaining broadcasts with sales of advertising slots. They had the power to exclude advertisers based on whether they paid, which created incentives for advertisers to purchase ad slots on popular stations. These types of tying and bundling arrangements, in which a public good is bundled with a private good, can be used to privately finance public goods.

Tying and bundling arrangements can be understood as a subset of "selective incentives." As Mancur Olson explains "selective incentives either punish or reward individuals depending on whether or not they have borne a share of the costs of collective action, and thus give the individual an incentive to contribute to collective action that no good that is or would be available to all could provide" (Olson 1989: p. 64). Making paying for a public good a condition to receive some excludable benefit is one way of setting up a system of selective incentives. Rules or social norms that stigmatize or otherwise punish noncontributors to a public good can also act as selective incentives.

However, selective incentives are not the only way that individuals in polycentric systems can provide public goods from the bottom-up. To provide public goods, *public entrepreneurs* act creatively to kick start collective action. Problems of providing public goods are a particular instance of a "collective action situation" which is defined as "one where members of a group have a common interest in a collective good, but there is a mismatch of individual interests" (Aligica 2019, p. 42). Treatments of public good dilemmas usually frame them around a "*free rider* problem, where each individual holds back their contribution, expecting that a sufficient number of others will take care of it" (Aligica 2019,

p. 42). However, a similar collective action problem can arise from "a *collective efficacy* problem, where individuals lack sufficient cohesion and willingness to provide the common good" (Aligica 2019, p. 42). These dilemmas partially arise from the notion that any individual's contribution will not impact the tendency of others to contribute. But as Aligica notes, under some real-world circumstances our contributions to collective action are interdependent. I may be more likely to contribute when I observe my neighbor contributing. Under conditions of interdependence, particularly those characterized by "potential domino effects," Aligica notes that "the successful entrepreneur may be able to arrange interdependence to form a critical mass" (Aligica 2019, 47). An approach that emphasizes interdependence and critical mass "does not necessarily involve distributing selective incentives for non-collective goods over and above the collective good in question. It merely involves making contributors believe that the next one in line cares about the collective good enough to contribute if the person before them also does, but not enough to still contribute upon noticing that the person before them has defected" (Aligica 2019, 48). The relationships among people thus provide fertile ground for public entrepreneurship that encourages contribution to collective action. In a polycentric system, public entrepreneurs can leverage relationships forged within a wide range of organizational and social arrangements.

The feasibility of these solutions to social dilemmas will vary depending on the transaction costs facing key actors. In a world of zero transaction costs, institutions would be unnecessary, as individuals would costlessly bargain with one another to reach the Pareto optimal solution. But in the real-world, transaction costs are real and significant. This means that some agreements that would be mutually beneficial in a frictionless world are too costly to reach or enforce in practice. A polycentric system enables individuals and groups to try out a diverse variety of organizational and institutional forms, the nature of which will vary depending upon the transaction costs involved. Polycentricity does not preclude the existence of large or hierarchical organizations, which may in some cases be useful ways of responding to the transaction costs of relying upon markets or dispersed networks.

All of this holds true not merely at the level of theory, but at the level of empirical case studies. In a range of real-world case studies and laboratory experiments, Elinor Ostrom and her colleagues observed cooperation and collective action where economic theorists had predicted free-riding and

collective *inaction*. The reason that we need theories that illuminate the process of collective action in polycentric systems is precisely because such action occurs. This does not mean that it *always* occurs. Social dilemmas still exist and they will not always be successfully solved. But they *can* be solved. Examining the literature on polycentric approaches to coping with climate change suggests that they can be solved even for *global* public goods.

Polycentric Approaches to Coping with Climate Change

Climate change is a global problem that impacts people all around the world. As a result, the greenhouse gas emissions that cause climate change can be understood as a "global public bad." Conversely, reducing greenhouse gas emissions and thereby mitigating climate change "would be a global 'public good'" (Ostrom 2009: p. 5). As Elinor Ostrom explains:

> Millions of actors affect the global atmosphere. All benefit from reduced greenhouse gas emissions, but the problem is they benefit whether or not they pay any of the costs. In other words, beneficiaries cannot be excluded from the benefit of cleaner air. Trying to solve the problem of providing a public good is a classic collective action dilemma—and potentially the largest dilemma the world has ever knowingly faced. (Ostrom 2009: p. 5)

As Ostrom succinctly expresses here, mitigating climate change is a global public good, and this leads to collective action problems and the risk that mitigation efforts will be undermined by a free rider problem.

One might think that this collective action problem means that a binding global treaty or a solution enforced by a global hegemon are the only available means to mitigate climate change. However, this same collective action problem makes it difficult to negotiate and agree upon a binding treaty in the first place. After all, one "plausible explanation for the slow path toward decarbonisation is the tendency toward, and fear of, free-riding among the countries sending delegations to UN conferences" (Milinski and Marotzke 2022: p. 2). When you throw in the high transaction costs associated with negotiating an agreement that will be viewed favorably by leaders of a diverse variety of countries, with different languages and cultures, the problem of a global solution becomes more difficult still.

If a binding global agreement is difficult, is hegemony a better solution? This solution runs into serious problems. Ultimately, a global hegemon enforces its edicts through force and threats thereof. This can breed resentment among the people around the world subjected to the hegemon's imperial control. Such resentment raises the cost of enforcing the hegemon's edicts, as many people on the ground may be inclined to resist and evade these edicts. As Elinor Ostromexplains:

> The problem of collective action does not disappear once a policy to deal with an externality is made by a government. Even governmental policies need to rely to a great extent on willing cooperation by citizens. When citizens approve of a governmental policy, think they should comply, and this view is complemented by a sense that the governmental policy is effectively and fairly enforced, the costs of that enforcement are much lower than when citizens try to evade the policy. Trust that governmental officials are objective, effective, and fair is more important in enabling a governmental policy to work than reliance on force. (Ostrom 2009: pg. 13)

So simply dictating that a hegemon will impose a solution to a collective action problem by force is insufficient.

Given the challenges associated with monocentric approaches to climate change mitigation, Ostrom suggests looking to polycentric approaches. Rather than placing all our hope in a single global solution, a polycentric approach allows us to use a diverse range of associations. Yet the specter of free riding still lurks. If the relevant benefits of mitigation are all global in scale, then there is an incentive for voluntary associations and national, subnational, and local governments to free ride on the mitigation efforts of others. Are there selective incentives that can help alleviate this problem?

Yes, argues Ostrom. Reducing one's greenhouse gas emissions often does not merely mitigate climate change. Instead, it also can come bundled with private or local benefits. Consider the private benefits first. As Ostrom points out "families that decide to invest in better insulation and more efficient furnaces and other appliances, to join a carpool whenever feasible, and to take other energy-conserving actions can save funds over the long run. They may face high up-front investments to achieve some of these benefits, but there are potential benefits to be achieved even at a household level" (Ostrom 2009: p. 15). So while an individual or household does not internalize the benefits of mitigating climate change,

the activities that lead to those benefits are bundled with an excludable private benefit, or selective incentive, in the form of reducing the amount an individual must spend on energy. Similarly, a local community or government may invest in projects that simultaneously provide local benefits and reduce greenhouse gas emissions. For example, policies that reduce local air pollution will improve local air quality and therefore local health. These benefits on a local scale may be easier to organize people around, as they directly impact the well-being of local community members regardless of the choices made in other jurisdictions. However, these local air quality improvements would be achieved by reducing pollution that happens to contribute to the global public bad that is climate change. The fact that pollution involves nested externalities, some local and some global, means that there are more opportunities to align incentives for collective action than we would expect if there were only global externalities involved.[1] Similarly, improving local public transit or effectively conserving a local common-pool resource such as a forest would have various local benefits in addition to the benefits associated with climate mitigation. These various non-climate benefits of mitigation activities are often described as "co-benefits."

As Diana Ürge-Vorsatz, Sergio Tirado, Herrero, Navroz K. Dubash, and Franck Lecocq explain "Because most co-benefits, unlike the primary benefit, are enjoyed typically at regional or local scales, are closer to the agents bearing the mitigation costs (typically the taxpayers and/or the consumers), and have more immediate welfare effects, they provide incentives for decision makers to engage in more resolute climate action" (Ürge-Vorsatz et al. 2014: p. 554).

In practice, a variety of climate mitigation policies, projects, and experiments have been tried in numerous contexts. The book *Innovating Climate Governance: Moving Beyond Experiments* documents some of these instances of polycentric climate governance, their effects, and how the public entrepreneurs involved in them have used them as a starting point to promote wider change (Turnheim et al. 2018). In addition to this evidence from case studies, evidence from laboratory experiments also illustrates the benefits of polycentric climate governance. Milinksi and Marotzke (2022) conducted a laboratory experiment that placed students

[1] Ostrom (2010) discusses several concrete cases of these sorts of actions.

into an economic game meant to simulate contributions to a climate mitigation effort. Some participants were split up into a polycentric array of subgroups while others were not. As Milinski and Marotzke explain:

> We find support for Ostrom's hypothesis in an economic game by comparing climate mitigation at the 'global' level with that in a world subdivided into smaller communities. In our game, the groups of volunteers are subdivided into subgroups and, according to Ostrom's suggestion, are provided with an incentive of repaid saved energy the closer their subgroup approaches a sub-target. Polycentric groups with incentives for subgroups reach the global target significantly more often than groups without subdivision and without incentives for subgroups. With polycentricity and incentives, subjects choose less often zero-contributions and more often the fair-share contribution. This polycentric approach is about 30 percent more successful in reaching the global target at the entire group level (Milinksi and Marotzke 2022: p. 7).

This experimental evidence adds to a broader body of theoretical, historical, and qualitative evidence of the benefits of polycentric climate action. This presents a possibility proof for the feasibility of polycentric approaches to providing global public goods. The next section discusses how similar approaches can be applied to other global public goods.

Other Global Public Goods

Of course, climate change is not the only global public good that deserves concern. Other goods that have been identified as global public goods include "identifying virulent pathogens, ameliorating global financial crises, adopting universal regulatory practices, protecting essential ecosystems, allocating geostationary orbits, diverting earthbound planetesimals, preserving cultural heritage, reversing ozone layer depletion… eradicating infectious diseases, developing disease treatment regimes, fostering cybersecurity, preserving biodiversity, reducing transnational terrorism, maintaining world peace, discovering scientific breakthroughs, and addressing refugee flows" (Buchholz and Sandler 2021: 488–489). Discussing all of these is outside the scope of this chapter. However, I will discuss the polycentric provision of several of these goods, thereby illustrating that polycentric provision of global public goods is promising. If polycentric approaches are promising, then one-size-fits-all monocentric

approaches should not be presumed as default solutions to the challenges of providing global public goods.

As noted above, international peace is widely considered a global public good. As Deepak Lal (2004) argues "The definition of order is congenial to an economist, for it deals with the provision of the pure public goods of defense and law, the primary function and duty of every state … The goal of an international order is to preserve the peace. This is an international public good…" (Lal 2004, p. xxii, quoted in Coyne 2023, p. 6). Lal uses this to argue for a very monocentric and hierarchical approach to international governance, namely an imperial hegemon. Under current circumstances, he believes that the United States is best suited for this role. However, while an imperial hegemon could in principle help provide global public goods, they may also create global public bads. These include direct violence by the hegemon, negative unintended consequences of their imperial interventions, and future uses of the concentrated power the imperial leaders develop (see Coyne and Davies 2007, Coyne 2022). Given the violent capabilities that an imperial hegemon cultivates and wields, it can be just as much a purveyor of war as a protector of peace.

Given this dilemma, it is worthwhile to seek out polycentric means of promoting international peace. Fortunately, a variety of polycentric arrangements do contribute to peace among nations. For instance, civil society can play an important role in protecting international peace. If people are free to form and join various forms of associations, they can act collectively to monitor, pressure, and protest the actions of political leaders. This social accountability interacts with other features of democratic institutions to help hold political leaders accountable, reducing the likelihood of interstate conflicts escalating (Hegre et al. 2020). Moreover, competitive markets are a polycentric system in which many individuals interact as buyers and sellers, freely associating in the form of firms and other organizations, often forming new such organizations that enter the market. This gives rise to emergent patterns that no individual participant intends. Interactions within the market process can build peace by creating opportunities to achieve one's ends by nonviolent means, that is, through voluntary exchange.

Trade can increase the opportunity cost of warfare by creating a situation where warfare would mean foregoing lucrative future trades (see Coyne and Pellillo 2013; Coyne et al. 2022). Moreover, entrepreneurship and markets can create social spaces that bring people together, helping

them forge relationships in which they build social capital, resolve conflicts with one another, and so on (Coyne et al. 2022). International agreements, including polycentric interstate federations such as the European Union, can help preserve free trade between states, thereby enabling these peacebuilding market processes.

Some may object that maintaining the conditions necessary for free trade is itself a global public good, and that therefore a monocentric global hegemon is necessary to keep the trade routes open (Ferguson 2004). Yet this neglects that people have developed institutions and efforts to preserve and protect trade from the bottom-up. For instance, much of international merchant law was developed via private agreements and reputation mechanisms, creating a body of privately developed international merchant law known as the *lex mercatoria* (Benson 2010, 2011). Proponents of empire might say that the *lex mercatoria* is fine for resolving disputes among international merchants, but a strong military hegemon is still necessary to protect ships from piracy and predation. However, DeAngelo and Smith (2020) show that private security has played a significant role in protecting ships from piracy. A monocentric, militarized state is not the only way to secure property rights and thereby enable trade.

Stiglitz (1999) argues that knowledge is a global public good and that it cannot be efficiently provided privately. Scientific knowledge's status as a public good has been questioned, however. Terence Kealey (1996) argues that scientific knowledge is better understood as a "contribution good" than a public good. This means that properly understanding a scientific finding often requires engaging in practices that involve contributing to science oneself. Therefore, while scientific knowledge remains non-rivalrous, in practice aspects of it are naturally excludable, as they can only be effectively accessed by contributors to the scientific community (Kealey and Ricketts 2014, 2022). This generates greater incentives to contribute to the production of scientific knowledge than we would expect if it were a pure public good. However, even if we assume that scientific knowledge is a global public good, monocentric production and provision of scientific knowledge is totally infeasible. Scientific discovery relies upon the polycentric characteristics of the scientific community. Science flourishes precisely because diverse research teams cooperate, compete with one another, and contest one another's findings. Any attempt to render the scientific community monocentric would seriously damage processes of scientific discovery, contestation, learning,

and error correction. This is likely to be true for useful knowledge of technology as well. Fortunately, a growing literature on Governing Knowledge Commons examines the diverse polycentric self-governance arrangements by which communities solve social dilemmas related to the discovery, provision of, production of, and use of knowledge (see Goodman and Lehto 2023; Hess and Ostrom 2007; Strandburg 2008; Madison et al. 2010; Frischmann et al. 2014; Dekker and Kuchař 2022).

These examples do not exhaustively cover global public goods. However, they illustrate that monocentric governance arrangements are not the only means available to provide and produce global public goods. A diverse range of polycentric approaches are available.

Conclusion

As we confront pressing problems that have an international scale and scope, it may be tempting to turn to centralized, one-size-fits-all solutions. Yet monocentric systems are plagued with serious problems, including dangerous concentrations of power, vulnerable single points of failure, and knowledge problems associated with relying upon a single decision-making center that cannot consider the full diversity of dispersed knowledge.

To truly provide important global public goods, we need to leverage the creativity, knowledge, and cleverness of a diverse variety of people. We need to learn from our mistakes, adapt, and solve social dilemmas that occur at multiple scales of organization. To effectively do this, we need polycentric governance. Polycentric governance will remain crucial to providing a wide range of global public goods, from peace and security to environmental sustainability to scientific knowledge.

Not only is polycentric governance a feasible option for providing global public goods, it is also morally preferable to monocentric systems of hierarchical control. People should be free to govern themselves and devise solutions that work for them. They are not pawns to be subordinated to central planners, imperialists, or would-be rulers. The social scientific endeavor of studying polycentric governance is therefore valuable not just as a means of understanding the world, but of learning how we can realize freedom.

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