Feature
The Problem of Social Benefit
By Frank Nagle
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Illustration by Michael Waraksa

Economists apply the term “externalities” to cases in which the actions of one agent impact another without their permission or agreement. Externalities can be either negative or positive, depending on whether the impact imposes a cost or benefit on the one affected. For example, if one person pollutes another person’s water source without their permission, the one affected experiences a negative externality. But if one person plants lots of trees and improves another person’s air quality without their permission, the person benefited experiences a positive externality.

Economists have theorized about many ways of addressing externalities that involve the agent creating them “internalizing” the costs or benefits generated, including taxes, regulation, and direct negotiations between the parties involved. For example, the government could impose a pollution tax or regulation that would make the polluter pay for the negative impact on the water source (and thus internalize the negative externality). Or, in the case of tree planting, the planter could be paid directly to seed extra trees (and would thus internalize the positive externality).

Policy makers have toiled over reducing negative externalities but paid scant attention to encouraging positive externalities. This discrepancy has likely occurred for a number of reasons, although two are especially prominent. First, people prefer to avoid losses than to attain comparable gains because of what behavioral economists Amos Tversky and Daniel Kahneman call “loss aversion”—the anxiety I feel about the prospect of losing $10 outweighs the happiness I anticipate from gaining $10. Similarly, the loss I sense from my water becoming polluted is greater than the gain I foresee from a comparable increase in my water quality. In this way, reducing negative externalities draws more attention than encouraging positive externalities. Second, and relatedly, it is often easier to price a loss than a gain. If my water is made undrinkable, my loss is the cost of cleaning that water or getting water from somewhere else. But if my water is made cleaner (and it was already drinkable), how I should price this improvement is unclear.

Whatever the reasons, economists, governments, and individuals have focused on reducing negative externalities at the expense of encouraging positive externalities. Indeed, a focus on addressing negative externalities (among many other important contributions) helped Ronald Coase win the 1991 Nobel Memorial Prize in Economic Sciences. In his seminal 1960 article, “The Problem of Social Cost,” Coase discussed how inefficiencies in the market can lead to an oversupply of negative externalities—including natural-resource overuse and pollution (air, noise, etc.)—and argued for an increase in market-based solutions (rather than government interventions) in a variety of contexts.

The potential of positive externalities, however, went underexplored by Coase and has languished in mainstream economics. Yet in this context, a problem similar to Coase’s 1960 puzzle exists: the problem of social benefit. Inefficiencies in the market lead to an undersupply of positive externalities in matters of common good. In what follows, I try to rectify this neglect by considering the flip side of Coase’s argument and how it lends additional weight to calls for increased collective action and support for various social innovations to help address global challenges.

PIGOVIAN SUBSIDIES

To better understand the problem of social benefit, let us consider a brief history of economic thought on the topic. Coase’s Nobel-worthy analysis built on, and rebutted, earlier arguments by Henry Sidgwick, Alfred Marshall, and Arthur Pigou, who had discussed negative and positive externalities in their work. The year 2020 marked the 100th anniversary of Pigou’s book The Economics of Welfare, in which he formalized the concept of externalities and argued for the implementation of what has come to be known as a Pigovian tax, where the government taxes those who are creating
a negative externality and uses the revenues to offset the negative impacts on the general public. Such taxes have support from a long list of economists—a group that Harvard University economist Greg Mankiw has called the Pigou Club.

In a classic example of a Pigovian tax, governments impose carbon taxes on greenhouse gas emitters, the revenues from which they use to offset the impacts of global warming (while at the same time decreasing the release of carbon dioxide by making it more expensive for the producers). Such taxes force the party generating the negative externality (e.g., carbon dioxide) to internalize at least some of the costs that society as a whole previously paid. Coase’s work argues that such taxes (or other types of government intervention) are unnecessary if the two parties (in this case, the greenhouse gas emitter and those impacted by global warming) can easily negotiate directly and come to an agreement for one to compensate the other directly. Of course, such an arrangement is confounded by the fact that the polluter is one entity and those negatively impacted are numerous dispersed individuals. The associated transaction costs from this direct negotiation are prohibitively expensive in most cases (a point that Coase acknowledged).

For this reason, non-market-based solutions have arisen. The importance of dealing with, and discouraging, the uninternalized impacts of negative externalities—whether by taxation, regulation, or direct negotiation—has become a long-running topic in economics and public policy. However, the potential opportunities of encouraging positive externalities have often been overlooked, for the reasons mentioned above. In particular, systems for helping companies or organizations gain some of the benefits from positive externalities (which would in turn increase the incentive to produce such externalities) have been limited. Economists often refer to such benefits as Pigovian subsidies (compared with Pigovian taxes).

Carbon-offset credits are a standard example. If a logging company plants a forest so it may harvest lumber in the future, it is unable to (directly) reap the added benefits of carbon capture that the forest provides to society. Therefore, carbon-offset credits enable the logging company to capture additional value from the positive externality it creates by planting trees. Rather than reducing its level of pollution, a polluting company can pay the logging company to offset its pollution, thus encouraging the logging company to plant more trees, creating a virtuous cycle.

The carbon-offset credit system has led to societal innovations that allow both organizations and individuals to contribute to collective action for reducing global warming. For example, the non-profit Nexleaf Analytics has created a device to monitor the reduced black-carbon emissions when individuals in India switch from traditional cookstoves to cleaner models. This precise monitoring allows the individuals to receive payments through the carbon credit system and leads to direct monetary gains from individual behavior changes that generate positive externalities.

The logging and carbon-credit example shows how we may incentivize individuals or organizations, but the issue becomes trickier when we think about the need for collaborative, collective action to solve such problems. Take Coase’s example of a rancher’s cattle straying onto a farmer’s land and eating his crops—a negative externality created by the rancher and suffered by the farmer. We can use that same example to illustrate the problem of social benefit through collective action. Say the farmer is considering purchasing a technology that would increase rainfall in an area, and thereby boost both the farmer’s crops and the rancher’s grass. If the cost of the technology is greater than the benefit the farmer alone will receive, then the farmer will not invest. But if the cost is less than the aggregate benefit both the farmer and the rancher will receive, it behooves the rancher to pay the farmer—to help the farmer internalize the positive externality—or for both of them to collaborate and purchase the technology together (although the coordination of this purchase may have transaction costs, and thus the purchase may still not happen).

EXAMPLES OF UNREALIZED BENEFITS

This simple example helps illustrate the problem. We can turn to many different real-world examples to see how the problem of social benefit plays out across different contexts and domains. As we shall see, many societal problems requiring collective action go undressed because of the inability of organizations and individuals to reap the benefits of positive externalities.

COVID-19 Vaccination | Vaccinations have two benefits. First, the person receiving the vaccine directly benefits from a drastically reduced chance of getting the disease. Second, jabs provide spillover benefits (positive externalities) to society in the form of lower health-care costs (in general, the cost of getting a vaccine is much lower than the cost of being treated at a hospital for a serious disease) and lower likelihood of disease transmission. Any one person is unlikely to directly reap any of these spillover benefits in a form that is tangible to them. Therefore, the cost-benefit analysis behind an individual’s decision to get vaccinated does not factor in the societal benefits.

This dynamic generates problems for diseases like COVID-19, in which you can be infected but not suffer any serious symptoms and can take steps that limit your likelihood of getting the disease, such as isolation and social distancing. If you believe you will not suffer serious symptoms or do not see the avoidance measures as onerous, the direct benefits of getting the vaccine are low for you. Further, given the novelty of the mRNA technology behind the earliest available COVID-19 vaccines and the lack of long-term testing of such vaccines, people may see the potential risks of getting the vaccine as outweighing possible benefits to them. Such a calculation potentially explains the more than one-quarter of the US public who report that they probably or definitely would not get the vaccine, according to polling by the Kaiser Family Foundation.

However, such individual calculations do not factor in the positive externality to the rest of society (e.g., reduced health-care costs), because any one individual who takes the vaccine does not capture this benefit directly. This discrepancy led some observers, such as Brookings senior fellow Robert Litan, to propose paying people to take the vaccine long before it was even available. This payment (like a carbon credit) allows people to capture a portion of the positive externality, thereby addressing the problem of social benefit in this context. In the United States, many policy makers resisted the payment idea at first, arguing that it was unnecessary and perhaps even

FRANK NAGLE is an assistant professor at Harvard Business School and is also the co-director of the HGST/Linux Foundation Core Infrastructure Initiative. His work studies how companies can collaborate with communities and competitors for mutual benefit. Prior to academia, he worked in cybersecurity for nearly a decade.
counterproductive. However, as vaccine supplies became more plentiful but many individuals remained hesitant to get the vaccine, numerous states paid holdouts directly, entered them in a lottery for large cash prizes, or offered other incentives (such as free beer and fishing licenses). Further, some private companies are paying their workers to be vaccinated, including Target, Trader Joe’s, and Dollar General.

**Cybersecurity** Cybercrime costs $1 trillion per year worldwide, or just over 1 percent of global GDP, according to a 2020 report by McAfee. Although companies are hard pressed to prevent an extremely determined attacker from breaching a network, they can employ numerous levels of safeguards to limit both the risk of a break-in and the potential damages when it occurs. Complicating matters, attackers frequently breach multiple systems before accessing their final target. For example, a cybercriminal based in Russia may break into a computer in India, and then use that computer to break into a computer in the United States, and then use that computer to attack the actual target company, also in the United States. Although the cybercriminal could directly attack the end target, using these “hop points” makes tracing the attack much more difficult, and thus the criminal is less likely to be caught and held accountable for their actions.

The ability to perform this chain of attacks is partially due to the problem of social benefit. If the company that owned the computer in India had invested more in cybersecurity, the cybercriminal would have had a harder time hiding their true identity and would thus have been easier to catch; in turn, future attacks by that attacker might have been prevented. Therefore, companies underinvest in cybersecurity, because they tend to invest only to a level that allows them to capture the direct benefits of their organization’s being less likely to be breached successfully. They do not capture the positive externality of the increased difficulty for cybercriminals to use their computers as hop points to attack other systems.

**Education** Investments in education provide yet another example of a problem of social benefit. Research has shown that if a person invests in higher education, they not only receive an individual benefit but contribute a positive externality of increasing wages for other people in their city, even if those people did not go to college. However, the person making the investment does not reap this spillover reward in any direct way. Thus, on the whole, individuals underinvest in education, since they are unable to appropriate the full benefits. This dynamic has led some states and countries to provide free (or nearly free) college education to citizens to help people gain some of the societal benefits from their investment in higher learning.

**Natural resources** The Amazon rain forest has been called the “lungs of the planet” because it produces a great deal of oxygen and also captures a great deal of carbon dioxide. Further, it represents more than half of the planet’s rain forests and supports more than half of the world’s species of animals and plants. Thus, the entire globe has an incentive to see the Amazon thrive. Approximately 60–65 percent of the Amazon is located in and controlled by Brazil. Recently, Brazil’s government has been attempting to support local industries and increase its own revenue by allowing larger tracts of the Amazon to be cleared for lumber, agriculture, and ranching. Here, the problem of social benefit looms: The world benefited from prior protection of the Amazon, but Brazil was not able to reap direct benefits from this spillover.

Further, in August 2019, more than 26,000 forest fires threatened the destruction of large areas of the Amazon. Given the importance of the region to the world, numerous countries offered to give Brazil money to help fight these fires. However, because of concerns about potential strings attached to this financial support, Brazil rejected a large percentage of the money it was offered, thereby limiting its ability to fight the fires.

**A SOLUTION: FREE AND OPEN-SOURCE SOFTWARE**

Now that we have reviewed some examples of the problem of social benefit, let us turn to a case where participants have found an effective solution: free and open-source software (FOSS). A concept formalized in the 1980s, FOSS now pervades the digital economy and can be found in everything from cell phones to cars to refrigerators. In the traditional, centralized model of production, a company hires employees and pays them to create a product over which it retains intellectual property rights. The FOSS model, by contrast, embraces a distributed production model where users of a piece of software collaborate to create and enhance the software, whose code is released publicly and is generally free. Although many contributing users are volunteers, some companies pay their employees to contribute to FOSS, even if their competitors are then able to use the software at no charge. However, no one is required to contribute to FOSS to use it, and that creates the potential for free-riding behavior.

Many commentators consider FOSS critical to social innovation and have emphasized this point in the pages of this magazine. Further, in many areas, including big data, machine learning, and artificial intelligence, FOSS has come to be more heavily relied upon than its closed-source counterpart. Indeed, an estimated 75 percent of corporate codebases are FOSS, according to a 2021 report by Synopsys. Although such software is not always free of charge, it is free of intellectual property protections that prevent others from seeing the source code of the software (hence the pithy saying “Free as in free speech, not as in free beer”)—though not entirely so, as an open-source license dictates how the code can be modified and whether or not it can be used for commercial purposes. FOSS advancement has been enabled and sped up by the creation of FOSS hosting platforms like SourceForge, GitHub, and GitLab, which enable the production and sharing of FOSS code. Such platforms liberate coders from dealing with software hosting, distribution, and associated tasks so that they can focus on coding.

In many ways, the FOSS ecosystem allows developers (both individuals and companies) to solve the problem of social benefit. Over the past decade, I have examined this phenomenon in partnership with other individuals and organizations, including the Laboratory for Innovation Science at Harvard (LISH) and the Linux Foundation. We found that one of the most common reasons a developer contributes to FOSS is that they need a particular feature that does not currently exist. Thus, by writing this code, they obtain a direct benefit while creating a positive externality: Anyone else can also have access to this feature for no (or little) cost. The problem of social benefit would arise in this context if developers contributing the code had no way to gain any benefit from this externality. However, the fact that they have multiple ways to do so limits the problem of social benefit in the FOSS context.
To start, when developers contribute FOSS code, they are typically not building an entire program from scratch but building upon FOSS code others have written. For example, consider an internet of things (IoT) developer who needs to write software that monitors the temperature of a refrigerator and then sends alerts via the internet when the temperature departs a certain range. Without FOSS, the developer would first need to write an operating system that allowed for basic functions (input and output, connecting to the internet, etc.) and then could create the particular feature that monitored temperature and sent alerts. However, with FOSS, the developer can utilize existing IoT operating systems, so the only thing they need to create is the feature itself. Therefore, by using FOSS and adding a feature, the developer has saved a great deal of time and is already capturing the positive externality from the efforts of others.

Perhaps a more concrete manner through which FOSS addresses the problem of social benefit is via maintenance. If a developer chooses to make a feature open-source and other developers adopt the feature, then, as the community grows, other people can help maintain the software, address bugs, and add more features. Thus, the original developer gains some of the positive externality in the form of reduced maintenance costs—if they had kept the software closed-source, they would have needed to do all maintenance on their own. But not all FOSS users contribute back, so if no users of a particular FOSS project help with its maintenance (even if it is widely used), that responsibility may fall solely on the creator.

Over the past decade, companies and other organizations have become more directly involved in FOSS. Although it may seem ill advised, at least at first glance, for a company to pay its developers to write code that its competitors can use for free, more and more companies are doing exactly that. We might expect the problem of social benefit to undermine this trend: Companies can't directly capture the positive externality, and they might damage their ability to compete, since competitors can use the same code. However, my research has shown that companies that both use and contribute to FOSS have greater productivity gains from using FOSS than their free-riding peers who only use FOSS and don't contribute. Full participants benefit from the learning that comes with contributing. Importantly, this learning accrues more to newer contributors, who have more to learn. Further, other research has shown that companies that hire experienced users (whose potential for learning may be limited) and contribute to FOSS at higher levels (maintaining and managing projects) can nudge projects in a beneficial direction, enabling the companies to capture some of the positive externalities.

My research has found similar effects at the country level. When a country encourages the usage of FOSS, its citizens contribute to FOSS in greater quantities, creating large positive externalities for the world. However, the country is also able to partially capture value from these externalities through increases in tech-oriented labor, tech startups, and the usage of FOSS by companies, which lead to productivity boosts for some of these companies. These additional benefits do not accrue to other countries that do not increase their contributions to FOSS.

In aggregate, at the individual, company, organization, and country levels, FOSS enables the creation of a public good while allowing the contributor to capture both a direct benefit and part of the positive externalities that are created at the same time. This promise generates a stronger incentive for actors to contribute to FOSS, as they know they will get more benefit than simply the direct gain of creating a feature that they needed. This dynamic in turn creates a virtuous cycle that promotes the continual creation of more and better FOSS.

**GENERALIZING A SOLUTION**

We can learn a great deal about how to encourage the creation of goods and services that generate social benefit from the disparate examples we have reviewed. In particular, four factors have proven crucial to solving the problem of social benefit: 1) aligning incentives, 2) reducing the costs of participation, 3) building a shared platform, and 4) limiting the power of gatekeepers. Let us consider them in turn and how they might provide insights into the problem of social benefit in other fields.

**Aligning incentives** | The primary driver of the problem of social benefit is that actors cannot easily internalize positive externalities. So, a natural tack is to align incentives to make such internalization easier. We already see attempts to do exactly this under way. For example, the aforementioned goal of combining carbon emission limits with carbon credits aligns the incentives of both carbon emitters and carbon capturers so that the latter (who are performing the prosocial behavior creating the positive externalities) can capture the positive externalities they help create. Likewise, proposals to reward individuals for getting the COVID-19 vaccine attempt to align the incentives of individuals with those of the entire community by allowing the individuals to capture some of the positive externalities they create by taking the vaccine. We see a similar tactic with FOSS licenses, which allow the contributors to a FOSS project to determine whether or not the project can be integrated into closed-source software. Further, newer contributors are able to internalize positive externalities by learning more about the software from senior contributors, while more senior contributors can internalize externalities by steering the project in a direction that benefits them and their employers.

**Reducing the costs of participation** | If every decision to do something that benefits the collective is based on a cost-benefit calculation, then the second factor that follows increasing the benefits to the actor is reducing participation costs, especially transaction costs that create friction in the system. To partially resolve the abovementioned problem of social benefit associated with higher education, many have proposed making college (or at least community college) free, or canceling student debt. Though both of these tactics might have the desired effect, it might also be helpful to think about how to also reorient the system to further reduce opportunity costs and transaction costs. Although many individuals would like to go to college, the direct monetary costs are not the only factor that prevent them from doing so. The need to take four years off from full-time employment to become a full-time student can be prohibitive, and thus alternatives to the traditional four-year bachelor’s degree (which do exist) can be encouraged, and social perceptions that such alternate methodologies of attaining education are lower quality should be discouraged.

Lowering costs is critical to diminishing entry barriers to contributing to FOSS, which helps the growth of the ecosystem and its ability to overcome the problem of social benefit. For example, new participants can contribute in ways other than writing code, including identifying software bugs, suggesting new features, and writing documentation. All of these activities allow less experienced
individuals to contribute at a lower cost and, in time, to learn how to make other types of contributions.

**Building a shared platform** If it is possible to build a platform that allows others to contribute more easily to the creation of goods with positive externalities, then not only are entry barriers reduced, but the overall effectiveness of the effort will further benefit from the wisdom of crowds and the broader involvement of a wider array of actors. In the example of cybersecurity, organizations called information sharing and analysis centers (ISACs) were established in the United States in the late 1990s as the result of a presidential directive. ISACs help to address the problem of social benefit by allowing organizations in the same industry to share information related to cyberattacks so that they can all benefit from what each has learned individually, thus reducing the likelihood that cyberattackers will be successful. Although ISACs do not completely solve the problem, these platforms allow competitors and formerly siloed organizations to be more effective at doing so in domains as widespread as financial services, election infrastructure, and aviation. Creating such an arena allows competitors to collaborate on the core while competing on the edges—a theme that recurs in much of my research.

Another example from my research into shared platforms comes from the United Nations Development Programme (UNDP), the UN agency tasked with addressing many global-scale challenges, including poverty, hunger, and clean water. In recent years, the UNDP has increased its efforts to create innovative localized solutions to these problems. However, after some trial and error with full-blown localized efforts, the agency found a great deal of success by developing UNDP Accelerator Labs, a well-connected network of small teams in 90 countries, with only three people per country. Our research has shown that the platform the UNDP built allows these small, distributed labs to identify existing local efforts to solve global challenges, help expand them locally, gather the learning from these various efforts around the world, and share it with other countries that may benefit from a similar solution, thus enabling the positive externality to be harnessed. They have had a great deal of success with programs as disparate as limiting food shortages in Zimbabwe, addressing depopulation in Serbia and Bosnia and Herzegovina, and reducing plastic waste in Vietnam.

In the FOSS world, the creation of platforms like SourceForge, GitHub, and GitLab has reduced the costs to participate and provided a centralized location for the decentralized efforts of the various FOSS communities. These platforms provide a hosting environment, information on licensing, and other tools to help FOSS projects launch quickly. They also make it easier for people to search for FOSS projects that others have already started, so that they don’t duplicate efforts.

Finally, a word of caution on this subject: For some organizations, research has shown, shifting from trying to solve the problem themselves to focusing on enabling social benefit and solution creation by others can lead to internal tensions if they are used to being the problem solvers. This issue can challenge the identities of people who have spent their life trying to solve the problem themselves. Thus, this transition must be managed with care.

**Limiting the power of gatekeepers** In the context of the Amazon rain forest, it is very clear that an individual gatekeeper oversees this critical natural resource—namely, Brazilian President Jair Bolsonaro. Thus, despite the Amazon’s importance to the global biosphere, outsiders do not have a say in how it is governed (e.g., how much of it can be cleared, how forest fires should be dealt with, etc.). Although respecting national sovereignty makes sense, given that the majority of the Amazon is Brazilian territory, other models for governing globally important natural resources have been developed. For example, the Antarctic Treaty System, ratified in 1959, made the frozen continent accessible to anyone for research purposes and banned military activity. Thus, this resource is governed by an agreement among numerous nations and has no individual gatekeeper.

The gatekeeper issue has arisen in the FOSS ecosystem as well. Perhaps the most well-known example is the case of “left-pad,” an 11-line piece of FOSS code that was widely used across the internet for adding padding characters to the beginning of a row of text. Because of a legal dispute with a FOSS hosting company, the creator of left-pad chose to delete it. Although it was a very simple piece of code that any programmer could have written on their own, it was simpler for people just to use one line of code to integrate left-pad into their code. However, once it was deleted, every website across the world that used it broke. As a result of this experience, FOSS users have discussed various methods to allow for FOSS code to exist permanently, such that any individual (including the creator) cannot delete it.

**WHERE WE GO FROM HERE**

Although the problem of social benefit is not new, its importance has grown amid the number of global-scale challenges the world faces. Fortunately, we have many examples of solutions (or at least partial solutions) that have led to an increase in positive externalities in various domains.

By considering what is generalizable about these solutions, social innovation organizations can encourage activities that create positive externalities and lead to greater social benefit. Together, whether as individuals, companies, nonprofits, or governments, we can solve the problem of social benefit and better address the global challenges of today and tomorrow.

**Notes**