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"Public Good" or "Good for the Public?" Political Entrepreneurship and the Public Funding of Scientific Research

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Abstract
Public goods are traditionally classified according to an exogenous, technological definition of possessing the characteristics of nonrivalry and nonexcludability. This paper takes a more endogenous approach, where goods are defined by the political purposes that specific actors have regarding these goods, and emerge through political entrepreneurship. I use government sponsorship of basic scientific research as a case study. Proponents argue that scientific research constitutes a public good requiring government assistance, but in fact, government provision of science is endogenous, and better explained by the political entrepreneurship involved in convincing the public of the superiority of political over private provision.

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I. Introduction

"Public goods" are one of several concepts in economics where noneconomists assume the everyday meaning of the phrase and then unwittingly commit fallacies. Ask the average undergraduate to provide examples of "public goods" and they will invariably produce a laundry list of government-provided services: roads, national defense, infrastructure, healthcare, social safety nets, etc. Perhaps they make this mistake because the term "public goods" is so close to "public services," a set of activities that is coterminous with what governments *actually* provide.

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In the consensus economic definition, a good is technically defined as "public" if and only if it is (a) not strictly rivalrous in consumption and (b) not strictly excludable. This means that only those goods for which one person's consumption does not diminish another's ability to consume and for which a user cannot exclude others from consumption are classified as public goods.[1]

Naturally, such a technical definition for an ordinary-sounding term has led to much conflation between the real-world activities and expenditures of governments and the abstract economic models in public finance and welfare economics. It is typical for economists and noneconomists alike to claim that markets provide private goods and governments provide public goods, as well as to normatively claim that this demarcation is laudable. In any case, the analytic concept of "public goods" is easily conflated with government activities that are commonly viewed as simply "good for the public." The rhetorical distinction between these two phrases is minor, but in terms of understanding the distinction between public and private enterprises, it is crucially important.

The main contribution I make in this paper is to suggest an analytic distinction between what we might term the traditional or "exogenous" theory of public goods—whereby the technological properties *assumed* about a good directly imply market failures—and a more "endogenous" theory of public goods. In this latter framework, the "publicness" of a good is not a technological assumption, but the *rationalization* (in light of history, often ex post facto) of individuals making intentional choices in the service of specific policy goals.

Ultimately, collective action determines which goods will (and ought to) be provided privately versus publicly (Buchanan 1959). Rather than an objective criterion that can be known in advance, the nature of such collective action creates opportunities ripe for political entrepreneurship to sway collective decisions about the various uses of resources. While an individual's preferences *about goods* can often be interpreted through their consumption choices, interpreting preferences over *other people's actions* and uses of goods involves a

[1] The first prong is often considered in a technological sense: independently of ownership or legal institutions, many goods *physically* cannot be used by multiple persons simultaneously, or be put to multiple uses simultaneously. The second prong is implicitly contingent on existing property rights arrangements that determine who has the right to exclude others. Some scholars debate whether each prong is necessary or sufficient for "publicness," but most textbooks define public goods using both prongs, as shown below.

significant degree of subjectivity (Aligica and Tarko 2013). An action that one person describes analytically as a *negative* externality may be perceived by another person as a *positive* externality; one person's economic rent may be another person's public good. If economists hope to maintain the value-freedom implied by positive economics, we must first admit the difficulty in trying to objectively disentangle these subjective relationships based on exogenous technological criteria. By applying the broader lens of political economy to look at the incentives of various players and the institutions that they operate within, we can better understand the process that collectively determines how goods are provided (Buchanan 1959).

People with different interests may establish organizations or attempt to change social institutions to further those interests regarding particular goods, and it is only through the emergent result of all these activities that a good ends up being provided by private entrepreneurs in markets, government agencies, or by some other institution of civil society (Ostrom 1990, 2010). Just as oil in the ground is not a valuable resource until private entrepreneurs recognize and persuade others that it can be extracted and used in some productive process for future consumption, *public* goods are similar in social and political relationships. Enterprising individuals may find it in their interest under certain conditions to claim that a good should be provided by a public or quasi-public agency, rather than through market-based transactions. Historically, a critical mass of these types of market-politicizing decisions are made during national emergencies such as wars and natural disasters, which generate a sympathetic public, and institutional momentum carries these new enterprises far beyond the national emergency (Higgs 1989). Consistent with this story, public enterprises often end up being led by the very people or coalition who called for such political action in the first place.

The goal of this paper is expressly *not* to argue from a normative or optimal standpoint how to determine which goods should be produced, funded, or subsidized by governments, and which left to market processes. Instead, this paper modestly observes that the reasons these industries are subject to government involvement are rarely due to any inherent property of the goods themselves or their interactions with others in the market process, but often because enterprising political and social entrepreneurs have convinced society that *they must be.*

I first survey the traditional view of public goods and its connection to public finance, and then sketch an alternate theoretical framework of endogenous public goods, which is driven by political entrepreneurship. I apply this framework and demonstrate its insight with a case study of basic scientific research, where governments allocate grants of financial capital to scientific projects.[2] This practice is commonly justified to the public on the grounds that scientific discovery is a quintessential public good that markets find difficult to provide, and thus, government funding is necessary to ensure optimal provision for society. I argue that this particular institutional outcome is driven less by the classic economics story of public goods and market failure, and more by political entrepreneurs successfully engineering public opinion to consider science a "public" or government enterprise.

II. The Standard (Exogenous) Theory of Public Goods

Economists and their predecessors writing on public affairs have long noted that certain goods may not be produced naturally except by government and collective action. Adam Smith ([1776] 1904) argued that the political sovereign had, among several others, the express duty of "erecting and maintaining certain public works and certain public institutions which it can never be for the interest of any individual, or small number of individuals, to erect and maintain; because the profit could never repay the expence to any individual or small number of individuals, though it may frequently do much more than repay it to a great society" (book VI, chap. 9). This idea was ultimately formalized almost two centuries later by Samuelson (1954, 1955), who identified the lack of a clear preference-revelation mechanism in Smith's invisible hand to cope with what Samuelson termed "collective consumption goods."

Certain goods allow multiple users to consume the good simultaneously without detracting from one another. This characteristic opens the possibility of free riding, where each user will purchase (or contribute) less than their true willingness to pay for the good (compared to a private, fully rivalrous, and excludable good), as they still benefit from using the good regardless of their contribution. If a significant portion of potential users chooses not to contribute, then the good will not get produced at all, and society loses out on

[2] For the purposes of this paper, I avoid the important but separate question of entirely state-run scientific enterprises.

efficient gains from exchange. Samuelson's papers were firmly in line with the neoclassical microeconomics tradition of precisely specifying marginal conditions for an individual or social optimum.[3] Samuelson's attempt to describe the logic of government spending was synthesized with other problems in markets by Bator (1958), which helped solidify market failure and public goods theory as part and parcel of both public finance and welfare economics.

Modern economics textbooks define public goods as those that possesses the properties of (a) not being strictly rivalrous and (b) not being strictly excludable. For instance, Mankiw (2004, p. 225), a leading principles of economics textbook, uses the example of a tornado siren in a small town: "Public goods are neither excludable nor rival. That is, people cannot be prevented from using a public good, and one person's use of a public good does not reduce another person's ability to use it. For example, a tornado siren in a small town is a public good. Once the siren sounds, it is impossible to prevent any single person from hearing it. Moreover, when one person gets the benefit of the warning, he does not reduce the benefit to anyone else."

Gruber (2011, p. 183), a leading public finance textbook, uses national defense as "a classic example of a pure public good": "National defense is not rival because if I build my house next to yours, my action in no way diminishes your national defense protection. National defense is not excludable because once an area is protected by national defense, everyone in the area is protected: there is no way the government can effectively deny me protection since my house is in a neighborhood with many other houses."

The implication, explicit or implicit, is that government must step in to provide the corrective remedy to improve market outcomes. The failure of the market process to elicit true preferences and contributions from users risks the underprovision of public goods. Hence, traditional public finance and welfare economics suggests that government provides these goods to correct for this market failure, as it can use its coercive powers to compel sufficient payments for the good to be produced. From this straightforward logic, it is easy to shift between positive and normative accounts of government expenditures, which simultaneously become both explained by and justified by public goods theory. Thus, public finance textbooks such as Rosen et al. (2003, p. 53) state "just as analysis of pure competition

[3] See, e.g., Blaug (1996, chap. 13 passim) for a concise history of this tradition.

yields important insights into the operation of actual markets, so the analysis of pure public goods helps us to understand problems confronting public decision makers."

I term this standard account of public goods just described as the "exogenous theory of public goods," since the "publicness" of any given good is determined solely based on some exogenous physical characteristic that makes them not amenable to efficient market provision. Leading economics textbooks simply apply the exogenous definition of public goods to various public policy problems.

The standard literatures about public goods, public finance, and welfare economics have met many critics during their tenure. They might be described according to three main categories: lack of a clear real-world connection between the blackboard analysis and actual public policy, accounts of markets or other private institutions successfully providing public goods, and the fact that most government expenditures are not actually on public goods.

First, Hammond (2015) documents the original controversies and debates between Samuelson, Minasian (1964), and Buchanan (1967), among others, launched by Samuelson's original definition. Much like some other formalistic economic concepts in neoclassical theory (Clapham 1922), it has been difficult to find real-world examples of what cleanly satisfies the definition of public goods. Blaug (1996, p. 581), for example, comments:

> It is true that there are very few examples of pure public goods: congested public roads really yield divisible, not indivisible, benefits in the sense that 'the more there is for you, the less there is for me'. The concept of public goods is indeed far more limited than might appear at first sight. It is not enough to have joint consumption; the condition of equal consumption must apply to all, whether they pay or not . . . It is doubtful, therefore, whether roads, police protection, parks, playgrounds, schools and hospitals are really instances of public goods. Nevertheless, as long as some activities have a high degree of 'publicness', price calculations will fail to drive the economic system to the social optimum.

Much rarer have been clear documentations of a preexisting market failure (due to public goods concerns) that governments stepped in to remedy. Samuelson (1969), after being pressed for many years on the theory of public goods and their relationship to actual public decisions and expenditures, ultimately found the

concept to be a rather empty economic box for public policy purposes.[4]

Second, a large volume of scholarship has provided case studies of markets or other voluntary social organizations historically providing many of the "classic" public goods that today happen to be provided by governments, such as lighthouses (Coase 1974), property rights (Anderson and Hill 2004), roads (Klein 2002), police (Davies 2002), law and order (Friedman 1979; Benson 1989; Ellickson 1994), and the internalization of externalities (Cheung 1973). A number of scholars have described theoretical methods by which private entrepreneurs can use the market process to cleverly get around free-rider problems. Entrepreneurs can, for instance, employ price discrimination (Demsetz 1970), tying of private and "public" goods (Demsetz 1964), or dominant assurance contracts (Tabarrok 1998) to provide the optimal quantity of public goods, even consistent with Samuelson's (1954) marginal conditions. Furthermore, "institutional" entrepreneurs often create new organizations or rules that provide spaces where public goods can be provided. Groups can establish a "club" and only provide public goods to paying members, creating exclusion rights and negating the free-rider problem (Buchanan 1965; Goldin 1977). "Higher-tiered" entrepreneurs can innovate new forms of organization to better protect property where state capacity is lacking (Leeson and Boettke 2009; Li, J. Feng, and Jiang 2006), or change political rules to reach more profitable political outcomes (Martin and Thomas 2013). Or they can tap into an informal community-defined set of norms and rules (Ostrom 1990, 2010; McGinnis 1999; Aligica and Tarko 2013: Safner 2016).

Finally, the goods typically provided by modern democratic governments are largely not "public goods," under the exogenous technical definition. In the United States, as of the last quarter of 2019, nominal US gross domestic product was about $21.7 trillion, with total government expenditures accounting for about $7.4 trillion, or about a third of nominal GDP (FRED 2020a, 2020b). In 2019, about 61 percent of federal expenditures went to mandatory programs such as Social Security, Medicare, and Medicaid; about 15 percent went toward defense spending; and about 15 percent went toward nondefense spending (CBO 2020).

[4] See Hammond (2015), which traces the evolution of Samuelson's thoughts on public goods.

Economists debate how many government-provided goods actually constitute public goods in the Samuelsonian sense. In general, Woolley (2006, p. 5) describes how goods in the abstract, such as "law and order," can certainly be considered public, but inputs into these goods, such as physical courthouses or police officers on the beat, are certainly rival, as they can only be in one place at one time. Even something as "obviously" public as national defense turns out to be more complicated when we consider it not as a single good with a supply of one unit, but as a discrete series of marginal decisions (see, e.g., Rothbard [2009, p. 1031]; Holcombe [1997, pp. 15–16]; Woolley [2006, pp. 4–6]; Coyne [2015, pp. 374–75]). "The military," when considered as a homogenous unit, surely provides domestic citizens with the nonrival benefit of invasion deterrence, but what about the actual strategic decisions made to commission or allocate a new ballistic missile defense system, which can only operate over a particular area?

Government budget items that are closer to the Samuelsonian concept of public goods, such as general governance and protection services (courts, police, maintenance of law and order), collectively account for well below 15 percent, according to the numbers above. Woolley (2006, p. 3) suggests that hypothesizing about how a good can be nonexcludable in theory is easier to conceptualize in practice by observing what the government provides to everyone for a money-price of zero at the point of use (e.g., roads, education, and in many countries, healthcare). As a result, it is all-too-tempting to make the leap of implying nonexcludability from those goods that happen to be financed and distributed by the government.

Holcombe (1997) argues that the theory of public goods created by Samuelson (1954) and Bator (1958) is often conflated with positive explanations of public expenditures, as most goods provided by governments are private goods. Yet, the public goods argument is inexorably linked to both positive and normative accounts of public vs. private behaviors. Holcombe argues that governments encourage the analytic theory of public goods as means to increase their budgets by propagating a myth that technical economics proves that only governments can provide these goods.

In addition to the main criticisms above, there is a more foundational issue with assuming an exogenous technological or physical standard for defining public goods. As Wagner (2013) astutely observes, the problem of "free riding is an artifact of a particular set of institutional assumptions." That is, the possibility of

free riding is contingent on the existing institutions. In the abstract realm of pure economic theory purged of any real-world institutions, anonymous rational-maximizers can indeed fall victim to the free-rider problem.[5] Thus, it is not sufficient to identify that a good has the *potential* to exhibit the free-rider problem; what matters is the institutional environment within which this good exists. Enterprising individuals recognizing an opportunity can thus use various market, political, or cultural institutions to maximize their own income in ways that might be "productive, unproductive, or destructive" for broader society (Baumol 1990).

Thus, it is more productive to treat the "publicness" of various goods as being determined by collective decision-making, as they are primarily a feature of a political claim made by some individuals for their own interest. An economist, pundit, or political actor may invoke the concept of public goods as a normative argumentation device, perhaps contingent on their relationship with a political authority, in order to extend their political influence over the production or distribution of a particular good.[6]

III. The Endogenous Theory of Public Goods: Political Entrepreneurship

In laying out the endogenous theory of public goods, it might be useful to start with an analogy to the theory of private goods: Oil in the ground is mere black goo. Were geologists or physicists to discover it first, they might derive technical and conceptual definitions for oil based on its chemical content, fluid dynamics, or other objectively verifiable characteristics. However, it takes individual acts of entrepreneurship to subjectively envision the

[5] Indeed, some experimental evidence further confirms that individuals free ride less when their actions are no longer anonymous (McCaleb and Wagner 1985). Applying this critical role of institutions in preventing the original tragedy of the commons example in Hardin (1968), Cole, Epstein, and McGinnis (2014, p. 353) similarly point out that Hardin's (1958) original tragedy of the commons results only with a specific set of institutions.

[6] Holcombe (1997) comes closest to suggesting this, but instead puts forth a more general argument that it is simply in the interest of "the State" (collectively conceived as a homogenous unit) to promote a mythos of public goods *qua* nonrivalrous, nonexcludable goods requiring government provision, using the examples of education and national defense. Holcombe's analysis consists of broad strokes, where a truly endogenous approach would consider individual persons with subjective and conflicting views of what are public goods and how to direct scarce and rivalrous public finances toward providing them.

possibility of transforming that black goo into a resource of value for society. Those individuals must also bear the risk to bring about the potential benefits of extracting, refining, processing, and selling oil and oil by-products to consumers and other firms. It requires integration with the current capital structure of complementary goods, all calibrated to serve the demands of consumers through time. Entrepreneurship is ultimately what creates value from land.

I propose to consider a similar analogy for goods that economists typically define as "public." It requires acts of choice by individuals, often collective, to consider a good to be worth producing politically or privately. Political entrepreneurs often recognize and bear an opportunity for personal gain, to convince members of the public (as voters, bureaucrats, legislators, and firms) that the government must provide a good to meet society's needs. As the realm of politics is largely one of deliberation and persuasion, it requires considerable rhetorical investment in the scientific language of public goods (the exogenous definition) to convince enough people that they are "good for the public" and should be produced or subsidized by the public till. Thus, just as oil in the ground is only given value by private entrepreneurship, goods often take on "publicness" attributes by political entrepreneurship. For some individuals, there is often a greater profit opportunity in utilizing the political process rather than the market process to provide certain goods (Holcombe 2002, p. 143).

The logical models of public goods in blackboard abstractions must necessarily omit the critical components of time, innovation, and economic organization that go a long way in determining real-world outcomes.[7] However, these characteristics, when combined with the present institutional environment, are crucial in determining how a particular good (of whatever exogenous characteristics) will be provided. As an example, consider the example of wireless networking (Wi-Fi). In and of itself, Wi-Fi *prima facie* meets the exogenous public goods test: one's use of a Wi-Fi network in a public area does not prevent other people from simultaneously using the same Wi-Fi network, and no person has the ability to exclude other people from using the network. However, it is simple, almost trivial, to transform Wi-Fi from a public good to a club good, where a group of users can exclude nongroup members from using the network

[7] I thank an anonymous reviewer for calling my attention to the importance of these omissions.

(Buchanan 1967): The owner of the network can simply place a password on the Wi-Fi network and selectively give the password out to her friends (the "club" members). This simple act makes the nonrival good excludable, regardless of whether the owner requires payment in exchange for the password.

Several major aspects of political entrepreneurship are important in seeking public support for government provision or assistance in producing a public good. First, what constitutes a public good, or a good that has benefits that spill over to others, is to a large degree subjective, and depends on individual preferences for how other individuals are to behave. Second, individuals seeking to use the political process to obtain a private benefit must build a coalition to persuade enough other individuals that political authorities ought to invest in a particular enterprise. Rather than economic competition or innovation, this persuasion requires the employment of rhetorical strategies and the masquerading of private benefits as something "good for the public" and may use the logic of public goods as justification.

A. Subjectivity of Public Goods

As economic value is subjective and determined by individual choosers, outside observers can only make sense of the value and purposes placed on economic objects by interpreting human exchanges. A person purchasing an apple to consume can safely be said to value the apple more than the money given up for it in exchange. It is less clear cut, however, to analyze actions that affect other people, or individual preferences over how *others* are to behave (Aligica and Tarko 2013). Just as "one man's trash is another man's treasure," one person's subjective belief that an action constitutes a social harm may just as legitimately be another person's belief that it constitutes a social benefit.

Suppose a fervent vegetarian argues for moralistic reasons that the slaughter of animals for consumption ought to be prohibited by law. Assuming the law can be perfectly enforced, all citizens can simultaneously enjoy the "benefit" (in the vegetarian's view) of living in a humane society where animals are not slaughtered, and none can be excluded from it. This good appears to pass the exogenous public good criteria, so long as it is viewed from the subjective perspective of the vegetarian. On the other hand, a fervent carnivore could plausibly argue for equal and opposite moral or practical reasons that the slaughter of animals must be allowed, encouraged, or perhaps

even subsidized. Advocates of such a dietary choice would view the fact that meat is equally available to all as a social benefit, again, making it appear to be a public good. Each advocate may furthermore view the opposite proposal as a public bad, conferring moral or material harms upon society.

While this example may seem docile or slightly absurd, it is effortless to extend this logic to contemporary political issues such as gay marriage, environmental preservation, gun ownership, transgender bathroom access, immigration, social welfare programs, or certain religious practices. Each issue depends on how different individuals subjectively view the external benefit or harm to society from allowing persons to marry whom they choose, to carry firearms, or to engage in peculiar religious practices. Even the existence of markets and democratic institutions themselves may constitute exogenous public goods as (ideally) all individuals can enjoy the services these institutions provide without excluding or subtracting from others' benefits from the system. Such arguments are common in the literature on sentimental or "existence value" for preserving the environment—people who do not use or may never even visit the preserved land supposedly all enjoy positive value from simply knowing that it exists (Krutilla 1967).

In any event, the relevant issue is how these different individuals subjectively perceive these externalities to be policy relevant (Aligica and Tarko 2013). People who have very strong preferences about other people's behavior will view the other person's behavior as an externality upon themselves and upon society. Those that are indifferent or do not have a horse in the race may not be swayed by the public good argument. Rather than whether a good can objectively be proven to exogenously exhibit nonrivalry and nonexcludability, the key component is that these criteria are largely met within the mind of a proponent of these services.

B. Democratic Coalition-Building

In modern democracies, government provision of or contribution to public goods requires at least the passage of a new law or the establishment of a new regulatory agency. As Buchanan and Tullock (1962) demonstrate, individuals have heterogeneous preferences that may often be incommensurate, but political institutions in some sense reach consensus on the goods that must be provided (e.g., common defense). In a modern, democratic society, political entrepreneurs must assemble a coalition that is either sufficient to

command a majority in the legislature, or can influence a regulatory agency. Again, due to the subjectiveness of public goods, entrepreneurs need not convince *everyone* of the goods' public benefits (as is unlikely in a large pluralistic society), but only a minimal coalition of sufficient size.

Public choice economists have long noted the dominant influence on politics of those coalitions that are able to concentrate benefits and diffuse costs. Olson (1965) describes how smaller groups that stand to benefit more from a particular policy have lower costs of organizing and lobbying political authorities than larger groups. In the case of many goods that the government provides or helps pay for, from agricultural subsidies to sports stadiums to scientific research, the individual taxpayer only pays pennies or dollars each year in taxes to finance these programs. However, the recipients of these expenditures—the wheat farmers, the sports team owners, and the scientists receiving grant money—each earn considerable private benefits.

The exogenous theory is often invoked as a positive, explanatory account of why government provides the particular goods that it does, often alleging markets had failed to adequately provide the goods prior to government involvement. However, many meticulous works of economic history have uncovered that numerous episodes of the US federal government expanding its regulatory or administrative powers have been as a response to market players lobbying the government to intervene to weaken rivals in a robustly competitive market. Kolko (1963) provides a revisionist history of the Progressive Era, where large private interests captured the government and passed landmark antitrust and pro-labor legislation in order to dominate rivals in competitive markets, unlike the standard story of progressives regulating industry and setting up administrative agencies as a benevolent response to monopoly power and market failure. Among other studies, McGee (1958), DiLorenzo (1985), DiLorenzo and High (1988), Boudreaux and DiLorenzo (1993), and Boettke, Duncan, and Snow (2015) document, in similar fashion, how many of the key regulatory expansions over economic competition (namely, antitrust laws) originated not as a reaction to overt monopolization, but rather, in most cases, as rent-seeking by industry players in fiercely *competitive* markets masquerading as protecting consumers from monopoly. Many tools economists use today to positively explain and normatively justify regulations or antitrust policies came about during the mid-twentieth century, once

welfare theorists such as Pigou (1920), Samuelson (1954), and Bator (1958) formalized the catalog of market failures with the analytic concepts of externalities and public goods. These tools emerged after the key regulatory powers were assumed by progressive governments, and hence provide great ex post facto rationalizations, but inaccurate economic history.

Thus, when the government subsidizes production of a particular good, there are often clear beneficiaries who will organize public opinion by way of public-goods-type arguments. Public-goods arguments can catalyze individuals to support a program that would provide something argued to be "good for the public." Indeed, many scholars have pointed out reasons that political provision may crowd out private provision (Podemska-Mikluch and Wagner 2013; Martin 2010; Wagner 2007). Ideas, ideological rhetoric, and cognitive biases toward political control may bias public support toward political provision relative to market provision, where entrepreneurs must make practical appeals to price and material satisfaction.

In politics, since there is no residual claimancy (Acemoglu 2003), agreement over the most efficient stewardship of public resources cannot be settled by reference to market prices or other objective criteria. As a result, heterogeneous preferences in politics create conflict that is inefficiently and ephemerally resolved. Indeed, it is often conflict in preferences and dissent from the status quo that sets the political process in motion, as discussed below. The cost of holding and acting upon irrational beliefs is minuscule due to the low probability that individual voters will affect policies or have to face direct consequences of their beliefs (Caplan 2007).

Entrepreneurs hoping to use the political process rather than the market process must employ language that masks their potential to gain from particular policies, or else others will see through the rhetoric and reject the proposal (Wagner 2007). Instead, they make appeals to the "public interest" or other vague notions that tend to corrupt the language of politics and create deviations between announced and actual intentions (Ostrom 1997). In Yandle's (1983) parable, bootleggers must use the moralistic language of the Baptists to convince the polity of the beneficence of their proposal to restrict alcohol sales, even if they or their allies stand to materially benefit.

Naturally, one of the most appealing and convincing rhetorical devices is to propose a political enterprise that appears to have some objective backing from the mantle of science. Public goods

arguments, using the exogenous definition above, may provide a perfect combination of such qualities.

IV. Case Study of Political Entrepreneurship in Creating Public Goods: Scientific Research

Scientific research is one of the quintessential examples of a public good. Indeed, it is difficult to find a purer public good than ideas and inventions that can benefit all of mankind. Once an idea or an invention is discovered, all can potentially acquire the knowledge and benefit from it. Scholars can use scientific theories posited from across the globe, economic competitors can copy and produce one another's profitable inventions, and consumers the world over can benefit from the creature comforts spawned by improvements in technological understanding. Partially as a result of this logic, modern democratic governments sponsor basic research by allocating grants to fund scientists out of the fear that private markets do not face adequate incentives to do so. However, although basic scientific research might appear logically to constitute a public good, this logic neither explains neither the historical lack of government sponsorship of science, the widespread private sponsorship of science, nor the political advocacy of prominent scientists.

A. Scientific Research as an Exogenous Public Good

As "science" and "knowledge" constitute an enormous swath of human endeavors, this paper focuses primarily on basic scientific research. The International Council for Science defines basic research as "fundamental theoretical or experimental investigative research to advance knowledge without a specifically envisaged or immediately practical application. It is the quest for new knowledge and the exploration of the unknown. As such, basic science is sometimes naively perceived as an unnecessary luxury that can simply be replaced by applied research to more directly address immediate needs" (ICSU, 2004).

At this stage, there is the highest degree of uncertainty whether one's exploratory efforts will yield anything of value, either in terms of advancing scholarly understanding or producing a technology that can be transformed into a profitable good or service by private enterprise or government procurement. Projects such as the European Organization for Nuclear Research (CERN)'s use of particle accelerators in the search for fundamental physical particles constitute an example of this category. It is this particular type of

research that is often argued to be far too abstract to be profitable for private enterprise to fund, and where Smith's dictum above applies strongest. Hence, the average person can point to the Manhattan Project's construction of the first US nuclear weapon, NASA's operations that landed a man on the moon, and the Department of Defense's ARPANET launching the network that would evolve into the modern internet. All were significant projects undertaken by the US federal government and requiring massive expenditures. Some economists argue that we do not take these instances seriously enough, that we undervalue the extent to which the federal government involves itself with what is ostensibly private research (Mazzucato 2013).

The view of science as a public good in the West can be traced back at least as far as Sir Francis Bacon, one of the earliest and most revered scientists, and also the person who popularized the very idea of "progress" (Dalrymple 2003, p. 37). Bacon (Jardine and Silverthorne 2000, p. 99) notes that "the benefits of discovery may extend to the whole human race [and] for virtually all time." Kealey (1996, chap. 1; 2006, chap. 1) describes how Bacon's motivation for famously claiming that "knowledge is power" was the Englishman's search to discover how the Spanish succeeded in becoming the world's greatest empire in his day. Bacon concluded that it was a result of the Spanish government's command of technology, derived from Prince Henry the Navigator's public backing of scientific discovery. Bacon (Jardine and Silverthorne 2000, p. 99) concludes, "there is not any part of good government more worthy than the further endowment of the world with sound and fruitful knowledge."

The idea that knowledge is—in modern economic parlance—nonrivalrous has been floated by the scientific and political elite for ages. Thomas Jefferson's famous letter to Isaac McPherson describes how "he who receives an idea from me, receives instruction himself without lessening mine; as he who lights his taper at mine, receives light without lessening mine" (Lipscomb and Bergh 1905). Economists for centuries have taken the idea of granting specific patents and copyrights for inventors and authors as an important function of the sovereign. Solow (1957) famously described the paramount importance of technological development for economic growth, linking innovation and technology policy with development policy. It was primarily Arrow (1962) who provided the first major examination of the problems of "inappropriability" of information through the lens of public good theory, where an original discoverer

could not appropriate a sufficient amount of the social surplus generated by the discovery to justify innovation in the first place (as expected returns would be negative). Furthermore, as ideas can be shared at a marginal cost of at or near zero, the efficient "price" of information would also be zero, a clearly unprofitable venture. Later endogeneous growth theory researchers such as Romer (1990) famously describe the positive spillover effects of knowledge and scientific discovery, where productivity gains are captured by entire industries, rather than just the discovering firm or inventor, which cannot be captured in market prices. Dalrymple (2003) extends the logic further and calls science a "global public good" for these reasons.

B. Is Science a Public Good?

Challenges arise from modeling scientific research as a public good (in the exogenous sense, as described above). The exogenous approach to public goods seems to imply that any new discovery is akin to a radio or television broadcast: the discovered knowledge instantly reaches all nearby persons capable of receiving it, and those users in turn can put that knowledge directly to use. The real economic cost of transmitting knowledge, however, is rarely zero. As any teacher intimately understands, both instructor and learner must expend substantial effort to convey and understand ideas (even when they are often "freely" accessible on the internet). Even if the cost of disseminating information or inventions were truly zero, once a discovery is reverse engineered and replicable, the copier still must replicate the embodied knowledge and produce the product, which requires high investments in a complementary structure of capital with specific uses directed at producing that good.

Mansfield, Schwartz, and Wagner (1981) study forty-eight products that were reverse engineered and copied by market competitors. The authors estimate that the copying cost incurred by competitors constituted about 65 percent of the cost of the original innovation, and replication took about 70 percent of the time it took the first mover to come to market. This finding should not surprise economists familiar with Hayek (1945), who reminds us that most relevant knowledge for economic action is tacit, and can only come from experience and from "rapid adaptation to changes in the local circumstances of time and place."

Only those experts who have generated enough tacit knowledge through their own studies and scientific pursuits (and publications)

are able to utilize the knowledge and discoveries of others. A new pharmaceutical pill or a nuclear propulsion system is worthless except to experts who already maintain the tacit knowledge and experience to properly reverse engineer, copy, and implement the new knowledge into commercially useful applications.

Kealey (2014) appropriately models science and discovery as a "contribution good" or a club good instead of a pure public good, as it benefits only those who are already scientists in the relevant fields. Thus, when academics send out manuscripts in the hopes of publication, they are reviewed by other academic experts who have often published in the same field, rather than to random academics from other fields, or, worse yet, nonacademics from the real world. Only those other academics have the tacit knowledge to criticize and/or disprove the article in question, something journal editors would prefer, rather than having an obviously wrong or misleading article slip through and reduce the journal's reputation. As a consequence, many scholars have productively examined science and discovery as a common resource, governed by the informal norms of the scientific community. Polanyi (1962) famously describes the "republic of science" as a spontaneous order of individual scientists cooperating and interacting according to the rules and norms of the scientific method, peer review, and prestige. Tarko (2015) documents the successes and challenges of the scientific community in the context of an institution that manages public goods on a global scale.

To be clear, the scholarly debate over whether science is a public good does not disqualify other legitimate reasons for governments to fund, nudge, or allocate grants for research. Indeed, even those who agree that basic scientific research does not constitute a technical public good put forth arguments on other grounds that scientific research deserves government sponsorship to some degree (see, e.g., Guston [2013]; Harden [2013]). There may be many other legitimate reasons for government intervention or direction in scientific research. The controversy over the status of scientific research as a public good only implies that it may not be as prone to undersupply problems compared to the present regime of government allocation of scientific grants. This possibility is especially worth considering, as the United States' present institutional arrangement of scientific research grants is barely half a century old.

C. Political Entrepreneurship and the Origins of Government-Funded Science

Historically, science was rarely, if ever, funded by governments. Rather, science was either the pursuit of independently wealthy men like Bacon, Descartes, or Montaigne, or of the wealthy elite acting as philanthropic patrons for clients like Galileo, Da Vinci, and Copernicus (David 2001, 2008). Many researchers recognize that technological advancement and economic growth largely do not come from basic scientific research (Ridley 2011, pp. 255–258). Indeed, it is a common refrain among economic historians to note that civilizations like Song China and the Islamic caliphates of the Medieval era had spectacular bursts of invention and discovery—printing, gunpowder, algebra—and yet it was only comparatively "backward" Medieval Europe that would one day escape poverty at an unrivaled scale (Rosenberg and Birdzell 1986, p. 9 and chap. 9; Diamond 1999).

Indeed, the Organization for Economic Cooperation and Development itself surprisingly demonstrates that technological and economic growth are negatively impacted by government research and development, and positively impacted by private research and development. Their results "suggest that publicly performed R&D crowds out resources that could be alternatively used by the private sector, including private R&D" (OECD 2003, p. 84). Park (1998) finds similar results in a theoretical model, noting a negative correlation between government research and economic growth in developed countries, while cautioning that it is not clear how causal these results are. In any event, government sponsorship of research is a relatively new phenomenon.

Gruber and Johnson (2019, chap. 1) describe how the inventions of the second industrial revolution led to large industry-based research labs, epitomized by Thomas Edison's General Electric and Bell Telephone's Bell Labs, among other corporate leaders' labs. Both government and universities were equally removed from research until World War II. Kealey (2013) notes: "As late as 1940 . . . the US total annual budget for research and development (R&D) was $346 million, of which no less than $265 million was privately funded (including $31 million for university or foundation science). Of the federal and states governments' R&D budgets, moreover, over $29 million was for agriculture . . . and $26 million was for defence . . . America, therefore, produced its industrial leadership, as well as its Edisons, Wrights, Bells, and Teslas, under research *laissez faire*" (emphasis in original).

The US Constitution does authorize Congress to act "to promote the Progress of Science and useful Arts" in Article I, Section 8, Clause 8, but primarily to establish patents ("by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries"). It was under this and other constitutionally enumerated authority that early Congresses quickly passed acts establishing patents (1790), copyrights (1790), the Library of Congress (1800), and a Coast Survey (1807). None of these, however, was viewed or designed to have the federal government administer, manage, or fund scientific research.

The fear of the politicization of science was never far from the minds of the public and of scientists. Ultimately, it was only during wartime and national emergencies that scientists were able to have their lobbying efforts pay off and yield any substantial transfer of scientific resources from private to public hands. As Higgs (1989) demonstrates, it is through crisis periods that governments obtain new authority, and once the crisis ends, institutional momentum makes it difficult for the new authority to recede. Below are three major episodes of how three different political entrepreneurs utilized these crisis points to found national institutions that progressively brought government influence over scientific research.

The first push for any major government involvement in science occurred, along with many other expansions of federal power, during the Civil War. A tidal scientist (and prestigious great-grandson of Benjamin Franklin) named Alexander Bache had been campaigning for an American academy of science (Kealey 1996, p. 234). Bache helped create his own private group of elite scientists, whom he called the Scientific Lazzaroni (Italian for beggars), to push for the standardization and nationalization of American science, modeled on the prestigious government-backed national academies in Europe (NAS 2016a).

As early as 1851, Bache and the Lazzaroni sought to convince Congress and the public that "an institution of science [was needed] to guide public action in reference to science matters" (NAS 2016a). Such cries fell on deaf ears for over a decade. Only the outbreak of war in the 1860s would provide the key opportunity for Bache to emphasize the public benefits of science for the war effort. Another leading scientist and Lazzaroni member, Joseph Henry—who worked for the US Navy—called for the establishment of a commission to test new weapons (NAS 2016a). Together with the political support of Massachusetts Senator Henry Wilson, Congress finally established

the National Academy of Sciences (NAS) in 1863 to advise various government departments "whenever called upon," and consistent with the history of the separation of science and state, "the Academy receives no compensation from the government for its services" (NAS 2016a; 2016b). Bache, naturally, was appointed as the academy's first president. The academy historically assisted the government in understanding how to upgrade its wooden naval fleet to ironclads and update its infantry's weapons amidst the Civil War.

The academy's founding was surprisingly controversial among scientists and the general public. The popular scientific periodical, *Scientific American*, wrote op-eds about how this new institution would enable government control of science and the provide benefit to government scientists at the expense of objective truth (Kealey 1996, p. 235). However, the NAS persisted, as no group could sufficiently organize to remove the institution.

During World War I, the next major expansion of government involvement in science occurred amidst the opportunism of wartime. An astronomer and influential member of the newly established academy, George Ellery Hale, called upon the NAS to form the National Research Council (NRC) to assist the president the day after the United States declared war on Germany in 1917 (Kealey 1996, p. 240). Hale himself chaired the council, which oversaw the development of poison gas, submarine detection, and IQ tests.

Hale wrote to President Wilson to indicate that although the council had been created for wartime expediency and aid to the military effort, he saw a role for the council during peacetime to "stimulate pure and applied research for the national welfare" (Kealey 1996, p. 241). This mission creep would allow Hale's council to continue after the national emergency ended. Although persistent lobbying efforts could not persuade Congress to fund the NRC after the war (the Democrats in control remained skeptical of government management of science, which they viewed as a commercial activity), Wilson's connection to Hale convinced Wilson to issue an executive order mandating the council's continuity.

The final major act of political entrepreneurship that ushered in our current regime of government allocation of scientific grants also had its origins during wartime. Vannevar Bush, the president of the private Carnegie Institution (then the largest funder of science in the United States) publicly lamented in his renowned book, *Science: The Endless Frontier*, that "we have no national policy for science," calling for a national foundation to coordinate and invest in science for the

whole country (Kealey 1996, p. 245, cf. Gruber and Johnson, chap. 1). Following the hints of war with Japan and Germany in the early 1940s, Bush was able to lobby President Roosevelt into creating the National Defense Research Committee (NDRC), with Bush as its chairman. Congress ultimately adopted the NDRC by law as the Office of Scientific Research and Development, again with Bush as chairman. It had access to $1.6 billion in federal funds, primarily to research defense and the feasibility of nuclear weaponry (Kealey 1996, p. 245).

Following the war's conclusion, Bush and his allies lobbied further for a National Science Foundation. They envisaged a federal institution that would allocate research grants to scientists, as selected by other scientists on the basis of merit. This proposal met with significant political opposition, led by Senator Harley Kilgore and ultimately even President Truman. Truman vetoed Bush's proposal, instead suggesting that the institution be run by politicians and bureaucrats who allocated the grants according to "national need," indicating that Bush's proposal of scientists funding other scientists would "vest the determination of vital national policies, the expenditure of large public funds, and the administration of important governmental functions in a group of individuals who would be essentially private citizens. The proposed National Science Foundation . . . implies a distinct lack of faith in democratic processes" (quoted in Kealey 1996, p. 247).

Even the president noted that such a policy would provide concentrated benefits to recipient scientists. However, the opposition faded as yet another wartime opportunity, this time the Korean War and the start of the Cold War, took hold. Congress passed the National Science Foundation Act of 1950 and gave the agency the mission "to promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense" (NSF 2015). Following the Soviet Union's launch of Sputnik in 1957, public support soared for government funding of scientific research, both through the NSF and through the newly established NASA. In 1940, the federal government had spent $22 million (in 1950 USD) on financing research, but by 1960, it had spent almost $3 billion (in 1950 USD) (Kealey 1996, p. 248). In recent years, the NSF has had a budget of about $8.5 billion in nominal USD (NSF 2020). As evidenced by the common popular quips about how the United States can put a man on the moon or build atomic weapons, public support for federal funding of science remains strong.

V. Implications

The connection between formal public goods theory, welfare economics, and public finance has been engrained in the technical economic literature for over fifty years. As scholarship taking institutional and political economy analysis seriously is on the rebound, we should welcome extensions of this form of analysis into sacred areas of formal economics. As such, this paper has provided a sketch of how we might consider a more robust form of public goods as defined by their emergence within an entangled system of political economy.

The goal of this type of analysis is to continue extending positive analyses of public finance and public goods that describe them as they actually exist and emerge, rather than as normative policy prescriptions. The normative aspect of public goods theory is safely and hermetically sealed within the preferences of different individuals over the behavior of others within a society. Public goods theory cannot by itself provide a normative policy prescription through technical economic analysis. It requires further preferences and ideological support on the part of the economist or advocate, which requires a shift of intellectual resources away from technical public goods arguments and into other territory. As for the public goods economists typically describe, it seems more appropriate to consider them an endogenous component of collective decision-making: governments provide particular goods not from a normative imperative or technological determinism, but simply because people want them to.

Perhaps a better approach would be to follow Woolley's (2006) apparent advice to deemphasize public goods as a separate research program and pedagogical tool in favor of a concept that is far more robust and with a more fruitful literature: externalities. What is a public good if not simply a special case of a very large positive externality? In fact, Woolley (2006, p. 10) demonstrates that Samuelson's (1954) optimality condition for efficient public goods provision,

$$\sum_{i=1}^{n} MRS_i = MRT$$

can trivially be rewritten as

$$MRS_i + \sum_{i \neq j}^{n-1} MRS_j = MRT$$

where provision of public good x for person i produces a private benefit to person i plus a positive externality to all other individuals $j \neq i$. Hence, an efficient solution requires internalizing these positive externalities to produce enough of good x to reflect private valuations of the benefits of x. There is still the preference-revelation mechanism dilemma that Samuelson (1954) is correctly concerned with. Furthermore, by reframing the dilemma as coping with a positive externality, we are able to tap into the vast literature of how different institutional arrangements cope with externalities.

There is some evidence for using this approach. Hammond (2015) describes how Samuelson (1969, p. 102), attempting to set the record straight for his critics, redefines a public good as "simply one with the property of involving a 'consumption externality,' in the sense of entering into two or more persons' preference functions simultaneously." Operationalizing a public good as any good entering multiple utility functions (and not necessarily everyone's utility function) virtually makes every good a public good, and therefore reduces the analytical insight of public goods as a unique economic concept.

Where does this leave economists in using public goods as justification for government expenditures? Perhaps rather than attempting to use the mantle of science and justify government intervention through the public goods argument, we should instead call a spade a spade and recognize that arguments for government provision are normative and based on differing preferences, not technical disagreements. A positive theory of government expenditures and public goods recognizes the normative aspect as the product of political economy. A better distinction between "public" and "private" goods might be that those goods provided by government are de facto "public" and those provided by markets are de facto "private." Both entities are capable of providing both types of goods, and this explanatory definition says nothing normative about whether an entity *should* provide one or the other.

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