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The political economy of state responses to infectious disease

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Abstract

How can public policy best deal with infectious disease? In answering this question, scholarship on the optimal control of infectious disease adopts the model of a benevolent social planner who maximizes social welfare. This approach, which treats the social health planner as a unitary "public health brain" standing outside of society, removes the policymaking process from economic analysis. This paper opens the black box of the social health planner by extending the tools of economics to the policymaking process itself. We explore the nature of the economic problem facing policymakers and the epistemic constraints they face in trying to solve that problem. Additionally, we analyze the incentives facing policymakers in their efforts to address infectious diseases and consider how they affect the design and implementation of public health policy. Finally, we consider how unanticipated system effects emerge due to interventions in complex systems, and how these effects can undermine well-intentioned efforts to improve human welfare. We illustrate the various dynamics of the political economy of state responses to infectious disease by drawing on a range of examples from the COVID-19 pandemic.

KEYWORDS

bureaucracy, complex systems, coronavirus disease 2019, COVID-19 pandemic, economic knowledge, infectious disease, polycentricism, public choice, system effects

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1 | INTRODUCTION

How can public policy best deal with infectious disease? The global COVID-19 pandemic has brought this question to the forefront. Insights from the field of epidemiology, the branch of medicine focused on the causes, incidence, distribution, and control of various health-related conditions, including infectious disease, are crucial for formulating an answer to this question. However, as Gersovitz (2011, p. 278) notes, epidemiology is not a social science and "it does not provide theories of the responses by individuals to differences in the risks of infection or to differences in the options for prevention and therapy and their associated costs." Economics, therefore, can offer important insights into responses to infectious diseases.

Scholarship in the area of "economic epidemiology" blends insights from the two fields to better understand how human behavior contributes to various health-related conditions and allows for deeper consideration of various policy responses (see Philipson, 2000 and Laxminarayan and Malani, 2011 for an overview). Within economic epidemiology, one category of research focuses on the optimal control of infectious disease (see Barrett and Hoel, 2005; Francis, 2004; Geoffard and Philipson, 1996; Gersovitz, 1999, 2011; Gersovitz and Hammer, 2003, 2004, 2005; Goldman and Lightwood, 2002; La Torre *et al*., 2020; Rowthorn *et al*., 2009; Smith *et al*., 2005; Weimer, 1987). Scholarship in this area studies how governments can improve social welfare through the optimal allocation of resources based on the following logic.

A defining feature of communicable diseases is the existence of "infection externalities" (Gersovitz, 2011, 2014). When making decisions, individuals only consider the benefits and costs that affect them directly while neglecting the costs associated with infecting others. In the case of COVID-19, for instance, those at a lower risk for severe illness from infection may engage in behaviors that increase the chances that others, who are at a higher risk for severe illness upon infection, will contract the disease. The result is a socially inferior outcome—without incurring the full cost of their actions, individuals within the lower-risk group are likely to "over consume" behaviors that will spread the disease to more vulnerable populations, leading to higher rates of infection and death (see Boettke and Powell, 2021). This creates space for potential welfare-enhancing interventions on the part of government.

Following the standard approach of welfare economics, the literature on the optimal control of infectious disease adopts a model where a benevolent social planner identifies this divergence between individual choices and the socially optimal outcome and intervenes to maximize social welfare. This approach is valuable for clarifying the externality aspects of infectious diseases and broad potential policy responses. What is left unexamined, however, are the presuppositions regarding the social health planner.

These include assumptions regarding knowledge about the social welfare function, the existence of appropriate incentives resulting in the allocation of resources that maximizes social welfare, and the absence of unintended consequences which undermine efforts to improve welfare. The standard approach treats the social health planner as standing outside of society and removes the policymaking process from economic analysis. The purpose of this paper is to open this black box by extending the tools of economics to the policymaking process.

Our analysis is an extension of Buchanan (1949), who distinguished between two foundations for a theory of public economics. The "organismic view" models the state as a unitary entity that acts as a "fiscal brain" working to expertly manipulate specific variables to efficiently maximize social welfare. In this model the state acts in a purely allocative capacity, distributing the optimal quantity and quality of resources to the appropriate recipients to maximize a given and known social welfare function. The fiscal brain itself is, by assumption, not subject to the logic of economizing behavior.

Alternatively, the "individualistic view" of public finance focuses on individual choosers and the specific institutions in which they are embedded. In this model, government actors are human beings who engage in economizing behavior just like their private counterparts. The focus is on the epistemic and incentive properties generated by the political institutions within which policymakers operate. Under this view there is no given and known social welfare function available to social planners. Moreover, political incentives may create numerous frictions limiting government attempts to improve welfare, or disincentivizing the purely other-regarding behavior assumed in the organismic model.

Given the assumption of a benevolent social planner in the economic epidemiology literature, Buchanan's distinction remains relevant. Instead of assuming a "public health brain" that efficiently addresses infectious disease, we approach the problem through the lens of the individualistic view. In doing so we explore the nature of the economic problem facing policymakers and the epistemic constraints they face in trying to solve that problem. In addition, we discuss the incentives facing policymakers in their efforts to address infectious diseases and consider how these incentives may limit welfare improvements. Though we draw on examples from the COVID-19 pandemic for illustration, the central insights of our analysis are applicable beyond this single case of infectious disease.

We proceed by considering three challenges facing social health planners. The next section considers the epistemic challenges facing health planners, which include identifying the nature of externalities and solving the economic problem necessary to maximize social welfare. Section 3 explores the public choice challenges that influence government responses to infectious disease and how political frictions may adversely influence policy regardless of epistemic constraints. Section 4 analyzes how system effects emerge due to interventions in complex systems and considers how these effects can undermine well-intentioned efforts to improve human welfare. The final section concludes.

2 | THE EPISTEMIC CHALLENGE

The public health brain approach to infectious disease assumes that a benevolent social planner has the knowledge necessary to identify the nature of the infection externality and the optimal response to maximize social welfare. This neglects the multiple epistemic challenges facing health planners that result from the nuances of the economic problem. The cause of this neglect is explained by Buchanan's (1964) distinction between two alternative orientations for economic study—the allocation paradigm and the exchange paradigm.

The allocation paradigm treats the economic problem of society as one of allocating scarce resources among known competing ends. From this perspective, the economic problem is one of computation and maximization. A solution exists and can be known by an analyst. The allocation paradigm is at the foundation of the public health brain approach to infectious disease, as it assumes that the social health planner can step outside of the system being studied, access

the appropriate data, and calculate both the size of the negative externality and the optimal policy response. In this model, epistemic limitations are assumed away, and optimal control is a purely technical problem. Individuals in the system are treated as units of account with given and known utility functions that can be acted upon by an external analyst to achieve the optimal outcome for society.

As an alternative to the allocative paradigm, Buchanan offered the exchange paradigm, which focuses on the process of interaction between people within context-specific, and varying, institutional environments. From this perspective, economics is the study of how human choosers interact and coordinate to discover how to use scarce resources to achieve their disparate and evolving ends. The institutional environment in which people act influences the epistemic and incentive aspects of their interactions. Hence, the institutional environment directly corresponds to the type of coordination that takes place (see Buchanan, 1954b; Wagner and Yazigi, 2014).

In contrast to assuming a pre-existing solution to a known economic problem, the exchange paradigm holds that individuals must discover the best means of utilizing scarce resources to achieve their disparate goals through the process of experiencing life and interacting with others in an open-ended system. While the allocation paradigm views order as preexisting and moldable by an external analyst, the exchange paradigm holds that order emerges and evolves as people engage in choice (see Buchanan, 1982). The exchange paradigm has important implications for economic epidemiology because it emphasizes that there is no single economic problem for society separate from the individuals that comprise it, each of whom face the challenge of discovering how to best use scarce resources to achieve a multiplicity of ends which vary from person to person.

Even within the context of a pandemic, people do not exclusively value their health, but a number of other goods—for example, food, shelter, financial security, entertainment, social interaction, etc. (Storr *et al*., 2021). Furthermore, within each of these categories, people differ in the specifics of what they value—for example, the quantity and quality of health care (Boettke and Powell, 2021). Take, for example, two individuals within the context of the COVID-19 pandemic. One individual is at high risk for serious complications should they acquire the illness while the other is at low risk for complications. The high-risk individual may place a relatively high value on avoiding infection and a relatively low value on things like social interaction. The low-risk individual, meanwhile, may hold reverse valuations. While a pandemic like COVID-19 may alter how both individuals value various ends, it does not change the fact they desire an array of specific ends that differ between them. Indeed, differing individual valuations are apparent from surveys of perceptions regarding the COVID-19 pandemic (Ballew *et al*., 2020; Schaeffer and Rainie, 2020).

As another example, consider working parents who must balance their careers with childcare and schooling. Uniform public health policies such as closing public schools require all families to face the costs associated with at-home education, while limiting each family's ability to make choices based on their unique risk profile, financial situation, and professional work situation. Surveys and interviews suggest that policies related to schooling and childcare affect the professional careers of some parents more than others (see Catalyst, 2020; Chatterjee, 2020).

Conceptually, the disparate and multiple ends of individuals are accounted for in the calculation of a welfare function, which considers alternative social states and allows the dispassionate external analyst to select the best allocation of scarce resources to maximize social welfare. But this assumes that individual utilities are fixed and given to the analyst. The exchange

paradigm, however, emphasizes that individual utilities are neither given nor known and, therefore, cannot be aggregated into a single welfare function to be optimized by a benevolent social planner. As Buchanan put it, "A necessary condition for deriving a social welfare function is that all possible states be ordered *outside* or *external* to the decision-making process itself. What is necessary, in effect, is that the one erecting such a function be able to translate the individual values (which are presumably revealed to him) into social building blocks" (Buchanan, 1954a, pp. 121–2, emphasis original).

The social planner, however, cannot access individual values which are subjective and in the mind of the individual chooser (Buchanan, 1959, 1969). "Utility is measurable, ordinally or cardinally, only to the individual decision-maker. It is a subjectively quantifiable magnitude" (Buchanan, 1959, p. 126). The economist, therefore, "must remain fundamentally ignorant concerning the actual ranking of alternatives until and unless that ranking is revealed by the overt action of the individual in choosing" (Buchanan, 1959, p. 126). Economics is not a science of society-level optimization subject to given data and fixed constraints, but a *social* science of human choice, and hence subjective valuation, by individual choosers embedded in specific institutional environments (Buchanan, 1979a).

Further compounding the issue is that individual utility functions change through time as individuals engage in the process of choice in the actual world. As Buchanan (1979b) argues, individuals possess scope to imagine who they might be and take active steps to become that person. These "prospects of becoming are sufficient to channel action, to divert resources away from the automatic routine that utility maximization, as normally presented, seems to embody ... We move through time, constructing ourselves ... We are not, and cannot be, the 'same person' in any utility maximization sense" (Buchanan, 1979b, p. 100). Human choice in an open-ended system is future oriented and involves creativity over the utility function itself, meaning that individual utility functions cannot be treated as fixed units of account. In the case of COVID-19, for instance, "individuals do not face a single 'either-or' decision but are required to constantly evaluate their choices to go out or stay at home. Thus, cognitive re-evaluation is a core feature in our setting and is based on dynamic feedback loops" (Chan *et al*., 2020, p. 10). As these re-evaluations occur, individuals will continuously update their understanding of the trade-offs associated with staying home (Storr *et al*., 2021) and adapt their behavior as new costs and benefits emerge.

Taken together this means that in order to construct a social welfare function the analyst must impose an ordering of preferences on the individuals whose utility they purport to maximize. "Individual preferences, in so far as they enter the [social welfare] construction must be those which appear to the observer rather than those revealed by the behavior of the individuals themselves. In other words, even if the value judgments expressed in the function say that individual preferences are to count, these preferences must be those presumed by the observer rather than those revealed in behavior" (Buchanan, 1959, p. 126). The result is that the multiplicity of nuanced and evolving ends that constitute human life are replaced by a single hierarchy of known ends as determined by the analyst, who has narrow expertise and a limited understanding of context-specific conditions (Bylund and Packard, 2021).

The health planner's epistemic challenges do not end here. Even when a single hierarchy of ends is imposed, the public social planner still faces the epistemic challenge of determining the best use of scarce resources to achieve the desired end in an efficient manner. In order to maximize efficiency, planners must determine the opportunity cost of scarce resources and allocate those resources to their highest-valued uses. Attempting to transform the economic problem

into a technological problem to achieve a single end does eliminate the opportunity cost of scarce resources.

Within the context of the COVID-19 pandemic, for example, one critical concern was the availability and allocation of ventilators—mechanical devices used to assist patients with breathing. Officials in the United States, Europe, and elsewhere warned of a potential scenario in which the demand for the machines would grossly outpace their supply, with lethal consequences (see de Puy Kamp, 2020; Kliff *et al*., 2020). Faced with this potential scenario, planners would need to decide how ventilators should be allocated to patients, necessarily leaving some patients without access (Liddell *et al*., 2020; Meltzer and Patel, 2017; Rothstein, 2010). Other questions surrounding ventilators came to the forefront. How many additional ventilators should be produced? Should existing ventilators in some hospitals be transferred to others? These questions surrounding ventilators are but a few of a potentially significant number of similar queries regarding other health care equipment and personnel, as well as other "essential" goods and services (Storr *et al*., 2021).

As another example, consider the case of U.S. federal government relief programs, totaling over $4 trillion, meant to mitigate the negative economic effects of the pandemic (Whoriskey *et al*., 2020). A true economic accounting of these relief funds would need to weigh the opportunity costs of these resources. This would require judging the return on specific resource allocations versus alternative uses for those funds to determine their highest-valued use.

In the allocation paradigm, these questions are easily answered because it is assumed the analyst has the necessary information to maximize social welfare. The exchange paradigm, in contrast, emphasizes that information regarding the opportunity cost of scarce resources is not given, but must be discovered. In the context of markets, economic calculation is a crucial aid to this discovery process. Economic calculation, which refers to the ability of people to gauge the expected value-added of alternative resource uses, operates as follows.

Property rights over the means of production allows for the development of markets in goods and services. Exchange in these markets, in turn, generates monetary prices reflective of the relative scarcity of goods. These prices aid economic decision-makers in judging the expected profitability, and hence value, of alternative uses for scarce goods and services. The repeated interactions of economic actors and the prices these interactions generate allow for adaptability and error correction (Boettke, 2018, pp. 945–6). Responding to profit-and-loss signals and the incentives provided by hard budget constraints, people adjust their behaviors as conditions change. The result of this ongoing process of discovery and adjustment is the re-allocation of resources toward higher-valued use.

Public administration by the state takes place outside of economic calculation (Boettke, 2018, p. 945; Aligica *et al*., 2019, pp. 1–2; Bylund and Packard, 2021). Government organizations are, by design, not motivated to maximize profit and often do not rely on competitively determined market prices to allocate resources. As such, economic calculation is unavailable as a tool to ensure that scarce resources are being re-allocated to their highest-valued uses. This calculation problem plagues efforts at both comprehensive (see Hayek, 1948 and Mises, 1920, 1922, 1949) and non-comprehensive economic planning (Lavoie, 1985) and delineates the limits of what state planning can accomplish.

Planners can potentially increase the amount of pre-determined outputs available, but they cannot know whether the resources used in production, or the final outputs themselves, are allocated in a manner that maximizes social welfare (Coyne, 2008, pp. 70–79). Producing outputs and ensuring that those outputs are produced and employed efficiently are not equivalent. In the context of a health crisis, social health planners can choose to increase certain pre-

determined outputs—e.g., medical supplies and equipment—but they cannot know whether their actions maximize social welfare.

3 | THE PUBLIC CHOICE CHALLENGE

Epistemic constraints prevent public health officials from maximizing social welfare, but do not inhibit them from allocating resources to satisfy pre-determined output targets independent of opportunity cost considerations. Planners can, for instance, choose to reallocate resources to increase the quantity of COVID-19 tests, personal protective equipment (PPE), or medical equipment. The possibility of increasing pre-determined outputs, however, is not a guarantee of meeting the conditions necessary for successfully achieving these targets from a purely technological perspective.

Social health planners must first identify the specific output targets they wish to pursue. They must then determine what is required to meet these targets—increasing the production of certain outputs (e.g., producing more ventilators) or re-allocating existing goods to increase availability (e.g., re-allocating existing ventilators to certain locations). Planners then need to facilitate the production of new outputs or re-allocation of existing outputs and ensure they are delivered to the intended recipients. Each of these steps requires coordination within and across different levels of government. These conditions cannot be assumed to exist, but instead must be analyzed as part of the political process through which health-related policies are designed and implemented.

A large literature in public choice economics identifies various frictions in democratic political processes (see Mueller, 2003; Reksulak *et al*., 2014; Rowley and Schneider, 2004) that can frustrate attempts to produce policy outcomes in a variety of settings, including during public health crises. At the foundation of these frictions is the competition that takes place in political institutions during the formulation and implementation of policy. The reliance on politics, versus markets, as a means of allocating scarce resources changes the nature of competition, but not the existence of competitive pressures in determining outcomes (Buchanan, 1954b; Wagner and Yazigi, 2014). As Buchanan (Buchanan, 1987, p. 246) noted, "The relevant difference between markets and politics does not lie in the kinds of values/interests that persons pursue, but in the conditions under which they pursue their various interests. Politics is a structure of complex exchange among individuals." In the context of public health crises, political competition manifests in two main forms.

First, political competition occurs among various levels of government. Responding to health crises requires involvement from government officials at the federal, state, and local levels. Ideally, these efforts would be coordinated around a unified and shared goal of helping those who are suffering, or at the greatest risk of suffering. However, two factors may prevent this from happening.

One factor is differences in the perceptions of need held by elected officials at various levels of government. State and local officials focus on constituents in the relatively small geographic areas under their jurisdiction as opposed to the broader focus by officials at the national level. The result is that priorities for officials may vary greatly. For instance, a disease "hotspot" within a state may be the top priority of state and local officials but may be insignificant to a national-level official.

In May 2020, President Trump called on all states to re-open places of worship and pressured the Centers for Disease Control and Prevention (CDC) to change its guidelines to reflect

his policy stance (Breuninger and Higgins-Dunn, 2020). Some state governors publicly pushed back due to local conditions and an increase in the number of COVID-19 cases in their states. A similar conflict arose in summer 2020 between the Trump administration and local leaders regarding schools reopening, with the administration threatening to cancel funding for schools that failed to reopen while mayors, with the support of local teachers' unions, prioritized online-only openings (Shapiro, 2020). In general, disconnects between the levels of government may lead to incoordination as different officials prioritize and pursue different goals.

Another factor is that government officials at higher levels may use their control over health-related policies and resources to reward allies or punish enemies in political sub-units. For instance, federal officials may attempt to divert resources away from states where governors are not political allies, even if the citizens in that state need assistance. In the case of COVID-19, some state's shipments of medical equipment in route to local hotspots have been seized by federal agencies (Jankowicz, 2020; Rivero, 2020) and rerouted to areas with political connections to President Trump, "even if the state had not yet gone through the formal process to secure supplies" (Kanno-Youngs and Nicas, 2020, n.p.).

The second manifestation of political competition between interests can be broken into two general sub-categories. The first category includes individual voters, individual private organizations (e.g., firms, non-profits), and interest groups—collections of voters who join together in the pursuit of a common cause. The second category of interests includes government agencies—permanent organizations staffed by non-elected employees (bureaucrats) whose purpose is to provide goods or services to the public.

The underlying dynamics of this form of competition are as follows. When rents are made available through the political process individuals will expend effort and resources to engage in rent seeking to secure as much of that profit as possible (Krueger, 1974; Tullock, 1967). This is certainly the case in government responses to public health crises where a large pool of resources is made available with the pressure to distribute those resources quickly. The resulting political competition is negative sum as parties invest resources to secure part of a pool of politically-created rents, with some winning at the expense of others (Tullock, 1980).

Those who are politically connected, either based on prior political relationships or due to current resource endowments that allow them to exert political influence, are in an especially privileged position relative to those who lack these relationships or resources. The politically privileged are often able to utilize their clout to encourage policies and resource allocations that benefit their particular interests at the expense of others lacking these privileges (see Benson and Engen, 1988; Holcombe, 2018; Olson, 1965; Peltzman, 1976; Shughart and Tollison, 1986; Stigler, 1971). In the context of infectious disease, this suggests that politically connected interests may shape policies to advance their own ends, which may be at odds with the stated goals of public health policy.

The ability of privileged interests to exert influence on policy is exacerbated by limitations on voting as means of expressing individual preferences and rewarding, or punishing, elected officials (Buchanan, 1954b; Miller III, 1999). Because the probability of any single vote influencing the outcome of a political election is typically miniscule, voters face weak incentives to obtain detailed political information about their representatives, which is necessary for holding them accountable (see Bohanon and Van Cott, 2002; Brennan, 2016; Downs, 1957; Gelman *et al*., 2012; Heckelman, 2003; Somin, 2013).

Further limiting the effectiveness of individual voting is the time period between elections and policy bundling, which refers to the idea that voters cast a single vote for candidates representing a bundle of numerous complex issues, of which health policy is just one. Moreover,

given that numerous government officials at different levels are typically involved in the production of policy outcomes, it is often difficult, if not impossible, for an individual voter to effectively identify the connections between a specific elected official and particular outcomes. Together, these factors limit the ability of ordinary citizen-voters to communicate their specific preferences and to hold politicians accountable, which creates space for opportunism by privileged interests.

Examples of rent seeking in the COVID-19 pandemic abound (see Vogel, 2020). Consider, for instance, the Coronavirus Aid, Relief, and Economic Security Act, or CARES Act, a $2.2 trillion relief package passed by Congress and signed by President Trump in late March 2020. With more than 1,500 entities reporting lobbying activity related to the legislation, the bill became the second most lobbied bill in U.S. history (Evers-Hillstrom, 2020). Public Citizen, a nonprofit watchdog group, found that 40 lobbyists with ties to the Trump administration were able to secure more than $10 billion in coronavirus aid (Tanglis and Lincoln, 2020). Several members of Congress also secured funding for their businesses, with little transparency, through the Paycheck Protection Program they helped to institute, including the Chrysler Dodge Jeep dealership owned by Rep. Roger Williams, who is one of Congress's wealthiest members (Ferris *et al*., 2020).

Rent seeking happens at all levels of government. In California, for example, the entertainment industry has been granted exemptions to strict stay-at-home orders so that it can continue to operate. Public disclosures make clear that firms such as Sony Pictures, Walt Disney, Paramount Pictures, Warner Brothers, and trade associations such as the Motion Pictures Association, sent lobbyists to influence California officials to categorize television and movie production as "critical infrastructure" in order to gain exemption from the pandemic-related orders (Fang, 2020). In Pennsylvania, rent seeking activity by unions played a role in the initial closure of liquor stores, with store employees continuing to receive full state-funded paychecks, as well as in the government's eventual allowance of online sales when paychecks ceased (Redford and Dills, 2021).

Government bureaus, which constitute a distinct category as a political interest, are also subject to political competition. Unlike firms competing within the context of the market, bureaus do not compete for customers and profits. Instead, bureaus compete for resources allocated by their sponsor (government) (see Dunleavy, 2018; Migué and Bélanger, 1974; Niskanen, 1968, 1971, 1975; Tullock, 1965; Weatherby, 1971; Williamson, 1964). The battle for resources can lead to outcomes that undermine efforts to provide outputs to those in need. In the case of COVID-19, "[p]rotracted arguments between the White House and public health agencies over funding, combined with a meager existing stockpile of emergency supplies, left vast stretches of the country's health-care system without protective gear until the outbreak had become a pandemic" (Abutaleb *et al*., 2020).

Ideally, government agencies should be unified in coordinating their efforts to serve citizens. Political dynamics, both within and across agencies, often mean this ideal is not realized. In the case of COVID-19, "a Food and Drug Administration official tore into lab officials at the Centers for Disease Control and Prevention, telling them their lapses in protocol, including concerns that the lab did not meet the criteria for sterile conditions, were so serious that the FDA would 'shut you down' if the CDC were a commercial, rather than government, entity" (Abutaleb *et al*., 2020). The White House Coronavirus Task Force suffered from "[i]nfighting, turf wars and abrupt leadership changes" which hampered the effectiveness of the government response to the pandemic (Abutaleb *et al*., 2020).

The absence of market-generated profit and loss means that the feedback facing bureaus in their resource allocation decisions is weak, resulting in slow adaptation, ineffectiveness, and waste (Tullock, 1965; Boettke, 2018, p. 948). In response to fears of hospital overcrowding due to the spread of COVID-19, the Army Corps of Engineers partnered with private contractors on a $660 million initiative to construct emergency field hospitals across the United States. Many of the facilities did not treat a single patient because "there wasn't enough planning to make sure these field hospitals could be put to use once they were finished" (Rose, 2020).

Without profit and loss, bureaucratic management relies on a web of rigid rules and mandates established by superiors (Mises, 1944). Bureaucrats are tasked with following these rules and their job performance is judged against this standard. This stands in contrast to business management, where performance is judged through the contribution to profit and loss. The strict reliance on bureaucratic rules often contributes to inertia in government agencies. One effect of this bureaucratic "red tape" is a slowing of the response of government bureaus to meeting their output targets, an outcome that is especially obvious during times of crisis.

The effect of this red tape is evident during the government's response to the COVID-19 pandemic. Complex and rigid bureaucratic rules within the Federal Drug Administration (FDA) and Centers for Disease Control and Prevention (CDC) greatly slowed efforts to expand testing for the virus, an action deemed key to containing its spread (see Fink and Baker, 2020; Khazan, 2020; Whoriskey and Satija, 2020). As another example, consider that due to the bureaucracy of procurement, "the U.S. Army, the most powerful fighting force in the world, required nearly a *year* to develop a mask that would have taken the civilian sector mere days—if not hours—to develop" (Mizokami, 2020, emphasis original).

Policies intended to address public health crises are not created in a vacuum but are influenced by a variety of competitive forces. These competitive dynamics, the specifics of which will vary with context, introduce frictions into the process of producing pre-determined outputs to assist people experiencing public health crises. A complete economic analysis of policy responses to public health crises, therefore, must incorporate these dynamics and their implications since desired, first-best outcomes may not be feasible.

4 | THE SYSTEM EFFECTS CHALLENGE

Beyond failing to meet planner output targets, public health policies can generate perverse "system effects" which result in significant harms to intended beneficiaries. These effects emerge because public health policies are designed and implemented in complex systems with two defining characteristics—(1) elements within the system are interconnected such that intervening upon one element generates changes in other parts of the system, and (2) the system as a whole demonstrates behaviors and patterns that differ from its component parts (Jervis, 1997, p. 6; Potts, 2000; Wagner, 2016, 2020).

Policies are necessarily simple relative to the complex system being intervened upon such that well-intentioned, micro-level actions will differ from the macro-level patterns that emerge (Wagner, 2016, 2020). The complexity of the system means that an intervener "can never do merely one thing" (Jervis, 1997, p. 10) and that even well-intentioned interventions will result in a chain of consequences beyond anticipation and understanding given limitations on human reason. In the context of government responses to public health crises, these

system effects can potentially produce significant costs and undermine the goal of the initial intervention.[1]

System effects are the result of three factors (Jervis, 1997, pp. 10–27). First, while policy interventions in a system have direct effects, they also have indirect effects as people respond to the new environment created by the intervention. These indirect effects can be immediate, but also might be long and variable and not easily observable or connected to the initial intervention as illustrated by the following examples.

The World Bank estimates that the economic slowdown from the COVID-19 pandemic and response may drive more than 60 million people into poverty globally (Lakner *et al*., 2020, p. 3). Accompanying the economic stress, there is some evidence that the social isolation and decreased access to community support from stay-at-home orders contribute to increased suicide rates (Reger *et al*., 2020). Moreover, the combination of stay-at-home orders and policy-prescribed postponement of elective medical procedures contributed to a fall in the treatment of serious medical issues, with some areas reporting a 90% drop in reported heart attacks (Jauhar, 2020) and others reporting a 38% fall in surgeries to reopen blocked arteries (Santiago *et al*., 2020) and a 60% drop in stroke-related admissions (Stone and Yu, 2020). This was not due to a decrease in the prevalence of heart attacks or strokes, but rather to COVID-related policies that discouraged people from leaving home or scheduling procedures to avoid these negative health outcomes.

Second, since complex systems are characterized by interactions between any number of individuals, the relationship between any two actors is not simply determined by their direct exchanges, but also by interactions with, and by, others in the system. The implementation of policies to mitigate the effects of a pandemic, for instance, is not merely a function of the direct relationship between officials and targeted recipients, but also involves interactions among an array of other people who respond to the policy intervention in different, and often unanticipated, ways. To provide an illustration, the distribution of COVID-19 assistance—for example, stimulus checks and unemployment benefits—has incentivized significant fraud, with a reported $211 million in consumer fraud reported by the Federal Trade Commission (n.d.) as of December 16, 2020.

A third cause of system effects stems from the fact that complex systems are non-linear and non-additive (Wagner, 2020). Outcomes of the system as a whole are profoundly different and not equivalent to a simple summation of the individual elements that constitute the system. This means that simply adding more resources, or investing more effort is no guarantee of obtaining more of the desirable outcome.

To provide an example, the Trump Administration invoked the Defense Production Act to provide General Motors a $489 million contract to build 30,000 ventilators (Wayland, 2020). However, hospitals remained short on both the trained staff (Weintraub, 2020) and the drug necessary to sedate patients requiring intubation (Folmer *et al*., 2020). Dr. Doug White, an intensive care physician with the University of Pittsburgh School of Medicine, noted that even if a thousand ventilators arrived, the hospital would still lack "20 ICU doctors, 300 ICU nurses, 150 respiratory therapists and all of the [personal protective equipment] needed to support those 1000 new ventilators" (quoted in Folmer *et al*., 2020). As this illustrates, ordering more outputs does not guarantee success given the role played by complementary factors.

[1]In principle, system effects can be positive or negative. Given the assumptions of the public health brain model—that only welfare-enhancing policies are undertaken—we focus on the potential for negative system effects and how these effects can reduce the effectiveness of policies intended to improve human welfare.

An appreciation of systems effects has important implications for thinking about the constraints facing social health planners. For one, aggregate outcomes are not easily predicted from individual actions, even if those actions are benevolent. Further, people throughout the system behave strategically such that an action by one person will change the behavior of others, both in the present period and in future periods, in ways that cannot be fully anticipated or known at the time of the initial intervention. This adds an additional challenge for the social health planner even when they stay within the boundaries of what they can potentially accomplish since their efforts to meet pre-determined output targets may produce negative system effects.

Life is characterized by overlapping complex systems, meaning it is not possible to completely avoid system effects. In principle, however, there are several ways that policymakers may potentially lessen the likelihood of system effects or minimize their impact (Jervis, 1997, pp. 253–295).

First, policymakers can appreciate systems-type thinking and limit the ambitions of policy interventions or admit from the start that there is the possibility that interventions may generate unanticipated negative effects. Another strategy involves constraining third parties in order to limit their effect on the outcome of an intervention. In the context of a pandemic response this might mean removing or limiting the number of intermediary organizations involved in implementing pandemic response policies, thus limiting systems effects like waste or rent seeking. A third strategy is for policymakers to attempt to anticipate system effects and ensure that mechanisms are in place to respond. Had officials anticipated the fraud associated with government COVID-19 assistance, for instance, they may have been able to mitigate the effects by putting additional protections in place. Finally, policymakers can recognize that the goals of an intervention may be accomplished by both direct and indirect means. For example, federal or state officials may respond to an infectious disease by directly imposing blanket and uniform policies that apply to everyone equally regardless of their context. Alternatively, they may attempt to indirectly achieve their goals by empowering local officials to customize policies to meet the local, rapidly changing, and context-specific needs of people within their jurisdictions.

The challenges with implementing these coping strategies stem from the public choice issues discussed earlier. Crucial to mitigating system effects is adaptability, which refers to the ability to adjust in the face of information that a policy is failing to achieve its desired goal. Adaptability requires feedback informing policymakers of the specifics of negative system effects and the incentive to act on that information. The various frictions in democratic politics, however, weaken adaptability and can contribute to the persistence of negative system effects.

Limitations on individual voting—the ability of a vote to communicate nuanced information or the intensity of preferences, the timing between elections, the bundling of policies—reduce the accuracy and frequency of external information flows to government actors regarding system effects and dampens the incentive of officials to adapt quickly. Further weakening adaptability is that vested interests will tend to resist changes to the status quo in order to maintain their rents. This contributes to policy stickiness even in the face of negative system effects.

Government bureaus also face information and incentive-compatibility issues which can reduce their adaptability (Tullock, 1965). The transmission of information is a central issue in any bureaucratic structure. As a bureaucratic hierarchy expands, so too does the likelihood that key information will fail to be communicated from subordinates to superiors. Part of this is due to the inability of superiors at the top of a hierarchy to process significant amounts of information and part is due to the introduction of noise, or inaccuracies, as information moves through the hierarchy. As the complexity of the information and the length of the transmission chain increases, so too does the likelihood that noise is introduced.

One solution is to shrink the hierarchy to reduce the length of the information chain. This, however, creates a new challenge of incentive compatibility. With decentralized decision-making there is increased likelihood that the goals of each unit will fail to align around a common end. Contributing to this likelihood is the competition between units for resources and influence.

Yet another confounding factor is that bureaus often suffer from poor data collection and weak incentives to share information. This weakens the feedback mechanisms necessary for successful adaption. To offer an illustration, consider a report by the U.S. Government Accountability Office (GAO) (2020, p. 5) indicating that the GAO had difficulty gathering information from some agencies regarding their COVID-related relief activities. This included a lack of information regarding the Small Business Administration's (SBA) distribution of funds related to the Payment Protection Program (PPP). Despite an audit request on April 13, the SBA did not meet with the GAO until June 1 (Johnson, 2020), leading the GAO to note that the "SBA has not been as transparent in its reporting on the $670 billion PPP" (U.S. Government Accountability Office, 2020, p. 70).

System effects are non-existent in the public health brain approach to infectious disease because it assumes that the benevolent social health planner has the knowledge necessary to maximize social welfare and the incentive to do so. The actual design and implementation of public health policy, however, entails intervening in a complex system. The full effects of these interventions are unknowable at the outset, highly variable, and only emerge through time. A complete economic analysis of responses to infectious disease, therefore, must consider the ability of alternative institutional arrangements to adapt in the face of the guaranteed emergence of system effects.

5 | CONCLUSION

Infectious diseases produce infection externalities. Where these externalities exist, market prices will not reflect the full (social) cost of individual action and, as a result, negative health consequences are likely to occur. A central implication of our analysis, however, is that it cannot be assumed, *ex ante*, that government can correct this situation. Public health planners suffer from epistemic challenges that prevent them from designing policies that maximize social welfare. Given such epistemic constraints, what public health planners can potentially accomplish is to increase the amounts of certain pre-determined outputs. There is no guarantee, however, that this will be successful because of public choice issues.

The second implication of our analysis is that there is no abstract "benevolent social health planner" that stands outside of the system in which they are intervening. Instead, public health officials are embedded in a set of political institutions which create a range of incentive challenges. These include competition between various levels of government and various political interests pursuing their own goals. This competition, combined with limitations on citizen voting, can produce policy outcomes that run counter to the benevolence assumed in the public health brain model. This helps to explain why policies may fail to achieve their stated goals even when policymakers remain within the limits of what is, in principle, possible to achieve.

Third, the design and implementation of public health policy are relatively simple compared to the complexity of the system being intervened upon. This is the result of epistemic constraints, which limit the ability of human reason to fully grasp the nuances of complex systems. The resulting system effects mean that government policies, intended to alleviate suffering on

some margins, may contribute to increasing suffering on other, often unanticipated, margins. Epistemic constraints and political incentives limit the adaptability of health planners in the face of system effects, which often prevents adjustments to remove or minimize these harms.

Finally, the public health brain view needs to be reconsidered as a foundation for the study of infectious disease in economic epidemiology. In this model, the three categories of challenges identified in this paper are removed by assumption, despite the fact that they often frustrate real-world policymaking. At a minimum, adjustments to the assumptions and parameters of economic epidemiology models of infectious diseases are needed to account for these challenges.

A broader question that arises from our analysis is—How should we think about infectious disease in the absence of a given social welfare function available to a benevolent social planner to maximize? Following Boettke (2018) and Aligica *et al*. (2019), answering this question requires focusing on how different institutional arrangements allow individuals to successfully choose in groups to resolve collective action problems. This approach recognizes that there is no single economic problem, and hence no single, optimal solution that can be known and implemented. There is significant variation both in the ends people pursue and in the nature of the infection externalities associated with infectious disease. This variation exists not just across health crises, but also *within* a given health crisis such as the COVID-19 pandemic. Further, this approach appreciates that people are capable, but fallible, and that they must continually learn and make decisions in an open-ended and evolving environment.

From this perspective, the goal is to match externalities to the lowest-level decision making unit as opposed to implementing a one-size-fits-all approach (Aligica *et al*., 2019; Boettke, 2018). This matching process is one of discovery as compared to solving a problem with a pre-determined solution. One institutional arrangement that enables this matching process is a polycentric system characterized by numerous decision-making units, each with autonomy in action, operating within a shared set of rules (Aligica and Tarko, 2014; Ostrom, 1999, 2014; Polanyi, 1951).

Polycentricity, compared to top-down monocentric systems, allows people to leverage local knowledge, to engage in experimentation, and to satisfy a variety of preferences while dispersing risk because there is no single point of failure. Critically, polycentricity allows people to contract with other units if the size of the externality necessitates it. The operation of polycentric orders has been explored in other collective-action crisis contexts, such as the recovery from natural disasters (see, b; Coyne and Lemke, 2012; Storr *et al*., 2015; Storr, Grube, and Haeffele-Balch, 2017a), illustrating how this logic might be extended to the challenges posed by infectious disease.

The public health brain model leads to economics being viewed as a tool of social control "that sees the necessity of a single hierarchical government that must induce compliance from its citizens" (Boettke, 2018, p. 956). As Buchanan (1964) emphasized, however, economics is fundamentally the study of coordination and the institutions within which coordination takes place. As opposed to viewing public health crises and the collective response as an exercise in optimal control and welfare maximization by a benevolent social planner, such issues must be seen for what they are—complex interactions shaped by the knowledge of individual *human beings* and the various constraints they face.

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