

Polycentric local governance and the political economy of urban service delivery

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ABSTRACT: The focus of this inquiry is on understanding incentives actors face in the production and provision of alternative environmental goods. The key building blocks of the theoretical framework—types of goods, polycentric governance, and externalities—are each defined and used to formulate testable hypotheses regarding the nature of municipal environmental policy choices. From a micro-transactional perspective, political actors in cities seek policies that increase their political fortunes and citizens vote for politicians who offer policies closest to their ideal outcome. From a macro-polycentric perspective, cities compete and cooperate with other cities and are overseen by complex relationships with regional, state, and federal jurisdictions. This article introduces, defines, and explores the key building blocks of the theoretical framework and uses them to develop empirically testable hypotheses for understanding the incentives of political and economic actors at providing environmental goods.

Why do some cities provide certain environmental goods, while others do not? Over the past few decades, scholars have become increasingly interested in the ways in which modern urban areas impact environmental conditions, both negatively and positively. Within this broad field of inquiry, scholars have explored the conditions under which cities enact sustainability initiatives, pro-environmental policies, or carbon mitigation pledges, among others. In this project, I add to this literature by providing a political-economic theoretical framework for isolating the direct costs and benefits, as well as, importantly, the externality costs and benefits, from different types of environmental goods. The key to the framework developed is in combining the insights of the polycentric theory of public goods provisioning (Ostrom et al. 1961) with a broader theory of economic goods to understand the incentives faced by governments, by private actors, and by voluntary associations, respectively, in providing environmental goods to diverse consumers (Cornes and Sandler 2003, Ostrom 2003). Understanding why some metropolitan areas are better at adapting to changes in local or regional environmental conditions than others is a key concern in the broader book-project of which this manuscript is a part.

The fields of institutional economics and public policy analysis have a great deal to offer towards understanding the incentive structures facing actors in heterogeneous and complex metropolitan settings. Institutions are the rules of the game that define the relative costs and benefits to actors competing simultaneously in both economic and political markets to improve personal wealth and well-being (North 1990). While institutions are often taken as exogenous in order to study within stable policy-frameworks (Ostrom 2005), institutions can also be endogenous tools of competition between actors in settings, such as metropolitan areas, where multiple loci of political authority compete for residents and tax revenue (Tiebout 1956).

Similarly, institutions can be the endogenous output of localized political evolution (Ostrom 1990).

Sometimes governments directly provide environmental goods, like water purification at a treatment plant, but sometimes governments provide institutional frameworks (i.e. policies) that incentivize private or voluntary provisioning of other environmental goods, like providing tax breaks for firms making green capital investments. For the purposes of the current inquiry, institutions are policies that alter the costs and benefits to all types of providers and consumers of environmental goods, but they are not the only factor in determining those costs. Instead, I examine the provision of environmental goods within the broader context of the bio-physical attributes of the environmental goods, the economic implications of externalities and free-riding, and the political incentives facing policymakers seeking a variety of non-market goals¹. In this way, the methodological approach taken is heavily theoretical, relying on the tools of both institutional economics and public policy analysis to understand relationships among disparate actors in diverse institutional settings (Ostrom 2005). I believe these theoretical frameworks have a great deal of untapped explanatory power for exploring questions related to the production and provision of environmental goods and provide the basis for future empirical testing.

For this manuscript, I will first provide a basic background to the book project and specifically to the rationale for constructing the theoretical framework in the manner described. Section 3 then defines key terms and metrics that will be used to develop the theoretical framework and, eventually, to test the framework's empirical implications. Section 4 then introduces a sketch of the theoretical framework which will be used to develop a series of

¹ For the current chapter, I restrict analysis to elected politicians, rather than to a broader definition of policymaker that would include bureaucrats and potentially others.

testable hypotheses in subsequent analyses. Section 5 provides a brief discussion and direction for further refinements.

2.0 Background

E. Ostrom's (1990) celebrated work *Governing the Commons* marked a turning point for scholars studying environmental goods—those goods produced via ecological, biological, or geophysical processes, or through human-altered resource systems—in part because she integrated a political-economic framework of goods provisioning with conventional anthropological case studies of resource use. Though Ostrom's study was focused on common-pool resources, the implications of that study and her subsequent work (2003, 2005, 2007, 2009) extend to all four types of economic goods (public goods, private goods, and club goods, being the other three). One of the major contributions of her book was to point out that there is no a priori reason that governments are naturally better situated to provide common-pool resources than are private actors (i.e. villagers, home owners, businesses) or voluntary collectives (i.e. farmer managed irrigation projects, home owners associations, business improvement districts). The major contribution of this project is to formally extend Ostrom's (1990) insights to the provisioning of all types of goods by any of these three mechanisms (governments, private actors, voluntary collectives). This allows for a complete theoretical framework that brings an understanding of the costs and benefits to distinct actors of providing different environmental goods via different mechanisms at multiple jurisdictional scales. The ultimate goal of the broader analysis is to understand simultaneously why, for example, a local city would expend costly resources on climate change mitigation benefits that accrues at a global scale, and why that same city would also refuse to invest in local green infrastructure projects that benefit the water quality of its metropolitan region.

To get there, I extend Elinor and Vincent Ostrom's, respectively, political-economic frameworks of Institutional Analysis and Development (E. Ostrom 2005) and polycentrism (V. Ostrom et al. 1961, McGinnis 1999) to contemporary environmental dilemmas faced by metropolitan areas. One of the promises of polycentric theorizing is its incorporation of the typology of goods framework, which the Ostroms pioneered (e.g. Ostrom and Ostrom 1977). In its initial formulation, polycentricity was used to understand, given specific externalities of provisioning processes, which government in a metropolitan area is most efficient at providing a specific good, given the incentives of different political and private actors in the region (V. Ostrom et al. 1961).

While much has been written about which *government* best provides environmental goods, I focus on which *mechanism* of production or provision is most efficient, most equitable, and/or most environmentally sustainable. The question of which government—local, regional, or national—is a second order question of institutional scale that informs the relative costs and benefits of providing a collective good, but is not directly the main question of this book project. Instead, the focus is on the types of externalities resulting from the provision of different types of environmental goods and how strategic actors—politicians, consumers, and providers—compete and cooperate in economic and political markets to consume or provide the positive benefits from environmental goods for themselves, while attempting to push off the costs of and negative externalities from those goods onto others. For example, I assume that when possible, residents of one political jurisdiction will seek to push off negative externalities onto residents of another political jurisdiction. This results from simple NIMBYism where rational actions to protect one's own neighborhood result in environmental injustices in other neighborhoods. There are really two questions, then, rather than just one that a broader theory of polycentricity might be useful at

answering: What mechanism is most efficient, equitable, and/or environmentally sustainable at providing a particular environmental good? And, if the answer is ‘government’, then *which* government?

Section 3.0 Definitions of Key Terms and Metrics

In this section, I will define various key terms and metrics of interest for the theoretical framework developed in Section 4 and the future empirical work. First, I define an environmental goods typology, with particular attention to how externalities shape the costs of providing environmental goods. Next, I define *wealth* and *environmental dilemmas* within the context of this project. The section ends with an explication of a 3x3 framework of analysis that identifies the mechanisms of provision, types of actors, and jurisdictional level as the key analytical tools for investigating why some jurisdictions provide some environmental goods, while others do not.

3.1.1 An Environmental Goods Typology

The development of a typology of economic goods has a long history. Indeed, Adam Smith even references different good-types in *The Wealth of Nations* (Holahan and Lubell 2016), though modern scholarship generally begins with the debate between Musgrave (1959) and Samuelson (1954). As Ostrom (2003) explains, Musgrave and Samuelson were both interested in exploring the differences between private goods that are efficiently provided by markets and public goods that are efficiently provided by governments. The key difference in approach was that Samuelson identified private goods as either rivalrous (i.e. consumable to only one individual) or non-rivalrous (i.e. simultaneously consumable to multiple individuals), while Musgrave identified private goods as those for which an individual can relatively easily exclude others from accessing and public goods as those for which excluding others is highly costly.

Ostrom and Ostrom (1977) combined the two concepts and produced a 2x2 typology of goods that is rounded out with the addition of common-pool resources and club goods.

Table 1. Economic Goods Typology		
	Rivalrous	Non-Rivalrous
Low Exclusion Costs	Private Good	Club Good
High Exclusion Costs	Common-pool Resource	Public Good
Adapted from Ostrom and Ostrom (1977)		

Another means through which to evaluate a goods typology is through the externalities that the good produces (Cornes and Sandler 2003). Collective goods (public goods, common-pool resources) are defined by their lack-of exclusion, which also implies that producing a collective good results in incidental externalities in proportion to the degree of (non)exclusion. For example, factory emissions are neither excludable nor rivalrous, and therefore a public good, the externalities of which manifest as smog. Similarly, carbon sequestration produced by a reforestation project is a public good, the externalities of which manifest as a decrease in the rate of global warming.

When one identifies a collective good (public good or common-pool resource) and tries to match an effective policy intervention to it manage its production or provision, one is essentially attempting to either minimize or maximize positive externalities of the good, depending on the exact policy goal of a given situation. For example, a policy goal of discouraging free-riders from consuming a good would entail minimizing the positive externalities of the good to ensure only those who contributed towards its production receive benefits. However, it may also be a policy goal to maximize the total positive externalities of a good, such as in creating a new park in a blighted area in order to encourage developers to ‘capture’ these externalities as an incentive to build in that particular neighborhood. The same is true for negative externalities, the point simply being that managing negative or positive

externalities are an inherent dilemma of the production or provision of any collective good. In the empirical examples above, the goal of policy is typically to minimize smog, while still permitting factories to operate, and to maximize the decline in the rate of global warming, by encouraging additional reforestation projects, respectively.

Additionally, the rivalry of a good defines the opportunity costs of consumption, such that a rivalrous good produces relatively high opportunity costs for individuals that are not able to access or consume the good, while nonrivalrous goods have low opportunity costs since multiple individuals can simultaneously access or consume the good. Therefore, pure public goods have extremely low opportunity costs in rivalry, while pure private goods have extremely high costs in rivalry. In the extreme, a pure private good has no externalities since all of the benefits (and costs) of the good are easily captured by the producer or consumer of the good (Cornes and Sandler 2003); in contrast, a pure public good produces, in the extreme, a constant stream of externalities since it is virtually impossible at any cost to prohibit an individual from accessing or consuming it. Notice this says nothing about whether the externalities are positive or negative, however, nor does it address the distributional impacts of those positive or negative externalities.

From a purely technical standpoint, a public good could produce myriad negative externalities that are born by individuals who have no part in its production or intentional consumption. For example, hazardous air quality produced by heavy industry or vehicles is a public good since breathing the hazardous air is neither rivalrous nor excludable. To get around the popular confusion with the technical definition of the good, scholars and practitioners frequently refer to such a good as a 'public bad'; however, this term has no technical political-economic meaning. In its place, I will explicitly state the individual negative and positive

externalities produced by particular good, respectively. This allows for a simultaneous examination of the good's true distributional impacts which may be positive for all, negative for all, or, in likely most cases, positive for some and negative for others. The danger is when popular understanding of public goods gets tangled with a belief that such goods only produce positive externalities. Indeed, introductory microeconomics textbooks are filled with examples of positive-externality public goods like lighthouses and national defense, further confusing the phraseology from the technical nature of the argument².

Like any economic good, whether a particular environmental good will be provided or not is partly a function of the externalities produced by the good. When the externalities are positive, such as in most canonical public goods provisioning contexts³, providers of a good must first overcome the free rider problem to fully incentive beneficiaries to contribute towards the good's production. In a sense, the goal is to lower the costs of excluding non-contributors from accessing the good. When the externalities are negative, such as in most common-pool resource provisioning contexts, providers of a good must similarly overcome the shirking problem. In a sense, the goal is to increase the costs of excluding non-contributors from accessing the good. Though these potential problems in providing collective goods are frequently solved by utilizing

² Political science journals have not been good at differentiating the technical definitions of public goods from common-pool resources, even though these goods differ in rivalry, which has enormous implications for their respective production and provisioning. For example, in a recent American Journal of Political Science article, Bolsen et al. (2014, p. 18) describe their field experiment as “build[ing] on a vast literature in the social sciences that uses laboratory experiments to elucidate the voluntary provision of public goods, including the exploitation of common-pool resources.” Common-pool resources are not a sub-class of public goods, though both types of goods are collective goods. Similar confusion can be found in recent American Political Science Review articles that empirically examine public goods provisioning with variable lists of common-pool resources. For example, articles frequently measure public projects like water purification facilities or irrigation projects, which are certainly rivalrous and therefore not public goods (e.g. Baldwin and Huber 2010; Olken 2010; Tsai 2007). This sloppiness on the part of political scientists is easily solved by inserting the term public projects in place of many uses of public goods in article titles, abstracts, and text.

³ There is nothing in the definition of a public good that requires it to produce positive externalities

governments to provide the goods, there is no a priori reason that a government is necessarily the ‘natural’ or ‘optimal’ mechanism of provision.

Instead, the appropriate mechanism of provision for a given good is determined holistically by the good’s relative costs and benefits—both direct and externality—under the status quo institutional framework, technological bundle, and environmental condition, respectively⁴. Goods can be produced or provided via three mechanisms, either individually or as hybrids: private action, government action, collective action; all three mechanisms could be voluntary or coerced. Private action includes the actions of individuals or firms, but is defined by a single decision-maker, whose capital is privately owned and revenues are earned through competitive markets. Collective action is the action of multiple agents acting in consort, be it a group of individuals, firms, or even governments. Governments gather revenue via a taxation method (either directly on citizens and businesses) and fee-based services.

While the existence of collective goods is often used as a justification for government involvement (because, for example, positive-externality public goods will be under-provided by private actors as a result of large scale free-riding), there is no reason that any type of good cannot be provided by any of the three identified mechanisms. In other words, public goods can be (and are) provided by governments, voluntary associations, and private actors, just as private goods are frequently provided by governments, voluntary associations, and private actors. For example, governments (military) provide bullets (private goods) and private businesses (electrical utilities) provide carbon-neutral energy systems (public goods or common-pool resources depending on the specifics of the system). Which mechanism best provides for which

⁴ Institutions are the rules of the game that define the opportunities for actors competing simultaneously in both economic and political markets to maximize that actor’s wealth. Available technological bundles determine the feasibility of providing a good at different scales. Environmental conditions determine both the demand for an environmental good, and the opportunities for accessing it.

type of good depends on the externalities produced by the good, the technological options available to provide the good, and on the institutional framework that specifies ownership over those externalities. For example, a private company might be effective at producing electric vehicles because it can fully capture (commodify) the benefits at the time of sale and driver-owners can exclude others from many of the positive personal benefits. In contrast, a private firm is unlikely to produce stormwater management in a polity that does not price stormwater runoff because the private firm can easily push the costs of stormwater off to the regional watershed district.

All goods require both a production mechanism and a provision mechanism, which frequently are different, both in type and substance. The production of a good or service is the process of creating the final unit to be appropriated or consumed. Once produced, a good or service then must be provided via an allocation scheme. For simplicity, I focus only on the provision of goods in the current inquiry, though the same basic concepts utilized are applicable to the production of goods as well.

3.1.2 Wealth and Environmental Dilemmas

One goal of this inquiry is to provide resilient urban sustainability over time by better understanding the differences in the types of goods being provided. But really, the goal is about *wealth* creation—I take an unabashedly anthropocentric view of how ecological resources benefit human society. I define wealth to be anything that improves the human condition and consists of physical or monetary assets, but also environmental or ecological resources held collectively by a society. For example, a wetland that serves ecological functions like water purification and wildlife habitat directly benefits, and therefore increases the wealth of, water

consumers and wildlife enthusiasts, respectively, even if those consumers and enthusiasts don't hold property title over the wetland.

Individual wealth, then, is defined as an individual's private assets plus an individual's share of all collectively held resources. Negative externalities decrease an individual's wealth, while positive externalities increase an individual's wealth, since captured externalities are, by definition, costless to obtain. Therefore, we can define the wealth of an individual, i , as the summation of her private wealth, K_i , and her share ($1/n$) of collectively-held resources, $K_{collective}$, as:

$$\begin{aligned} \text{where } \text{Wealth}_i &= K_i + (1/n) * K_{collective} + (\text{Net Externality Benefit})_i \\ K_{collective} &= \sum B_i(\text{Ecological} + \text{Engineered Collective Goods}) \end{aligned}$$

An environmental dilemma is an externality resulting from an imperfectly-specified property rights system. In this definition, an oil spill on private property that stays on that property and does not impact any systems outside that property, is not an environmental dilemma. In this example, the oil spill is a private concern for the property owner who can invest in clearing the spill if the benefits to do so outweigh its costs or can choose to ignore the spill if the costs to cleanup outweigh the benefits. If the oil spill impacts two properties, however, then it becomes an environmental dilemma subject to Coasian (1960) bargaining over who pays the costs of ex post cleanup or ex ante prevention. Notice, however, that if property owner 1 fully compensates property owner 2 viz-a-viz Coasian bargaining, then there is no externality anymore and no remaining environmental dilemma. So long as externalities are fully compensated, there is no policy debate needed to solve an environmental dilemma.

Notice also that environmental dilemmas can be defined as either wealth increasing or wealth decreasing, depending on the specifics of who is providing what good and who is

benefiting (costing) from that provision. For example, while an individual enjoying the shade of an apple tree planted along the edge of a private orchard would be a canonical example of a positive externality, to the owner of the orchard it would represent an environmental dilemma because someone is free-riding on his provisioning of the shade. To wit—any time an externality exists in an environmental goods provisioning context, an environmental dilemma exists. This says nothing about the desirability of solving the dilemma; the transaction costs of charging for the use of shade from the aforementioned apple tree, for example, makes that example trivial and probably negates any benefits a solution would bring. However, the existence of a dilemma does present the opportunity for policy options to alter the compensation for environmental goods providers and the payment from environmental goods consumers.

Environmental dilemmas are solved through the application of institutions, which may be formal or informal, that define who is included and who is excluded from receiving the benefits from and paying the costs for goods production and provisioning, and from the externalities produced in other political jurisdictions that spillover. So long as an environmental dilemma can be solved privately by an individual or voluntarily between or among parties to an externality, then private or voluntary action is the de facto efficient solution. However, when private or voluntary collection action is too costly to undertake, then actors can also turn to one of multiple governments to produce or provide various goods⁵. If actors in one political jurisdiction face negative externalities from a neighboring political jurisdiction, then those actors may petition a higher-level political jurisdiction to enact institutions that internalize the externality and redefine the inclusion/exclusion criteria for who benefits and who pays costs.

3.1.3 Defining a Framework

⁵ Or, the net benefits from government action to a minimum winning coalition of included actors is greater than the net benefits from private or voluntary collective action

So far I have introduced the typology of goods framework and noted that three mechanisms of provision exist. I now combine these insights to develop a 3x3 theoretical roadmap that investigates the mechanisms of environmental goods provisioning, the actors benefiting from and bearing costs from the provisioning of goods, and the levels of governance at which the provisioning process takes place. The efficiency, equity, and environmental sustainability of goods provisioning are evaluated (in subsequent chapters) within the context of the 3x3 framework, as each component directly and indirectly impacts the relative costs and benefits of the other components. Once an environmental good has been identified and its externalities fully described, then the next step in understanding why it is sometimes provided and sometimes not is to identify contextually each of these three categories. Notice these categories are not mutually exclusive: a provider-actor can be any of the three mechanism at any of the three levels of governance. Instead, defining the good-type and the categories below helps to produce a full-scale picture of a setting that allows for institutional analysis to develop.

- 1) *Actor*: Consumer, Provider, Politician
- 2) *Mechanisms of provisioning*: Private, Government, Collective
- 3) *Levels of governance*: Local, Regional, National

There are three actors in the model. Consumers improve their wealth by consuming private and environmental goods, which are either purchased or free-ridden on. Providers allocate environmental goods and attempt to increase contributions, while deterring free-riding. Politicians seek a variety of non-market political benefits (reelection, higher office, etc.). I assume that the primary means to achieve those non-market benefits for a politician are to improve the wealth of both consumers and providers located within their defined political

jurisdictions⁶. The mechanism utilized by politicians to achieve this means is the enactment of policies that either the directly provides an environmental good (a government provision mechanism), or incentivizes its provision through private or collective action. Notice that consumers can chose to either purchase an environmental good directly, can act as a policy entrepreneur to organize a group to collectively purchase the good, or can lobby politicians to have that good provided via government. Providers, on the other hand, are restricted simply to either providing or not providing a good to a given consumer based on the costs and benefits to the provider of doing so. Table 2 summarizes the choices available to each actor.

Table 2. Choice Set of Model Actors	
<i>Actor</i>	<i>Choices</i>
Consumer	Purchase, Organize, Lobby (3)
Provider	Provide, Do not provide (2)
Politician	No policy, Encourage, Discourage, Direct Provisioning (4)

Table 2 introduces four choices for politicians in the model—no policy, encourage, discourage, and direct provisioning. An obvious choice for a politician seeking to provide a specific environmental good (or seeking to prevent in the case of negative externality environmental goods) is to utilize government provisioning at the jurisdictional scale of the politician’s authority. Similarly, a politician that is indifferent to a good’s provisioning could simply seek no change in the status quo. However, two other options are considered in the model, a policy that encourage a good’s provisioning by private or voluntary means (i.e. a subsidy) or a policy that discourages a good’s provisioning by private or voluntary means (i.e. a tax). While simplistic, Table 2 actually provides a great deal of leverage in modeling the full

⁶ In later chapters, this can be relaxed when examining a politician seeking higher office’s incentives to, for example, provide collective goods from his current constituency to benefit a future larger constituency.

range of consumer, provider, and politician when deciding whether to provide an environmental good and, if so, how best to do so.

For now, I assume that politicians are only interested in benefiting consumers and providers within their defined political jurisdictions. In future chapters I will relax that assumption to allow for a variety of political incentives to drive action (higher office seekers may seek to benefit potential future constituents at the expense of confirmed current constituents, for example), but for now this assumption allows for a clearer political bargaining model to emerge. Political jurisdictions occur both horizontally and vertically. For example, two neighboring municipalities would be horizontally linked, while a municipality is vertically linked with its county. Thus, we can think of vertical linkages as ranging from municipal to county to district to state to nation to global, while horizontal linkages occur within a vertical layer of equal-standing jurisdictions.

Key to the model are cross-jurisdictions. A politician in a local jurisdiction, for example, seeks to push off negative externalities onto horizontally linked jurisdictions (i.e. one state wants to send its polluted air to another state) or to get a vertically linked jurisdiction (i.e. the federal government) to take over responsibility for the costs of that externality (i.e. get the federal government to regulate local air quality through the EPA). Similarly, a politician in a local jurisdiction wants horizontally linked jurisdiction to spill over positive externalities or to otherwise get vertically linked jurisdictions to encourage the production of positive externalities that benefit the local jurisdiction without cost. Unlike Tiebout's (1956) early model of 'voting with their feet', in my model consumers are immobile, and respond only to the increases and decreases in their individual wealth brought by their private consumption choices and by the collectively shared choices of political actors.

4.0 Theoretical Framework

This section develops the micro-foundations of a tractable model of metropolitan environmental goods provisioning. The model incorporates the individual policy preferences of citizens living in jurisdictionally distinct polities with the electoral and career-ambition preferences of political actors. Key to the model is that distinct environmental goods can be produced by myriad actors, in multiple polities, for consumption by the same or different groups or individuals (Ostrom 2005). Identifying who produces what, where, and for whom is a first step to understanding how policies interact with actors and ecological conditions to produce outcomes. Once the model is complete, I will produce a series of testable hypotheses that are the focus of the later empirical chapters of the book project. For now, I begin by describing the three key actors of the model, then

Similar to standard neoclassical models of markets, in this model a citizen consumes environmental goods that improve her wealth and avoids environmental goods that decrease her wealth. Wealth in this model consists of two components: privately owned goods and a proportional share of collectively owned goods. Similarly, providers of environmental goods decide the level of provision based on a standard cost-benefit analysis, but their provision decision is also augmented by the presence (or lack) of free-riders in consumption, which is to say that providers seek to minimize free-riding on positive collective goods and maximize free-riding on negative collective goods. Which type of provider (private actor, voluntary collective, or a government) is most efficient at producing an environmental good, then, is largely dependent on the jurisdictional extent of externalities, whether the externalities are positive or negative, and the potential number of free-riders post-provision. Politicians are elected by citizen-consumers (for now I ignore the role of lobbying by producers) to implement policies at different jurisdictional levels that encourage positive externalities and discourage negative

externalities. In this way, a city council member, for example, seeks to increase the production of positive externalities within her city boundary, but also to either reduce negative externalities in production, or to simply push off those negative externalities onto neighboring or high-level jurisdictions.

Notice there is no need for a strict optimization perspective here, for either citizens, producers, or politicians. The impacts of environmental goods are complex, so there is no a priori reason to assume that a citizen perfectly understands which policies optimize her wealth—indeed, citizens rarely select such policies anyways. While a firm may be reasonably assumed to be profit maximizing, even here the information asymmetries about who is free-riding are large and thereby augment strict rationality. For politicians, tradeoffs are almost always discreet and, at least domestically in the US, frequently binomial (yes or no; Republican or Democrat). In fact, optimizing vote shares or maximizing constituent wealth may actually be misaligned with political incentives, which is discussed in further detail in subsequent chapters. For now, I assume political actors seek to provide environmental goods that increase the wealth of constituents and to prevent environmental goods that decrease constituents' wealth. Therefore, the model is one of boundedly rational actors in which consumers, providers, and politicians all seek to improve their wealth or welfare within the constraints of the transaction costs and information asymmetries that define a complex modern world.

Public policies are enacted by political actors who seek 1) to provide environmental goods to constituents that are net beneficial, 2) to *minimize* the wealth loss from negative externalities, and 3) to *maximize* the wealth gain from positive externalities to their constituents. Externalities spill across political jurisdictions horizontally (i.e. from one city to another city, or from one nation to another nation) and across political jurisdictions vertically (i.e. from one city

to an entire region, or from one region to an entire nation). In a polycentric framework, multiple sources of political power compete with and cooperate with one another to maximize the wealth of jurisdictional constituents. Efficient outcomes depend on the relative costs and benefits of the provisioning situation. Equitable outcomes similarly depend on the asymmetrical bargaining strengths of diverse economic and political coalitions. Environmentally sustainable outcomes result when renewable resources are maintained at or below their replenishment rate and when nonrenewable resources are produced at a rate that minimizes physical waste.

Each actor in this world, then, seeks to increase the benefits of consumption or provision, respectively, by consuming (providing) more of a good, while decreasing her costs of consumption (provisioning). Political payoffs are a function of the wealth of consumers and providers within a political jurisdiction. Both consumers and providers increase wealth through one of two mechanisms; either pay for or free-ride on a good's providers. The choice to directly pay for an environmental good is taken autonomously by individuals, collectives, or governments, but the choice to free-ride is taken politically at the jurisdictional-level. This is to say that while a private business may ultimately provide an environmental good with externalities, its decision to do so is heavily influenced by the institutional framework under which it operates. Consumers seek policies that *increase* positive externalities from a good's provision, while providers seek policies that *decrease* those same externalities. Similarly, consumers seek policies that *decrease* negative externalities from a good's provision, while producers seek policies that *increase* negative externalities. The tension between these two strategies plays out in the political realm and is mediated by political actors seeking a variety of incentives.

These political fights can be modeled or conceptualized as conflict over alternative policy bundles that specify who will implement and be impacted by which type of policy. Indeed, once an environmental good has been identified and its incidental externalities are understood, then a policy bundle can be defined as a vector that contains at least three elements: the type of policy, the mechanism of its provision, and the jurisdiction of its provision. The outcome of interest throughout this book is which policy bundle, p^* (out of set p), provides the highest level of social welfare, as measured by the provision of environmental goods. In particular, for a particular environmental good of type $t \in T = \{\text{Private, Public, Club, Common-pool resource}\}$, a policy bundle, p , can be defined as:

$p \in P: \{ \text{Policy} = \{\text{Null, Encouraging (i.e. subsidy), Discouraging (i.e. tax), Direct provisioning}\}, \text{Jurisdiction} = \{\text{Municipal, Regional, State, National, Global}\}, \text{Provision Mechanism} = \{\text{Private, Voluntary Collective Action, Government}\} \}$

Once a type of good and a policy bundle have been identified, then the relative costs and benefits of alternative policy bundles can be explored and contrasted to better understand which bundle provides more social welfare (or whatever else the metric of interest is). In the following pages (unfortunately out of time pre-WoW!) I will further explain and expand on this model and provide empirical examples to illustrate.

5.0 Discussion and Future Directions

From this model, I will (in subsequent manuscripts/chapters) derive testable hypotheses about the most efficient, equitable, and/or environmental sustainable mechanism of goods provisioning, and the scale at which the production or provisioning processes take place.

Applications to the theoretical model include investigating the ‘best’ mechanism, actor, and scale to produce and provide for stormwater management, environmental justice, and climate change mitigation, respectively.

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