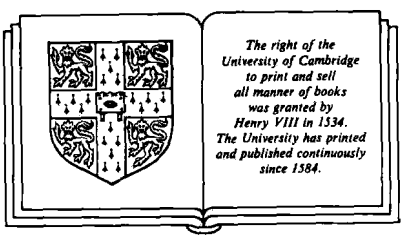
THE THEORY OF EXTERNALITIES, PUBLIC GOODS, AND CLUB GOODS

CORNES AND SANDLER

The theory of externalities, public goods, and club goods

RICHARD CORNES
Australian National University

TODD SANDLER
University of South Carolina and University of Wyoming



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To
OUR PARENTS

Preface

Concern with various potential sources of market failure, of which the topics treated in this book are important examples, has a long history, dating back at least to the writings of Adam Smith and David Hume in the eighteenth century. Recent years have witnessed a tremendous growth in this literature and, one hopes, a significant advance in our understanding of the principal issues. Much of this material is scattered throughout the economic journals, and some of it is technically demanding. At the same time, textbooks in microeconomics and public economics are able, by their very nature, to provide only a tantalizingly brief treatment of the nature and implications of externalities.

This book aims to provide a more extended discussion of the theory and policy implications of externalities, with particular emphasis on those special cases represented by public goods and club goods. We have attempted to discuss the main conceptual issues and have used mathematical techniques only as much as is necessary to pursue the economic argument. In particular, our exposition in Part III is, we believe, greatly clarified by the exploitation of a simple diagram capable of demonstrating many features of public goods that economists have found interesting.

The result, we hope, is a book that should be accessible to well-prepared undergraduates and should also be of interest both to graduate students making their first serious foray into this branch of economics and to professional economists wanting to find out what some of their colleagues in public economics have been up to in recent years.

We would like to thank a number of individuals for their help along the way. Parts of the initial draft were written by Cornes during a brief but productive stay at the Graduate Institute of International Studies in Geneva. He would like to thank Hans Genberg and Henryk Kierzkowski for providing this opportunity, and also Max Corden, who arranged a further short stay in the Research School of Pacific Studies at the Australian National University. Thanks, too, are owed to Ted Bergstrom for stimulating collaborative work on aspects of

public goods theory, the influence of which is particularly evident in Chapter 6. We also thank John Tschirhart, whose joint work with Todd Sandler contributed significantly to the material in Chapters 10–14 on club goods. Finally, we acknowledge helpful comments provided by Fred Sterbenz and John McMillan.

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Contents

PART I

Introduction to the theory of externalities, public goods, and club goods

CHAPTER 1

Views on market intervention

Even Adam Smith, a champion of laissez-faire, *recognized* the need for government intervention and provision in a number of select areas, including the establishment of a justice system, the enactment and enforcement of laws, protection against invasion, and the provision of schools and other public goods. Thus, the interest in public goods, whose benefits simultaneously affect a group of individuals, can be traced back to classical economics. With the publication of Samuelson's (1954, 1955) seminal pieces, research interest in public goods and in their relationship with other types of goods grew rapidly among English-speaking economists. Samuelson's contributions gave a formal foundation to ideas mentioned earlier by European economists, such as Lindahl, Sax, and Wicksell (see Musgrave and Peacock 1958). At first, economists focused on the two poles of a spectrum of goods, the poles consisting of pure public goods and pure private goods. Private goods could be parceled out among individuals and efficiently allocated by markets, whereas public goods could not be divided among individuals owing to nonrivalry of benefits and nonexcludability problems. Collective provision was first thought essential for these public goods.

With the publication of Mancur Olson's (1965) *Logic of Collective Action* and James M. Buchanan's (1965) "An Economic Theory of Clubs," economists began rigorous explorations of the spectrum of goods to analyze what are called impure public goods, a catchall term for any good not purely public or private. Though its definition was later broadened (see Sandler and Tschirhart 1980), a club was viewed as a group sharing a particular type of impure public good, characterized by *excludable benefits*. Buchanan (1965) and others argued that goods whose benefits were simultaneously received by more than one individual (e.g., swimming pools, golf courses, highways) could be allocated privately by a sharing group (or club), provided that an exclusion mechanism could be installed at a reasonable cost. Costs of an exclusion mechanism are reasonable whenever the gains in allocative efficiency, achieved through the use of the mechanism, are greater than the associated costs. Exclusion costs include the value

of the resources expended to erect and to man barriers that force preference revelation. The exclusion mechanisms might consist of a toll booth, a guard, a fence, or a ticket office; only those individuals who pay a user fee or toll can pass through the exclusion device and use the good. Hence, the scope of government provision was duly reduced, since public goods admitting exclusion could be provided by firms or private collectives.

Once economists understood that few public goods at the local, state, national, or international level possess the nonexcludability and strict indivisibility of benefits properties required for pure publicness, the allocative principles of club theory as they applied to impure public goods took on added importance. Even defense, once thought to be the perfect example of a pure public good, was seen to permit excludability and partial divisibility, especially for tactical nuclear and conventional weapons, weapons that the North Atlantic Treaty Organization (NATO) and the Warsaw Pact have increased in importance since 1970 (see Olson and Zeckhauser 1966; Sandler 1977; Sandler and Forbes 1980; Murdoch and Sandler 1982, 1984, 1985). Gradually, the list of impure public goods expanded to include, among others, recreation areas, schools, highways, communication systems, information networks, national parks, waterways, and the electromagnetic spectrum. Thus, any theory that could analyze the allocative and distributive aspects of such a wide range of goods would indeed make an important contribution to the theory of public finance. Club theory was put forward for this purpose.

More than a century and a half after Smith's *Wealth of Nations*, Pigou (1946) introduced another rationale for government intervention into the marketplace that, at first, appeared not to involve public goods per se. The Pigouvian correction concerned externalities, in which the action of one economic agent influences the utility or production function of another and no mechanism for compensation exists. Governments were viewed as outside agents who, through the imposition of taxes (or subsidies), could induce the externality-generator to limit (or increase) his or her activity so as to achieve efficiency. In subsequent contributions, the notion of externality encompassed an ever-increasing variety of economic situations until it was equated by some with market failure (see, especially, Bator 1958). As such, externality included public goods as a special case. Thus, the list of market failures requiring government intervention was broadened way beyond those instances given by Adam Smith.

With the publication of Coase's (1960) "The Problem of Social Cost," economists realized that the mere existence of an externality

was not a sufficient reason for government intervention. When, for example, few individuals were involved, participants could bargain with one another, thereby eliminating the potential inefficiency associated with the externality. Furthermore, Coase argued that any *liability assignment* for the uncompensated costs, whether imposed on the externality-generator or the recipient, would achieve efficiency. Hence, much as in the case of clubs, bargaining or liability assignments provided nongovernmental means for correcting externalities.

Since these early contributions, a vast literature has been written on externalities, public goods, and club goods. Many of these articles have examined the relationships among these three concepts, while others have investigated the best methods for correcting the associated inefficiencies. Corrective means include both governmental and nongovernmental (private) action. With the development of public choice, economists saw that governments, like markets, also could fail owing to incentive incompatibility, nonconvexities, (political) constraints, and imperfect information. Thus, nongovernmental corrections to market failures continued to grow in importance. The growth of public choice also renewed interest in governmental corrections that took account of potential pitfalls and that designed incentive schemes to elicit more efficient results. For example, more sophisticated preference-revelation mechanisms were proposed, including Clarke–Groves taxes, which provided individuals, in the absence of income effects, with the proper incentives to reveal honestly their preferences for pure public goods. In the instance of local public goods, the Tiebout Hypothesis suggested that the mix of public goods–tax packages offered by various local jurisdictions would induce an optimal partition of population through a process of voting-with-one's-feet. This process would lead to efficiency, provided that there were no impediments to mobility and that there were a sufficient number of jurisdictions to choose from.

Like the preceding studies mentioned above, this book concerns market failures and what can be done about them. Using modern tools of microeconomics, we reexamine the relationship between externalities, public goods, and club goods. Both allocative and distributive issues for these three types of market failures are discussed. The Tiebout Hypothesis, the Coase Theorem, preference-revelation mechanisms, Pigouvian corrections, the spectrum of public goods, institutional arrangements, and club theory are among the many topics examined. This volume provides both a survey of existing contributions and extensions to this body of knowledge. Many new principles of collective action are presented.

1.1 Some basic terms and definitions

Up to now, we have used such terms as indivisibility of benefits and nonexcludability rather loosely. Before proceeding, we should clearly define these and other terms. Throughout this book, the expressions *nonrivalry of consumption* and *indivisibility of benefits* are used interchangeably. A good is nonrival or indivisible when a *unit* of the good can be consumed by one individual without detracting, in the slightest, from the consumption opportunities still available to others from that *same* unit. Sunsets are nonrival or indivisible when views are unobstructed. Deterrence, as provided by a fleet of Trident submarines, does not diminish as more allies join an alliance and share in their threat-based protection; thus, strategic nuclear weapons yield nonrival benefits. Nonrivalry also characterizes benefits derived from pollution-control devices, weather-monitoring stations, disease-eradication programs, crisis-warning monitors, and information-dissemination networks.

If, however, an agent's consumption of a unit of a good fully eliminates any benefits that others can obtain from that unit, rivalry in consumption or perfect divisibility is present. Everyday goods such as food, clothing, and fuel are rival in their benefits; once a piece of pie is eaten, no further benefits remain whenever the consumer has been diligent in his or her consumption activity. Each unit of heat consumed from a fuel by one individual eliminates all others from using those same heat units; entropy sees to that.

Another distinguishing characteristic of goods is *excludability of benefits*. Goods whose benefits can be withheld costlessly by the owner or provider display excludable benefits. Benefits that are available to all once the good is provided are termed nonexcludable. Firework displays, strategic weapons, pollution-control devices, and street lighting yield nonexcludable benefits, since once provided it is difficult, if not impossible, to exclude individuals from their benefits. (In later chapters, we will argue that nonexcludability is the crucial factor in determining which goods must be publicly provided.) In contrast, homes, automobiles, and clothing yield excludable benefits whenever property rights are protected by law enforcement authorities or by private actions (e.g., locks, guard dogs). With these characteristics defined, the so-called spectrum of goods can now be distinguished. The benefits of private goods are fully rival and excludable, whereas the benefits of pure public goods are nonrival and nonexcludable. From the above examples, we see that food and fuel are private, whereas strategic weapons and pollution control are purely public goods.

In-between points along this spectrum refer to impure public goods whose benefits are partially rival *and/or* partially excludable. If, therefore, a good does not display both excludability (nonexcludability) and rivalry (nonrivalry) in their pure forms, the good is called impurely public. An important subclass of such goods are those whose benefits *are excludable* but partially nonrival; these goods are *club goods* and are analyzed extensively in Part IV. This spectrum is best viewed as a pedagogical device that provides a way of visualizing the diverse kinds of goods. Strictly speaking, however, there is no single spectrum or continuum, much as there is no single spectrum between perfect competition and monopoly, since impure public goods differ from one another along more than one dimension. Clearly, both nonrivalry and excludability properties can differ between classes of public goods. In some instances, an activity may give rise to multiple outputs, some of which are private, purely public, and impurely public. Such an activity yields *joint products*; these joint products are examined extensively in Part III and are shown to include the phenomenon of congestion, that is, the situation in which one individual's consumption reduces the quality of service available to others.

Other important definitions are gathered together in Chapter 2, where equilibrium concepts are presented. These concepts include Nash equilibrium, Lindahl equilibrium, and Pareto optimum.

1.2 Importance of externalities, public goods, and club goods

When one examines what governments do, a variety of activities appears at all fiscal levels. Governments allocate resources for those goods and services for which the private sector fails to assign sufficient resources. Defense, education, and highways were mentioned previously as examples. Governments also redistribute income for equity reasons; thus, progressive income taxation, social security, and socialized medicine are seen in many modern nations. Promotion of growth and stabilization of income and employment (i.e., fiscal policy) are other important governmental activities.

A study of externalities, public goods, and clubs, as attempted here, gives insight into the government's role in allocating resources. For instance, the theory can distinguish those cases in which government action is essential from those in which it is not. For the former cases, the theory of externalities, public goods, and club goods can help determine corrective taxes, provision levels, tolls or user fees, and financing decisions. This theory can also shed light on aspects