

A theory of efficient cooperation and competition

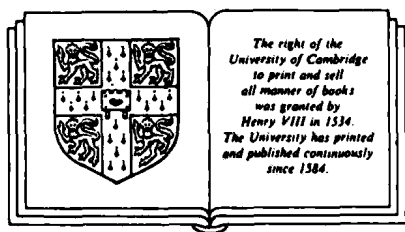
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Preface

Preliminary versions of some parts of this book came out in various articles published between 1982 and 1985. This holds true for parts of Chapters 2, 7, and 8 (Telser 1984a, 1984b, and 1982a). The material in Chapter 3 is based on a paper presented at a conference at the Hoover Institution in September, 1984, which was published in the conference proceedings (Telser 1985). I presented Chapter 2 at another conference at the Hoover Institution in February, 1986. Chapter 6 is a substantial revision of Telser (1980). Part 1 of Chapter 4 draws on some ideas in Telser (1982b) and corrects some errors therein.

Propositions and lemmas are numbered sequentially in each chapter starting with 1, and by part in each chapter with more than one part. Corollaries are numbered sequentially starting with 1 by proposition or lemma. Equations are numbered sequentially starting with 1 by section.

Sheldon Kimmel has been my most attentive and faithful critic. He has read preliminary versions of almost everything in this book and has saved me from many errors and obscurities. Howard Marvel carefully read preliminary versions of Chapters 2 and 3. George Bittlingmayer and David Haddock read these and some other chapters and gave me many useful comments and suggestions. I am also grateful to Frank Easterbrook, David Galenson, John Hause, Roger Noll, and Daniel Spulber for their helpful comments on various parts of this book. Two of my former students, Stephen Craig Pirrong and the late Yuichiro Hamada, deserve thanks for finding errors and ambiguities in some of the technical material. I also wish to thank Ken Judd, William Lynk, Menahem Spiegel, Hod Thornber, and Robert Topel for their helpful comments on Chapter 8, Part 2.

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The most important person who has constantly encouraged me, listened to me, read my attempts at explaining things in plain English, and tried to make me coherent is my wife Sylvia. I doubt whether this book would have been written without her.

Finally, I wish to thank Jaffer Qumar and Greg Pelnar for their help in proofreading.

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Prologue

1 Introduction

This book has three main divisions. The first introduces the major themes, the second studies the conditions under which an efficient equilibrium exists, and the third examines the consequences of rivalry.

The basic tenet is that an efficient equilibrium requires an appropriate combination of both cooperation and rivalry. Under the cost conditions typical of many industries in a modern free-enterprise economy, it is not possible to have efficient results unless there are areas of cooperation among firms and among customers as well as rivalry. This was not fully understood in the last half of the nineteenth century in the United States and is still hotly debated. The purpose of Chapter 2 is to place the debate in its historical setting by discussing the events preceding and following the passage of two major legislative acts, the Interstate Commerce Commission Act of 1887 and the Sherman Antitrust Act of 1890. The proposition that an equilibrium may not exist unless firms are allowed to cooperate in some areas would probably not have been accepted by the supporters of antitrust legislation and railroad regulation even if they had been aware of it. Many proponents of this legislation considered competition as good under all circumstances and did not recognize the complications arising from the new technology: capital intensive methods of manufacturing, mass production and the use of interchangeable parts, improvements in communication and transportation, and so on. Chapter 3 is a theoretical analysis of some of these issues using models of these new technologies. It shows that even the simplest models present very difficult practical problems for firms and their customers.

Efficient cooperation is the main theme of the second division (Chapters 4 and 5). The studies of efficient cooperation apply the theory of the core. Chapter 4, in three parts, describes conditions under which a stable coalition exists. A coalition is stable if none of its members wishes to secede and form subcoalitions. Each member believes he is better off in the given coalition than in some other coalition. The first

part of Chapter 4 studies semiprivate goods. These are goods that belong to all members of the coalition and are such that each member gets the same quantity of each semiprivate good. In addition, the members can prevent outsiders from deriving any benefits from these goods. The latter assumption explains why "private" and the former why "semi" join together in the name of these goods. Semiprivate goods are between private and public goods and share some features with both extremes. Private goods do not require each person to obtain the same quantity, whereas semiprivate and public goods do. No one can be excluded from the benefits of public goods, but this is not true of semiprivate goods. There are two different kinds of semiprivate and public goods. In the first kind individuals can contribute to the total on their own. Knowledge is the leading example of such public goods. Each individual can contribute to total knowledge and, we may say, the total is accessible to all as a public good. For the second kind of public goods, individuals cannot affect the quantity on their own. Instead it is necessary for them all to agree on some procedure for choosing the common quantity. An aircraft carrier is an example of this. Individuals do not have their own aircraft carriers as part of the public good, national defense. Public goods of the second kind raise both political and economic problems. The political problems refer to the nature of the mechanisms used to decide what and how much of these public goods to have. Semiprivate goods pose similar problems to some degree for the coalitions that can choose them. Part 2 of Chapter 4 studies private goods and gives necessary and sufficient conditions for a nonempty core in terms of the nature of the cost functions. It is shown that the core is nonempty if and only if there are nondecreasing returns to scale, that is, either constant or increasing returns to scale. The last part of Chapter 4 gives sufficient conditions for a nonempty core in an economy that has both private and semiprivate goods.

Chapter 5 describes in detail a situation for which no competitive equilibrium exists. It does so for a case in which there are many firms, each in a different location, that can ship their outputs to spatially separated markets. The cost function of each firm is the sum of two components: an avoidable cost and a shipping cost. Its avoidable cost depends on its capacity. This cost is positive only if the firm is active. If the firm is not active it can avoid this cost, hence the term *avoidable cost*. The other component of its cost is the transportation cost, which is proportional to distance and quantity shipped. The chapter describes an integer programming algorithm for finding the optimal allocation of outputs among the firms for given demand conditions. It also shows that there exists a set of upper bounds on firm output rates that, of

course, cannot exceed the capacity installed in the firm's plants such that subject to these constraints an efficient equilibrium exists that can satisfy the given demand conditions. There does not exist a set of lower bounds on prices that can give an efficient equilibrium. Therefore, upper bounds on outputs are not equivalent to lower bounds on prices in this case. The results illustrate how an appropriate combination of cooperation and competition can give an efficient equilibrium.

The remaining division of the book (Chapters 6–8) discusses various forms of rivalry. It opens with the theory of self-enforcing agreements in Chapter 6. This theory applies when those who wish to have an agreement cannot rely on outsiders to enforce it. If they are unable to have a self-enforcing agreement, then the result is a noncooperative equilibrium, not enforcement of an agreement by a third party. The latter is often a more costly and a less beneficial arrangement. The chapter describes four situations in order to display a broad range of circumstances for which a self-enforcing agreement may be pertinent. It shows when it is and when it is not possible to have a self-enforcing agreement. One situation, the Prisoners' Dilemma, applies to cartels. The alternative to a cartel is a noncooperative equilibrium. The theory shows when firms can gain from collusion even though a single firm could obtain a temporary gain from a violation of the cartel agreement. Chapter 7 examines duopoly in detail. Duopoly applies when the firms cannot collude either via a self-enforcing agreement or via enforcement by a third party. This chapter gives a complete enough description of the strategies available to the firms so that a computer would have enough information to play it as a game. In so doing the implicit assumptions of Cournot, Bertrand, and Edgeworth rise to the surface and new results emerge.

Rivalry by innovation is the topic of the last chapter. It pursues a line of argument first proposed most vigorously by Schumpeter. To him competition is not the impersonal abstract version popular in beginning economics texts. It is instead analogous to a sporting contest with winners and losers. When there is competition by means of innovation, the successful firms can obtain large profits that may last for a long time despite the efforts of others to emulate them. Firms enter an industry when they believe they are not at a disadvantage relative to the incumbent firms. Entry stops and the industry is mature when innovation by any firm in that industry is no longer expected to be profitable. The theory explains differences in merger rates among industries, the distribution of firm sizes in an industry, the dynamic pattern of prices and outputs by industry, and why there is so little trafficking in patent rights so that royalty receipts are a relatively

unimportant source of income even for firms actively engaged in research.

2 Guide for the reader

Although the theory of the core has a pedigree going back to Edgeworth's famous book *Mathematical Psychics* (1881), it is a newcomer to the economist's toolkit. It is therefore desirable to describe how this theory fits together with the more familiar tools of economics. My intention is to furnish a simple description of the relations among the pertinent parts of economic theory. It is not to describe the real economy and its social setting. The framework for this purpose uses two basic concepts: the status of contracting among the economic actors and the status of the core.

Contracting may be restricted or unrestricted. It is unrestricted if the economic actors may make any contracts they please among themselves without hindrance from outsiders. In short there is freedom of contracting. The status of contracting may be restricted. The restrictions take the form of constraints that set limits on the terms of the contracts and determine who may enter contracts. There are two states of the core, empty or not empty. The core is not empty if there is a feasible set of imputations acceptable to all of the participants and all coalitions of participants. A nonempty core combines an optimal mixture of competition and cooperation. The degree of cooperation implicit in a nonempty core is self-enforcing because no one can gain by rejecting the return received as a member of the grand coalition and instead going off independently outside that coalition. The core is said to be empty if for any feasible imputation there is at least one coalition that would do better on its own. Putting together these two basic concepts and the two possible states for each gives four categories. These four categories supply a framework for describing the relation between economic applications of the theory of the core and received economic theory. The contents of these four categories constitute the guide for the reader.

Received economic theory implicitly assumes the core is always non-empty and does not recognize the possibility of an empty core. Inquiry into the conditions that can bring about an empty core simply does not arise. Assume along with the received theory that the core is not empty. In terms of the preceding framework, there are two cases – freedom of contracting and restrictions on contracting. Take the category of unrestricted contracting and a nonempty core. This category includes the neoclassical perfectly competitive equilibrium. It includes the anal-

ysis by Edgeworth of pure exchange among traders with convex preference sets who have given initial endowments of goods. Edgeworth's analysis is the origin of the theory of the core. The extension to encompass production under conditions of constant returns to scale is the culmination of the neoclassical theory of perfect competition. Freedom of contracting in the presence of a nonempty core for an economy with constant returns to scale results in an efficient equilibrium.

While still assuming there is a nonempty core, let there be restrictions on contracting. The latter cause departures from perfect competition and become the subject of various theories of imperfect competition in the received economic theory. The simplest case in this category is monopoly. Cournot (1838) was the first to present a formal analysis of monopoly. The next important advance in the theory of monopoly, Alfred Marshall's concept of natural monopoly (1890), is not always in this category because a natural monopoly does not always have a nonempty core. When there is a nonempty core and restrictions on the freedom of contracting, then monopoly causes contrived scarcity and an inefficient equilibrium. This begs the question of what led to the monopoly. A facile reply blames government. Even if government is the source of the monopoly and enforces it, the reply is unsatisfactory because the actions of government are themselves a necessary and a proper subject of economic inquiry not a given on a par with the natural environment. Remember that economics used to be called political economy. A cartel is another example of restrictions on contracting. It is a form of monopoly and may produce the same result as a profit-maximizing monopoly. A noncooperative equilibrium may also fall into this category. The individual firms in the industry each act on their own and choose their strategies independently. In this theory, since the only legal coalitions are singletons, which are coalitions each with a single member, the effect is to impose restrictions on contracting because the theory assumes coalitions cannot have as many members as they please. The Cournot–Nash equilibrium for an oligopoly is usually inefficient. Still another case that fits into this category is the monopolistic competition of Chamberlin. This is a noncooperative equilibrium combined with free entry. It does not reduce to a competitive equilibrium for reasons apparently plain to Chamberlin but not to his critics such as Kaldor (1935) and Demsetz (1968).

Given a nonempty core and restrictions on contracting, there is the question of what sustains the restrictions. It may be a third party. For instance, in Imperial Germany a cartel agreement was legal, and there was a special cartel court to which the parties to a cartel agreement could bring their disputes. Although the members of the cartel could

fashion their own terms, the legality of these terms could be tested by bringing suit in the cartel court. In England the courts would not enforce a collusive agreement nor could firms who made such agreements be confident of immunity from prosecution by the crown. England had ancient common law against monopoly, and the crown could bring suit against a party for its monopolistic practices. These precedents of English common law also applied in the United States so that collusive agreements would not be enforceable in any U.S. court even before there was antitrust legislation. It was the federal system of the United States and the growth of large firms engaged in interstate commerce that partly explain the birth of federal antimonopoly laws. States and local governments do not have jurisdiction over transactions going beyond their political boundaries. If there was to be a national policy against collusion and monopoly, it would require federal legislation. Although in the United States cartel agreements are illegal according to the various antitrust laws, there are, however, numerous exceptions and circumstances under which the U.S. government does enforce monopolistic restrictions on contracting. Nor is this all. Illegal acts do occur. Even in the United States where price-fixing agreements are generally illegal, firms make such agreements. These may persist for a long time as self-enforcing agreements (see Chapter 6). Restrictions on contracting can endure because the parties to the restrictions individually may gain from them even after taking into account what they would obtain from violations of such agreements.

A large fraction of received economic theory explored various parts of the territory encompassed by the joint category of a nonempty core and the two states of contracting, unrestricted and restricted. When the core is not empty, unrestricted contracting yields an efficient equilibrium. Given a nonempty core, restricted contracting is a fall from grace that causes an inefficient equilibrium. The circumstances that may create an empty core, though not wholly unrecognized, met with considerable skepticism from most professional economists.

The conjunction of an empty core with the two states of contracting, unrestricted and restricted, is new terrain. Here several problems in formal economic theory were known to be troublesome such as non-convexities, indivisibilities, and externalities. For the most part, the main body of economic theory ignored these topics. As we shall see, these are often the source of an empty core. Businessmen complaining of excessive or chaotic competition are sometimes in situations that an impartial economic observer would describe as an empty core. It is hard for many economists to accept the proposition that competition may be excessive because the received theory regards competition as

always good, and the more there is, the better. The claim that unrestricted contracting combined with an empty core means no equilibrium is possible encounters disbelief. There are two common objections. The first denies there are circumstances that can lead to an empty core. The second asks for observable symptoms of an empty core.

To say there is chaos when the core is empty suggests that seeing chaos is to see the observable symptoms of an empty core. What is chaos? It does not mean that people run aimlessly in circles wringing their hands in despair. It does mean that under the existing rules and practices what happens is undesirable for nearly everyone. Unless there are new rules or changes in the existing ones, nearly everyone will suffer. It would be out of place here to dwell on the issues in greater detail, but something more must be said. There is chaos when price cutting is extreme, most firms in the industry are losing money, and yet it is plain that buyers want the product and are willing to pay higher prices than those currently prevailing. The state of the domestic passenger airline industry since 1980 may illustrate such chaos. A century ago, the railroad industry was in a similar state, and it remains in precarious health to this day. There are episodes in the history of the steel industry that seem consistent with the view that chaos can occur. A well-documented case occurred between 1920 and 1921 when there was a breakdown of the Pittsburgh-Plus basing point system. Periods of drastic price cutting coupled with large losses have also occurred in the cement industry. Merely to deny the possibility that conditions can exist that result in an empty core is a position that should have no claim to serious consideration. Yet it requires an answer. A way of doing so starts with the construction of a model consistent with plausible assumptions about cost and demand conditions. One can then show when, how, and why there is no efficient equilibrium.

While still assuming the core is empty, restrictions on contracting become necessary in order to restore an equilibrium. Whether or not it is an efficient equilibrium depends on the nature of the restrictions. The main point is that restrictions of some sort are essential; the alternative is chaos. Thus we are led to examine the nature of the restrictions.

It is possible to have restrictions that give an inefficient equilibrium. Monopoly or a cartel behaving like a monopoly illustrates such restrictions. Although in either case the result is an equilibrium, it may be an inefficient one. Let us examine the contrast between this case and one where the core is not empty. With a nonempty core a monopoly or cartel is not necessary for an equilibrium since competition in the form of unrestricted contracting can yield an efficient equilibrium. With