Competition and Cooperation: From Biology to Business Regulation

P. H. Longstaff

Program on Information Resources Policy

Harvard University

Center for Information Policy Research

Cambridge, Massachusetts

A publication of the Program on Information Resources Policy.

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October 1998, P-98-4

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 ISBN 1-879716-51-8

Printing 5 4 3 2 1

October 1998

PROGRAM ON INFORMATION RESOURCES POLICY

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United States Postal Service
Vanguard Technology Corporation of America, Inc.
Viacom Broadcasting
VideoSoft Solutions, Inc.

Acknowledgements

The author gratefully acknowledges the following people who reviewed and commented critically on the draft version of this report. Without their consideration, input, and encouragement, this study could not have been completed:

J. C. Burgelman
Vincent Mosco
William H. Read
Debora Spar
Ron Temminghoff
Anne Wheeler
Lynn Wheeler

Support for this project was provided by the Development and Leaves Committee, the Newhouse School of Public Communications, Syracuse University. Special thanks for research assistance to Melani Keni, graduate student in the Newhouse School of Public Communications, Syracuse University.

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Executive Summary

Why did government efforts to encourage competition in the communications sector result in more cooperation (through mergers, acquisitions and joint ventures) among firms in that sector? The answer may lie outside the usual models for communications and antitrust policy. This paper looks for clues to the mysteries of competition and cooperation in a discipline that has long studied them: biology. Many economists and biologists have begun to view the similarities between the two systems as more than coincidence. Although these systems may not be sufficiently similar for a precise duplication of models, studying both offers new tools for policymakers and business executives seeking a deeper understanding of competition and cooperation. The main focus of this report is the industrial sector known as "communications," but the concepts discussed may be applied to all industrial sectors and all human systems in which individuals cooperate in order to compete for scarce resources.

These concepts may be used to build analytic tools that do not lead to any predetermined outcome and may be applied in many different ways. One of the biggest advantages of looking to biology (and beyond the legal or political system of any particular government) is the possibility of discovering a culturally and politically neutral framework for discussion. Neutrality is increasingly important in an era of government regulation and business strategy of international scope.

In addition to policymaking for communications and other networked systems, the ideas presented here may be useful for framing discussions for a range of areas in which competition and cooperation are important—for example, in multisector or multiunit companies, where individual parts are being asked to cooperate with their competitors (or compete with those with whom they have always cooperated) on specific projects or products. These ideas will also have direct application to new ways of looking at antitrust law in all industrial sectors, particularly in the search for a common definition for the concept of "competition."

Competition and cooperation have an interesting property: one can cause the other. A new competitor in a system can cause incumbents to band together to fend off the new arrival. New cooperation among some individuals, however, increases competition for the particular scarce resource. Thus, it might have been predictable that introducing competition into the telecommunications sector (in the form off international invaders and invaders from other industries) would increase cooperation (in the form of vertical and horizontal consolidation) among the players as they seek a competitive advantage.

Competition and cooperation may have been misunderstood in some public policy debates. These concepts are two sides of the same coin, not opposite ends of a spectrum with points of relatively more or less in between. A *system* may have various levels of both within it, but they are different modes of behavior: no one can both compete and cooperate with regard to *the same*

thing at the same time. It is possible, however, to cooperate with regard to one resource and compete with regard to another or to cooperate at one time and compete at another. This has clear implications for government attempts to force competitors to cooperate with one another for such things as access to channels or programming resources.

Chapter One

New Tools to Fashion New Answers

The disadvantage of exclusive attention to a group of abstractions, however well-founded, is that, by the nature of the case, you have abstracted from the remainder of things. In so far as the excluded things are important in your experience, your modes of thought are not fitted to deal with them. You can not think without abstractions; accordingly it is of the utmost importance to be vigilant in critically revising your modes of abstraction.... A civilization which cannot burst through its current abstractions is doomed to sterility after a very limited period of progress.

Alfred North Whitehead
Science and the Modern World[1]

A perplexing problem facing policymakers at the turn of the century is the consolidation of firms taking place in many sectors of the economy just when many nations have placed renewed faith in both the marketplace and the benefits of competition. The more these policymakers try to promote competition, the more consolidation seems to take place. This phenomenon was obvious in the attempts of the United States, in the Telecommunications Act of 1996, to "open up" the communications sector. Not only did *competition* between industries (e.g., between cable television and telcos) fail to appear, but the firms began to *cooperate* at unprecedented levels: several of the "baby Bells"—the regional Bell operating companies that came into being following AT&T's 1984 divestiture—sought to merge, AT&T announced it would purchase Tele-Communications, Inc. (TCI), then and still the country's largest cable operation, other cable companies and channels gobbled one another up, and broadcast, newspapers, and magazines all underwent an unprecedented consolidation of ownership. The U.S. communications sector began to look as if it might evolve into several large organizations that would resemble Japanese *keiretsu*, with many interlocking ownerships that foster vertical and horizontal integration.[2] The result left many wondering what had gone wrong and whether it was possible for competition in the communications marketplace to be governed at all.[3]

Intraindustry consolidation and interindustry convergence have led many to express fears of a concentration of political power in large communications companies and of fewer "voices" for coverage and analysis of government. The concentration of ownership in communications has

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[1] *Science and the Modern World* (1926; reprint N.Y.: Mentor Books, 1954).

[2] For a graphic representation of these connections, see Ken Auletta, "The Next Corporate Order: American Keiretsu," *The New Yorker*, 20-27 Oct. 1997, 225-227.

[3] See, e.g., Thomas J. Dyersterberg, and Kenneth Gordon, *Competition and Deregulation in Telecommunications: The Case for a New Paradigm* (Indianapolis: Hudson Institute, 1997).

been seen as more dangerous than similar tenancies in other important sectors such as banking, energy, or steel.[4] One commentator asserted that "the difference between the media industry and the tin can industry is that the media are the source of our ideas and information."[5] The encouragement of diversity in messages about government has a long history in the United States,[6] and policymakers have usually assumed that many owners were necessary for many messages.

Although some of these assumptions and fears undoubtedly are justified, large entities can afford to deploy more resources for news gathering than small ones can, and not all media outlets owned by the same company will necessarily have the same political outlook. Large organizations may be more likely than small ones to pay the legal bills for fighting censorship by government. Still, there is not much reason to believe that large communications companies enjoy more political power than their smaller predecessors did, because those smaller (some of which were not tiny) companies banded together as trade associations with legendary influence in Washington. Yet it seems clear that large entities will not be welcomed by competitors or policymakers. But how can governments stop the mania for mergers?

Policymakers and business executives have long sought some kind of predictability for their actions in the analysis offered by economics and the various "social" sciences. Although these disciplines often can offer accurate descriptive analysis, they have proved less successful in their predictive power. In the late 1990s, economists began to question such fundamental beliefs as "rational" agents, "perfect" information, the efficiency of elaborate mathematics, even equilibrium theory.[7] Nevertheless, economics and the other social sciences have provided a kind of manageable analysis for many issues. But the time has come to look beyond traditional means of analysis for new models to deal with the concepts of competition and cooperation. Some fundamental assumptions about these concepts need to be reexamined yet again.

When pondering complex questions of public policy and business strategy ("simple" ones seem a vanishing species), it may be helpful to recall that the human and technological systems people seek to regulate are not unlike other real-world systems. The structures and behavior of one system may not be sufficiently similar to those of another to supply accurate predictions of activity, but the analogies may be close enough to offer insights or even suggest a range of outcomes likely to flow from attempts to move that system into an acceptable course. The notion

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[4]See, e.g., Ben H. Bagdikian, "Conquering Hearts and Minds: The Lords of the Global Village," *The Nation* (June 12, 1989), 805.

[5]Benjamin M. Compaine, *Who Owns the Media? The Concentration of Ownership in the Mass Communications Industry*, 2nd ed. (White Plains, N.Y.,: Knowledge Industry Publications, 1982).

[6]See, e.g., Daniel L. Brenner, "Ownership and Content Regulation in Merging and Emerging Media," *DePaul Law Review* **45** (1996), 1009–1034.

[7]See Paul Ormerod, *The Death of Economics* (N.Y.: St. Martins, 1995), and Geoffrey M. Hodgson, *Economics and Evolution: Bringing Life Back to Economics* (Ann Arbor: University of Michigan Press, 1996), 3-17.

of putting disparate ideas together to gain new insights, known as "abduction," has been an important path to creativity in describing and explaining many systems.[8]

Many scholars, business executives, and policymakers do not look outside their own fields or experience for new ways to examine problems. In an effort to find analogues that may be helpful in answering questions about consolidation in the communications sector, this report focusses on competition and cooperation in biological systems (a field of study clearly outside the ordinary economic or political focus of these debates). Fortunately, much of the interdisciplinary ground has already been plowed over the years by economists looking to biology for analogues[9]; in return, economics has contributed ideas to biology.[10]

This exercise is not intended to provide precise answers to questions that policymakers and business leaders face but, rather, as a preliminary discussion of possible insights that biology may offer for strategic business planning and the regulation of competition. The essay does not advocate either cooperation or competition but, instead, seeks a new way to look at both, without an economic or political agenda.

One of the biggest advantages of looking to science rather than to the legal-political system of a particular nation is that science may offer a framework for discussing these ideas that is as neutral culturally and politically as human beings have been able to devise. Such neutrality has gained in importance when government regulation and business strategy must be international in scope.[11] Even within a single jurisdiction, such as the United States, common assumptions about the nature of competition and cooperation would help in the formulation of crucial questions at all levels of government.

Using ideas from a discipline outside its ordinary arena may be hazardous if undertaken in pursuit of a particular agenda or when the "lessons" of the discipline are twisted to suit currently accepted answers to a problem. Modern history offers examples of the perversion of ideas from the so-called "hard" sciences in the service of political doctrine, from corporate and sovereign "survival of the fittest" to classifications of criminal or racial stereotypes.

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[8]C. S. Peirce, *Collected Papers of Charles Sanders Peirce*, edited by Charles Hartshorne and Paul Weiss, vol. 5, Pragmatism (1934) (Cambridge, Mass.: Harvard University Press, 1931–1958).

[9]For a wide-ranging discussion of this literature and an extensive bibliography, see Hodgson, *Economics and Evolution.*

[10]Economist Thomas Malthus was known to be an influence on Darwin, and more recent biological analysis has used such concepts as profit/loss and return on investment. See J. Hirshleifer, "Economics from a Biological Viewpoint," *Journal of Law and Economics* **20** (April 1977), 4-6.

[11]Science is not entirely culture neutral, but it is less culture-bound than the other options available. Some biological concepts discussed here remain controversial within the discipline. For an overview of the controversies, see Ernst Mayr, *This Is Biology: The Science of the Living World* (Cambridge, Mass.: The Belknap Press of Harvard University Press, 1997).

Taking great care, then, this paper looks to science for analogies that may help to locate common ground for understanding behavior generally thought of as competition and cooperation. It has been undertaken without any illusions that the insights gained will enable policymakers or business executives to make accurate predictions about the effects of their actions on industrial systems. But it may offer new ways to look at industrial competition and (perhaps) to predict a range of possible outcomes.

Current political ideas about industrial competition and cooperation are rooted in the two modes of economic behavior that, to some extent, have shaped all of the world's cultures. All human societies (consciously or unconsciously) seek the right blend of cooperation and competition that will help them to achieve political and economic stability. In the nineteenth and twentieth centuries, both these modes of behavior found champions, one in Karl Marx, the other in Adam Smith. The followers in each group characterized the others as evil.[12] This report examines biological systems, in which human value judgments have no meaning, and so no assumption is made here that either mode is in itself good or evil but, instead, that a blend of these behaviors in a particular system makes up the possible outcomes of that system.[13]

Although the discussion is focussed on the industrial sector known as "communications," this restriction does not mean that the concepts discussed do not apply outside that sector.

Within "networked" systems such as communications, transportation, and energy, radical new balances are being struck. Because the cost of delivery infrastructure, or "channel," is high, competition in the form of redundant channels once was considered wasteful and, in the long run, economically unfeasible. Until the 1990s, most such systems were operated as government-owned or heavily regulated monopolies in which competition simply was not allowed. In recent years, many governments decided that some level of competition was necessary. This change of attitude was brought on by a variety of developments, including technological improvements (e.g., quantum leaps in computing power) that broke down old geographic and industrial barriers to competition. At the same time, new technologies were making the cost of delivering service less expensive (e.g., microwave transmission), and competitors appeared in the highly profitable niches formerly protected by government for the monopolies. But these networks must interconnect to create national and international "systems," and cooperation among the parts of a system is critical to the success of each part.

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[12]But by the end of the twentieth century, policy analysts and economists were increasingly talking about a "blend" of competition and cooperation as the ultimate answer for nation-building and business strategy. See Lester G. Telser, *A Theory of Efficient Cooperation and Competition* (N.Y.: Cambridge University Press, 1987); James F. Moore, *The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems* (N.Y.: HarperCollins, 1996); Adam M. Brandenburger and Barry J. Nalebuff, *Co-opetition* (N.Y.: Doubleday, 1996).

[13]For a discussion of the roots of these ideas in the nineteenth century, see Bertrand Russell, *Freedom versus Organization 1814-1914* (N.Y.: W. W. Norton, 1934). Russell believed that monopoly was usually inevitable in a capitalist system and that the only logical solution was public ownership of organizations such as railroads.

Political changes, too, had an impact on these networked industries. After the collapse of the Soviet Union, in 1989, and other eastern European governments based on Marxism, confidence began to shrink in the ability of government to act as the cooperative center for providing these services or to regulate giant monopoly providers. Instead, faith was renewed in the ideas of Adam Smith, with the result that telecommunications, energy, and transportation systems were privatized and monopolies broken up.

But, because these all are networked systems, the new competitors were all also ordered to cooperate with one another to ensure that communications, goods, people, and power went where they were supposed to go, regardless of who owned which particular piece of the channel (e.g., the lines or tracks) or provided the routing within the channel. This situation created what seemed to be a new and unique question: Can a company simultaneously compete against and cooperate with another company over the same scarce resource? If so, can any outside authority, i.e., government, either mandate or forbid such behavior? What kind of cooperation is good and what kind is bad?

Keeping an industry free of government protectionism or regulation may encourage more competition in the short term (by lowering barriers to entry, for example), but experience has shown that competition is expensive and competitors will try to reduce it by cooperating, perhaps by dividing up territories or markets. Governments have expended considerable effort to stop this kind of cooperation through antitrust laws, but with limited success and often with confusing theoretical and political justification.

In some public policy debates, competition and cooperation may have been misunderstood. This paper suggests that they are two sides of the same coin, not opposite ends of a spectrum with points of relatively more or less in between. A *system* will have varying levels of both in it, but they are different modes and no one can both compete and cooperate with regard to *the same thing at the same time*. It is possible, however, to cooperate with regard to one resource and compete with regard to another, or to cooperate at one time and compete at another. This idea has important implications for public policy or for a business strategy that assumes competitors will cooperate with one another with regard to a scarce resource, such as channel capacity.

Competition and cooperation have another interesting property: one can cause the other. New competition in a system can cause the individuals in the system to band together to fend off the new competitor. On the other hand, new cooperation among some of the individuals will increase the level of competition for the scarce resource in question. Thus, it may have been predicted that introducing competition into the telecommunications sector would elevate the level of cooperation (in the form of vertical and horizontal consolidation) among the players as they sought a competitive advantage.

The concept of *scarcity* takes on a broader meaning here than most telecommunications managers and policy analysts have granted it in the past. Scarcity has generally been discussed in

terms of scarcity of channel capacity (e.g., spectrum or "natural" monopolies) and used as the theoretical underpinning for allocation of access to channels by government. Here the scarce resource in question will be assumed to include also consumers of communications products and services. The resources (time and money) that customers for point-to-point and point-to-multipoint services are willing to part with are not, it turns out, unlimited,[14] and the allocation of these customer resources by the market (i.e., by competition) will be the primary focus of communications business analysis, policy, and antitrust law in the foreseeable future.

Chapter Two begins with an overview of similarities between biological and economic systems as well as their differences. It goes on to present some large principles that can be distilled from biology which would seem to have application to economic and business systems.

Chapters Three and **Four** present evidence for the assertions made in Chapter Two. These chapters are particularly intended for readers interested in biological principles and their application to economic and business questions. They discuss both intragroup and intergroup competition and cooperation, because biologists and economists have noted different activities for each. Policy and business strategy debates should not ignore the differences between *intraindustry* and *interindustry* competition and cooperation. The discussion in these chapters is divided fairly evenly between competition and cooperation among industries (interindustry) and within an industry (intraindustry).

Chapter Five, which consists largely of diagrams, offers a visual example of a theoretical system of boxes (operators) and Xs (resources) shown responding to various changes in the system's environment.

Finally, **Chapter Six** outlines the implications of these analogies between biology and business for the regulation of competition.

In addition to policymaking for communications and other networked systems, the ideas presented here may be useful for framing discussions for a range of areas in which competition and cooperation are important—for example, in multisector or multiunit companies, where individual parts are being asked to cooperate with their competitors (or compete with those with whom they have always cooperated) on specific projects or products. These ideas will also have direct application to new ways of looking at antitrust law in all industrial sectors, particularly in the search for a common definition for the concept of "competition."

Limitations of space—a report as opposed to a book—and time preclude discussion of the disciplines mentioned here in the depth they deserve and which their practitioners would hope

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[14]Consumers of information and entertainment exhibit a relatively constant demand for these services, and the addition of a new service will mean they use less of the old services. See Jinok Son and Maxwell E. McCombs, "A Look at the Constancy Principle under Changing Market Conditions," *Journal of Media Economics* (Summer 1993), 23-36.

for—indeed, very limited attention is given to the "social" sciences (except economics). Interested readers wishing to learn more, for example, of work now under way in computerized modeling of biological and social systems and ideas about competition and cooperation generated from those models,[15] can consult the bibliography provided at the end of the report.

[15]For accessible discussions of this work, see Claus Emmeche, *The Garden in the Machine: The Emerging Science of Artificial Life* (Princeton: Princeton University Press, 1994); and Joshua Epstein and Robert Axtell, *Growing Artificial Societies: Social Science from the Bottom Up* (Cambridge, Mass.: Massachusetts Institute of Technology [MIT] Press and Washington, D.C.: The Brookings Institution Press, 1996).

Chapter Two

Biology and Business: The Big Picture

2.1 Some Definitions, Limitations, and Misconceptions

Some of the most interesting analogues for reconsidering cooperation and competition come from the branch of biology known as ecology,[1] which attempts to explain, in general terms, the origins and mechanisms of interactions of individuals with one another and with the nonliving world. In so doing, it takes into account many other fields, including physics, chemistry, mathematics, climatology, as well as the many other branches of biology. The word "ecology" was coined in 1866 to denote the study of the "economy of nature," already then a developing body of thought. Sociobiology, which applies ecological ideas to human activities, has been controversial in academic circles, usually in relation to what has been framed as a debate on whether "nature or nurture" is the preeminent force in human behavior. This essay does not leap into that fray but, instead, presents research about animal behavior that appears to be well documented.[2]

A variety of modes of interaction between different species (*interspecies*) and between individuals of the same species (*intraspecies*) have been identified (see **Table 2-1**).

The scholarly literature does not reveal examples in nature where two or more of these interactions exist simultaneously as between two individuals or populations, for instance, the two will not compete and have a parasitic relationship to each other. Similarly, there is no evidence that individuals or groups ever compete and cooperate at the same time and the same place for the same resource. Thus, cooperation and competition appear to be different modes of behavior and not two ends of a spectrum where any particular behavior could be characterized as "somewhat cooperative" or "extremely competitive."

Ecologists define true competition as "an interaction between individuals, brought about by a shared requirement for a resource in limited supply, and leading to a reduction in the

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[1]See, for example, Eric R. Pianka, *Evolutionary Ecology* (N.Y.: Harper & Row, 1974).

[2]For more information about the controversy, see, e.g., U. Segerstale, "The Sociobiology of Conflict and the Conflict about Sociobiology: Science and Morals in the Larger Debate," in *Sociobiology and Conflict: Evolutionary Perspectives on Competition, Cooperation, Violence, and Warfare*, edited by J. van der Dennen and V. Falger (N.Y.: Chapman and Hall, 1990), 273-284; and Edward O. Wilson, *Sociobiology: The New Synthesis* (Cambridge, Mass.: The Belknap Press of Harvard University Press, 1975).

survivorship, growth and/or reproduction of the competing individuals concerned."[3] Competition has also been defined as the "active demand by two or more individuals for a common resource."[4]

Table 2-1

Types of Interactions Between Organisms

Mode	Interaction	Effect
Competition	An individual or species consumes a resource that otherwise would be available to another individual or species	+ -
Predation	An individual (species) kills and eats another individual or species	+ -
Parasitism	An individual (species) takes resources from a host and damages the host	+ -
Commensalism	An individual (species) takes resources from a host but does not cause any tangible effects	+ 0
Detritivory	An individual (species) consumes another that is already dead	+ 0
Mutualism	Both individuals and species experience a net benefit	+ +
Protocooperation	Interaction is favorable to both but is not obligatory to the survival of either	+ +

+ = positive effect on individual or species
0 = neutral
– = negative

Source: Adapted from Michael Begon, John L. Harper, and Colin R. Townsend, *Ecology: Individuals, Populations, and Communities* (Boston: Blackwell Scientific Publications, 2nd ed., 1990), 193-195, and Eric R. Pianka, *Evolutionary Ecology* (N.Y.: Harper & Row, 1974), 173.

Competition can be seen in two modes.

The Scramble, or Exploitation. One species or individual uses up resources to the detriment of other species or individuals without a direct response from those displaced. For example, a plant species might colonize all the available sunny spots in an area or a herd of

[3]Michael Begon, John L. Harper, and Colin R. Townsend, *Ecology: Individuals, Populations, and Communities*, 2nd ed. (Boston.: Blackwell Scientific Publications, 1990).

[4]J. A. R. A. M. Van Hoof, "Intergroup Competition and Conflict in Animals and Man," in *Sociobiology and Conflict.*

buffalo might eat all the available grass, depriving other species of this scarce resource and driving them off the territory or into extinction. Interspecies competition generally takes this form. Intraspecies competition is generally observed where resources are distributed in such a way that it is not worth the necessary energy to defend small clumps of resources.

The Contest, or Interference. A species or individual responds directly to attempts to displace it or to appropriate a resource it uses. This situation can be observed in contests over territory or in dominance hierarchies, and it can take many forms, including siege, harassment, and actual battle. This strategy is observed where the resource in contention is large enough to spend energy defending but small enough to be surveyable and controllable.

The biological concept of *evolution* or *natural selection* has been widely misunderstood (and abused) in popular literature and political discourse concerning competition.[5] It is *not* "survival of the fittest." Evolution operates only by differential reproductive success, which is to say, by how many new members are added to the population. The ability of particular individuals to survive (perhaps because of better strength or speed) may be important only if it affects the number of surviving progeny. Natural selection should not therefore be thought of as "dog eat dog" or "the race to the swiftest."[6] No scientific findings support using Darwinism to judge some species or individuals "fitter" than others on an evolutionary time scale, because no one can predict what challenges these "types" may encounter in the future.[7] The notion that groups (as opposed to individuals) can be selected for remains controversial in both the biological and economic literature (see section **3.1**).[8]

Another common misconception about evolution is that it necessarily leads to adaptations that are the best or the most efficient. Some adaptations may be merely efficient enough but not the best solution to a problem. Adaptations that appear over a long period of time may not be what might have worked best for a particular challenge. They often exist solely because they appeared at the right time and place. Such adaptation can also be seen in a technological change

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[5]See Donald Symons, "On the Use and Misuse of Darwinism in the Study of Human Behavior," in *The Adapted Mind*, edited by Jerome Barklow (N.Y.: Oxford University Press, 1992). For an example of an apparently well-intended misuse, see, e.g., Sutton E. Griggs, *Guide to Racial Greatness: The Science of Collective Efficiency* (Memphis, Tenn.: National Public Welfare League, 1923).

[6]For an excellent and accessible discussion of the uses and misuses of natural selection, see Daniel Dennett, *Darwin's Dangerous Idea: Evolution and the Meanings of Life* (N.Y.: Touchstone/Simon & Schuster, 1995).

[7]See, e.g., Niles Eldredge and Marjorie Grene, *Interactions: The Biological Context of Social Systems* (N.Y.: Columbia University Press, 1992); and R. H. Layton, "Are Sociobiology and Social Anthropology Compatible? The Significance of Sociocultural Resources in Human Evolution," in *Comparative Socioecology: The Behavior of Humans and Other Mammals*, edited by V. Standen and R. A. Folely (Boston: Blackwell Scientific Publications, 1989), 433-457.

[8]Geoffrey M. Hodgson, *Economics and Evolution: Bringing Life Back to Economics* (Ann Arbor: University of Michigan Press, 1996), 186-194.

that gets "locked in" even though it is not the best answer to a problem, such as the QWERTY keyboard layout.

In most cases, the process of natural selection will lead to improvement, because it represents adaptation to change in the environment. But natural selection can sometimes lead to a suboptimal, even disastrous, outcome if the environment continues to change. If natural selection always led to the "best" answer, dinosaurs would still rule.[9] Misunderstanding about the function of natural selection led to the now thoroughly discredited theories of Social Darwinism, i.e., that people at the top of socio-economic hierarchies are there because they are the "best."

The controversies surrounding the concept of equilibrium in both economics and biology must also be acknowledged here. Debate is increasing in both fields about whether economic and biological systems ever reach a state where forces exactly match each other to bring the system to some kind of rest.[10] This report does not engage in this debate, but here the term *equilibrium* is used to refer to a situation in which the system moves within a narrow range and is not in a period of wild fluctuation.

A reader relatively familiar with economics will be wondering how some of these biological concepts translate into a business context, e.g., when does an industry or a firm have greater fitness? The term *fitness* is used here to refer to the ability of the industry (actually, its individual firms) to leave more progeny (i.e., more equity or return for shareholders) over time. This would seem a fairly noncontroversial way to measure success in the long term.[11] If a firm is providing lower rates of return on its investors' capital, it is certainly seen as less fit. Increased fitness may or may not mean an increased marketshare or larger work force. Similarly, it may or may not mean being more aggressive, faster to get new product to market, having more assets, or having a bigger (perhaps international) territory, although any of these factors would increase fitness in certain economic environments. Fitness changes over time, particularly in times of rapid change in the industry's environment (e.g., new regulation, new technology, etc.). What once was a very fit telecommunications company may now be doomed to extinction, unless, like the barnacles discussed in section **3.1**, it can find a new type of food to eat.

The term *adaptation* is used here to mean any heritable characteristic (i.e., that which comes with the firm when sold or when management changes) that increases or decreases the fitness of the firm or industry (of similar firms) in a given economic environment. *Environment* means all

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[9]Hodgson, 197. See also, Steven J. Gould and R. C. Lewontin. "The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme," in *Proc. Roy. Soc. London B***205** (1979), 581-98.

[10]In biology, see, generally, Michael A. Huston, *Biological Diversity: The Coexistence of Species on Changing Landscapes* (Cambridge, Eng.: Cambridge University Press, 1994); in economics, see Larry Samuelson, *Evolutionary Games and Equilibrium Selection* (Cambridge, Mass.: MIT Press, 1997) and Alfredo Giovanni, *Equilibrium and Economic Theory* (N.Y.: Routledge, 1996).

[11]Hodgson (50) suggests that "a better measure of the success of an institution within that system would be the growth rate of its assets, valued through the market in money terms."

the forces that have an impact on the industry—government, suppliers, customers, and macro economic forces, such as inflation and interest rates.

Some of the interactions between individuals described in **Table 2-1** have at least a passing resemblance to interactions between firms and industries. For example, some business interactions look like *predation* (e.g., predatory pricing to "starve" the competitor or buying a competitor with the intent of shooting it in the head). *Mutualism* might find its analogue in every business contract in which both parties (theoretically) receive a benefit. It is also exhibited when two firms get together to divide territories—both receive a net benefit (neither needs to compete anymore with the other)—but such division is generally seen as illegal activity because it tends to increase the price charged by each, which then has a detrimental effect on another species in the environment, consumers.

Protocooperation is probably best observed in the joint ventures and "alliances" that began to be common in the 1990s; analysis of their successes and failures might benefit from a study of protocooperation in the natural world. Regulators remain unsure whether these interactions are good or bad.

"True" cooperation (where the survival of both parties may depend on it) is almost always seen as good by regulators, even when it means less competition. Cooperation is generally allowed when two firms or industries find themselves in a position in which one will become extinct without cooperation in sharing or dividing resources. For example, the Joint Operating Agreements made possible for newspapers under the Newspaper Preservation Act[12] and multiple ownership limits which were increased for broadcasters by the Telecommunications Act of 1996.

What is a "species" in the business world? In biology, a species has been defined as a group of individuals that "may be expected to have many fundamental features in common, to use similar resources and to react in much the same way to conditions."[13] This report presents a search for analogies to species at the level of the industry. Unfortunately, there is no uniform definition in the business or economics literature for the term "industry." Here it is used to refer to a group of firms that share many institutional and technological characteristics, compete for the same resources (both production inputs and customers), and can be expected to respond in similar ways to changes in the environment. This definition is useful in order to discuss competition and cooperation both within and between groups of firms. It is also useful for analysis of firms that are currently evolving or converging to form new industrial "species."[14] A *firm* is thus regarded as an individual member of its industrial species.

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[12]15 USC 1801 et seq.

[13]Begon, Harper , and Townsend, 1990.

[14]In much of the literature that compares biology to business, the "unit" operated on in the process of natural selection is said to be the institution or firm, which seems appropriate because that literature is looking for analogues to give new ideas for strategy at the level of the firm. See Hodgson, 37-51, 252-267.

Finally, it is important to acknowledge that any similarities between biological and human systems will always be imperfect, because human beings can look into the future and, on the basis of assumptions about future events, they can change their behavior. This capacity accounts for the behavior of such human systems as the stock market. It allows human beings to change habits and other characteristics that would be more stable and thus more predictable in other organisms. Human beings also exhibit more complex resource requirements than other species. For example, given an opportunity to maximize their economic gain, some human beings may forgo it for the sake of serving other needs (such as ego gratification), a characteristic other animals appear not to have.

2.2 Mechanisms of Competition and Cooperation Drawn from Biology and Applied to Business

It is helpful to look at the mechanisms in biology and business side by side to see how close the analogies may be. **Table 2-2** draws on examples from the communications sector to illustrate regulatory issues facing many governments at the turn of the century and indicates many of the principles described **Chapters Three** and **Four**.

Table 2-2

Mechanisms of Competition and Cooperation Drawn from Biology and Applied to Business

Biological Systems	Business Systems
Competition exists when more than one species or individual seeks to use a scarce resource, i.e., a resource not available in sufficient quantity to satisfy all users. The resource may be anything needed for survival or reproduction: food, safety, appropriate environmental conditions, etc.	Competition exists when more than one industry or firm seeks to use a scarce resource, i.e., one not available in sufficient quantity to satisfy all users. The resource may be anything needed for survival of the business: customers, production input, labor input, capital, etc.
Over time, competition results in a greater reproductive success for one species while the competing species declines in number.	Competition results in winners and losers. Over time, losers will suffer displacement (loss) of investment and jobs.
Competition can be *active*, as in a contest (e.g., physical attack on members of the other species in order to appropriate the resources it has under its control), or *passive,* as in a scramble (e.g., use more of the resource so not enough is left for the other users).	Competition can be *active*, as in a contest (e.g., seeking another's current or potential customers through marketing, price competition, etc.), or it can be *passive*, as in a scramble (e.g., use more of a resource such as bandwidth, power, consumer time, so not enough is left for others to use).
Competition is expensive. Time and energy spent on competitive activities reduce the time and energy available for other critical activities, such as reproduction or food (resource) gathering.	Competition is expensive. Time and resources spent on competitive activities reduce the time and resources available for other critical activities, such as long-term investment in plant, equipment, and employee training. It also reduces fitness in the short term by lowering returns to investors.

When two groups or species compete for the *same resource* for an indefinite time, one group will become extinct or abandon its use of the resource. This is known as the *Competitive Exclusion Principle*. If both groups use the resource as *one of several* to support their needs, both groups can survive and use the resource at a level of equilibrium.	When two firms or industries compete for the *same resource* (e.g., customers for recorded video) for an indefinite time, one of them eventually will go out of business or change its strategy to target a new market (e.g., Betamax). If the firms use customers as *one of several markets* for the product, both firms may survive at a level of equilibrium (e.g., if both firms market the product to business and home users).
Cooperative behavior allows the allocation or acquisition of the scarce resource without expensive competition.	Cooperative behavior, such as territory or customer allocations and group purchasing or R&D, allows the allocation or acquisition of resources without expensive competition.
Cooperative behavior can be exhibited in situations of *inter*species and *intra*species competition. But cooperation and competition are different modes, and no species or individual exhibits both *in the same space and time with respect to the same resource.*	Cooperative behavior can be seen in *inter*industry and *intra*-industry competition, e.g., at the *precompetitive* stage or when competitors mutually agree to suspend competition for a time. Examples include R&D consortia or national emergencies. But no firm or industry will compete and cooperate *at the same time* or *in the same market with respect to the same resource.*
*Intra*species competition tends to be fiercer, because individuals are competing for the same resources. As two species come to "look like" each other, they will compete more fiercely.	*Intra*industry competition tends to be fiercer, because firms compete for the same customers, e.g., competition between TV networks is fiercer than between networks and newspapers, because networks hunt for the same national advertisers while newspapers (sometimes) hunt for slightly different ones. If networks and newspapers begin to publish on the Internet, they will look more like each other and will hunt for the same advertisers.
Cooperative behavior can evolve (i.e., be selected for over many generations) in populations of competitors if it enhances the reproductive success of individuals exhibiting it, i.e., makes them fitter.	Cooperative behavior can evolve without conscious intent by firms when they tend (over time) to concentrate on certain customers more easily sold to and leave other customers to the competition, e.g., if it is easier to sell DBS services in rural areas, companies are likely to concentrate there while cable companies back away. Over time, a de facto market split occurs without overt attempts to cooperate, because the behavior makes both industries fitter.
Systems that have a reliable amount of a resource (even if the resource is limited) will tend to be more stable, because this situation allows for allocation of the resource to evolve toward equilibrium.	Economies that have a reliable (even if not unlimited) amount of the resources needed by firms (capital, labor, raw materials) tend to be more stable, because the situation allows allocation of the resources to evolve toward equilibrium. Economies with unreliable access to critical resources (such as oil) will endure industrial "shocks," which upset allocations and destabilize the economy.
A stable system will support more diverse groups as each finds a relatively secure *niche*. A system destabilized by the unreliability of a resource forces groups to look to other niches for the resource in times of scarcity and, over time, to reduce the number of groups that survive.	An economy supports more diverse industries if each industry finds a relatively secure *market niche* not in danger of invasion by other industries. If one industry loses access to a critical resource (capital, labor, customers), it may look to resources used by others and reduce the number of industries or firms that can use it. If an industry begins to lose access to capital because of market saturation (thus, limited growth potential), it may try

	to invade the turf of closely related industries, using up some of the limited customers for that good or service and reducing the number of firms that can survive.
The introduction of scarcity into a stable system (where allocation of the resource has evolved into equilibrium) may cause former cooperators to compete or former competitors to cooperate, or both.	If a resource becomes scarcer than formerly (e.g., customers) and firms cannot find substitutes, the scarcity will drive firms that had cooperated with respect to that resource (e.g., through territory allocation) to compete, or it will drive those that had formerly competed for it to cooperate (e.g., through collective buying).
Within species, an individual that "learns" adaptive behavior will cooperate with other members of the group with respect to a scarce resource if cooperation increases the individual's access to other critical resources. For example, an individual may share food if that will allow it to gain safety from predators.	A firm may be expected to cooperate with respect to a scarce resource if cooperation will give it access to resources it could not otherwise obtain, e.g., cable firms may cooperate with respect to programming and production if it will gain them access to more local cable systems.
Cooperation may be exhibited by a species when the availability of a resource is unreliable because of random distribution and because of the greater access some individuals have simply owing to luck (e.g., predators have large hunting territories).	Firms may be expected to cooperate with respect to a resource, such as copper wire, when availability depends on political conditions in other countries. This allows all to stay in business when supplies are cut off.
Individuals cooperate in sharing resources only when *on average* they obtain more of the resource by being part of a group than they could obtain by acting alone.	Firms would not be expected to cooperate with respect to a resource if *on average* they could locate more by themselves. Thus, firms would not cooperate to produce entertainment programming if each could expect to locate enough acceptable programming to fill its needs.
There is a limit to the size of a group. If a group is too large, the individual's "share" is not enough to ensure survival, and the individual is better off taking the risk of seeking the resource alone or in a smaller group.	Firms would not be expected to cooperate or form larger organizations if the larger group could not gain access to sufficient resources to support all divisions or participating firms. In this case, each firm would be better off running the risk of finding its own resources. If a cooperative group (e.g., a trade association) were to lose access to certain suppliers (e.g., paper suppliers) and did not have enough of the scarce resource to supply all members, the strongest members of the cooperative group could be expected to leave and seek the resource on their own, even if their departure would decrease the fitness of the remaining members.
Individuals and groups are more likely to adopt cooperative behavior if there is an ongoing relationship (e.g., kinship, occupation of the same territory) and encounters between the individuals or groups. This allows a "tit-for-tat" strategy that rewards cooperative behavior while punishing noncooperation.	Firms or industries are more likely to cooperate if they have an ongoing relationship (e.g., long-term contracts or "sharing" customers through complementary products) and a tit-for-tat relationship can develop, building trust and shared expectations.

"Induced" cooperation (i.e., an individual or group surrenders a resource in response to force or a "trick") or competition (i.e., individuals or groups fight for a resource they do not need or that is not scarce, in response to force or a trick) is exhibited only for as long as the inducement exists.	Cooperation between firms or industries induced by government incentives (e.g., tax credits) or government threats (e.g., civil or criminal penalties) is effective only as long as the benefit is useful or the threat is real. If the firms have few profits to tax or if they know government cannot possibly investigate all price increases, they will ignore the incentives or threats.

DBS = Direct Broadcast Satellite
R&D = research and development

Chapter Three

Competition

3.1 Biological Systems: *Interspecies* Competition and Natural Selection

Because two species almost never require exactly the same resources, they generally compete in limited areas. *Interspecies* competition usually involves only a part of a resource required by both species (e.g., types of food, shelter) and accounts for only part of that requirement for each species (i.e., each will have other sources). Only part of the niche of each species will overlap with that of the other in the area in which they compete. For example, a barnacle that filters its food from the water may have a physical configuration so that it can process only food particles .3 to .6 millimeters (mm) in diameter, while a jellyfish in the same area uses only particles .1 to .3 mm in diameter (see **Figure 3-1**). Thus, the two species compete for food particles that are .3 mm in diameter. If the barnacles reproduce at a faster rate than the jellyfish, the barnacles will use up more of the .3 mm particles, and less will be available for the jellyfish. Over time, this trend will force down the population of jellyfish.

Evidence suggests that the extent of overlap must be limited for the two species to coexist, but the exact extent of overlap will vary according to conditions in the environment.[1] Under some circumstances, the results of competition between two or more species using the same scarce resource can be predicted and used to exploit or control these populations or the resource they exploit.

If the overlap is 100 percent, the possibility of coexistence is virtually nil. Ecologists see evidence that two species with exactly the same resource utilization cannot exist in the same place at the same time.[2] One will be pushed out of the local ecosystem or forced to extinction, according to the principle of *competitive exclusion*. This process can take place very slowly, allowing the species to coexist for a long time, but in the end one species will lose.[3] Competitive exclusion will not occur at all if the populations of both species are otherwise self-limiting, so that one stops increasing before the other goes extinct, which might happen if one occupies a slightly different niche or both are controlled by parasites specialized to feed on them. The greater the differences between the species, the greater the likelihood of independent population controls[4] and the likelihood that they will be able to co-exist while using the same resource.

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[1]Michael Begon, John L. Harper, and Colin R. Townsend, *Ecology: Individuals, Populations and Communities*, 2nd ed. (Boston, Mass.: Blackwell Scientific Publications, 1990), 269–272.

[2]See Michael A. Huston, *Biological Diversity: The Coexistence of Species on Changing Landscapes* (Cambridge, Eng.: Cambridge University Press, 1994), Chapter Five; and Robert E. Ricklefs, *Ecology* (N.Y.: W. H. Freeman, 1990, 2nd ed.), 445.

[3]Huston, 123.

[4]See G. F. Gause and A. A. Witt, "Behavior of Mixed Populations and the Problem of Natural Selection,"

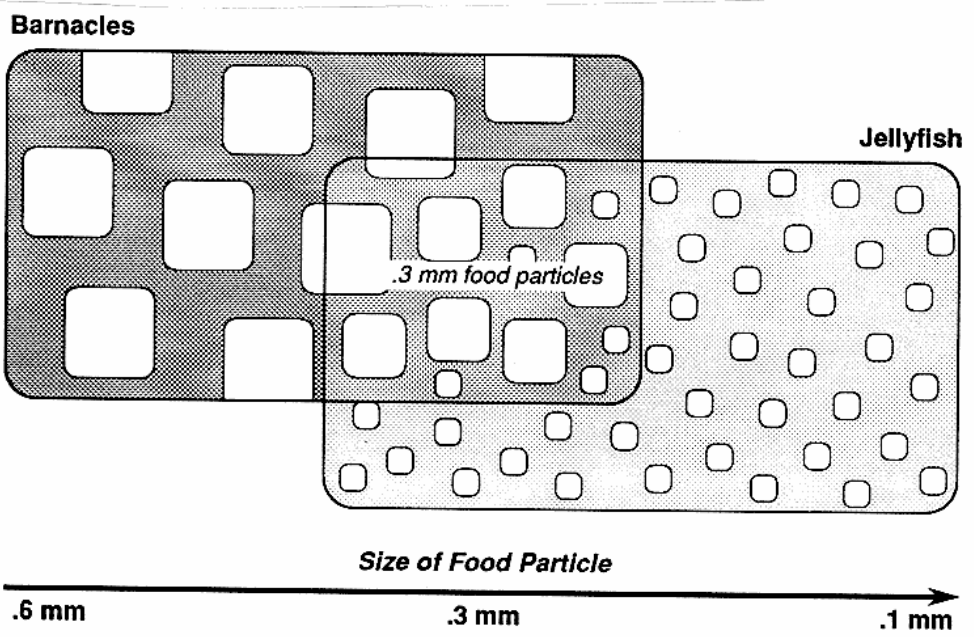

Figure 3-1

Examples of Interspecies Competition: Barnacles and Jellyfish

When two species compete they are more likely to defend territories if the species "look alike," that is, have the same resource requirements. They will keep individuals that look like themselves off their territory. One species may evolve either to resemble the second species (until they look alike and are better able to identify those competing for the resource) or to make it look *less* like the second species (thus reducing the likelihood of challenge). In response, the second species may evolve counterchanges in appearance, a response that takes many generations. Other options for the subordinate species include surrendering the field—that is, abandoning the habitat—or adapting to the new situation by using other resources within the habitat.[5]

Because competition increases or decreases the reproductive success of populations, over time it produces the phenomenon known as "natural selection" or "evolution." Under stable conditions, "average" members of a population leave more progeny than those at the extremes. Very fast or very aggressive members of the population will leave fewer progeny if they spend so much energy being aggressive or fast that not enough remains for reproduction. But when either the environment or a scarce resource changes, the most successful individuals (i.e., those leaving

American Naturalist **69** (1935), 596–609.

[5]See, generally, Begon, Harper, and Townsend, Chapter 7, "Interspecific Competition."

the most offspring) may not be the average members but individuals whose characteristics offer advantages in dealing with the changed conditions. In time, directional selection will shift the population toward those characteristics. The helpful characteristics may—or may not—be increased aggression or swiftness. Indeed, were swiftness and aggression always selected for, every species would get faster and faster and more and more combative. Given that this does not happen, countervailing selection pressures must exist.[6]

In the case of the competition between barnacles and jellyfish, an increase in the jellyfish population may be caused by an increase in a resource they use (.1 mm food particles) or a decrease in their predators, and it may have nothing to do with any decreased fitness of the barnacles. If no change occurs in the behavior of the barnacles, they will now eventually die out, because the increasing numbers of jellyfish will use up more .3 mm particles. If, however, some of the barnacles develop the ability to eat .7 mm particles, they will reproduce in larger numbers than their cousins, eventually becoming the norm in the population. This increase in the difference between barnacles and jellyfish may enable them to coexist while competing for .3 mm particles, particularly if the barnacles now were to compete with another species for .7 mm particles, in a new competition that would limit the growth of the barnacle population.

Selection does not always involve increasing the fitness of a population. It can also occur when something happens to decrease the fitness of a population, so long as the same cause decreases the fitness of competitors even more. This phenomenon is known as "spite." For example, if a plant that several animal species eat is totally consumed by species X, the fitness of X to survive in this environment will decrease. But if X uses this plant only for 20 percent of its food while species Y and Z use it for 80 percent of theirs, X is more likely to survive than either Y or Z despite its decreased fitness. Similarly, something that increases fitness will be selected against if, at the same time, it increases the fitness of competitors even more.[7]

The diversity of species in a system is affected by many forces. In many ecosystems competitive balances are constantly changing, and local increases in resources or decreases in predation alter the balance so that one population will not have time to develop a new niche and will either go extinct or leave the territory. In ecosystems located near the earth's poles, the harsh climate and low levels of available resources result in low levels of species diversity and niche differentiation. Nearer the equator, with higher energy from the sun (the basic resource for all ecosystems) and a more stable environment, species vary tremendously.[8]

Even in systems without sunlight (e.g., ocean depths on the Continental shelf), if there is stability over a long period of time, many species can survive. Delicate balances are not upset by

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[6]Pianka, *Evolutionary Ecology*, 10.

[7]D. S. Wilson, *The Natural Selection of Populations and Communities* (Menlo Park, Calif.: Benjamin/Cummings, 1980), 16.

[8]Begon, Harper, and Townsend, 816–844.

changes in the environment that offer some species an advantage over others, and extensive niche differentiation means a limited overlap in the use of resources. In a stable system, intraspecies competition is more prevalent, because individual members of a species are trying to use exactly the same resources.[9] Even in stable systems, where scarce resources have been allocated among different species, competition continues to be part of the equation by maintaining individual populations at a level that does not upset the equilibrium.

Do the same processes operate at the level of the group? As mentioned in **Chapter One**, this area remains one of the most active controversies in the biological sciences. Natural selection of groups appears to be possible only when all members of the group are "bound together by the same fate," regardless of individual fitness. Selection acts on a group if, and only if, a force impinging on those agents makes it the case for all members of the group. That is, some property of the group determines the fitness of every member, and should something happen to all, the effect will be the same for each individual member.[10]

But shared fate is not enough to cause selection, because it includes things such as collections of cells that make up plants and animals. Attempts to model group selection have concluded that it is unlikely or of little significance in real-world settings.[11] In experiments with flour beetles, group selection and individual selection were found to occur simultaneously.[12] Levels of selection have been proposed in a variety of contexts, but the subject remains controversial.[13]

What about cases where two levels of biological systems "compete" for resources or the benefits of natural selection, where the good of an individual conflicts with the good of the larger system, for example, where the good of a cancer cell is different from the good of the body? It has been suggested that the "winner" will be that level that is (1) most independent from its competitor, or (2) most able to benefit before it begins to suffer from the ill effects caused on the other level, or (3) most able to exercise "discipline," that is, to control the situation.[14]

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[9]Ibid.; and see, e.g., H. L. Sanders, "Marine Benthic Diversity: A Comparative Study," *American Naturalist* **102** (1968), 243-282.

[10]E. Sober, "Holism, Individualism, and the Units of Selection," in *PSA 1982: Proceedings of the 1982 Biennial Meeting of the Philosophy of Science Association*, edited by P. D. Asquith and T. Nickles, vol. 2 (East Lansing, Mich.: Philosophy of Science Association, 1983).

[11]D. S. Wilson.

[12]M. J. Wade, "Group Selection among Laboratory Populations of Tribolium," *Proc. Nat. Acad. Sci.* **73** (1976), 4604-4607.

[13]See, e.g., Niles Eldredge, *Unfinished Synthesis: Biological Hierarchies and Evolutionary Thought* (Oxford, U.K.: Oxford University Press, 1985).

[14]Raghavendra Gadagkar, *Survival Strategies: Cooperation and Conflict in Animal Societies* (Cambridge, Mass.: Harvard University Press, 1997).

3.2 Biology and Business: *Interindustry* Competition

Many popular business publications have used biological or so-called Darwinian analogies in discussions of business strategy. Not all writers using these terms have understood such biological concepts and some have even stretched them to fit preconceived political notions about industrial or social "fitness," but whether biological and industrial systems are similar enough to generate important insights has not itself been controversial. Similarities between biological and economic theories can even be found in literature that does not consciously use these analogies to discuss competition among industries. For example, Michael Porter opened his now classic work on competition with this advice: "The essence of formulating competitive strategy is relating a company to its environment."[15] Porter could have been discussing the model of interspecies competition (described in section **3.1**) in his description of industrial competition:

> Competition in an industry continually works to drive down the rate of return on invested capital toward the competitive floor rate of return, or the return that would be earned by the economist's "perfectly competitive" industry. This competitive floor, or "free market" return, is approximated by the yield on long-term government securities adjusted upward by the risk of capital loss. Investors will not tolerate returns below this rate in the long run because of their alternative of investing in other industries, and firms habitually earning less than this return will eventually go out of business. The presence of rates of return higher than the adjusted free market return serves to stimulate the inflow of capital into an industry either through new entry or through additional investment by existing competitors. The strength of the competitive forces in an industry determines the degree to which this inflow of investment occurs and drives the return to the free market level, and thus the ability of firms to sustain above-average returns.[16]

Porter here describes how firms capture resources and hold on to them by virtue of their fitness (return to shareholders) relative to another industry (species) that seeks to use the same resource. Porter's analysis also describes the way economic organisms die and economic species go extinct: other economic organisms or species use the necessary resources to survive. This competition need not involve a *contest*, but, rather, a gradual use of necessary resources, i.e., the *scramble* in interspecies competition (section **2.1**). This aspect of competition has been largely ignored by policy analysts, whose focus tends more toward competition that looks like *the contest*.[17]

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[15]Michael E. Porter, *Competitive Strategy* (N.Y.: Free Press, 1980), 3.

[16]Ibid., 5-6.

[17]See, e.g., D. McL. Lamberton, "Open Competition," *Telecommunications Policy* **19**, 7 (1995), 587-588.

Porter lists five competitive forces that work on an industry: (1) the entry of competitors, (2) the threat of substitution, (3) the power of buyers, (4) the power of suppliers, and, (5) rivalry among current competitors. These forces can determine whether one industry can successfully invade the territory of another.

Potential entrants may be firms or industries that have never had a territory before (entrepreneurs), have lost their old territory, or have just learned to use the resource of the incumbent firm or industry (perhaps with new technology). Two important barriers to the entry of competitors identified by Porter are economies of scale and government policy.

As in biological systems, there are advantages to being BIG. One advantage may be using a lot of the resource in question (horizontal integration) or controlling production in the chain of that resource (vertical integration). Either advantage theoretically gives the competitor economies of scale that can keep others off its territory.

An industry may enter a new business territory by offering a substitute product. This may not look like direct competition, but the substitute will eat up scarce customers (like the .3 mm food particles) that would have been used by the incumbent industry and, over time, may use so many that capital will start flowing out of the incumbent and into the substitute. As a result, the situation will look more like intraspecies competition and may shift from the scramble to the contest with active advertising and market share battles.

But this competition will be expensive and to the extent that the industries fight over the same resource they are at risk of falling victim to the competitive exclusion principle, i.e., over time one of them will either go extinct or find some other resource to use. This principle may well have been at work in the extinction of Betamax video and eight-track audio businesses. These are both "network markets" i.e., their customers want to buy products that are compatible with those purchased by other consumers. Network markets are said to be "tippy" in that one product will eventually tip the balance and take over the entire market. In such cases competitors may want to avoid a fight to the death by picking the industry "standard" in advance, either by mutual consent or by asking government to impose one. This also makes it difficult for other industries (or firms from other countries) to invade this market.[18]

The least "expensive" way to keep other industries away from a resource may be to have government keep them away. This can be accomplished through licensing schemes for access to government resources necessary to entry (local right-of-way, spectrum, etc.) or by making the cost of doing business higher for new entrants, through taxes, government regulation, etc.

Another way to avoid competition in both biology and business is specialization. In both systems the competing species will drift away from using resources in the area of overlap where

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[18]Martin C. Libicki, *Information Technology Standards: Quest for the Common Byte* (Newton, Mass.: Butterworth-Heineman, Digital Press, 1995).

competition is the most fierce. This results in an equilibrium separation distance between species (or industries). In economics this generally referred to as product differentiation competition, locational competition or monopolistic competition. However, this situation can be bad for both if a generalist species comes in and eats both their lunches.[19]

3.3 Biological Systems: *Intraspecies* Competition

Intraspecies competition is always more intense than *interspecies* because individuals in the population have similar requirements for survival.[20] As the population grows it uses more of the resource, and, at some point, when the resource no longer supports the large population, individuals begin to compete for its use. Some individuals will not survive, and the population will decline until it reaches a level the resource can support.

Intraspecies competition by territory also controls the population. Since there are a limited number of territories and only one individual (or mating pair) can occupy each, the population size will remain stable. There will be winners and losers each time a territory is contested based on the ability to defend the turf or push the incumbent off.

The size of the territories is also controlled in this system. Defending and patrolling a territory costs energy that could be used for reproductive functions. It will only be expended for a territory large enough to support the needs of the incumbent. If the resource is abundant the territory will be small, but if it is more widely distributed a larger territory will need to be defended.[21]

Thus, *intraspecies* competition has the effect of controlling the population of the species, while *interspecies* competition can result in one species going extinct.[22]

Intraspecies competition takes the same two forms as interspecies competition:

The Scramble, or Exploitation. Individuals do not interact with each other but use up more resources than others of the same species. This may be possible by virtue of things like location (more sunlight or prey are available) or relative size (larger bushes can get more sun, larger lions can kill more prey). Size may also be important when small individuals are more vulnerable to environmental fluctuations or extreme conditions.[23]

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[19]See J. Hirshleifer, "Economics from a Biological Viewpoint," *Journal of Law and Economics* **20** (April 1977), 1-52.

[20]Begon, Harper, and Townsend, 197.

[21]Begon, Harper, and Townsend, 230-234.

[22]Ricklefs, 439.

[23]Huston, 116, 178.

The Contest, or Interference. Individuals interact directly to prevent another from using a resource. This can be seen in plants that "overgrow" their neighbors to take more sunlight or animals that defend territories from others of the same species.

As in interspecies competition, there are limits to the usefulness of aggressive behavior. Animals generally prefer ritualized combat or bluff to actual fighting, because above a certain level, aggression actually lowers fitness levels. As just noted, the individual or species may spend so much energy fighting that they haven't enough left for things like courtship, nest building, and the feeding and rearing of offspring. For this reason, they won't reproduce more quickly than their neighbors, and, in the long term, very aggressive individuals will be selected against. In addition, very aggressive individuals that direct violent behavior against relatives lower the replacement rate for genes shared by the aggressor and the relative.

In most animal species, aggressive competition between individuals is reduced by two methods: territoriality and dominance hierarchies. Some species use primarily one or the other, while others use both. Wolf packs have a territory that they defend and a hierarchy within the pack.

Many animals set up dominance hierarchies while individuals are still in infancy.[24] In most species that raise young in groups, or "litters," the development of dominant siblings occurs very early, perhaps as early as the first hours of life. This hierarchy reduces aggressive behavior and makes survival of at least one of the offspring more likely by giving it first call on the available food.

A rare form of intraspecies competition is cannibalism. It usually occurs where there are significant differences in the size (or other fitness criteria) among individuals in the population.[25]

3.4 Economic Systems: *Intraindustry* Competition

The goal of intraindustry competitive strategy, according to Porter, is to find a position in the industry where the company can best defend itself against these competitive forces or can influence them in its favor.[26]

This seems a good description of what individuals in many biological species do: they find a territory or a grouping of resources and then defend it.

Intraindustry competition takes place between firms that look alike (e.g., between telephone companies or between television networks). It is always more intense than interindustry

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[24]Laura Smale, et al., "Competition and Cooperation Between Littermates in Spotted Hyena," *Animal Behavior* **50** (1995), 671-682.

[25]Huston, 178.

[26]Porter, 4.

competition, because they go after exactly the same limited resources (e.g., suppliers, customers). A telephone company may see another telephone company as a more serious competitive threat than an electric company, even if both telephone companies are trying to invade the same territory by providing local phone service.

The mode of intraindustry competition is more likely to be the *contest* than the *scramble*. That is, it takes the form of direct confrontation and aggression. When two industries start to look like each other and to use the same resources or go after the same market, they will more and more exhibit *intraindustry* competition. For example, as direct broadcast satellite systems grew to resemble cable services (by using the same programming services and going after the same customers), competition grew hotter. Sometimes, when a competitor comes into a new territory, it evolves to look more like a successful incumbent as it tries to use more of the limited resource both species need. Wireless telephony may become an example of gradual resemblance.

Like intraspecies competition, intraindustry competition can act to control the population of firms in an industry. In any given territory there will be winners and losers. The territory need not be geographic; it can be a resource niche. When the current territory of an industry is invaded, the battle can be intense because the fight may be "to the death." Thus, competition within an industry reduces the number of firms that try to stay in the business.

A firm's territory may break down because of a reduction in a critical resource (e.g., fewer radio listeners) or because more individuals are seeking turf (e.g., increased allocation of FM licenses by the Federal Communications Commission). In both cases, the number of firms will decline until it reaches a level the industry can support (which is clearly true in radio). Winners will manage to get enough of the resource to stay alive. Losers will not and will go bankrupt, sell out to a stronger competitor, or seek alliances to gain competitive advantages.

Thus, the net effect of encouraging competition in an industry with dwindling access to a limited resource or of increasing the competitors for a resource will be either to "cull" the weakest competitors or force them to cooperate. Cooperation might take the form of mergers and acquisitions or agreements to share resources (e.g., local marketing agreements in radio.

The same forces that favor large organisms in the biological world also bear on business firms. In the face of increased competition, firms can increase their fitness either by using up the resource that would have been available to smaller competitors or by aggressively pushing these smaller competitors off the turf. Larger firms will be better able to "store up" resources, making themselves less vulnerable to environmental fluctuations (e.g., changes in technology) and extreme conditions (e.g., economic recessions) than the small firms are.

Individual firms in most communications industries have relied on territoriality to gain and maintain access to resources. They have used resources at their disposal to become very "fit" for

their environment, i.e., they were able to give good returns to their owners, even though they were not particularly fast or aggressive or efficient.

Unlike incumbents in biological territories, most of these firms did not need to defend their territory—the government did that for them. But government defenses are unraveling and territories are up for grabs, and more individuals may be expected to try to gain territory at the same time that incumbents on those territories may be expected to try to survive.

All of the competitors would be faced by the same choices available in the biological world:

Find a new resource on the firm's present turf. Perhaps use the present infrastructure or expertise to sell other services to present customers, thus finding new resources to make up for the those that may be taken away by the new competitor. Unless the service is totally new and not a replacement of another currently available in the market, a firm should prepare to fight current providers of the service. If the firm is a telephone company that serves everyone on its turf, it may find itself competing with some of its own best customers (e.g., mass media firms) as it tries to find new ways to use its assets.

Move to a territory the species can defend. If the invader whose forces are massed at the border looks unbeatable, maybe take the resources stored up and invest in another business. Or invest in the stock market and move to Florida.

Try to keep challengers off the present territory.

- *Make it expensive.* The incumbent firm or industry could let it be known that it will fight to the death and expect any invaders to take so many casualties they will be unable to defend the territory even if they win. This encounter could take the form of "spite" (selling a service below cost until competition is driven off) or of making the invader's access to a local resource more expensive than the incumbent's (that is, making sure suppliers give the incumbent a better deal).

- *Get bigger.* Larger organisms or firms may gain access to increased resources, which will permit them to put up a better (and longer) fight and make them appear more formidable; as a result, smaller competitors will not even try to challenge the turf. An organism or firm can increase in size by forming permanent coalitions (mergers) or temporary ones (joint ventures, alliances) or by eating former comrades, the surrounding small or dying species or firms.

Chapter Four

Cooperation

4.1 Biological Systems: *Interspecies* Cooperation

How do species struggling for survival come to cooperate? How can species like yeasts do so, if they cannot look into the future or form intent? Biologists believe cooperative behaviors are selected for over many generations (perhaps millions of years), because they increase the fitness of the participating species. For example, a plant that uses yeasts to detoxify itself will be fitter in some environments and therefore leave more progeny. Over many generations, only that species of plant will thrive in that ecosystem.

Cooperation has been shown to emerge either spontaneously in a population of competitors or by the invasion of a new cooperating species. Experiments with computer simulations demonstrated that "players" who used a tit-for-tat strategy could gain the most points (become the most fit) over many "rounds" of play and that this strategy would spread to others, who saw that it would increase their own fitness.[1] This "game" consists of many iterations (generations) of the game developed by economists called The Prisoner's Dilemma, which Axelrod has described:

> The Prisoner's Dilemma is simply an abstract formulation of some very common and very interesting situations in which what is best for each person individually leads to mutual defection, whereas everyone would have been better off with mutual cooperation.[2]

Axelrod saw many examples of this strategy at work in nature and in business and it has been widely discussed in biological and economics literature.[3] He found four things that are necessary (but not necessarily sufficient) for cooperation to become established:

1. There is a good chance that individuals or species will come into contact with some frequency.
2. This contact will be for an indefinite period.

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[1]Robert Axelrod, *The Evolution of Cooperation* (N.Y.: Basic Books, 1984), 88-105.

[2]Ibid., 9. In the game two players have two choices, either cooperate or defect. The game is usually explained as a story about two prisoners arrested for committing a crime who are asked to testify against each other. If both agree to testify (that is, if both defect), both lose. If one agrees to testify in return for a reduced sentence, that player wins something but the other player loses. If both refuse to defect (that is, if they cooperate with each other), then both win, because the police will not have evidence to convict either. The complication is that at no time can the players communicate with each other.

[3]Robert E. Ricklefs, *Ecology*, , 2nd ed (N.Y.: W. H. Freeman, 1990), 617-637; Raghavendra Gadagkar, *Survival Strategies: Cooperation and Conflict in Animal Societies* (Cambridge, Mass.: Harvard University Press, 1997), 125-138; and Geoffrey M. Hodgson, *Economics and Evolution: Bringing Life Back to Economics* (Ann Arbor: University of Michigan Press, 1996), 210-211.

3. The individuals or species can recognize each other.
4. The individuals or species can "remember" what happened in the previous encounter.

Interspecies cooperation generally falls into two categories, *induced* and *reciprocal*.[4]

Induced cooperation, or parasitism, offers a benefit to the recipient but not to the giver. Givers are sometimes tricked into thinking they are acting for their own benefit. For example, European cuckoos and American cowbirds lay their eggs in the nests of other birds, which then raise baby cuckoos instead of their own young. But some birds cannot be fooled and will roll the cuckoo egg out of the nest. Induced cooperation lasts only as long as the inducement.

Reciprocal cooperation, also called mutualism or protocooperation, benefits members of both species. For example, among some birds and fish, "cleaning" behavior gives the "cleanor" food and removes parasites from the "cleanee." Birds of different species flock together during winter months for protection but separate into distinct territories again in the spring as they prepare to mate. Benefits may also occur at a chemical level. For example, some yeasts gain nutritional support from host plants by eating their waste products, while the host plants are detoxified of harmful chemicals produced when parts of them decay.[5]

Such reciprocal interactions between species (known as symbiosis) seem to occur only when members of two species are in frequent contact with one another. It can occur when the two species share a territory that concentrates their populations into an area where they come into contact frequently. Where groups mix only sporadically or infrequently, this kind of cooperative relationship cannot work, and parasitic or competitive relationships instead occur.[6] For example, ant colonies participate in many symbiotic relationships with other organisms occupying the same territory over long periods of time, while bumblebees (which have no permanent abodes) have no symbionts but do have several parasites.[7]

Even species that are symbionts may develop parasitic relationships when there is little possibility of a future relationship. For example, bacteria that exist in human beings to ordinarily beneficial effect can turn harmful if the body becomes sick or is injured.[8]

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[4]Christopher Badcock, *Evolution and Individual Behavior: An Introduction to Human Sociobiology* (Oxford, U.K., and Cambridge, Mass.: Basil Blackwell, 1991), 61-93.

[5]See, e.g., William T. Starmer and James C. Fogleman, "Coadaptation of Drosophila and Yeasts in Their Natural Habitat," *Journal of Chemical Ecology* **12**, 5 (1986), 1037-1055.

[6]Axelrod, 101-105.

[7]Edward O. Wilson, *The Insect Societies* (Cambridge, Mass.: Harvard University Press, 1971), 349-388.

[8]Axelrod, 101-105.

Analogously, research on human relationships indicates that frequent, honest communication between individuals is necessary for the formation of cooperative efforts, and cooperation, in turn, promotes frequent and honest communication.[9]

4.2 Economic Systems: *Interindustry* Cooperation

Like two species, two industries may evolve cooperative behavior when it serves to increase the fitness of both. It emerges in the presence of the four criteria identified by Axelrod: the industries are in frequent contact; the contact is for an indefinite period; they recognize each other; and they remember what happened in their last encounter. Cooperative behavior is more likely to emerge when there is great uncertainty about the future structure of the industry and when for one or both of them there are high sunk costs, which makes finding a new niche difficult in the short term.[10]

Obvious examples are supplier relationships (including production input and labor) and customer relationships. Business gurus of the late twentieth century have urged a greater emphasis on cooperation and the creation of interdependent "networks" or "environments" when industries have a reciprocal relationship, i.e., they exhibit behavior beneficial to all participants. Japanese *keiretsu* are regarded as role models in this respect: in *keiretsu,* all firms in a production process are organized for mutual aid and protection, with interlocking directorships around a central bank. In the United States in the late 1990s, high-technology firms began to form similar networks around venture capital companies, and communications firms developed several large interlocking networks.[11] In such cases, cooperation is caused by a desire to maximize their absolute gains and positions in relation to competitors. Even if they cannot be perfectly cooperative, e.g., compete for other resources, their activities can still be mutually beneficial if they exhibit Axelrod's criteria:

1. they believe they have a long-term relationship,
2. which brings them into frequent contact;
3. they recognize each other's agents or interests, or both; and
4. an institutional "memory" keeps track of cooperation and defection.

If the supplied resource is needed only occasionally, if the supplier does not have a long-term contract, if the supplier deals through a variety of distributors, or if the supplier deals with a variety of people or departments within a firm, no truly cooperative relationship will develop, and

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[9]David W Johnson and Roger T. Johnson, *Cooperation and Competition: Theory and Research* (Edina, Minn.: Interaction Book Co., 1989), 114.

[10]Franz Traxler and Brigitte Unger, "Governance, Economic Restructuring, and International Competitiveness," *Journal of Economics* **28**, 1 (1994), 1-23; and Ken Auletta, "The Next Corporate Order: American *Keiretzu*," 225-227.

[11]John Heilemann, "The Networker," *The New Yorker* (Aug. 11, 1997), 28-36.

instead a *parasitic* one might form. This outcome could include suppliers that take advantage of a high employee turnover by delivering poor quality or overpriced goods.

Without these minimum conditions, *induced* cooperation may occur, in which one side tricks the other into thinking it is acting in its best interest or offers the other species or firm or customer a different consideration to induce it temporarily to ignore its own interest. As in the natural world, such cooperation will last only as long as the inducement. When the other firm or customer knows it has been tricked, or when the supplier no longer receives above-market prices, it will do as self-interest dictates.

When trying to set up joint ventures or alliances between firms, the following appear necessary (although not in themselves sufficient) for real cooperation to emerge:

1. long-term commitment enforceable by both sides, usually by contract;
2. frequent contact, in which the parties must defect or cooperate (frequent meetings are not this kind of contact);
3. the parties recognize each other's agents and interests; and
4. staff that does not turn over so quickly that no one remembers the tit-for-tat.

But not all cooperation between industries is perceived as good. Sometimes cooperating with a supplier or a customer can put the competition out of business, as in exclusive dealing agreements, whereby suppliers of a critical resource refuse to deal with a new competitor. For example, Hollywood production firms could refuse to deal with telephony-based services in order to protect the broadcast, cable, and film industries; or, long-term, exclusive supply agreements with customers could mean competitors would have no opportunity to compete for business. Regulators may view both examples as serious restraints on trade.

Whether cooperation is seen as good or bad depends on the vantage point. Cooperation will always benefit those engaging in it (unless it is induced), but the firm or industry cooperation is used against may be put at a competitive disadvantage. As industries develop increasingly complex and international relationships, new webs of dependencies increase the difficulty—already considerable—of recognizing and enforcing politically cooperative behavior that may reduce the level of competition.

4.3 Biological Systems: *Intraspecies* Cooperation

Conscious cooperation is not possible unless animals have at least some ability to "learn," but other forms of intraspecies cooperation are observable. Because all individuals are thought to operate in their own best interests for reproductive success, behaviors that, at first glance, appear altruistic, i.e., surrendering reproduction (and even life itself) to benefit others, are hard to explain. Why does a prairie dog stand up to warn its neighbors of a predator, thereby calling attention to and endangering itself? Why do some insects (e.g., ants and honeybees) give up

reproduction in order instead to raise siblings? The sacrifice of the altruist increases the likelihood of its genes surviving because these are shared with other individuals that survive.[12] Such cooperation can be found fairly often in nature when individuals cluster in kinship groups, because individuals genetically related work to preserve their genetic material. Their contact is frequent enough that they can develop a tit-for-tat relationship.[13]

Cooperation is not always so dramatic. It may be as simple as the synchronization or asynchronization of signals sent to other members of the group. For example, many species use acoustic signals, such as can be heard in the massive "choruses" of birds and insects. Some species use bioluminescent signals to attract mates.[14]

Competition can evolve into cooperation in groups of individuals. Littermates often are fiercely competitive (as in human families), until a dominance hierarchy is established, but because they share, on average, 50 percent of their genes they also have a strong genetic reason to cooperate.[15] Cooperative behavior among brothers and sisters has been noted in many species.[16]

Many species also exhibit mutual restraint in competitive situations, as in a mutual stand down when a "fight to the death" would be too costly. Mutual restraint can be observed among wolves, apes, or even human beings. Perhaps the most dramatic and well-documented example in the human community occurred during the First World War when soldiers in the trenches of both sides stopped shooting to kill once it became clear neither could gain much ground by doing so, and mutual restraint could be enforced with a tit-for-tat strategy. For example, the side shelling outside the opposing trenches was rewarded by a similarly nonlethal bombardment from the other side.[17] Although this conduct may look like simultaneous cooperation and competition, it is really a mutual agreement to cease competition in a period of cooperation. As soon as one side was ordered by its commanders to begin lethal shelling, the other side responded in kind.

A more sophisticated form of cooperation is seen in the development of coalitions, i.e., when groups of individuals align themselves to deal with a danger or to exploit a resource more efficiently than one group could on its own. Coalition builders include primates, canids (dogs and wolves), lions, hyenas, and dolphins. Dolphins and human beings even form coalitions of

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[12]William D. Hamilton, "The Evolution of Altruistic Behavior," *American Naturalist* **97** (1963), 354-56.

[13]Ricklefs, 617-637.

[14]See Michael D. Greenfield, "Cooperation and Conflict in the Evolution of Signal Interactions," *Annual Review of Ecological Systems* **25** (1994), 97-126.

[15]William D. Hamilton, "The Genetic Theory of Social Behavior," *Journal of Theoretical Biology* **7** (1964), 1-52; also, Richard Dawkins, *The Selfish Gene* (N.Y. and Oxford: Oxford University Press, 1976).

[16]See, e.g., Edward O. Wilson, *Sociobiology: The New Synthesis*, 106-129.

[17]See Axelrod, 73-87.

coalitions. Human coalitions of coalitions can be seen in the development of the nation state and, more recently, in international industrial and military alliances.

Coalitions of males alone are rare and occur only among some primates (human beings, chimpanzees), dolphins, and canids. They can change almost instantly (as in the case of baboons) or endure for a lifetime (as in the case of chimps). Forming a coalition or group allows members to gain more of a scarce resource (such as food or safety) than the individual could on its own. For example, hunting or foraging in groups may yield more food for each member, and traveling or living in groups may increase protection from predators. But there may be a maximum size to a group that offers the individual more efficiency than going it alone. Put another way, if a resource must be shared among too many individuals, there may not be enough to sustain all of them.[18]

In each of these instances of cooperation, the individuals come in contact with one another frequently or even regularly. This contact allows cooperative behavior to evolve and to be sustained, because a tit-for-tat situation is created in which cooperation is rewarded and competitive behavior punished. In addition therefore to kin relationships, cooperative behavior may emerge from and be reinforced by other opportunities for reciprocity.

As in interspecies cooperative behavior, such as symbiosis, stability of contact among individuals appears crucial to maintaining the relationships, but stability may be affected by the individuals' life span and relative mobility.[19] A species with short individual life spans and high mobility, such as house flies, is unlikely to develop kinship groups or form other types of group identity from which cooperative behavior could emerge. On the other hand, chimpanzees, which have long life spans and relatively little mobility, have frequent contact in groups over long periods of time and therefore exhibit complex cooperative behavior, including kinship formation, altruism, and mutual restraint.

4.4 Economic Systems: *Intraindustry* Cooperation

Cooperation can emerge naturally, even within a system of economic competitors, and may even be predictable, as in the wave of vertical and horizontal business integration that occurred in the late twentieth century. An organism or organization will protect its own interests on its own so long as it gains more that way than if it were part of a group. This observation has long been recognized in economic literature. Rousseau offered the archetypal example of the stag hunt, where two hunters working together kill more meat than either could alone, and Adam Smith saw it simply as the rational choice of self-interested agents.[20] If a group can command more of a

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[18]Esa Ranta, Rita Hannu, and Kai Lindstrom, "Competition versus Cooperation: Success of Individuals Foraging Alone and in Groups," *The American Naturalist* **142**, 1 (1993), 42-58.

[19]Ibid., 93.

[20]For a broad discussion of this literature see, e.g., Herve Moulin, *Cooperative Microeconomics: A Game-Theoretic Introduction* (Princeton: Princeton University Press, 1995).

resource than individuals can alone, then cooperative behavior would be expected to be selected for over time, and, similarly, within an industry large firms would be expected to predominate over small ones.

In the real world, however, only a few organisms (or organizations) discover the best solution to a particular problem in acquiring resources. In species that can "learn," this best solution can then be spread by imitation. In human systems, cooperation does not require many generations to emerge but can do so in the short term, when two or more organizations follow a cooperative optimizing behavior, and other organizations learn from and imitate it. Sometimes a "critical mass" is required before the behavior is widely adopted.[21]

Cooperative *altruistic* behavior is rare in intraindustry interactions, because relationships there do not approximate kinship. Kinship relationships may develop within a firm, if the individuals perceive that their sacrifices can benefit their group (e.g., their children or other family members) and that their relationship to the firm might prove long enough for the benefit to accrue. This sort of relationship is not likely to be found in firms that execute frequent layoffs or one with which family members are not associated.

Group signaling (as in bird or insect choruses; see section **4.3**) is a common form of intraindustry cooperation engaged in to compete with a product or service that can be used as a substitute. For example, many industries, particularly commodity producers, form coalitions to promote their products through advertising.

Signaling can be used also within the group to reduce competition. A price increase by one firm may signal a desire for mutual restraint in a price war. If other firms respond with similar price increases, a tit-for-tat relationship may be initiated and become the basis for other cooperation. A fascinating example of signaling for mutual restraint was the cooperation between U.S. and Soviet naval forces to avoid collisions in times of high tension and close quarters. By using special signaling that announced present position and intent, the forces were able to avoid a competitive response.[22]

In business, cooperation might take the form of backing off from the use of overlapping customers and developing product niches that would act as mutually recognized territories. Geographic territories also might emerge in this way, but territories are not necessarily the product of intentional cooperation. They can evolve because competition is expensive, and when the customer a firm needs to fight for is an expensive one, the prize may not be worth the price.

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[21]See Geoffrey M. Hodgson, *Economics and Evolution: Bringing Life Back to Economics* (Ann Arbor: University of Michigan Press, 1996), 210-212.

[22]Robert Hilton, "Roles of the Joint Chiefs of Staff in Crisis Management," *Seminar on Command, Control, Communication, and Intelligence, Guest Presentations, Spring 1985* (Cambridge, Mass.: Harvard University Program on Information Resources Policy, April 1986, I-86-1).

The firm tends to want to sell more where competition is less, until, over time, it finds itself selling more to certain markets or in certain geographic areas.

Intentional cooperation is obvious in the formation of coalitions. Coalitions of competitors are formed to obtain a resource that none in the coalition can alone obtain or defend from a larger competitor which no single member of the coalition could tackle on its own. For example, two competitors might make a joint bid on a contract that is too large for either alone to fill, or they might band together to induce customers, through, say, bid-rigging, to pay higher than market rates. Competitors have been known to band together to get a better price for a commodity that all of them then use in their production process. Competing firms in an industry form coalitions to fight off another industry that threatens to take their customers or to fight government activities that threaten their resources. Perhaps the most visible form of intraindustry (and sometimes interindustry) cooperation in the late twentieth century was joint efforts in research and development. Joint R&D, which granted each participant access to the same technology, was said to be *precompetitive*. Participants then used the new technology to compete with one another on price, features, and service.[23]

All such coalitions will probably dissolve when individual members find that they can obtain more of the resource, suffer fewer government regulations, or achieve greater safety from a competing industry when going it alone.

It should be noted that the firms in such groups are not cooperating and competing at the same time for the same resource. The two modes are separated either by time or by the resource in question. Although much attention has been given to "networks" of small firms that are in the same industry and are expected to be intense competitors, these networks are designed to find areas where intraindustry competition can be set aside in order to facilitate competition with a much larger firm or a new industry by offering their customers a substitute product. This kind of cooperation generally takes the form of sharing technical information, combining political strength, coordinating purchasing to get a better price, and cooperating in advertising and common signage. But small firms that continue to compete on the basis of quality and price at the retail level seem to assume that the increased fitness of the group confronting a large rival will not decrease individual fitness of each competing against the others within the group.[24] This cooperation represents a sophisticated form of mutual restraint in a situation where an all-out contest would leave small firms vulnerable to the large one.

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[23]Norman S. Zimbel, *Cooperation Meets Competition: The Impact of Consortia for Precompetitive R&D in the Computer Industry 1982–92* (Cambridge, Mass.: Harvard University Program on Information Resources Policy, December 1992, P-92-10).

[24]See Brad Brown and John E. Butler, "Competitors as Allies: A Study of the Entrepreneurial Networks in the U.S. Wine Industry," *Journal of Small Business Management* (July 1995), 57-66.

In complex organisms, such as human beings, modes can change rapidly, depending on currently perceived interests. Rapid change of this kind was evident in the multifaceted relationship between the United States and the former Soviet Union in 1950–1992 regarding the exploration of space. At some moments the two powers competed, each wanting to be "first," while at others they cooperated, for example, to develop new systems and advance science. And sometimes they appeared to cooperate while simultaneously making plans for military uses of space.[25] Similar rapid shifts in mode can be seen in industry, when firms that usually compete form temporary or semi-permanent alliances in order to use a resource or to fight off a larger competitor; but these alliances never involve simultaneous cooperation and competition for the same resource.

All intraindustry cooperation appears to require Axelrod's four criteria for interindustry cooperation noted above (section **4.2**).

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[25]See, Matthew von Bencke, *The Politics of Space: The History of U.S.-Soviet/Russian Competition and Cooperation in Space* (Boulder, Colo.: Westview Press, 1997); for USSR's perspective on this competition and cooperation in space, see John D. H. Downing, "Cooperation and Competition in Satellite Communication: The Soviet Union," in *Tracing New Orbits: Cooperation and Competition in Global Satellite Development*, edited by Donna A. Demac (N.Y.: Columbia University Press, 1986).

Chapter Five

Competition and Cooperation: Visualizing the Relationships

Anyone accustomed to viewing competition and cooperation as two ends of a spectrum may find it difficult to see how one of them could *cause* the other. Given that a picture may be worth a thousand words, this chapter presents visual depictions of ideas discussed here. Each diagram shows a system, biological or business, in an initial state of approximate equilibrium, that is, its population of *operators (*organisms or businesses) and the availability of resources used by those operators are relatively stable. Then the system undergoes a change.

Figure 5-1 indicates a very simple system, with one group of operators (species or business) represented by boxes and the resources the operators use represented by Xs. A limit on the number of Xs—whatever the cause—acts as a ceiling on the number of boxes that the system can support, and the number of both Xs and boxes generally fluctuates within a narrow range. As the operators (boxes) compete with one another for resources (Xs), only the "fittest" among both survive into the next generation. The figure diagram illustrates intraspecies or intraindustry competition in approximate equilibrium.

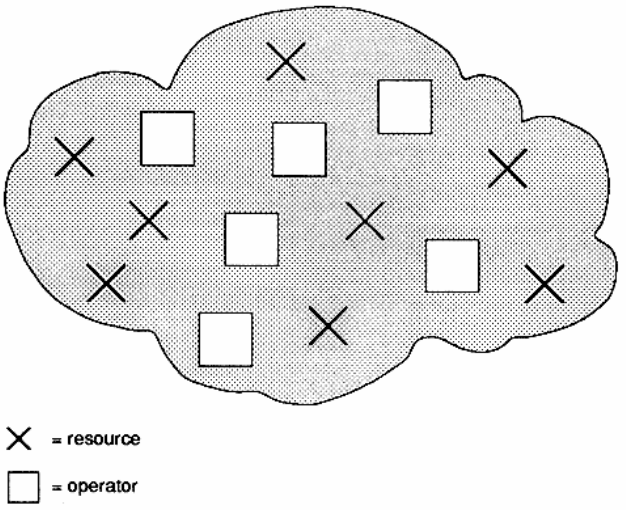

Figure 5-1
A Box and X System

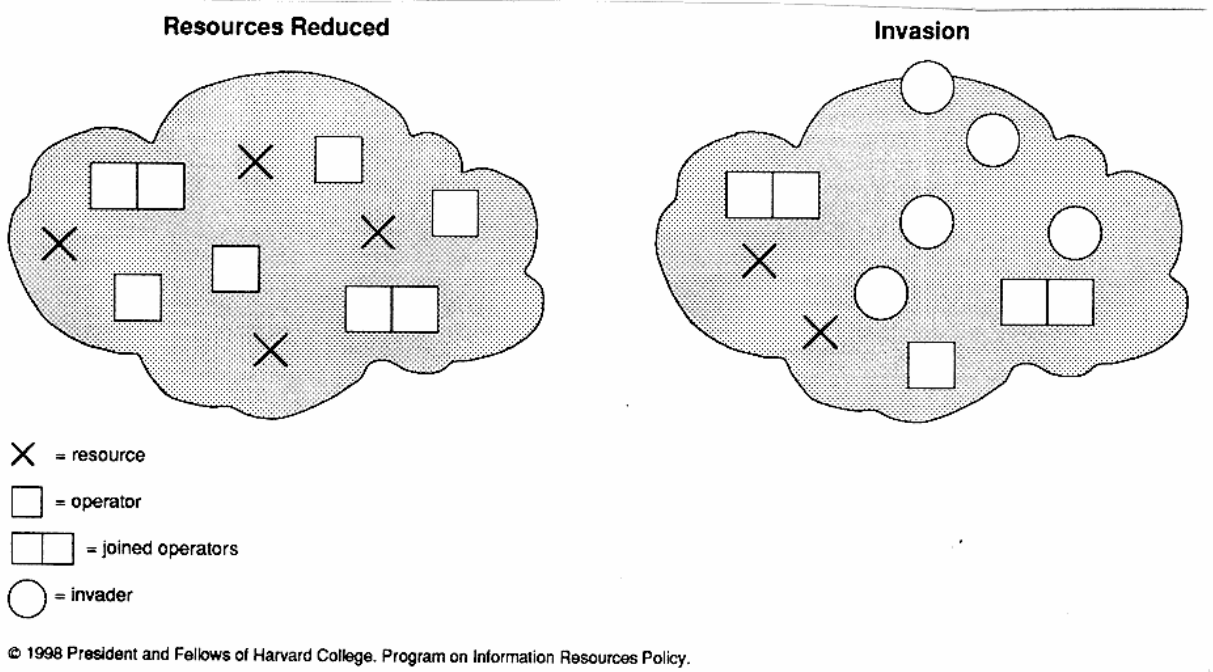

Figure 5-2

Effects of Reduced Resources and of Invasion of Turf

On the left in **Figure 5-2**, the number of Xs in the system has been significantly reduced and some boxes have joined together to gain an advantage over others in the competition for Xs. A reduction of a crucial resource has led to increased competition for the resource, leading to cooperation. A reduction of resources is not strictly necessary for cooperation to occur. Cooperation may occur whenever two (or more) boxes could gain more Xs by working together than by working alone.

But cooperation means that fewer boxes are competing in the system. Although there might be some way to make cooperation among boxes impossible, it would not increase the number of boxes that could survive. Reduced resources mean that the system can no longer support its formerly greater number of boxes. Another way to discourage cooperation might be to add Xs to the system or to encourage boxes to use some other resource than Xs.

On the right in **Figure 5-2**, the box and X system has been invaded by circles (which also use Xs), and the invasion has caused some boxes to cooperate in order to gain a competitive advantage over circles and other boxes. This diagram illustrates a change in interspecies or interindustry competition. It might be caused by an insufficiency of resources in the invader's old niche or by a new invader forcing the old one out of its niche. In the business world, an invasion might also be facilitated by a breakdown of regulatory barriers or the development of a new technology that now allows circles to make use of Xs.

To prevent boxes from cooperating, circles might be removed from the system (thereby reducing the competition for Xs). But just adding more Xs to the system would not reduce competition between boxes and circles if both must rely exclusively on Xs to survive—here, the competitive exclusion principle comes into play, and, over time, either boxes or circles, but not both, would survive. For both boxes and circles to survive, one of them, at least, would need to use another resource to satisfy some portion of its needs.

Figure 5-3 shows the box and X system with the scarce resource X allocated by territory, rather than in the equilibrium shown in **Figure 5-2**. For each box there is a specific turf in which it uses Xs. To use another box's Xs a box needs to oust the incumbent from its turf. This situation mirrors biological systems such as animal territories. In business, it indicates an intraindustry system that may have been designed to function on a territorial basis (e.g., telephone monopolies) or one that evolved into that form (e.g., daily newspapers in most communities). The diagram also illustrates an intraindustry territorial system divided by type of customer (e.g., high-end or low-end, business or residential).

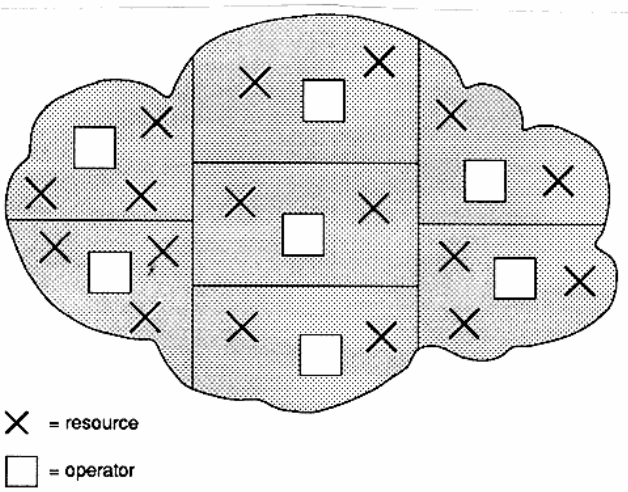

Figure 5-3
Territorial Allocation of the Resource

On the left in **Figure 5-4** a reduced number of Xs causes two boxes to combine turf, which may enable them to use Xs more efficiently, to defend their combined turf better, or to invade now smaller neighboring turf. On the right in **Figure 5-4**, the original territorial system (shown in **Figure 3-1**) is invaded by a circle, and two neighboring boxes join to compete against the invader.

One way to prevent mergers of turf by boxes might be by making sure they could not communicate across the boundaries of turf or by building walls at those boundaries which they

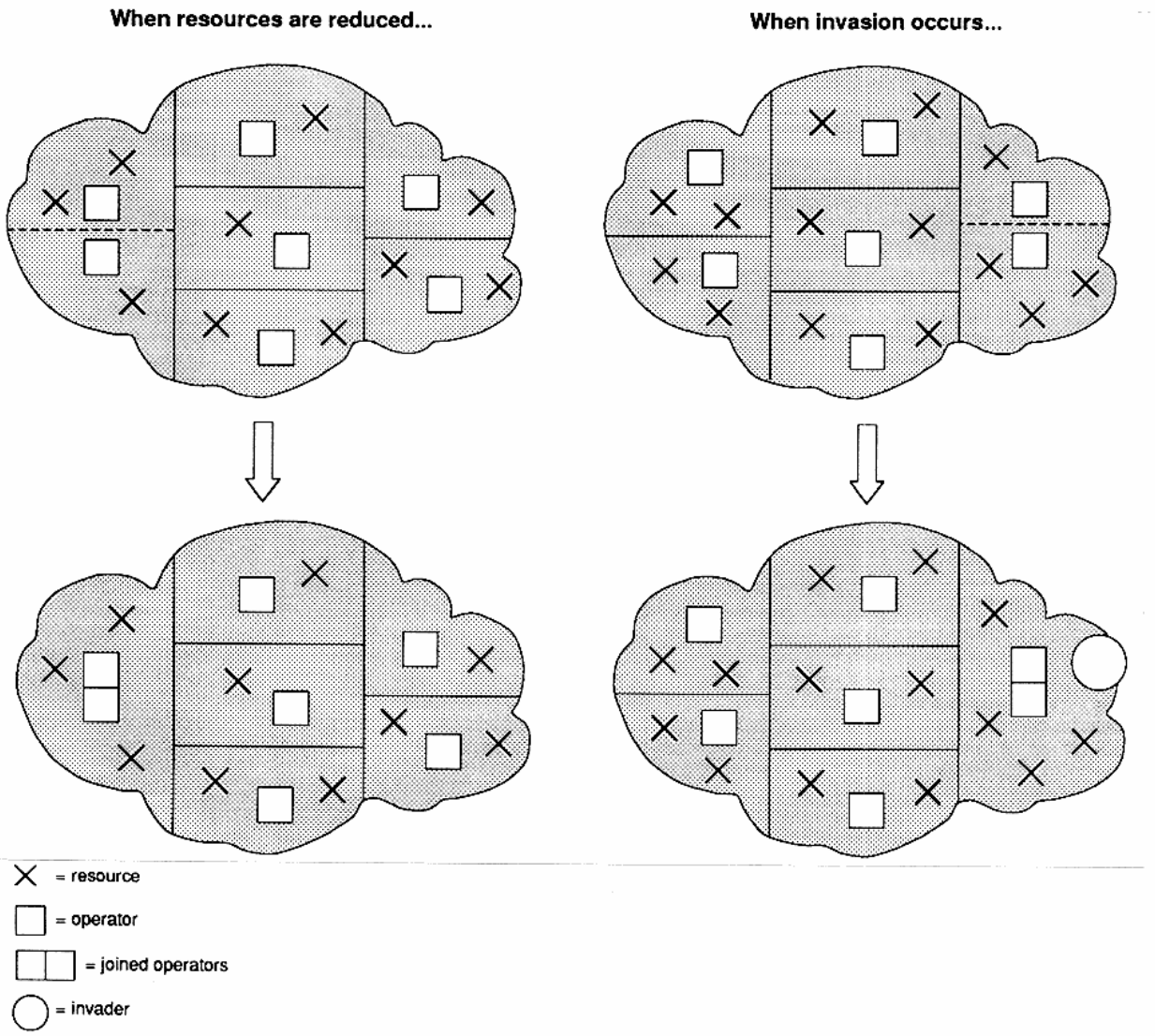

Figure 5-4

Combining Turf as a Response to Reduced Resources or Invasion

could not remove. Both moves would leave the boxes vulnerable to invasion by circles. Another option might be to make sure that circles have enough Xs within their turf so they do not need to invade the territories of others.

Figure 5-5 shows the original, simple system of boxes and Xs invaded by a single very large box (rather than by circles roughly the same size as the original boxes) or operator. Some of the boxes respond by banding together to compete with the giant invader.

To prevent cooperation among the smaller boxes, the big box would be kept entirely out of the system. Were the smaller boxes forced to compete at their current size, they would almost

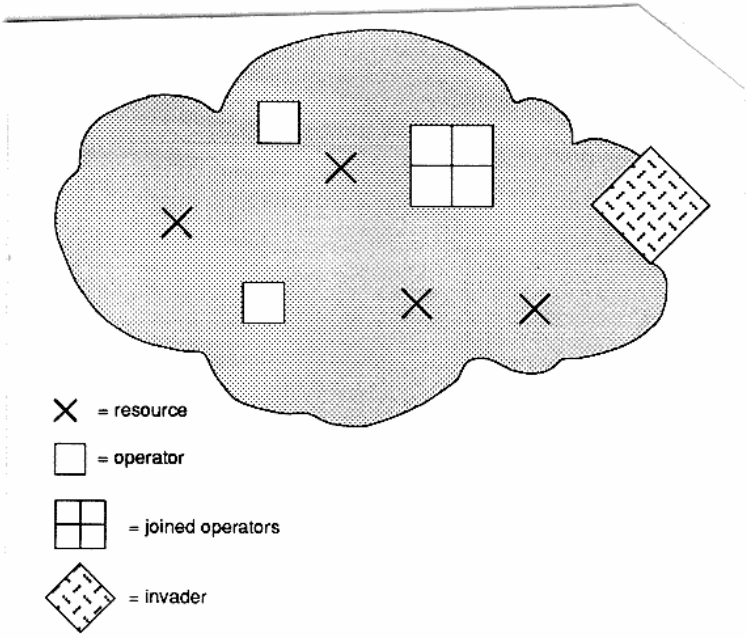

Figure 5-5

Invasion by a Large Operator

certainly perish at the hands of the large box and the system would be left with only one large box. This diagram illustrates a real dilemma for regulators in many sectors of the economy: they want to keep the boxes competing (for various economic and political reasons), but if mergers are forbidden to them, they will fall prey to a large invader, perhaps from another country, now entering the territory under the rules of the General Agreement on Tariffs and Trade (GATT; 1994).

Chapter Six

Implications for Regulation of Competition and Cooperation

6.1 The Role of Government

Some economists and business leaders have occasionally asserted that competition and cooperation are natural processes, and therefore governments should not interfere with the natural selection of industry. It is difficult, however, to foresee a time when the industrial sectors of all countries would actually allow complete noninterference, because it would make many industries forgo protection from competition that they receive and rely on from government.

Contrary to the views expressed by many policymakers, competition does not necessarily increase the fitness of a firm or industry. It is expensive, and it takes energy away from gathering resources and preparing for the long term. In the short term, firms and industries can thus be expected to attempt to avoid competition. But in the long term, some competition seems necessary to keep a firm or industry from settling into an equilibrium from which its stakeholders will not allow it to break free when new competitors appear.

The real winners of a competitive *contest* in the short to medium term are those peripheral to the competitors—that is, customers or suppliers—because *they* will be a scarce resource which must be paid for out of funds that otherwise would have been used for long-term activities and stockholder equity. Customers and suppliers are also potent political forces in most democracies (especially customers for consumer goods) and will have a large say in how much effort government puts into forcing competition that will benefit them.

Thus, asking whether antitrust laws or ownership limits should be employed to stimulate competition is almost a purely academic question. They will be. Making these laws do what policymakers want them to is a different matter. The ideas from biology used here offer guidance for subtle course corrections that may be necessary in the twenty-first century. The implication here is that some of the basic assumptions of antitrust law need to be reexamined. For example, the definition of "market" should be expanded to take into account all the operators that use a scarce resource (e.g., the time and money of consumers of a particular type of service or product) in order to determine the probable rate of survival of all the operators in the system. The "entertainment" market would then include film, video, TV, cable, satellite, print, and all other industries that compete for consumers' entertainment time and money.

Biological principles may also be applied in the continuing debate on what constitutes a "market" where competition occurs. If two species or industries try to use the same resource, it is interspecies or interindustry competition and the results will be different from in intraspecies or intraindustry competition; even though in both instances competition occurs in the same system

or market. Markets can therefore be thought of as similar to ecosystems, which may be local or large and may have only a few species or a whole variety of them competing for resources.

A recurring policy debate in many nations centers on the definition of "competition."[1] Does it only mean an actual *contest* between two or more firms for customers? Or does the meaning include situations in which a contest is only theoretically possible ("contestable markets")[2] if government restraints and other barriers to entry are removed? Often it does not take into account the subtle (but often crucial) competition that resembles the scramble (see section **2.1**), when competitors weaken one another by using up critical resources. Although biologists do not have one single definition of competition, most would include the following: (1) an interaction or active demand (2) for a shared requirement (3) that is a scarce resource, (4) leading to a reduction in the survival of one group of competitors. The fourth requirement is the most debatable: does competition require *losers*? Would that mean that real competition is only a fleeting loss of equilibrium until the losers are pushed out according to the competitive exclusion principle (discussed in **Chapter Three**)? Perhaps governments should focus their energies on finding ways to foster a stable competitive situation in which only a part of an industry's resources would be contested, thus making the survival of all contestants more likely.

6.2 Forcing Competition within Industries

The more two firms look like each other (that is, use the same resources), the more each will defend its territory. But because competition is expensive and deprives both firms of resources they need to increase their value to shareholders (their fitness), they may be inclined to do what biological species do—allocate the resource in question by cooperation, rather than competition. They might do the following:

- use cooperation to divide the turf (territory, customers) by "signaling" or avoiding overlapping customers; or
- starve out a new competitor by agreeing between themselves to deny it access to critical resources (e.g., programming); or
- engage in "spite" by lowering the fitness of all competitors until the new competitor dies or leaves the battle (predatory pricing).

Regulators are not always concerned about (or aware of) "spite" phenomena at the intraindustry level, even when undertaken intentionally. A group of established firms may do something that decreases the fitness of all firms (such as put a supplier out of business) if the

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[1]For a discussion of this debate in the telecommunications industry, see, Alexander C. Larson, "An Economic Guide to Competitive Standards in Telecommunication Regulation," *CommLaw Conspectus: Journal of Communications Law and Policy* (1993 ed.), 31-55.

[2]See William J. Baumal, *Contestable Markets and the Theory of Industry Structure* (N.Y.: Harcourt Brace Jovanovich, 1982).

decrease in fitness would hurt the new competitor more than themselves because the new competitor may depend on that supplier for a greater percentage of its total resources. Regulators seeking to maintain competition may want to be careful in regulating all players of an industry (or of several competing industries) in the same way in cases where that would disproportionately decrease (or increase) fitness.

Regulators concerned about competition for consumer (i.e., household) services may want to consider that *contests* over territories occur only where a resource occurs in concentrations sufficiently large to make them worthwhile to defend. Telephone and cable companies are finding individual households extremely expensive to hang on to, and business services are more likely to be the locus of intense competition unless households can find a way to aggregate their demand in order to attract the competitors.

6.3 Forcing Competition among Industries

Attempts to increase or maintain competition among industries will also benefit from consideration of biological principles regarding diversity and niche stability. Competition should be more prevalent where resources are declining and change is taking place rapidly. Niche development is more likely when there is change in the environment and new opportunities are opening up, but niches will become stable only if and when the environment settles down again. Turbulence in a system may lead to adaptation by (or extinction of) incumbent players as they search for new resources, but this adaptive phase would probably be short-lived, lasting only until a new equilibrium is reached.

Thus, although there may be increased competition in an environment of rapid technological or regulatory change (e.g., telecommunications, broadcasting), the competition may last only until "winners" become apparent and systems again settle down. An industry losing resources to other industries (e.g., radio, newspapers) would not be expected to compete on an intraindustry level but, instead, would cooperate to fend off the new competition that threatens the entire group. In a stable environment, however, more aggressive competition would be expected within an industry, not between industries.

Biological concepts also indicate that some of the best strategies for increasing or maintaining competition between industries include making sure that cooperation (discussed in **Chapter Four**) does not exist. These strategies would assure the following:

- that sufficient resources are available for the competitors (long-term competition),
- that it is possible for one industry to invade the turf of another (short-term competition),
- that long-term agreements are discouraged by law or tax penalties,
- that contact between industries is infrequent, and

- that very little "information" (e.g., product development or interoperability) is exchanged among industries.

6.4 Mergers and Acquisitions

Another similarity to biology bears discussion in regulatory debates: When two industries rely on the same limited resource (e.g., the same customers for the same type of product), chances are better that both will survive if neither overlaps relies on this resource 100 percent. If both use the resource exclusively and one gets to use more than the other, the principle of competitive exclusion may come into play and, over time, one industry will either go extinct (e.g., evening newspapers) or leave the market in search of other customers for its product (e.g., firms seeking growth outside their country of origin). Mergers and acquisitions may be the only option other than extinction for some firms.

When attempting to determine the level of competition a firm or industry faces, thus the acceptability of a merger or acquisition, regulators should not ignore competition in the form of the scramble (i.e., critical resources are used up by another firm or industry that may not be in a direct or immediate contest). An industry or firm losing some resource in a *scramble* may become too weak to survive a *contest* and, to survive, may need to engage in cooperative activities.

Regulators may also take comfort from the knowledge that there is a limit on how large an organization or association can get. It will only hold together if on average the participants receive more than they would have by going it alone. If it cannot locate sufficient resources for all divisions of the firm, then it may break down into smaller firms.

6.5 Forcing Cooperation with Competitors

One fundamental proposition of biology important for business regulation is that no two individuals or species can cooperate and compete over the same resource at the same time. Competition and cooperation are different modes of action and cannot be undertaken simultaneously. Even the business consultant-cum-authors of the late 1990s who counseled companies to find ways to cooperate did not say to do so with competitors over the same resource. Instead, they urged cooperation with suppliers, customers, and competitors when these did not involve some resource both needed to survive.[3]

This proposition has important implications for regulations that demand that firms allow new firms access to their facilities (that is, to cooperate) so that the new firms can compete with them for customers. For example, phone companies are asked to offer competitors access to their infrastructure (not an unlimited resource) at prices that will allow a new competitor to offer

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[3]See, e.g., James F. Moore, *The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems* (N.Y.: Harper Collins, 1996); and Adam M. Brandenburger and Barry J. Nalebuff, *Co-opetition* (N.Y.: Doubleday, 1996).

service at or below the incumbent's price. A similar problem is presented by regulations mandating access to the wiring of multichannel service providers in apartment buildings for competing cable and satellite providers. This type of regulation has proved extremely difficult and may be attempting the impossible. When firms must cooperate with respect to a scarce resource, allocation of that resource by competition may not be possible. It may be necessary to create a third party, such as a board or agency, to allocate access to the network, or resource. This resolution would limit the competitive behavior that interfere with the cooperation necessary to keep the system working.

Regulators will also want to support policies that encourage the four pillars of cooperation identified by Axelrod:

1. A long-term commitment enforceable by both sides, usually by contract. This might include programs to improve the settlement of disputes outside the court system.

2. Frequent contact, in which the parties must either defect or cooperate (frequent meetings are not enough). Contracts with frequent "transactions" might get special tax considerations.

3. The parties know who is really empowered and what is really needed by both sides.

4. Staff does not turn over so quickly that no one can remember who gave tit for tat.[4]

Cooperation may also be induced by government policies that make it possible for both sides to get what they could not get without cooperation. Tax credits, pollution credits, zoning variances, and access to government-owned rights of way are just a few types of inducement. But this kind of cooperation is only as good as the inducement. If competitors no longer need access to rights-of-way because wireless technology overcomes the need, cooperation will vanish. Further, an inducement will be ineffective if it cannot be delivered, especially if the inducement is a threat of criminal or other legal action and such actions would prove so costly that governments would be unlikely to bring many of them.

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[4]See Axelrod, passim.

Glossary of Biological Terms Applied to Business

adaptation	Any heritable characteristic (i.e., that which comes with the firm when sold or when management changes) that increases or decreases the fitness of the firm or industry (of similar firms) in a given economic environment.
competition	"[A]n interaction between individuals, brought about by a shared requirement for a resource in limited supply, and leading to a reduction in the survivorship, growth and/or reproduction of the competing individuals concerned" (Begon, Harper, and Townsend, *Ecology: Individuals, Populations, and Communities,* 2nd ed., 1990).
contest (interference)	Competition in which an industry or individual firm responds directly to attempts to displace it or to appropriate a resource it uses; individuals interact directly to prevent another from using a resource, as in plants that "overgrow" their neighbors to take more sunlight or animals that defend territories from others of the same species.
cooperation	"True" cooperation (where the survival of both parties may depend on it) is generally allowed by regulators when two firms or industries find themselves in a position in which one will become extinct without cooperation in sharing or dividing resources.
ecology	The study of the "economy of nature," to explain, in general terms, the origins and mechanisms of interactions of individuals with one another and with the nonliving world (coined 1866).
environment	All the forces that have an impact on the industry: government, suppliers, customers, and macro economic forces, such as inflation and interest rates.
fitness	The ability of an industry (actually, its individual firms) to leave more progeny (i.e., more equity or return for shareholders) over time, thus a measure of success in the long term; fitness changes over time, particularly during rapid change in an industry's environment (e.g., new regulation, new technology, etc.).
induced cooperation	Offers a benefit to the recipient but not to the giver: one side tricks the other into thinking it is acting in its best interest or offers the other firm or customer a different consideration to induce it temporarily to ignore its own interest;as in the natural world, such cooperation will last only as long as the inducement; also known as parasitism.
interindustry competition	Usually involves only a part of the resources required by two industries (e.g., customers), i.e., each industry will have other sources; only part of the niche of each industry will overlap with that of the other in the area in which they compete.

intraindustry cooperation	Two firms may evolve cooperative behavior when it serves to increase the fitness of both; emerges in the presence of Axelrod's four criteria: the industries are in frequent contact; the contact is for an indefinite period; they recognize each other; and they remember what happened in their last encounter (Axelrod, *The Evolution of Cooperation*, 1984).
intraindustry competition	More intense than interindustry because individuals in the population have similar requirements for survival (Begon, Harper, and Townsend, 1990); in business, takes place between firms that look alike, e.g., between telephone companies or between television networks; can act to control the population of firms in an industry.
mutualism	In business, contracts in which both parties (theoretically) receive a benefit; may be illegal activity if two firms get together to divide territories: both receive a net benefit and neither needs to compete anymore with the other.
natural selection	The survival of firms with the highest fitness; leads to improvements in an industry over time, because it represents adaptation to change in the environment; can sometimes lead to a suboptimal, even disastrous, outcome if the environment continues to change rapidly.
predation	For example, predatory pricing to "starve" the competitor or buying a competitor with the intent of shooting it in the head.
protocooperation	Benefits cooperating firms or industries but not critical to survival; can be observed in joint ventures and "alliances," common in the 1990s.
scarcity	Generally in telecommunications, scarcity of channel capacity, and a theoretical underpinning for allocation of access to channels by government; here also consumers of communications products and services.
scramble (exploitation)	Competition that occurs when an industry or firm uses up resources to the detriment of other industries or firms without a direct response from those disadvantaged.
sociobiology	Field of study that applies ecological ideas to human activities.
species/industry	A group of firms that share many institutional and technological characteristics, compete for the same resources (both production inputs and customers), and can be expected to respond similarly to changes in the environment.
territory	Geographic, customer, or a resource niche.

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