

Towards a universal theory of competition and selection

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1 Introduction

Competition plays a major role in several different fields of study, most notably in the theory of market economy and in the Darwinian or Neo-Darwinian theory of evolution.

The present paper - inspired by the Darwin year 2009 - is an attempt to find similarities between different kinds of competition in very different fields. Competition is found everywhere in modern life. Athletes are competing for medals, sellers of all kinds of products are competing for our money, politicians are competing for our votes, evangelizers of different denominations are competing for our souls, TV stations are competing for our eyes and ears, and different advocacy groups are competing for our attention.

Do all these different kinds of competition have anything in common? Do they all lead to some kind of optimal equilibrium between supply and demand, in the way that economic competition does according to traditional economic theory? Do they lead to some kind of evolution towards increased adaptation in the way that the competitive struggle for survival does in Darwinian theory? Competition has created wonders in biological evolution, in cultural evolution, in economic markets and in many other fields. Competition has also caused pain and suffering. An untold number of creatures have suffered immense pain everywhere in nature from the cruelty of competition between egoistic organisms. Egoistic competition has given rise to unbelievable amounts of cynicism, brutality, war and suffering throughout human history.

A general overview of the possible outcomes of competition can hopefully help us decide when competition is good or bad for our society, when it has undesired consequences, when intervention or regulation is needed, and what consequences such intervention may have.

In chapter 2 of this paper I will list many of the different spheres of life where competition plays an important role. Chapter 3 is a brief discussion of different models and an explanation of differences between evolutionary and non-evolutionary models of competition. Chapter 4 gives an overview of many different possible outcomes and consequences of competition in relation to the different fields of competition. Chapter 5 concludes with a discussion of possible applications of this theory to improve our understanding of the dynamics in modern society.

This paper is based on concepts and ideas from many different fields of study and many different scientific schools of thought. I cannot assume that the reader is familiar with the terms and concepts used in all these disciplines. Terms that may be unfamiliar are briefly explained in the glossary on page 23. It is recommended to seek further information on unfamiliar concepts in a science library or on the web. I have not found it wise to recommend any particular textbooks in the list of references. I am sure that a reader who is unfamiliar with the theory of, for example, market economy or population genetics will be able to find a suitable textbook on that subject in a library or a university bookstore.

2 Fields of competition

2.1 Biological evolution

The traditional Darwinian model of evolution assumes that individual organisms are struggling for survival. There may be competition for food, competition for territories, competition for mates or competition for any other resources. The winners in this competition will multiply while the losers produce less offspring or no offspring at all. The result of this process through many generations is what we call evolution. The Darwinian model says that evolution can take place when three elements are present: variation, selection and reproduction.

Evolutionary biologists have found many different mechanisms of evolution with different degrees of complexity. What all these mechanisms have in common is variation, selection and inheritance. The details can be found in any textbook on evolutionary biology or population genetics.

2.2 Memetic evolution

Traits that are transmitted by cultural inheritance rather than by genes can be the basis of a similar selection process. This is called cultural evolution or cultural selection. The study of the selection of cultural traits is also called memetics.

For example, there can be a competition between different scientific theories. The theory that best explains the observations is likely to gain wider acceptance than other theories. Ideas, beliefs, skills, cooking recipes, fashion fads, urban legends, rumors, jokes and chain letters are all examples of pieces of information that can be selected, transmitted and spread to multiple persons according to the principles of memetics.

Certain ideas are mutually exclusive. For example, the belief that the Earth is flat and the belief that the Earth is round are mutually exclusive. Therefore, there is competition between different beliefs about the shape of the Earth. There is less competition in other areas of memetics. For example, a person can master multiple skills, know multiple cooking recipes and tell multiple jokes. However, there is a limit to how many jokes a person can tell before the listeners get tired. In this sense there is still competition between the jokes.

While genes are transmitted only from parent to child, memes can be transmitted from any person to any other person with whom he or she communicates. Memes can be selected by many different mechanisms and many different criteria. These mechanisms and criteria are explained in books about memetics and cultural selection³.

2.3 Cultural dynamics

Memetics is not a complete model of cultural evolution. Many aspects of cultural change don't fit well into the framework of memetics. Consider the example that country A is capturing a piece of land from country B in war. Country A grows bigger and B gets smaller. This change is quantitative rather than qualitative. The piece of land that changes owner may be rich in natural resources but have no inhabitants. In this case there is no person who changes the meme of nationality from B to A. Therefore, this example doesn't fit into the framework of memetics, but it is nevertheless a process where competition and selection leads to cultural change.

There are many areas of culture where changes can be seen as quantitative rather than qualitative. Market economy (see below) is an obvious example. Many changes in social structure and culture are driven by competitions of power and influence between different social classes, between different economic, political or religious interest groups, and between different mass media and opinion makers. These competition processes are typically dynamic in nature with many feedback paths. The appropriate models of dynamic systems with feedback may be analogous to dynamic systems in physics, electronics and cybernetics. Only if such a system fluctuates to one of its extremes do we have a qualitative change.

Cultural dynamics is not a well-defined discipline, and the term may in fact be somewhat misleading since some scholars using this term reject complex models of cause and effect. An alternative name for this area of study is sociocybernetics.

The disciplines of memetics and cultural dynamics or sociocybernetics may be subsumed under the umbrella of "cultural selection" or "cultural change"³.

2.4 Market economy

Economic competition where sellers compete for buyers in a free market is probably the most well known form of competition in modern society. The different kinds of economic competition have been studied so extensively that it makes no sense to summarize it here. The reader is referred to any textbook on market economics.

2.5 Economic competition between jurisdictions

Local administrations or municipalities compete for attracting wealthy taxpayers and keeping poor people out.

Countries are competing with each other to export products, to attract profitable businesses, and to attract workers with the best education. For example, a country may lower corporate taxes and lower minimum wages in order to attract firms that might otherwise be established in some other country.

2.6 Evolutionary economics

Where economic competition between firms or between countries resembles the models that I have termed "cultural dynamics" above, there is also a branch of economics that uses the evolutionary models of memetics. The discipline of evolutionary economics deals with the evolution of new products based on innovation and learning from experience. Firms that have invented a successful product or a successful business strategy are copied by others, while the unsuccessful firms perish or change their strategy. This model contains the three fundamental elements that are necessary for evolution to take place: variation, selection and reproduction.

2.7 Democratic competition

Democratic election is an important form of competition with a strong influence on modern society. Political candidates, parties or ideologies are competing for votes, and the degree of influence on the social structure depends on the number of votes. These processes are studied in several disciplines, including political science, political psychology, public choice theory and media effects theory.

2.8 Competition for attention

The modern urban environment is crowded with information, messages and sense impressions. There are traffic signs, neon lights, advertisements, political posters, public information posters, bulletin boards, shop windows, street vendors, exhibitions, street art, beggars, charity collectors, evangelizers, church bells and many other sources of information bombarding our senses. Inside our homes, the radio, TV, newspapers, magazines and Internet are equally crowded with information. There is so much information everywhere that it is impossible to pay attention to it all.

Catching people's attention is the key to changing consumer choices, political opinions, beliefs, life styles and social behavior. Public attention has therefore become one of the most precious and contended resources in modern society. Commercial advertisers, political opinion makers, government organizations, NGO's, religious preachers, artists and many others are competing for a limited amount of advertising space and TV airtime. Likewise, lobbyists of all kinds are competing for the attention of politicians. The competition for attention is so tough that an impressive amount of inventiveness is being applied for finding new places to advertise and new ways of catching our attention.

It is obvious that the outcome of the competition for attention has far-reaching consequences for the way our society works and develops; yet this competition is a highly neglected field of study.

2.9 Mass media competition

TV stations compete for viewers, radio stations compete for listeners, newspapers compete for readers and they all compete for advertisers. I have included mass media competition here as a separate category for several reasons. The mass media do not necessarily sell anything to their audience. In many cases they get most or all of their revenue from advertisers. What these media are selling, from a purely economic point of view, is not news or entertainment, but advertising space. The TV stations are not selling programs to their viewers; they are selling the viewers' eyes to the advertisers. We have a *dual market* situation here. The media compete for viewers *and* they compete for advertisers. The satisfaction of the viewers and the delivery of good quality programs is not a primary goal of commercial TV stations, but a means for attracting viewers to the commercial breaks. If viewers can be attracted with biased or poorly researched news and cheap entertainment then so be it. If advertisers prefer programs that bring the viewers into a *buying mood* rather than thorough investigating journalism and controversial debates, then this is what we get. The competition for advertisers has far-reaching consequences in a democracy if citizens base their voting decisions on insufficient or distorted information, but this is irrelevant to the economic decisions of the commercial media producers⁶.

2.10 Competition for social status and prestige

People compete for social status, prestige and popularity, for example by wearing expensive clothes and jewelry, driving big cars, joining prestigious clubs, mingling with celebrities, etc.

2.11 Court cases

The two parts in a legal conflict compete on legal arguments and on the production of evidence.

2.12 War

International war is the ultimate manifestation of competition between countries. The competition is based on who has the biggest army, the highest military discipline and morale, the most advanced weapon technology, the most powerful allies, etc. Civil war is a violent competition between different factions within a country.

2.13 Sport and games

Sport and games is organized competition. The purpose may be entertainment and excitement. It may be a struggle for prestige. It may be a reflection of other forms of competition elsewhere in social life. Or it may be a way of motivating physical or mental training.

2.14 Negotiation

Negotiation is often an alternative to other more costly forms of competition. The outcome of the game of negotiation depends on strategic knowledge as well as on elements of power. This power is typically derived from the threat of not negotiating.

Consider the situation where two countries are competing for a piece of land. They can compete either by war or by negotiation. Negotiation is initially preferred because it is less costly than a war. However, it would be advantageous for one country to leave the negotiation and turn to war if it can gain a larger piece of the contested territory by war than by negotiation and if the value of the extra land that can be gained exceeds the cost of engaging in war. If both countries are willing to use the threat of war as a power element in the negotiation then the result of the negotiation must be within the range of possible outcomes where it is not advantageous for any of the competitors to turn to war. The higher the cost of war the larger is the range of possible outcomes where it is not advantageous for any of the contestants to turn to war. Within this range, the outcome of the game is determined by several other factors, as described in textbooks on negotiation theory.

Negotiation can be an alternative to other power games as well, such as lawsuits, strike, lockout, boycott, or defamation in the mass media. In all these cases, the threat of not negotiating is a power element that can be used by either competitor to make sure the outcome of the negotiation is within the range where it is not advantageous for any of the competitors to leave the negotiation and turn to another power game.

3 Models of competition

In this chapter, I will outline the fundamental concepts that we need for describing different fields of competition, or *games*, as we may metaphorically call it. I will not bother the reader with a strict mathematical formalism because this will only obscure the qualitative understanding of concepts that are often intuitively clear. Such formalism can be found in the literature within each of the different fields of study, such as game theory, population genetics, life history theory, reproductive strategy theory, ecology, cultural evolution, market economics, evolutionary economics, etc.

3.1 Evolutionary systems

Evolutionary models are based on discrete information units subject to the three elements: variation, selection and reproduction. The information units can be genes or memes, giving rise to biological evolution or memetic evolution, respectively. The selection process is a result of competition between alternative genes or memes. Random drift may play a significant role besides systematic selection, but the presence of drift is not necessary for a system to be evolutionary.

The evolutionary processes can be mimicked in computers to create what is called artificial life. Analogous principles are used for solving difficult optimization problems in mathematics in the so-called evolutionary computation method.

3.2 Dynamic systems with feedback

Dynamic systems are based on quantitative, rather than qualitative, changes. A dynamic system can involve competition between different forces pulling the system in different directions. Dynamic systems often have feedback, which can be positive or negative. Dynamic systems can be useful models of, e.g., cultural dynamics, market economy, democracy, competition for attention, social prestige, and war.

3.3 Competition-only systems

Athletic games are systems where the competition itself is the most important aspect, while dynamic or feedback elements are absent or less important.

3.4 Complex systems

Isolated systems with only one parameter of competition are rare. In most cases there are multiple systems with different kinds of competition and selection interacting with each other.

In biological systems, we can have multi-level selection, kin selection, reciprocal selection, sexual selection, coevolution of predator and prey, coevolution of parasite and host, coevolution of two species in symbiosis, coevolution of genes and culture, etc.

In economic systems, we have agents that participate in more than one market. Firms compete on the product market as sellers and on the labor market as buyers. The workers do the opposite. Mass media compete for audience as well as for advertisers.

In social and cultural systems, we often have multi-level selection as well as interaction between many different fields of competition and selection. The coupling between different fields of competition and selection forms a big and very complex network with many feedback paths. The identification and analysis of the most important causal pathways in this system is the key to improve our understanding of the dynamics of the complex society we are living in.

3.5 The roles in the game

A field of competition or a game has certain roles. The most important roles can be generalized as follows:

Competitors. In an economic market, the sellers are usually considered the competitors, but the buyers may as well compete if the demand exceeds the supply. A good example is an auction. In evolution, the competitors may be individual organisms competing over food, territories, mates or any other limited resource. Theorists often prefer to see the

genes as the true competitors, while the organisms carrying the genes are seen as products of the genes.

The *contested resource*. In an economic market where supply is higher than demand, the sellers are competing for buyers. In this case the buyers constitute the contested resource. In sport the contested resource is perhaps a medal. In evolution, the contested resource may be food.

Beneficiaries. The contested resource may be persons, companies or living organisms and these may benefit from the competition. Where sellers compete for buyers, the buyers benefit from the fact that the competition is likely to lead to higher quality and lower prices. Where buyers compete for sellers, the sellers benefit from higher prices and lower quality.

Victims. The persons, companies or living organisms that are contested may be harmed by the competition. For example, the prey animals in a competition for food.

Judges. Athletic games have a separate role for judges. In other cases, the judges may be the same as the beneficiaries. For example in a market, the buyers are the judges of which product they prefer. In evolution, there are no judges other than the laws of nature.

The *rule definers* and *regulators*. In economic markets, the rules are defined by politicians and governments. In war, the rules may be defined by international organizations or by religious authorities, or there may be no rules at all. In evolution, the rules are the laws of nature.

Affected *others*. Where firms compete for customers, the workers in these firms are affected by the outcome. Where TV stations compete for advertisers, the viewers are affected. Where a firm is polluting the environment by its production process, the neighbors of the firm are affected.

3.6 Fitness measures

When studying competition, it is useful to have a measure of the ability of a competitor to succeed. Evolutionary models often use the term *fitness*. There are various ways of defining fitness. The *absolute fitness* of an organism is the expected number of progeny produced by that organism. The absolute fitness can be calculated even if there is no direct competition. The *relative fitness* of an organism is the expected number of progeny of that organism divided by the expected number of progeny of a competing organism.

The word *fitness* is also sometimes used in non-evolutionary models, e.g. in sport. Economists use the term *competitive advantage*. The competitive advantage of a firm or a product is measured by its profit or its market share.

The most clear and unambiguous measure of fitness is found in evolutionary computation. The goal of an evolutionary computation program is to find the optimum of a predefined mathematical function called the *fitness function*. But outside the realm of computer models, we rarely have such a well-defined and unambiguous measure of fitness. There may be a discrepancy between what we want a competition to optimize and what it

actually achieves. I will therefore propose a distinction between different concepts of fitness:

The *normative fitness* is the achievement according to the official rules of the game, if such rules exist. For example, in athletic games the normative fitness is the speed of running, the height of jumping, etc. In market economy, the normative fitness is the profit for the owners or shareholders.

The *functional fitness* includes circumventions, manipulations and violations of the rules. If a seller of products can influence market laws through political lobbying then he may possibly contribute to his functional fitness by doing so. If an athlete can win a game by using doping, by bribing the judges or by harming his opponents, then the ability to do so with impunity is included in the sum of skills that are actually optimized by the game.

The *desired fitness* includes what we expect or wish to optimize, but which are not necessarily secured by the rules of the game. The expectation of what is optimized may be what legitimizes the competitive system. For example, we would like the winner of an athletic game to also be a good role model and a good entertainer because this relates to the reason why we arranged the game in the first place. In an economic market, we would like to optimize the total *social welfare*. This includes what economists call *externalities*, i.e. the influences that the competition may have on affected others. For example, the cheapest possible way of producing a certain product may involve the use of underpaid child workers and a highly polluting process. From society's point of view it is preferred to use a more socially responsible production method, even if this makes the product more expensive. What we want to optimize is not the normative fitness but the total sum of welfare to all people including those who are not directly part of the game. This is the philosophy behind *welfare economics*. There are a lot of difficulties in this approach, though. Obviously, it is very difficult to agree on how much weight to apply to each factor when calculating the total social welfare.

We can expect a free market economy to be successful if externalities are small and rule violations can be prevented. In this case, the functional fitness is a good proxy for the desired fitness so that we can expect the competition to increase the social welfare (by maximizing quality and minimizing prices). If externalities are so high that the actual fitness function is very different from the desired fitness function, then we would like to intervene and regulate the market in a way that corrects this so-called *market failure*.

This principle may also apply to other fields of competition. In the case of war, for example, the negative externalities are likely to be much higher than the benefits so that we would be better off by not playing this "game" at all.

3.7 Strategy parameters

A competitor may have different possible strategies to choose between. For example, a firm producing and selling a product may need to choose between low price and high quality. It can be useful to model such a tradeoff as a *parameter of strategy*. I will use this term mainly when a competitor has a limited amount of resources to invest in the competition and there is a tradeoff between two opposing ways of investing this resource.

The competitor may want to find the optimum compromise between the two opposite extremes. The fitness function can thus be seen as a function of one or more parameters of strategy and the competition can be seen as a game of finding the parameter values that optimizes this fitness function.

There are sometimes analogies between parameters of strategy in different fields of competition. Some of these analogies will be mentioned in chapter 4 below under the discussion of each parameter.

3.8 External intervention

A game of competition can be manipulated by persons or organizations other than the participants in the game.

Human intervention in biological evolution is seen in artificial selection, selective breeding and genetic engineering.

Governments often intervene in economic competition in order to correct market failures. Examples are subsidies, selective taxes and anti-trust legislation.

Various interest groups often intervene in democratic elections by supporting the campaigns of particular candidates or parties.

3.9 Vicarious selection

Vicarious selection is the situation where one game of selection is replaced by another game that is faster or less costly and that leads in approximately the same direction.

A biological example is sexual selection. A female of a particular species may prefer to mate with a male that looks strong. If strong-looking males also have high fitness then the female who chooses a strong-looking male may forestall the natural selection based on strength. By choosing a strong-looking mate she lowers the risk that her offspring will be weak and perish for lack of strength. The sexual selection based on apparent strength is less costly in terms of deaths than the natural selection based on the effect that strong individuals have higher chances of survival than weak individuals. The sexual selection does not lead in exactly the same direction as the selection based on strength because there may be a difference between looking strong and being strong. The female may actually have a preference for characters that reduce physical viability in the male, such as a large and colorful tail in the peacock. This is called runaway sexual selection.

Cultural selection can be regarded as vicarious for genetic selection. Selection based on cultural inheritance (memes) is faster and less costly than selection based on biological inheritance (genes) for a number of reasons. Mutations in genes are random while innovations in memes can be intelligent and goal-directed. Traits that are acquired by learning or experience can be inherited by cultural inheritance but not by genetic inheritance. A person can change his or her cultural memes at any time, while genes can only be changed by death and birth. It is commonly believed that the capacity for culture

has evolved in humans because it provides a faster and more efficient mechanism of evolution whereby our adaptivity is increased³.

Negotiation can also be seen as a vicarious game that replaces some other more costly or less efficient game. If the outcome of a costly game, e.g. a lawsuit, can be predicted then it may be advantageous for both competitors to negotiate if the same outcome can be obtained by the less costly game of negotiation (see chapter 2.14).

4 Possible consequences of competition

In this chapter, I will summarize many of the possible consequences of different "games" of competition as reflections of different strategies, different parameters of competition, different environmental conditions, different feedback effects, etc.

4.1 Optimizing the normative fitness

The first expectation to the outcome of competitive "game" is an optimization of the normative fitness. In biological evolution, the ability to find food, to breed, and to avoid predators and parasites are optimized. In economic markets, we expect the quality of products to be optimized and the prices to be minimized.

This ideal is the first approximation to a model of a competitive system. As we shall see below, there are many possible reasons why this expectation can be inaccurate.

4.2 Difference between desired fitness and functional fitness

The normative fitness and the desired fitness are only approximations to the functional fitness. A competitor may do anything that improves his chances of winning the game, including the most unexpected methods that may be harmful to others. These unexpected or undesired behaviors are what makes the functional fitness different from the desired fitness and possibly also different from the normative fitness. Several examples are given in the subsequent sections.

4.3 Inaccurate performance measurement

Incentives for workers or organizations to compete and optimize their performance are created by marketization of government agencies and by performance management and performance appraisal in private corporations. However, the performance measurements are likely to be either inaccurate or very costly. If workers or organizations are rewarded for their performance then they are likely to optimize their functional fitness, which is exactly what the performance-measuring instrument gives, rather than the desired fitness, which is the true need of the organization or the society.

For example, police officers thus rewarded are likely to go after small and easily solved crime cases and let the big criminals go. Hospitals are likely to reject patients with a poor prognosis because such patients give them a bad performance statistics. Schools that are rewarded for their performance are likely to give students better marks than they deserve.

Scientists who are rewarded for the number of publications they produce are likely to pollute scientific journals with articles of poor quality or poor relevance.

4.4 Externalities

Externality is defined in economics as the costs or benefits that an economic transaction has to third parties not involved in the transaction. For example, if a factory is producing something to compete for buyers then there is a benefit to the workers who are working for the factory. If the production gives rise to pollution then there is a cost to all the people who are affected by the pollution even though they are not involved in the buying or selling of the product.

It is easy to extend the definition of externalities beyond the field of economics. We will let externalities mean the costs or benefits to affected others in any game of competition.

In biology, the activities of one species may indirectly benefit or harm other species beyond the obvious interaction between predator and prey or between parasite and host. Nitrogen-fixating bacteria live in symbiosis with legume plants. These bacteria produce fertilizer that benefits not only the legume plants but other plants as well. The Crown-of-Thorns Starfish (*Acanthaster*) eats corals whereby it destroys the habitat of many other species.

In a sports competition, there is a benefit for the spectators who are entertained and perhaps inspired to also become active athletes, which is good for their health.

4.5 Imbalance between competitors and beneficiaries

In the ideal market situation there is a balance of power between the sellers and the buyers of a product thanks to the equilibrium between supply and demand. The game may have undesired consequences if there is a strong imbalance between the powers of buyers and sellers. This imbalance can have various causes such as a situation of monopoly, an imbalance between supply and demand, or a difference in the amount of information available to the two parts.

A situation of monopoly gives the seller an advantage. For example, a restaurant catering to the captive audience on a boat can charge unusually high prices if the passengers have no other source of food.

The buyer is at an advantage if the supply exceeds the demand. Consider the example of a TV company seeking participants for a reality show. There are usually thousands of applicants for only a handful of jobs. This makes it impossible for the applicants to negotiate a fair contract.

4.6 Cheating

In biological evolution there are no rules and thus no cheating. In sport there can be cheating, for example by the use of doping. In economic markets there can be cheating, for example by tax evasion. In court cases, there can be cheating by producing false

evidence or by threatening witnesses. In democratic competitions there can be election fraud.

Cheating appears to be contagious. If one competitor is cheating then the other competitors may have no other option than to also cheat or lose the competition. Consider the case where one shop can get away with evading taxes. This enables it to sell at lower prices than its competitors. The other shops in the area may now have no other option than to also cheat with taxes or be forced out of business. The likely result is a collective degradation of moral standards. People base their moral norms on what others do. If a shop owner knows that everybody else is cheating then he may also cheat without feeling that he is violating the prevalent moral norms.

4.7 Harming the competitors

In biological competition, it is quite common to see animals harming their competitors. Male animals rivaling over a female may fight for life against each other. Similarly, an alpha male among group-living animals may kill offspring that he hasn't fathered.

Harming the competitor in human affairs is usually considered cheating. A notable example from sports is the Tonya Harding vs. Nancy Kerrigan figure skating scandal⁴.

Mudslinging is a common form of harming the competitor in democratic elections.

In economic markets, aggressive competition may be legal in some cases even if the purpose is to harm the competitors. More direct forms of harming the competitor, such as making false claims about competing products, are usually illegal.

Harming the competitor in war is part of the game, although international treaties may set limits to the types of weapons that are allowed.

4.8 Manipulating the environment

The environment may provide the resources and set the limits to what competitors can do. A competitive advantage can often be obtained by manipulating the environment. In biology, beavers and earthworms are examples of animals that change their own environment, and so do humans.

Manipulating the environment is common in economics. A mobile phone factory might, for example, set up antenna networks in order to increase the area where mobile phones can be used.

The parts of the environment that might possibly be manipulated include the competitors, the contested resource, the judges and the rules of the game, as discussed below.

4.9 Manipulating the contested resource

Modern humans are increasing the production of food far beyond what can be obtained by hunting and gathering the fruits of nature. Intensive agriculture has thus allowed humans to multiply far more than we would otherwise be able to.

In economic markets, the buyers may be the contested resource. Sellers are often manipulating the buyers through advertising. Addictive products such as tobacco are also manipulating the buyers by making them addicted.

4.10 Manipulating the judges

The most direct form of manipulating the judges in a competition is by bribing judges in court cases or sports games. Such methods are illegal and hopefully rare, but more subtle ways of manipulating the judges in other competitive scenarios are actually quite common.

In economic markets, the buyers are also the judges of the quality of products. A manipulation of the buyers through advertising is thus also a manipulation of the judges.

In democratic elections, the final judges are the voters. But the voters often rely on media commentators and other opinion makers as "vicarious judges" when evaluating complicated issues. These vicarious judges can be manipulated through lobbying activities, by supporting certain media, or by changing the economic conditions of the mass media. Advertisers have particularly powerful means of influencing the commercial mass media because the media can't survive without advertising money.

4.11 Manipulating the rules of the game

One of the most sophisticated ways of improving one's position in a game is by changing the rules of the game.

The strongest part in a competition often has the most resources, including the power to change the rules. This is often seen in weak democracies and pseudo-democracies. Throughout history, we have seen many cases where the leader of a poorly functioning democracy has used his power to change election rules in a way that gives him still more power. Manipulating the legal environment is called rent seeking in economics. Manipulative tactics such as gerrymandering and changes in the voting system are sometimes seen even in apparently well-functioning democracies.

While the stronger part in a competition may have the strongest power to change the rules, the weaker part may indeed have the strongest incentive to do so. An underprivileged group in a society may make a political campaign for changing the rules that they see as the reason for their poor status.

The competition for attention in modern society is an almost anarchic game where some competitors are at such an extreme disadvantage that they have strong motivations to break the rules. The demand for attention and advertising space is so far in excess of the supply that the price for efficient mass communication is beyond the means of most small businesses and interest groups. Most of the advertising space on TV, billboards, etc. goes

to those who have the most money to pay rather than those who have the most important messages to tell. Organizers of small cultural events are often putting posters on house walls without permission simply because they have no other efficient way of advertising their events. Political movements without money are often writing political graffiti on walls without permission. Some political groups are finding other unconventional outlets for their messages. Greenpeace, for example, is making dramatic stunts in order to get media attention⁵.

A particularly alarming case of changing the rules is seen in asymmetric wars where the weak part may use terror as a last resort when no other effective weapon is available to them, well knowing that the weapon of terror is against the accepted rules².

The competition between different sets of rules can be seen as form of meta-competition. For example, we can have a choice between conventional war, terror and peaceful negotiations.

4.12 Path dependence

Path dependence means that past events have a lasting effect. Most evolutionary processes have path dependence, which means that there is more than one possible outcome, depending on initial conditions and transitory events.

In biological evolution, path dependence is evident in phenomena such as suboptimal design, exaptation, homology and vestigiality.

In technological evolution, path dependence is manifested in the strong needs for backwards compatibility and standardization.

Path dependence is also obvious in the evolution of languages, in social and cultural institutions, and indeed everywhere in human history.

In evolutionary computation, it is attempted to avoid path dependence in order to find the global optimum, while real-world evolutionary systems get stuck in local sub-optima.

4.13 Bounded rationality

Simple models of market economy assume that all actors behave rationally and choose the course of action that is most advantageous to them. However, it may be difficult or impossible to know which course of action is most advantageous. The costs of acquiring the information necessary for deciding which course of action is optimal may be higher than the gain. The average customer in a supermarket does not read the declarations on all the different brands of toothpaste or read scientific studies to find out which toothpaste is best.

Biological evolution is driven mainly as a blind search through random mutations. There is not much rationality in this process. Cultural evolution has goal directed innovations as well as random discoveries.

A strategy game like chess is indeed a competition on rationality. The player who is best at calculating the possible consequences of each move is likely to win.

4.14 Altruistic actors

Many models of competition assume that competitors are perfect egoists, but this assumption may not be true.

Egoistic behavior is common in biological evolution, but behavior that is helpful to others can evolve according to the theories of kin selection, group selection and selection for reciprocal altruism.

Altruistic behavior in economic markets has become quite popular, as epitomized in the roles of the political consumer and the ethical investor. Ethical producers can survive only when competition is weak and consumers can afford to make political or ethical choices. The ethical behavior of a producer can be difficult to control. This has given rise to pseudo-ethical producers who exaggerate minimal ethical improvements in their products and hide the negative sides such as unethical subcontractors.

Voters in democratic elections are often basing their voting decision not only on their strictly personal interests, but also on the interests of their friends, their employers, or the society as a whole.

Altruistic behavior can be profitable if it is likely to be reciprocated. This phenomenon has been studied extensively in game theory with the famous example of the prisoner's dilemma.

4.15 Underserving unprofitable beneficiaries

Competitors are likely to discriminate between different groups of beneficiaries and prefer the ones that are most profitable.

For example, municipalities are competing to attract rich taxpayers and avoid the poor. Insurance companies are avoiding high-risk customers. Medicine companies prefer to make patentable products and are unlikely to develop medicine for diseases that occur only in poor countries. Commercial mass media prefer to cater to the audience that is most attractive to their advertisers, i.e. business decision makers and wealthy people. The interests of social groups with less spending money are possibly not catered for.

4.16 Cooperation between competitors

Agreements of cooperation can be advantageous for the players of a game. Firms can lower competition by forming trusts, which enables them to increase prices. Workers can form labor unions to improve their wages and working conditions. Buyers of products can form consumer organizations, collective buying groups, and organize boycotts.

In war and arms races, the competition can be broken by disarmament agreements.

The general effect of cooperation between competitors is to decrease the intensity of competition and thus decrease the costs or increase the gains for the competitors. If the competitive game has beneficiaries, then the cooperation between the competitors can be a disadvantage to the beneficiaries. A trust is a disadvantage to the consumers, a labor union is a disadvantage to the employers, and a consumer organization is a disadvantage to the sellers. A war has no beneficiaries other than the winning competitor; hence a disarmament agreement may not be a disadvantage to anybody.

Cooperation between competitors is effective only as long as all competitors obey the agreement. The advantage can be spoiled if even a small fraction of competitors break the agreement. The calculation of whether it is most advantageous for a particular competitor to obey or break the cooperation is analogous to the prisoner's dilemma in game theory.

Cooperation can change the nature of a competition into a game of negotiation. If two firms form a trust and agree that each take a certain share of the market then they are no longer competing mainly on price or quality. Instead they are competing on negotiating their share of the market and using the threat of non-cooperation as a power element in the negotiation game (see chapter 2.14). Only if the trust turns into a merger with monopoly does the competition end.

4.17 Specific versus general adaptation

An important strategy parameter in biological evolution as well as in cultural evolution is the choice between specific and general adaptation. Specific adaptation means the evolution of traits that fit the specific environment and nothing else. Specific adaptation is advantageous only as long as the environment and living conditions do not change. General adaptation means the evolution of flexibility and adaptivity.

Specific adaptations may be advantageous on a short timescale, but specific adaptations are more likely than general adaptations to be dead ends in the course of evolution because the environment will always change on a sufficiently long timescale.

4.18 Niche formation

Specific adaptation is related to niche formation. In ecology, a species that specializes in a particular range of foods or a special type of habitat is said to occupy a narrow niche. In economy, a firm that specializes in a narrow range of products or a special type of customers is said to use a niche strategy.

Competitors may reduce competition by dividing the contested resource into niches where each competitor has its own niche. Each niche represents a different competitive strategy or a narrow interval of a strategy parameter.

In a democracy with more than two parties, each party may either place itself near the center of the political spectrum in order to attract as many voters as possible, or it may use a niche strategy and cater to voters with a special interest or a particular political opinion.

A firm may occupy more than one niche. For example, a TV station with multiple channels may show different types of programs on the different channels, while a TV station with only one channel is more likely to show light entertainment programs that appeal to the broadest possible audience. Whether it is advantageous for a TV station to use a niche strategy depends on the number of competitors on the market, the size of the audience of each niche, the costs of producing niche programs, and the attractiveness of the niche audience to the advertisers.

4.19 Biological r/K theory

One of the many strategy parameters in evolutionary biology is parental investment. In an unstable and unpredictable environment where a high reproduction rate (r) is essential for survival, a parent cannot afford to invest too much in each offspring. The optimal strategy here is to produce numerous offspring and invest little in each of the young. The opposite strategy is seen in a crowded niche where the population is limited by the carrying capacity (K) of the environment. In this case it is more advantageous to have few young and to invest more in each of the young. An environment that favors a high reproduction rate (r -selection) leads to small organisms that breed fast. As the opposite, an environment that favors an efficient utilization of limited resources (K -selection) leads to large organisms that breed slowly and make a high investment in each of their offspring. The human species is a typical example of K -selection.

The parental investment or r/K parameter is one of many strategy parameters in the so-called life history theory. The r/K parameter is singled out here for the sake of analogy with other fields of competition.

4.20 Cultural r/k theory

There is an analogy between the biological r/K theory and another theory named cultural r/k theory. (The biological theory has a capital K , while the cultural theory has a small k). The analogy is arguably remote, but it becomes clearer if the strategy is seen from the point of view of the memes, rather than from the point of view of their bearers, the humans. A meme, or set of memes, that spends most of its resources on propagating itself to as many other humans as possible but uses few resources on satisfying the needs of each human bearer is said to use an r -strategy. As an opposite, a meme that obtains its fitness from satisfying the needs of its bearer rather than propagating itself as much as possible is said to use a k -strategy. The cultural r and k strategies are also called *regal* and *kalyptic*, respectively.

The regal strategy is seen most strongly where a cultural group (nation or tribe) can expand by war or where a cultural group is threatened by a warlike neighbor or by any other collective danger. The regal selection leads to bellicosity, authoritarianism, intolerance, strict discipline and a high birth rate. The opposite is the kalyptic strategy. It is seen where war or group conflicts are effectively prevented and there are no other collective dangers. The kalyptic selection leads to peacefulness, tolerance, individualism and a low birth rate.

The cultural r/k theory is further explained in the references³.

4.21 Price versus quality

In economics, the strategy parameter of price versus quality may be seen as somewhat analogous to the r/k parameters in biological and cultural evolution. A firm that produces goods with a low quality and low price is using a strategy of selling as much as possible, but providing poor satisfaction to the consumers. The opposite strategy of producing products of a high quality and high price means selling less but providing more satisfaction to those who buy the products. The optimal strategy depends on the customers and the intensity of competition.

4.22 Fixed costs versus variable costs

In economics, the fixed costs of a production are the costs that do not depend on the quantity produced, while the variable costs increase with the quantity of product that is produced. The fraction of the total costs that are fixed has a number of consequences for the optimal strategy of competition and for the consequences of competition, as explained below.

4.23 Consequences of high fixed costs

A high level of fixed costs can be a barrier to the entry of new competitors on the market. There may be monopoly or oligopoly and consequently high prices. Or the fixed costs may be so high that there are no producers at all.

Another complication can arise when the fixed costs are high, but not so high that the number of competitors is kept low. We are assuming that the demand is limited. If the total sales is shared between a large number of competitors then each competitor has less revenue to cover the fixed costs. It is not optimal, from a welfare economics point of view, to have a large number of firms paying the same fixed costs. This is called wasteful duplication. Each competitor may now have no other option than to lower the fixed costs by lowering the quality of the product if he wants to stay in the market.

This phenomenon is seen clearly in the television market. A high quality television program has high production costs, but the costs are completely independent of the number of viewers. In areas where there are many competitors on the TV market to share the total income, each competitor is forced to lower the quality of the programs because the income per competitor is reduced⁶.

4.24 Consequences of low variable costs

The variable costs are particularly low if the product is pure information that can be copied and distributed electronically. This is the case with news, entertainment, software and other information. The low variable costs can lead to a change from a traditional market economy to a gift economy. A supplier who is willing to provide a product for free can possibly outcompete anybody who is providing a product of similar quality for pay.

The supplier can be a group of unpaid volunteers as we are seeing for example with Wikipedia¹ or a government organization as in the example of Red Flag Linux in China.

4.25 Positive feedback

Feedback is very common in dynamic systems. It is found in ecology as well in economics, politics and culture. Feedback can be positive or negative. Positive feedback is the characteristic of systems with a self-amplifying effect.

Positive feedback is seen in the progress of science and technology. Each new invention or discovery enables us to make still more advanced new inventions and discoveries.

Positive feedback is seen in economic progress and growth. The returns from a successful investment enables us to make still more investments.

Positive feedback is harmful when we want a system to be stable and in equilibrium. The prices of stocks and other investment objects subject to speculation become unstable when they are determined more by supply and demand than by any intrinsic value of the objects. Increasing prices make the demand go up which causes the prices to increase further. Decreasing prices make the demand go down which causes the prices to decrease further. Such positive feedback patterns give rise to instability and large fluctuations on the market.

Positive feedback is common in politics and cultural norms. An opinion held by the majority of a population is likely to be reflected by the mass media and by influential opinion makers. The majority may be able to suppress the expression of minority views so that those who hold the minority views have difficulties in recruiting new adherents.

Positive feedback is common in war and in undemocratic governments. Whoever has the most power can use this power to gain still more power.

4.26 Negative feedback

Negative feedback in a dynamic system can have two different consequences. Either it can move the system towards a stable equilibrium, or it can make the system oscillate. If we want to predict whether a system with negative feedback is stable or unstable, we have to make a mathematical model of the system and solve the underlying differential equations. At least this is what the theory says, but it may be practically impossible to determine the parameters of a complex social/cultural/economic system with sufficient accuracy to make such calculations. As a rule of thumb, we can say that a dynamic system with negative feedback is more likely to be unstable and oscillate if the negative feedback is strong and delayed.

Negative feedback systems are common in ecology as equilibria between predator and prey and between parasite and host. Most such systems are stable. Unstable ecological systems may possibly have been terminated in the past by extreme oscillations extinguishing one or both of the species involved.

Negative feedback is common in economics as the equilibrium between supply and demand. Such systems are usually stable, but they may be unstable if there is a delay in the response pattern. For example, young people may choose an education in a trade where there is a shortage of manpower. The education of these people may take so long time that overcompensation has taken place before they have finished their education.

5 Discussion and conclusion

The present paper has outlined a framework for improving our understanding of the possible effects of competition in evolutionary as well as non-evolutionary systems. This framework has been pieced together of mainly existing knowledge from several different scientific disciplines. It is found that the different fields of study each have something to contribute to a general understanding of competition and that findings from one field of study can be applied to other fields.

Economic theory uses the term competition where evolutionary theory talks about selection. The analogies between these theories become clearer when we realize that selection is the result of competition. Talking about competition is to focus on the process, while talking about selection is to focus on the result of this process.

It is clear that some fields of competition have been studied more thoroughly than others. The fields of market economy and population genetics have been studied extensively with detailed mathematical models while other fields of competition have been largely neglected. The focus on analogies can hopefully make it easier to study other fields of competition as well.

There are many fields of competition that could benefit from more detailed studies. Perhaps the most important and most neglected field is the competition that controls the flow of information in our society. The competition for attention has been studied mainly from an advertising point of view while the consequences for the social, political and cultural dynamics remain almost unexplored. The communication of the mass media has been studied in disciplines such as political science, political psychology and media effects theory, but these fields of study are rarely coupled with the effects that the competition of the mass media for advertising money have on the selection of information. We need to study the couplings between the economic, political and public communication fields of competition in order to understand the dynamics of the society we are living in. We need to identify the most important causal paths in this complex network in order to get beyond the usual vague holistic statements and make models that actually are useful for explaining or predicting social phenomena.

The study of detailed cause-and-effect models is currently out of fashion in large parts of the social science community. We need to strengthen disciplines such as social systems theory, social dynamics and cultural selection theory in order to understand the fast changes that are taking place in the culture we are living in.

Competition as a control mechanism is entering more and more fields of modern society thanks to the current trends of marketization and performance management. The increasing importance of competition also makes the study of competition more important.

The political and economical dynamics of modern society can best be described as a large web of interdependent phenomena with a degree of complexity that resembles an ecosystem in biology. The circulation of money and commodities in an economic system makes everything interdependent just as the cycles of energy and nutrients in an ecosystem makes different species interdependent. Instability in one part of the social/political/economical system can have severe consequences for other parts of the system just as a disturbance of one species in an ecosystem can affect many other species.

Unfortunately, we have very little understanding of the dynamics of the "ecosystem" of social and political movements in modern society. The evolution of cultural ideas, political opinions and religious beliefs in the modern world is mediated mainly through the mass media. A large part of these media are controlled by the free market forces - not in the competition of ideas - but in the competition for advertising money. Likewise, the competition for attention is mainly an economic competition. Our senses are bombarded with redundant messages from big companies so that there is very little space left for things we didn't know and which might be more important to us or to the functioning of our democracy. Maybe all these unregulated competitions in the information market are leading our culture in an unknown direction. The cultural and political evolution is governed by irrelevant forces and the direction is out of control. Our society is drifting around by random winds and we don't know where they are taking us⁶. There is a lot to do for scientists to study these mechanisms!

6 Glossary

This list contains only short explanations for quick reference. The reader is encouraged to seek further information about these terms and concepts on the web or in a science library.

Adaptation. Adjustment of the strategy to fit the environment and the rules of the game.

Adaptivity. A flexibility that enables fast and efficient adjustment of the strategy to changes in the environment.

Alpha male. The highest-ranking male in a group of animals.

Anarchic. Not regulated by rules.

Artificial life. An experiment that imitates the mechanism of biological evolution, often by means of computer simulation.

Asymmetric war. A war where one part is much stronger than the other.

Beneficiary. See page 9.

Carrying capacity. The maximum population size of an organism that the environment can support.

Coevolution. The coupling between two different evolutionary systems. Examples are the influence of the evolution of predator and prey on each other, of parasite and host, of two species in symbiosis, or of genes and memes.

Competition. A game where two or more persons, organisms or organizations each try to get as much as possible of a limited resource that they cannot both have. What is gained by one is lost by another.

Competition for attention. See page 5.

Competitor. A player in a game of competition. See page 8.

Contested resource. See page 9.

Cultural dynamics. This term has various meanings. It is used in the present context to represent scientific models of cultural change, including cultural selection, sociocybernetics and social systems theory. See page 4.

Cultural evolution. Cultural evolution simply means cultural change. The term is used mainly if an evolutionary mechanism is assumed.

Cultural selection. The selection of cultural traits. This includes the selection of memes as well as the change in quantitative parameters. See page 4.

Culture. The part of human behavior and artifacts that are transmitted by learning or imitation rather than by biological inheritance.

Cybernetics. The mathematical study of dynamic systems that involve feedback.

Darwinian. See evolution.

Demand. The maximum amount of goods that can be consumed in a particular market.

Desired fitness function. See page 10.

Drift. The accumulation of random changes in an evolutionary system, including the effect of selection being non-deterministic.

Dual market. A system where two different markets depend on each other.

Dynamic system. A physical or mathematical system where quantitative parameters can change in time. Often involves feedback.

Ecology. The study of the interaction of biological organisms with other organisms and with their environment.

Ecosystem. All the animals, plants and microorganisms living in an area regarded as a system of organisms interacting with each other and with the environment.

Endogamous. A group of organisms is endogamous if there is no interbreeding with other groups.

Environment. The conditions under which a game of competition takes place.

Ethical investor. An investor who bases his or her strategic decisions not only on egoistic motives but also considers the political or ethical consequences of the enterprise that he or she supports with the investment.

Evolution. A process involving variation, selection and reproduction of information units. Examples are biological evolution, memetic evolution, evolutionary computation and artificial life.

Evolutionary computation is a method for finding the maximum or minimum of a mathematical function when the function is so complex and has so many parameters that simple search methods cannot be used. Evolutionary computation uses a method that is analogous to Darwinian evolution. See page 9.

Evolutionary economics. An evolutionary change in material culture, mainly driven by economic forces. See page 5.

Exaptation. The fact that an organ or trait that evolved to serve one function has later been modified to serve some other function.

Externalities. See pages 10 and 13.

Feedback. A circular causal process whereby some proportion of a system's output is returned to the input.

Field of competition. A system or that involves a particular type of competition. For examples animals competing for food or firms competing for customers.

Fitness. See page 9.

Fitness function. See page 9.

Fixed costs. See page 20.

Functional fitness. See page 10.

Game. The term game is used metaphorically here to describe any system that involves competition.

Game theory. Mathematical theory that studies optimal strategies in games.

Gene. Information unit in biological inheritance.

Gerrymandering. Manipulation of the boundaries of electoral districts for the purpose of obtaining electoral advantage.

Gift economy. An exchange of goods where no payment is required.

Global optimum. The highest peak on the fitness function. See also local optimum.

Group selection. Evolutionary process where selection works on entire groups of organisms. This may be regarded as an extension of kin selection. Group selection is effective only if interbreeding or migration between groups is minimal, e.g. in social insects. The theory of group selection is controversial⁷.

Homology. Similarity between organs of different species due to a common descent. For example the similarity between our arms and a bird's wings.

Inheritance. The copying of information units, i.e. genes or memes, from parent to child.

Intensity of competition. A competition is intense if the competitors have to use most or all of their resources in order to survive in the game or if some competitors are forced to leave the game. A competition has low intensity if competitors can use a suboptimal strategy and still survive and stay in the game. A low intensity of competition may be found where there are few competitors or where the competitors cooperate.

Judge. See page 9.

Kalyptic. See page 19.

Kin selection. A possible strategy for an organism in an evolutionary game is to help other organisms that are likely to share the same genes. A gene can increase its own reproduction not only by increasing the fitness of the organism that carries it, but also by making this organism help other organisms that have the same gene. Kin selection is the phenomenon that such helper genes may be favored by evolution. Kin selection can make organisms help their close kin.

Life history theory. Study of the reproductive strategy of a biological species including the allocation of resources to different strategy parameters, such as body size, age at first reproduction, litter size, interbirth interval, parental investment, etc.

Local optimum. A peak on the fitness function that may not be the highest peak. A search for the optimum of a fitness function may get stuck on a local optimum because it is separated from the global optimum by a valley.

Market. A part of a market economy system defined by a single type of products or a limited geographic area.

Market economy. A system of buyers and sellers of various products where prices are determined mainly by the balance between supply and demand. The theory of such systems.

Market failure. The situation where a game of competition fails to optimize the welfare of the participants or where non-participants suffer a loss because of negative externalities. See page 10.

Marketization. A process whereby public service or state-owned organizations are enabled to act like market-oriented firms by engaging them in competition.

Mass media. Media of broadcasting messages to a large audience, such as radio, television and newspapers.

Media effects theory. The study of how mass media affect the knowledge, thinking and behavior of their audience.

Meme. Information unit in cultural inheritance. See page 3.

Memetic. Relating to the copying, selection and modification of memes. See page 3.

Memetics. The study of systems that involve the creation, selection and copying of memes. See page 3.

Merger. The joining of two or more firms into one.

Monopoly. A market with only one seller.

Multi-level selection. The interaction between selection taking place at the level of the individual organism and at the level of endogamous groups or entire species or clades. See group selection.

Mutation. A random change in a gene. Mutations are the source of variation in biological evolution.

Neo-Darwinian. The integration of Darwinian thought with genetics. See evolution.

NGO. Non-governmental organization, e.g. a grassroots organization representing a particular interest or a social issue.

Niche. This term is used in various meanings in ecology and economics. In the present context, a niche is a range of strategy parameters. A competitor that is specializing in a narrow range of strategy parameters is said to use a niche strategy. See page 18.

Nitrogen-fixating bacteria. Bacteria that consume molecular nitrogen from the atmosphere and convert it to ammonia. These bacteria can live in symbiosis with certain plants for which the ammonia is useful as a fertilizer.

Normative fitness. See page 10.

Oligopoly. A market with few sellers and possibly a low intensity of competition.

Optimum. The strategy that maximizes the fitness function. See also global optimum and local optimum.

Parameter of strategy. See page 10.

Path dependence. This term has various meanings in the social sciences, economics, physics and mathematics. In the present context, path dependence means that a system evolves or develops towards a local sub-optimum rather than a global optimum. See page 16.

Performance management. A strategy used by organizations to increase the performance of their workers by engaging them in competition or otherwise rewarding high performance.

Political consumer. A person who bases his or her buying decisions not only on egoistic motives but also considers the political or ethical consequences of the consumption.

Political psychology. The study of the role of human cognition, thought, emotion, and behavior in political systems.

Political science. The study of political systems and democratic processes.

Population genetics. The scientific study of the distribution of genes in a biological population and the changes due to the mechanisms of evolution.

Prisoner's dilemma. A famous problem in game theory where it is advantageous for each of the two competitors in a game to cooperate only if the other competitor also cooperates.

Proxy. An approximate measure used instead of a more accurate measure that it more difficult to obtain.

Public choice theory. The study of democratic systems under the assumption that voters, politicians, and government officials behave mostly as egoistic agents, similar to the assumptions behind traditional market economics.

r/K theory, biological. See page 19.

r/k theory, cultural. See page 19.

Reciprocal altruism. A possible strategy for an organism in an evolutionary game is to help other organisms that are likely to reciprocate the favor. This may lead to complicated mechanisms for estimating the likelihood that favors will be returned. See also prisoner's dilemma.

Reciprocal selection. The situation where multiple organisms mutually influence each other's probabilities of survival. This may lead to reciprocal altruism.

Red Flag Linux. A Chinese version of the Linux operating system, supported by Chinese government organizations.

Regal. See page 19.

Rent seeking. Manipulating the economic and/or legal environment in order to improve one's profit.

Reproduction. In evolutionary theory, reproduction is the copying of the information units, i.e. genes or memes. Genes are copied by creating new organisms bearing them, while memes can be copied from person to person with or without new persons being born.

Reproductive strategy. The strategy used by a biological organism to optimize its production of offspring.

Revenue. In the present context revenue means the income of a firm.

Rule. The rules of a game define the consequences of all allowed strategies.

Selection. Selection is the outcome of a competition event. In evolutionary systems, the winner of a competition leaves more of its information units (genes or memes) to descendants than the loser does.

Sexual selection. In the evolution of a species with sexual reproduction, sexual selection is the result of organisms trying to select the best mating partner.

Social structure. The social institutions, norms, relationships and cognitive framework that shape human behavior in a society.

Social systems theory. The study of social systems from the perspective of interaction between the whole and the parts as well as interaction between the individual parts.

Sociocybernetics. The study of social systems with feedback.

Strategy parameter. See page 10.

Suboptimal design. The observation that certain organs in biological organisms are constructed in a suboptimal way from a physical or functional point of view.

Supply. The maximum amount of goods that can be produced in a particular market.

Symbiosis. Interaction between organisms of two different species in a way that benefits both, for example flowers and bees.

Trait. A physical characteristic or behavioral pattern of an organism.

Trust. Cooperation between sellers to reduce the intensity of competition.

Underserving. See page 17.

Variable costs. See page 20.

Variation. In evolutionary theory, variation means any change in the units of inheritance. In biological evolution, the variation mainly originates from mutations. In cultural evolution, variation can be due to random errors or goal-directed inventions.

Vestigiality. Describes organs that have lost their function, such as our appendix.

Vicarious selection. See page 11.

Victim. See page 9.

Welfare. The sum of the utility for all members of a society. See welfare economics.

Welfare economics. The theory of calculating or optimizing the total welfare for all members of a society. See page 10.

7 References

1. en.wikipedia.org.
2. Fog, Agner: *Why terrorism doesn't work*. Draft article 2002. www.agner.org/cultsel/terror.pdf.
3. Fog, Agner: *Cultural selection*. Dordrecht: Kluwer, 1999.
4. *Tonya Harding and Nancy Kerrigan*. www.infoplease.com/spot/winter-olympics-harding.html
5. www.greenpeace.org.
6. Fog, Agner: *The supposed and the real role of mass media in modern democracy*. Working paper, 2004. www.agner.org/cultsel/mediacrisis.pdf.
7. Fog, Agner: Simulation of group selection models. www.agner.org/evolution/groupsel/.