#2004 Bremen Papers on Economics & Innovation

# The collapse of cooperation: The endogeneity of institutional break-up and its asymmetry with emergence

Christian Cordes*, Wolfram Elsner*, Claudius Graebner**, Torsten Heinrich***, Joshua Henkel*, Henning Schwardt****, Georg Schwesinger*, and Tong-Yaa Su*

**January 2020**

**Abstract**

Decline and break-up of institutionalized cooperation, at all levels, has occurred frequently. Some of its concomitants, such as international migration, have become topical in the globalized world. Aspects of the phenomenon have also become known as failing states. However, the focus in most social sciences has been on institutional emergence and persistence, not collapse. We develop an endogenous explanation of collapsing institutions. Collapse may be an implication of the very economic success of institutionalized cooperation and of increasing system complexity, when cognitive conditions for effective collective decision-making do not proportionately evolve. Moreover, we show that collapse is not a simple logical reverse of emergence. Rather, institutions break up at different factor constellations than the ones prevailing at emergence. We approach endogenous institutional break-up and its asymmetry from various paradigmatic and disciplinary perspectives, employing psychology, anthropology, network analysis, and institutional economics. These perspectives cover individuals, groups, interaction-arenas, populations, and social networks.

*) University of Bremen, Faculty of Business Studies and Economics, P.O. Box, 28359 Bremen, Germany; corresponding author: C. Cordes (c.cordes@uni-bremen.de).

**) Johannes Kepler University, Institute for the Comprehensive Analysis of the Economy (ICAE), Linz, Austria; Institute for Socio-Economics, University of Duisburg-Essen, Germany.

***) University of Oxford, Institute for New Economic Thinking (INET), Oxford Martin School, Oxford, UK.

****) University of Denver, Department of Economics, Denver, CO, USA.

**Keywords**

Anthropology; cognitive capacities; cooperation; economic decline; game theory; institutional emergence; network analysis; social institutions

**JEL Classifications**

A12 ; B52 ; C72 ; D02 ; D03 ; L14 ; O15 ; O17 ; O43 ; Z13

## 1. Introduction

Collapse of institutional structures has been ubiquitous over thousands of years of human history (e.g., Turchin 2003; Diamond 2005; Tainter 2006; Acemoglu/Robinson 2012). Recently, the collapse of the state-socialist countries of Eurasia in the 1990s and its socio-economic costs, a number of failing states, the apparent fragility of the entire global system, or the reduced collective-action capacity of the leading powers, when it comes to the maintenance of the global commons (e.g., Block 2000; Rasmus 2016), have become topical. And below entire systemic collapse, there usually are symptoms of institutional decline, at global, national or local levels, such as long-term economic downgrade, cumulative income inequality, social disintegration, or geographical fragmentation as well as symptoms of specific humanitarian crises as to food, health, water, land or shelter access, violence and wars, and subsequent enforced international migrations.

Yet, the focus of historical, evolutionary, and institutional perspectives in economics has been on the structural emergence of cooperation.[1] Explicit considerations of collapse have been considerably fewer, and if so, only recent (e.g., Acemoglu/Robinson 2012; Horiuchi 2015). The issue was largely left to other social sciences, particularly history, ethnography, anthropology, or social geography (Weiss/Bradley 2001; Tainter 2003, 2006; Brooks 2012; Meija 2018), and law and business (e.g., Richman 2016). Yet, most of these accounts consider the reasons for collapse as mainly exogenous: through the failure of a political system, an apparent mismanagement by the elites, and mostly through climatic factors, particularly ecological disasters. Sometimes, as in cases in Tainter (2003) and Diamond (2005), climate change and a population's failure to adapt take effect, but most explanatory significance has been given to exogenous events.

Only some few scholars have explicitly taken institutional aspects into account, such as a biased collective decision-making in the presence of sunk costs of institutions (e.g., Janssen et al. 2003). In this paper, we will consider relatively low interaction costs of established institutions and relatively high interaction costs under institutional break-up and change, even if such change were appropriate and warranted. More generally, most historical instances, in which a complex society disintegrated and developed into a less complex one, where the degree of complexity and adaptability of collective decision-making fell below a degree required for the maintenance of the larger, and changing, commons, have been candidates of collapse (e.g., Tainter 2003; Turchin et al. 2013).

[1] The contributions here come from various perspectives and paradigms: see, e.g. Axelrod (1984) for the evolution-of-cooperation approach, Hodgson (2000) for original institutionalist contributions, Epstein/Axtell (1996) for complexity sciences, or Boyd/Richerson (1985) for the anthropological approach.

Too little complex and too little adaptive societies and their governance structures, in relation to changing requirements, regardless of particular ecological or technological disasters, may have rendered interaction costs too high (Meija 2018). This causes a fragmentation of populations into relatively (too) small groups, in this way constraining communication and interaction, reducing higher-level collective-decision capacity, eventually leading to collapse.

The present paper contributes to that still small but growing literature on the degeneration, inadequacy, and eventual collapse of institutionalized cooperation, by adopting transdisciplinary and trans-paradigmatic perspectives. It is motivated by two key theses: First, collapse is not necessarily tied to exogenous events, but might well occur because of endogenous dynamics. This resembles the idea of "improving oneself into extinction" (Elster 1983,54), which was applied to an individualistic rationality in ubiquitous social dilemmas. It also applies to the development of populations, when the reach, complexity, or adaptability of collective decision-making is no longer appropriate to the size, complexity, and change of the socio-economic and natural conditions, namely of their commons, and when this stems from the very success of the earlier institutionalized coordination of the population, but these very institutions have at some point become inadequate. Second, collapse of cooperation also typically is not merely a reversal of its emergence. Otherwise, its theoretical comprehension would be a simple derivative of the work on emergence. Rather, as the various disciplinary perspectives developed below indicate, collapse follows different rules than emergence, it is asymmetric to emergence and is a subject of investigation in its own right.

To investigate these claims, we integrate arguments from various perspectives that have studied collapse each in their specific contexts: the biology and evolutionary psychology of the individual (section 3), the anthropology of group behavior (section 4), network science (section 5), and evolutionary institutionalism applying evolutionary game theory (section 6). At the end of each section, we derive hypotheses about the mechanisms and dynamics of collapse, i.e., its endogeneity and/or asymmetry. In section 7, we show that the perspectives employed in fact converge to a theoretical frame for modeling, where collapse is endogenous and asymmetric to emergence.

## 2. On the endogeneity and asymmetry of collapse

This section elaborates on the two main claims introduced above, namely that, first, decline, crisis, and collapse of large-scale institutional cooperation will often turn out to be some endogenous implication of its very success and, second, that it will not be a simple logical reverse of emergence.

We begin with the latter proposition. It can be illustrated, based on some formal modeling (see section 6), that institutional emergence is unavoidably subject to interactive learning, trial and error in evolutionary processes, and some risk-taking, as it implies some potential early disadvantage of the behavioral innovator compared to followers and imitators. Further, institutional emergence is subject to some broader and longer-run perspective, and, finally, to some generalization of experience into one's expectations and habituation. In all, institutional emergence implies unavoidable sunk fixed costs of individual and collective decision-making (e.g., Elsner/Schwardt 2014). Therefore, some institutional hysteresis may easily become prevailing at some later point, when institutional cooperation should be adapted to a changing decision situation, but the same institutionalized (and habituated) behavior will be retained beyond that point of adaptation, because it is easier for the individual to stick to the prevalent institution rather than again interactively learn a new institution incurring new sunk fixed costs (e.g., Setterfield 1996).

In other words, social institutions that are supposed to solve ubiquitous social dilemmas logically cannot be based on hyper-rational (short-term) maximization behavior. Institutions, thus, are to be applied semi-consciously, as long as there is no particular reason to expect that the next interaction partner will defect. Such learning and habituation will require individual investment in terms of time for trial and error and risk-taking of being exploited under fundamental strategic uncertainty. The sunk fixed costs not only imply a general relative persistence and stability of institutionalized behavior over more volatile socio-economic variables, but, specifically, some hysteresis, i.e., the institution's use beyond the point where it still was appropriate, when conditions change. In this way, it will be maintained just in order to realize economies of scale of collective decision-making. Thus, some institutional degeneration may occur: for some shorter or longer time, the established institution still may be appropriately problem-solving. And even if it becomes increasingly normatized and detached from the original basic problem structure, it still may be an appropriate norm. But it will sooner or later become dysfunctional and eventually an improper abstract norm (e.g., Elsner 2012; Sugiarto et al. 2015). Sticking to the old, now petrifying institution then may increasingly cause inappropriate decision-making, divert its carrier group from problem-solving, in this way entailing an institutional ceremonialization (Veblen 1899) of a formerly functional, instrumental institution. Then other motives come to the fore rather than collective problem-solving, such as redistribution of income, power, or status among individuals or groups, or bureaucratic hierarchization. Such increasing dysfunctionality may cause eventual collapse.

This may be a consequence of cooperation success, an endogenous process also in another respect. The instrumental institution promoted effective decision-making and socio-economic success. Economy and society, and their commons, may have grown in size and numbers, affording greater differentiation and heterogeneity of agents and their relations. A higher systemic complexity can then be accommodated for some time with the reduction of the complexity of the individual decision situation through the very institution. However, as more agents will be integrated, problems arise for both immigrants and incumbents. Institutions should adapt to accommodate larger numbers and more heterogeneity. But, cognitive conditions (changing experience and expectations) for both types of agents may deteriorate with increasing numbers, heterogeneity, and perceived increasing complexity and turbulence, and cognitive limits occur. If proper institutional adaptation will not or only insufficiently happen, both new agents and incumbents face incentives not to cooperate, and incumbents may stick ever more to the ossifying institution. Experience and expectations of trust and trustworthiness may deteriorate and cooperation may decay.

Turning to asymmetry, there will occur a turning point from institutional emergence, stabilization, persistence, and instrumental functionality towards ceremonial inappropriateness, decreasing performance, and eventual collapse. But when and how does non-linearity (asymmetry) between emergence and collapse come into effect, under parameters moving gradually (linearly) back and forth? The very sunk fixed costs suggest that institutions will tend to exist longer than would be effective for high performance, and still will exist under unfavorable circumstances, in which cooperation would not have emerged. For instance, the minimum critical mass of agents required to establish an institution may be larger than the minimum critical mass that still keeps an old institution somehow working, how (increasingly) poorly ever. Thus, a socio-economic collapse still may be prevented for some time.

Anthropology deepens the understanding of the endogeneity and asymmetry of emergence and break-up by putting emphasis on the environment of developing socio-economies. The presence or absence of competing groups or societies influences the cohesiveness and fragility of a cooperative regime. This is the essence also of Turchin’s (2003) argument on the emergence of large-scale cooperation through group-level competition and selection. In human evolution, selection favored prosocial, cooperative behavior within groups to an extent that is exceptional within the animal kingdom and cannot just be explained by genetic evolution. Rather, the emergence of human cultural capabilities facilitated processes of inter-group selection, helping particularly cooperative group cultures to gain competitive advantages over less cooperative ones. As a result, the human behavioral repertoire includes psychological dispositions for cooperation that were acquired in a co-evolutionary process of rising cultural capabilities and genetic adaptations required to live in cultural environments (e.g., Toth/Robinson 2007; Henrich 2016). The specific expression of those dispositions, however, depends on the cultural und institutional dynamics. The history of the last ca. 10,000 years provides very distinct solutions to large-scale coordination that may exhibit either cooperation or dominance (e.g., Traulsen/Nowak 2006; Wilson et al. 2013). This is consistent with the game-theoretic insight of multiple solutions for social dilemmas above the benchmark of complete defection, as given by the “folk theorem”.

Beyond such mechanisms of endogenous emergence, anthropology also provides evidence for asymmetry: the propensity to cooperate is asymmetric with respect to size. While small groups may spontaneously develop a cooperative culture, successful groups and populations that have grown into larger entities will have to rely on further provisions, particularly institutions that involve formal hierarchies. So, while institutions may emerge in small groups and persist in large ones through additional factors, institutional collapse may occur in large groups when those additional factors of stabilizing cooperation disappear (see sections 3 and 4).

Against this background, we state our two initial claims as hypotheses, which will be refined from the various perspectives in the following sections:

*H1: Endogeneity*: In the evolutionary process of the emergence of institutionalized cooperation, there are mechanisms (in group psychological, cognitive, interaction- and network-related respects) that make institutional decline and collapse endogenously occur through the very institutional success.

*H2: Asymmetry*: Due to different habituated, group-based, and cultural-dispositional aspects of institutional emergence, institutional collapse may occur asymmetrically to (at different parameter constellations than) its emergence.

## 3. The individual level: Psychological determinants of cooperation and its collapse

In this section, cooperation is conceptualized as a prosocial act towards another person, which comes at a cost for the acting individual. We refer to the fact that humans are characterized by a fundamental motivational ambiguity towards their social counterparts due to their evolutionary history (e.g., Boehm 1989; Eibl-Eibesfeldt 1997). This has also been the foundation of the theory of individual behavior in fundamental works in economics since Adam Smith's *Theory of Moral Sentiments* (1759), and later, for instance, in evolutionary-institutional economics (Veblen 1899): on the one hand, there is a phylogenetical legacy of our primate ancestors that can make us behave agonistic and opportunistic (Eibl-Eibesfeldt 1997, 525-560). On the other hand, evolutionary trends in early hominids, enhanced by processes of cultural group selection of competing hominid bands (e.g., Richerson/Boyd 2005), lead to the genetic fixation of several genuine human prosocial capabilities, such as empathic behavior, sense of fairness, and spontaneous cooperation. Which part of human nature is actually displayed depends on the circumstances of social interaction, variance in personality, learning processes, and cultural influences (e.g., Tomasello 2009). In the following, we discuss individual-level determinants for cooperation (3.1.) and those for collapse (3.2.). From this we specify our hypothesis on the endogeneity of collapse (3.3.).

### 3.1. Individual-level determinants for prosocial behavior and cooperation

According to Tomasello (1999), the evolution of empathy was a major evolutionary step not only for the development of cultural learning abilities, but also for our natural inclination to act prosocially. In neuroscience, empathic reactions are studied by using neuro-imaging techniques in experiments that involve social interactions and provide hints for a physiological basis of cooperative behavior. According to Singer/Lamm (2009), an empathic reaction occurs when the observation of affective states in another person induces shared states in the observer. fMRI studies have investigated empathic responses in several emotional states including pain, anxiety, anger, pleasant affects, social exclusion, or embarrassment (see Bernhard/Singer 2012). These responses are taking place in brain regions (anterior insula, anterior and midcingulate cortex) that are usually activated if the person herself feels these emotions. Additionally, brain areas that are associated with social recognition are active in empathic situations. Empathy is distinct from emotional contagion or mimicry: while these do not require a separation from the source of the respective emotion (the self or the other), empathetic reactions involve affective sharing, self-awareness, and self-other distinction. Batson et al. (2007) argue that while observing a person suffering, the observer does not only represent the related pain within her own brain, but is motivated to relieve the suffering of the respective person, which translates into prosocial behavior. Hein et al. (2010) find that the induction of helping behavior is triggered by empathetic reactions. That spontaneous prosocial behavior in humans is present already with young infants has been shown in experimental studies (e.g., Bischof-Köhler 1991; Warneken/Tomasello 2009). This indicates that altruistic tendencies in humans reflect genetic predispositions.

Why do humans have genetic dispositions toward prosocial behaviors that are so vital for the emergence of cooperation? Ethology explains this via the rearrangement of functional behavioral modules during human evolution. Lorenz (1974) argues that prosocial emotions emerged originally by a redirection of initially aggressive drives (evoked by the social partner) toward a third party. The social partner serves as a “release mechanism” of aggressive psychic energy that is diverted to the environment, preferably to out-group persons. Recent ethologists argue that brood-caring instincts, which initially evolved in the context of childcare, are redirected toward the “extended family”. The dyadic emotional dispositions between mother and child were extended first to a triadic relationship including the father and later on to the whole social group (Eibl-Eibesfeldt 1997, 525-560). Similarly, the “big-mistake-hypothesis” in evolutionary psychology argues that in the course of increasing social abilities in humans, behaviors that evolved for kinship relations were extended to non-kin present in the social surrounding (Burnham/Johnson 2005).

### 3.2. Individual-level determinants of opportunism and non-social behavior

As indicated, prosocial behavior and its correlating brain structures are, in phylogenetic terms, relatively young. They are therefore competing with a more ancient emotional heritage of our primate ancestors, which presumably has been much more agonistic. While humans are able to extend their prosocial inclinations into an environment that is very different from the situation under which the social brain has evolved, there are also situations that trigger agonistic and opportunistic behavior or make it more likely. Indeed, several mechanisms at the group level evolved to keep these non-social tendencies under control (see section 4). In the absence of such control, non-social behavior becomes much more likely.

Knickmeyer et al. (2006) show that fetal testosterone levels are responsible for the degree of empathy a person can display in later life. Women seem to be on average more capable of empathic reactions than men are, because of lower testosterone production in sensitive phases of social brain development. Accordingly, men are more likely to show agonistic behavior. Baron-Cohen (2002) argues that above-average expression of testosterone in early – usually male – infancy may even lead to an absence of emphatic abilities. These persons then often have tremendous problems in their socialization and show usually reduced prosocial abilities. Bischof-Köhler (1991) argues that the ability to empathize can also induce malicious gloating if the personal relation (e.g., with an observed person in pain) is bad. Bernhard/Singer (2012) argue on the basis of fMRI studies that empathic reactions of people may be reduced if competing neuronal networks, e.g., the ones associated with emotions of revenge in the nucleus accumbens, are active.

In human ethology, it is argued that agonistic behavior is induced by the so called “fight and flight” system, suppressing prosocial behaviors (e.g., Eibl-Eibesfeldt 1997, 525-560). In situations of danger and stress, several neuro-active substances and hormones are released to push muscular activation in order to facilitate defense. This holds true for social stress as well (e.g., Jansen et al. 1995). One situation that may induce stress reactions is the presence of strangers. In children of a certain age, as well as in many native hunter-gatherer communities, out-groupers are not evoking spontaneous prosocial behavior, but are treated with caution or even fear. Eibl-Eibesfeldt (1997, 242) argues that this is a universal trait that has to be modified by individual learning and cultural imprinting. Hein et al. (2010) find that the propensity to help in-group members via activation of empathic neuronal networks is increased compared to out-group members in adults.

A variety of in-group conflicts trigger agonistic behaviors, e.g., situations where a person is bullied or treated unfairly. In most cultures, people expect to be treated fair in social interaction and react with considerable willingness to punish defectors if these expectations are violated (e.g., Henrich et al. 2001; Fehr/Fischbacher 2003). This includes the costly punishment of someone who has treated a third person of the group in an unfair manner. Singer et al. (2006) find that empathic reactions are modulated by the perceived fairness of others. The strength of these reactions against a cheater receiving shocks is significantly reduced, which may correlate with the willingness to punish unfair agents. The defense of fairness rules and the suppression of bullying may also be connected to the human tendency to preserve an egalitarian social structure (e.g., Boehm 2001).

Bullying behavior may be triggered by a personality that lacks empathic abilities, harsh environmental conditions and stress, or by opportunities to exploit in the absence of functioning social control mechanisms. Extreme forms of anti-social behavior, however, are often associated with reduced sizes of brain structures associated with emotions, such as the amygdala or the prefrontal cortex (e.g., Kiehl et al. 2001; Raine/Yang 2006). The question whether there exists a drive for aggressive behavior per se, producing spontaneous aggression, or if aggression is mainly instrumental to achieve other goals, is by no means settled in the literature (e.g., Eibl-Eibesfeldt 1997, 535). Finally, the impact of hierarchy on spontaneous cooperation in the context of organizations is studied in Witt/Schwesinger (2013). Identification with a group or its goals is a major motivation to behave cooperatively, as is discussed in the following section.

From these findings it follows that individuals can be considered to show spontaneous cooperative and prosocial behaviors based on compassion and empathy and experienced as self-rewarding. People are more likely to show considerable degrees of prosocial behavior within their own social group, though, preferably against individuals they are emotionally attached to. However, this prosocial tendency is fragile: individual ontogeny and learning, stressful situations, crestfallen expectations concerning the behavior of others, as well as influences from the wider cultural background may trigger non-cooperative or even aggressive behaviors. We therefore expect that the ambivalent human nature facilitates cooperation in large-scale social systems if the institutional setting is robust enough to accommodate situations that would trigger opportunistic or anti-social responses. This is summarized by our first specific hypothesis:

*H1.1*: Humans have both a propensity for aggressive (selfish, non-cooperative) behavior and prosocial psychological predispositions. The latter provide a basis for large-scale cooperation, which is much more common toward perceived in-group members. The willingness to behave cooperatively relies on expectations regarding mutual compliance with social institutions, such as equal treatment, and related norms, such as fairness and reciprocity. The violation of these institutions activates antagonistic cognitive modules, i.e., the propensity for aggressive behavior. This evokes costly punishment and exploitative behavior, finally causing cooperation to collapse.

## 4. The group-level: Anthropological evidence on group-based cooperation and its collapse

A central tenet of evolutionary theories is that behavior of organisms should maximize genetic fitness. As a corollary of this, natural selection should lead to cooperation among large numbers of individuals only if they are genetically closely related. With the exception of humans, where cooperation with non-relatives emerges spontaneously in small- and medium-sized groups, this result is consistent with available evidence (e.g. Mayr 1991). Large-scale cooperation is a kind of first choice only for human agents. In most organizations, employees cooperatively contribute much more to their organization's overall goal achievement than the minimum that could be extracted from them by supervisory enforcement of the (not fully specifiable) employment contract (e.g., Cordes et al. 2008; Carpenter et al. 2009). Yet, every organization faces the problem of the commons: benefits that are jointly gained and shared by all – non-contributors and contributors – and the resulting temptation of free-riding (e.g., Hardin 1968; Simon 1991). Why, then, is there anything besides free-riding? Why are humans capable of large-scale cooperation among non-relatives? And when does this large-scale cooperation break down?

### 4.1. Cultural group selection and the emergence of group-bound cooperation

The ancestors of modern humans became highly cultural in the Middle Pleistocene, perhaps 250,000 years ago (e.g., McBrearty/Brooks 2000). Humans are unique in the degree to which they depend upon culturally transmitted information to create complex adaptations (Norenzayan/Heine 2005). Boyd/Richerson (2002) proposed that the dispositions for cooperation and group-beneficial behaviors have evolved in a process of (1) gene-culture coevolution in combination with (2) cultural group selection (also Tomasello 2009; Henrich 2016): (1) the prevalent level of cooperation in a group as cultural arrangements exert some selection on innate human social dispositions. Culturally evolved social environments favor an innate psychology that is suited to these environments, such as a psychology aiming at social rewards and avoiding social sanctions (e.g., Rilling et al. 2002; Reuter et al. 2011). Moreover, repeated gene-culture coevolutionary cycles established more and more complex social institutions of cooperation in groups based on these evolved cognitive features. Over many generations this coevolutionary dynamic generated a social psychology that facilitates cooperation and other prosocial behaviors. These cognitive dispositions are the coevolved products of genes responding to the social and moral environments created by cultural institutions. This selective mechanism involves quite different behaviors from those favored by selection on genes alone. (2) By producing multiple behavioral equilibria among groups that comprise group-beneficial equilibria, cultural evolution endogenously facilitated a mechanism of selection among groups that favored prosociality (Henrich 2004; Soltis et al. 1995): cultural group selection selected from alternative behavioral equilibria in favor of the ones most successful in competing with other groups. In this context, groups with higher prosocial norms including cooperation had an advantage over groups with more competitive internal cultures.

Many aspects of group life root in this evolutionary past of humans (Robson/Kaplan 2003; Henrich, 2016). Their evolved cognitive dispositions – including prosocial behaviors – adapted for living in groups. The more complex societies of the sort we live in today only began to evolve about 5,000 years ago, too little time for much evolution of the genetic aspects of our social psychology. Hence, contemporary complex societies are based upon the cultural evolution of institutions using our social predispositions that resulted from the processes described. Anthropology argues that human nature is fundamentally tribal (see Richerson et al. 2006). Consequently, the group is critical to an understanding of human behavior and the workings of society's institutions. Individual dispositions to cooperate can be sufficient, in the first instance, to initiate and sustain cooperation in small-scaled groups using informal face-to-face interactions. Moreover, these social predispositions include a tendency to identify with larger, symbolically marked groups and their institutions and norms (e.g., McElreath et al. 2003). Large, complex global societies, therefore, still depend upon the dispositions that help stabilize cooperation in small groups as their building blocks (e.g., Richerson/Boyd 2005).

Anthropologist Coon (1946) argued that small groups, in which people know one another personally and meet and communicate habitually, form the fundamental units of human organization. Thus, the only successful way to organize human agents in larger and more complex societies is through combination of small groups as face-to-face organizations.[2] Essential organizational processes are grounded in person-to-person relationships that are not part of formal control systems. Also, studies on village-scale commons management suggest that small, band-based systems can be maintained by informal agreements, but that larger systems may require formal rules and mechanisms as well, such as formal monitoring and sanctioning (Ostrom 2000) – and need to be built from basic modules as a layered multiplex network structure (e.g., Simon 1962; Wilson et al. 2013; see section 6). Thus, the band-sized group represents the limits of cooperation organized by purely informal means. Larger groups that produce significant benefits have clearly articulated (formal) institutions for monitoring and enforcement.

[2] See also Simon's (1962) theory of the modular architecture of complex systems.

## 4.2. Conditions of deteriorating cooperation and collapse: Group size and growth

Cooperation is fragile and highly contextual, as shown, e.g., by the cross-cultural variation of cooperation in ultimatum and public-good games (e.g., Henrich et al. 2006; Herrmann et al. 2008). A critical factor is group size and its growth (also sections 5, 6). A common finding in lab experiments and field data is that, as groups grow, performance declines: people who belong to larger groups are, other things equal, less satisfied with group membership, participate less often in collective activities, show more misbehavior, free riding, and contribute less often to group activities (Levine/Moreland 1990; Mukhopadhaya 2003; Forsyth 2006). Coordination problems through increasing uncertainty, decreasing trust, and motivation losses in larger, more anonymous groups with higher (perceived) complexity, opacity, and volatility (in meeting interaction partners) impair performance and prevent reaping productive potentials.

Marlowe (2005) reviewed group sizes among hunter-gatherers who most closely resembled our Pleistocene ancestors. Local residential groups (bands) averaged 48 (median 30) people, i.e., hunter-gatherer bands tended to equilibrate at group sizes around less than 50 individuals. These groups were nested within ethno-linguistic groups (tribes), whose sizes averaged 1750 members. The author found no indication of local-group sizes depending on other factors than cognition, such as, e.g., natural resources. Rather, the upper limit on group size appears to be determined by the frequency of bickering, reflecting an increase in free riding. This interpretation is further strengthened by the results of Dunbar (1993, 2008), who highlights the existence of cognitive constraints on our ability to maintain social, personalized relationships at a given level of emotional intensity (see Sawaguchi/Kudo 1990; Zhou et al. 2005). This manifests in the structure of the human brain: average species' group size correlates with relative neocortex size. The derived expected critical sizes of human groups correspond well with the observations of Marlowe.

These constraints are still relevant today. There is some anecdotal relevance given by the existence of tailored packages of management consultancy that aim at firms reaching a critical size at 50-60 employees. Firms below this threshold can be operated in more freewheeling, informal ways and face-to-face contacts by an influential business leader who maintains a cooperative corporate culture (Cordes et al. 2008). Above that number, a change toward more conventional management practices or transition to smaller subdivisions is needed (Witt 1998). This implies that to sustain cooperation in growing groups (particularly more than 50 people) requires (1) more explicit and formal institutions, control, and sanctioning or (2) sophisticated structures of subdivisions.

These findings suggest that the collapse of cooperation occurs endogenously when group sizes increase without these counter measures being put in place (also Elsner/Schwardt 2014). It becomes more difficult in larger groups to realize institutionalized cooperation and related social and economic performance. Greater group size easily gives rise to basic changes in members' behavior: more frequent appearance of opportunistic behavior in growing groups allows for the rapid actualization of non-social predispositions and the spreading of selfish behavior. Members who were willing to contribute to the benefit of the group may suddenly change their behavior when the group exceeds a critical size (see Gladwell 2000; Card et al. 2008).

These insights from anthropology have implications for collapse and emergence of cooperation:

*H1.2: Endogeneity*: In the course of cooperation-driven growth of groups, these reach a cognitive critical size beyond which the level of cooperation among their members may rapidly decline and collapse. Group size and the related economic entity are then likely to shrink again.

Moreover, once opportunistic or free-riding behavior becomes an established behavioral alternative to cooperation, a return to large-scale cooperation at the group-level is unlikely to happen. This leads to the following specific asymmetry hypothesis:

*H2.1: Asymmetry*: The tipping-point of size-induced collapse of institutions of cooperation within groups is asymmetric to its point of emergence. When groups decline, the former level of cooperation will probably not be reached again. Levels of cooperation and organizational unit sizes as well as socio-economic performance will therefore remain for longer periods below the threshold (of parameter settings) of earlier cooperation emergence.

## 5. Emergence and collapse of cooperation in networks

Cooperation emerges more easily in closely connected small groups because of a relatively high probability to meet each other again. In practice, however, there are also large cooperative groups. This is because of structured interaction in social networks: not every agent of a population typically interacts with every other agent. Dunbar's (1993) cognitive critical group-size remains valid in larger and more complex population networks and is applicable to their smaller individual sub-populations. In this way, the structure of networks forms another critical factor as to the evolution of cooperation: there is a systematic impact of a population's network structure, particularly of the degree distribution, clustering, average path-length, and the interrelations among those three, on the emergence and collapse of cooperation.

### 5.1. Network structures and the emergence of cooperation

Compared to models without or with very simple network structures, the dynamics of both emergence and collapse of cooperation are different on non-trivial networks (Zenou 2012). There are a number of network structures that facilitate the emergence of cooperation, especially in models with imitation learning, i.e., agents copying the strategies of more successful agents in their vicinity (Fu et al. 2008; Fehl et al. 2011; Santos et al. 2012). The most relevant network properties are heterogeneous degree distributions and high degree correlations.

High degree correlation is a property of a network according to which high-degree nodes (hubs) tend to have high-degree neighbors. High degree-correlation allows cooperation to spread more easily between high-degree nodes (e.g., Rong/Wu 2009). With lower degree-correlation, a network would have a substantial number of isolated hub-structures, in which defection may more easily persist. Heterogeneous degree distributions facilitate cooperation by generating a negative feedback for defecting hubs, and a positive feedback for cooperative hubs (e.g., Santos et al. 2012; Pacheco et al. 2009). Defecting hubs, i.e., defectors with many connections, cause their less well-connected neighbors to copy their defective strategy although well-connected neighbors will be less easily compelled to become defectors. The spread of defection to the neighborhood reduces the hub's success and forces it to copy the cooperative strategy from other hubs it remains connected to. Heterogeneous degree distributions are empirically highly relevant given that most social networks are heavy-tailed (or even scale-free).

Endogenous modifications of networks may also facilitate the emergence of cooperation. In this case, the network is dynamic and coevolves with the population. Choosing, avoiding, or cutting links to particular interaction partners facilitates attaining an initial critical minimum mass k (or ratio k/n) of cooperating agents. This enables cooperators to generate superior payoffs overall and thus take over the population and entailing social or spatial clustering among cooperators (e.g., Mantzaris et al. 2013). However, the mere fact that a network is dynamic does not inherently facilitate the emergence of cooperation on it. Network dynamics that are neutral or detrimental to the emergence of cooperation are conceivable.

### 5.2. Network structures and the collapse of cooperation

A change of the network structure toward a less favorable parameter setting, e.g., through the reduction of a high degree correlation, can hinder the emergence of cooperation. But can it also lead to the collapse of a cooperative population?

The effect of network structure is more complex indicating a clear asymmetry between emergence and collapse of cooperation. For the case of degree correlation, e.g., Rong/Wu (2009) found that a high degree correlation favors the emergence of cooperation, yet a low degree correlation stabilizes the current strategy configuration. Moreover, if a network is clustered, a cooperative group may be able to maintain itself as a cluster within a less and less favorable broader environment for some time. But if the environmental conditions deteriorate further, the group collapses and this collapse will be sudden and catastrophic. The group will quickly reintegrate with the rest of the population, once the mechanisms that protected the group vanish. The phenomenon has become known recently as *Seneca effect*, i.e., mechanisms entailing slow emergence but rapid collapse (Bardi 2017) and can conveniently be modeled within a catastrophe theory model (Heinrich 2018).

Empirical social networks are highly clustered and subject to dynamic modifications that favor clustering. The described asymmetry should therefore be expected to occur frequently and strongly in social networks. The deterioration of favorable conditions for cooperation may be caused by a variety of exogenous changes. One straightforward example, for which the effect has been demonstrated, is changing resource availability (Sugiarto et al. 2015).

Therefore, the network structure of a population has important implications for the asymmetry between emergence and collapse of cooperation:

*H2.2: Asymmetry*: Consider a system with a network structure in which changing environmental conditions should lead to an emergence of cooperation at parameter set A, but to the collapse of cooperation, if change is reversed, at point B. For networks with homogeneous degree distribution, points A (emergence) and B (collapse) are stable and identical. For networks with heterogeneous degree distribution, A and B will be stable and significantly different from one another.

*H2.3*: Endogeneity (partner selection) facilitates the emergence of cooperation by shifting both A and B in favor of the emergence and persistence of cooperation.

*H2.4*: Endogeneity (partner selection) facilitates the emergence of cooperation relatively more than the collapse of cooperation.

# 6. An evolutionary-institutional perspective on endogeneity and asymmetry

## 6.1. Emergence of cooperation

The puzzle of cooperation gained attention in economics in the context of the private provision of collective goods in the 1960s (e.g., Runciman/Sen 1965; Olson/Zeckhauser 1967). The interest in cooperation further developed in relation to behavioral experiments and game theorists have incorporated psychological, behavioral, biological, and anthropological evidence into their models since then (e.g., Axelrod 1984, Bowles/Gintis 2013). The emergence of cooperation, thus, is usually based on iterated prisoners' dilemmas in an evolution-of-cooperation approach.

Interpreting this result within the framework of evolutionary-institutional theory, cooperation is not feasible based on myopic hyper-rationality. It rests on interactively learned and habitually applied social institution followed by boundedly rational agents and on learned expectations to meet the same interaction partner again or, more generally, to meet a cooperator in a population. With learned, acquired, and habituated cooperation in some interaction arena, a spill-over into other arenas, where agents interact in other positions and with other partners, becomes feasible (e.g., Gintis 2004; Bednar et al. 2015). Institutionalization, habituation, and further normatization may anchor cooperative behavior beyond myopic calculus and choice. Institutionalized cooperative behavior then becomes part of the broader social environment (e.g., Bowles/Gintis 2013; McCain 2014). Agents may cooperate even toward strangers in one-shot interactions.

With this, cooperation behavior need no longer be tied to the original problem structure. It may be transferred to other arenas and may be maintained even after a problem situation has changed. In basic EGT, emergence and collapse of cooperation would formally appear symmetric and simply be reversals. Collapse would occur at the same set of values of, e.g., the discount factor or population shares, where emergence did before. But the institutional embeddedness of behavior allows to consider asymmetries between emergence and collapse.

## 6.2. Factors of institutional emergence bear endogeneity of collapse

Emerged institutionalized cooperation bears economic success through its superiority over common defection, for both the individual and the relevant population (or group), in the longer run. Nevertheless, the individualist incentive to defect and exploit remains dominant in the short run. The successful, cooperating population may grow in income and in numbers, be it through more progeny or higher attraction to outsiders and increasing immigration. This expansion may deteriorate the very cognitive conditions of cooperation. In a growing population, newcomers may not learn incumbent cooperative culture sufficiently fast. The cooperators' share in the population may fall below a minimum critical mass. Perceived uncertainty, over-complexity, and opacity may increase again. This implies a loss of recognized interdependence, of knowledge on problem-solving, of the perceived connection between action and reaction, or of a sufficiently long-run perspective (Glaeser et al. 2002; Solari/Gambarotto 2014). With returning myopia, the incentive to realize the short-run payoff becomes the dominant motivation again. Diamond (2005, 427-431) calls such backsliding into "rational bad behavior" the "most frequent" reason of collapse.

Another reason for the endogeneity of collapse may be the uneven distribution of the gains of cooperation under differential hierarchical status, power, or network centrality. The ceremonial motive of more differential status and power may strengthen the mechanism to unevenly distribute the gains in favor of the more powerful. The empirical evidence for the relevance of inequality as a cause of socio-economic collapse is large (e.g., Turchin 2003; Furman 2017). Distributional aspirations for higher relative socio-economic position may then dominate over absolute achievement in a society. The more distributional aspirations dominate, the less socially mobile the society and the worse overall performance often will become (e.g., Veblen 1899 on positional struggle in predatory societies; also Torgler et al. 2006; Wilson et al. 2013; Nishi et al. 2015).

Sticking to the old institution, then, is attractive for those agents who find themselves in the favored position. But, as C.E. Ayres (1962) pointed out, the dominance of ceremonial institutional behavior tends to lead even agents who do not benefit to continue following the established institutional habits. The habituated behavior provides institutionalized identity and belongingness to the lower ranks of the group (Brewer/Kramer 1986; Elsner 2012). Furthermore, habits save cognitive effort and match it with cognitive capacity and keep monitoring, punishment, and other transaction costs relatively low. The formally same habituated behavior will in those cases be exercised with different consequences, including a shift to a non-cooperative character, to exploitative relations, reduced socio-economic performance, and eventually economic decline, crisis, and collapse.

### 6.3. Factors of emergence also bear asymmetry

Cognitive limits and habituation also apply to the case of asymmetry. This relates to the fact that coordinating people onto a newly emerging institution is time-consuming and costly. In the short term, an already inferior old institution may rationally seem worthwhile to maintain. This may apply even beyond the point where conditions (parameters) have reversed to the same state where the institution initially emerged (for a model of such institutional asymmetry, e.g., Elsner 2012; Heinrich/Schwardt 2013). The inferior, and by now inappropriate, old institution will then be upheld beyond the point of instrumentality. Under both variants of institutional inappropriateness, (1) dominance of the ceremonial dimension causing an increasing unevenness of distribution and a change in incentive structures and (2) ineffectiveness as to institutional economies of scale, an asymmetry of institutional collapse vis-à-vis its emergence is to be expected. Be it that it is upheld beyond the point of appropriate change or beyond the point of earlier emergence should the conditional parametrical configuration simply reverse.

Due to such institutional hysteresis, there may be a period of stagnancy, while the final collapse is assumed to be relatively sudden. Further, once a culture of noncooperation spreads, it will be aggravated by increased monitoring costs and more costly punishment (Horiuchi 2015). Too fierce a punishment culture may also prevent innovation and further the degeneration of the institutional setting. High degrees of punishment are negatively correlated with cooperation, problem-solving, and socio-economic thriving (e.g., Povey 2014). Other related costs then increase as well, such as costs of building reputation, signaling, contracting, controlling, insuring, etc. (Fu et al. 2008). Real-world examples of collapse result in increasing short-termism (e.g., Aspara et al. 2014) and winner-takes-all cultures, both entailing decreasing system resilience (e.g., Acemoglu et al. 2015).

Our evolutionary-institutional argument is summarized by the following hypotheses:

*H1.3: Endogeneity*: Institutions of cooperation endogenously collapse when (1) their very success makes the relevant group or population grow, which may deteriorate the cognitive conditions required for cooperation through higher volatility, myopia, and opacity, i.e., perceived over-complexity, and increase monitoring and punishment costs. (2) Increasingly unequal distribution of the gains of cooperation in power- and status-asymmetries makes the same formal institutional behavior become ceremonial, so that the old cooperation eventually breaks up and general defection and a new distributive and positional struggle takes effect.

*H2.5: Asymmetry*: Institutional collapse occurs asymmetrically, i.e., at less favorable levels of parameter sets than emergence when (1) redistributive processes and transformed incentives not only make the winners stick to the institutionalized behavior, but inferiors as well, who yield stability, identity, and belongingness, matching cognitive limits as to the pace of institutional change. (2) Institutionalized behavior is used beyond the constellation of its emergence when parameters reverse in order to save cognitive effort by habituation and normatization and to exploit decreasing costs of collective decision-making of the old institution.

## 7. Conclusions

In this paper, we developed an integrative multiparadigmatic and multidisciplinary perspective on the collapse of cooperative institutions and their related socio-economies. We focused on mechanisms of the (1) endogeneity of institutional collapse and (2) the asymmetry between conditions of emergence and collapse.

First, in the biological and anthropological perspective of gene-culture coevolution, our psychological endowment as a heritage from thousands of generations of human social evolution provides us with some disposition to behave prosocially and cooperatively (section 3). This is linked to an expectation that a partner will comply to rules of fairness, reciprocity, and equal treatment. If this expectation is violated, humans tend to switch to a more agonistic behavior. If interactions violate our expectation or norm set, our propensity to cooperate is strongly reduced. We endogenously (i.e., within the dispositional spectrum available), but often asymmetrically (e.g., under more non-cooperation than prevalent when the institution emerged), switch back to a phylogenetically more ancient propensity of aggressive (non-cooperative) behavior. Particularly, cooperation is connected to a perception of “in-group” vs. “out-group” and may collapse through (1) growth of the relevant group or (2) intensifying interactions with out-groups, which both cannot be sufficiently cognitively absorbed by the in-group members.

Second, this is in line with findings from anthropology (section 4). Evolution and multi-level selection at individual, in-group, and between-group levels was a central driver of large-scale cooperation. Under strong between-group rivalry, cooperative institutions are favored by cultural group selection. However, the attenuation of external rivalry may relax the need to maintain these institutions entailing institutional decline and collapse in some groups (the relevant population).

Third, network structures can influence emergence and collapse of cooperation (section 5). Among the characteristics that have been identified as favorable to cooperation are heterogeneous degree distributions, high degree correlations, and some endogenous link formation and removal dynamics. Further, conditions of emergence and collapse of cooperation on non-trivial networks are not typically symmetric. Instead, cooperative structures may, once in existence, be able to support themselves even under less favorable conditions. This capacity is limited though. Reaching this limit leads to a catastrophic collapse, not a gradual one that would mirror the emergence.

Fourth, also an evolutionary-institutional analysis (section 6) reveals constellations where we find endogenous and asymmetric collapse. The very success of cooperation may lead to prosperity and growth of the group, which, in turn, may increase perceived turbulence and endogenously undermine the cognitive and expectational foundations of cooperation. Further, cooperation gains may be unevenly distributed, which also may endogenously undermine established cooperation. There is ample empirical, experimental, and computational knowledge that inequality may cause institutional and socio-economic decline and collapse (e.g., Elsner 2017). In all, increasing turbulence, rising inequality and ceremonialization, entailing myopia, higher monitoring and punishment costs, may lead to a collapse of cooperation and socio-economic prosperity.

In terms of asymmetry, the very sunk fixed costs of institutional emergence, particularly habituation, psychological generalization, and normatization, imply decreasing average costs of collective decision-making and thus a tendency to apply an institution beyond the point where it became inappropriate and a new one should have emerged. And even if the set of parametric conditions linearly reverses, the values originally prevalent at emergence may already be undershot when collapse eventually occurs. The overlong maintenance of the old institution makes it ever less problem-solving and lead the economy into decline over a period of time, while the institutional collapse may occur suddenly when institutions experience cumulative crisis.

Considering processes after collapse, it appears unlikely that a group will easily recover to re-emergence and previous levels of cooperativeness. This is known in the theoretical, historical, and empirical literature, e.g., for societies suffering from exclusive institutions (Acemoglu/Robinson 2012). Collapse of cooperation proved to be non-reversible for long periods, another asymmetry with the previous emergence and the foregoing collapse. We conclude that not only the process of emergence but also of collapse of prosociality is fundamentally endogenous to complex adaptive systems and their evolution. It is asymmetric in different disciplinary and paradigmatic perspectives. A largely consistent system of hypotheses could be derived, which can be used in further research for more detailed complex modeling and (empirically anchored) computational research. It is not only for theoretical and formal, but also for urgent contemporary practical reasons that economics should increasingly turn to problems of institutional and systemic collapse.

## References


Acemoglu, D., Robinson, J. A. (2012): Why Nations Fail. The Origins of Power, Prosperity and Poverty, London: Profile Books.

Acemoglu, D., Ozdaglar, A. and Tahbaz-Salehi, A. (2015): Networks, Shocks, and Systemic Risk, in: Oxford Handbook on the Economics of Networks. Columbia Business School Research Paper 15-18.

Aspara, J., Pajunen, K., Tikkanen, H. and Tainio, R. (2014): "Explaining corporate short-termism: self-reinforcing processes and biases among investors, the media and corporate managers", Socio-Economic Review, Vol. 12, No. 4, pp. 667-693.

Axelrod, R. (1984): The Evolution of Cooperation, New York: Basic Books (repr. 2006).

Ayres, C. E. (1962): "The Theory of Economic Progress", Foreword to the 1962 edition, UMKC internet edition, http://cas.umkc.edu/econ/Institutional/Readings/Ayres/tep/TEP.html.

Bardi, U. (2017): The Seneca Effect. Why Growth is Slow but Collapse is Rapid, Heidelberg: Springer.

Baron-Cohen, S. (2002). "The Extreme Male Brain Theory of Autism". Trends in Cognitive Sciences Vol. 6, No. 6, pp. 248-254.

Batson, C. D., Eklund, J. H., Chermok, V. L., Hoyt, J. L. and Ortiz, B. G. (2007) "An additional antecedent of empathic concern: valuing the welfare of the person in need", Journal of Personality and Social Psychology, Vol. 93, No. 1, pp. 65-74.

Bednar, J., Jones-Rooy, A. and Page, S. E. (2015): "Choosing a future based on the past: Institutions, behavior, and path-dependence"; European Journal of Political Economy, Vol. 40, pp. 312-332.

Bernhardt, B. C. and Singer, T. (2012): "The neural basis of empathy", Annual Review of Neuroscience, Vol. 35, pp. 1-23.

Bischof-Köhler, D. (1991): "The development of empathy in infants", in: Lamb, M. E. and Keller, H. (eds.), Infant development: Perspectives from German speaking countries, Hillsdale, NJ: Lawrence Erlbaum Associates, pp. 245-273.

Block, F. (2000): "Disorderly co-ordination: the limited capacities of states and markets", in: Burlamaqui, L. et al, Institutions and the Role of the State, Cheltenham, UK, Northampton, MA, USA: Elgar, pp. 53-71.

Boehm, C. (1989): "Ambivalence and compromise in human nature", American Anthropologist, Vol. 91, pp. 921-939.

Boehm, C. (2001): Hierarchy in the forest: The evolution of egalitarian behavior, Cambridge, MA, London: Harvard University Press.

Bowles, S. and Gintis, H. (2013): A Cooperative Species, Princeton, Oxford: Princeton University Press.

Boyd, R. and Richerson, P. J. (1985): Culture and the Evolutionary Process, Chicago: University of Chicago Press.

Boyd, R. and Richerson, P. J. (2002): "Group Beneficial Norms Can Spread Rapidly in a Structured Population", Journal of Theoretical Biology, Vol. 215, No. 3, pp. 287-296.

Brewer, M. B. and Kramer, R. M. (1986): "Choice Behavior in Social Dilemmas: Effects of Social Identity, Group Size, and Decision Framing", Journal of Personality and Social Psychology, Vol. 50, No. 3, pp. 543-549.

Brooks, N. (2012): “Beyond collapse: climate change and causality during the Middle Holocene Climatic Transition, 6400-5000 years before present”, Geografisk Tidsskrift—Danish Journal of Geography, Vol. 112, No. 2, pp. 93-104.

Burnham, T. C. and Johnson, D. D. (2005): “The biological and evolutionary logic of human cooperation”, Analyse&Kritik, Vol. 27, No. 2, pp.113-135.

Card, D., Mas, A. and Rothstein, J. (2008): “Tipping and the Dynamics of Segregation”, Quarterly Journal of Economics, Vol. 123, No. 1, pp. 177-218.

Carpenter, J., Bowles, S., Gintis, H. and Hwang, S. H. (2009): “Strong reciprocity and team production: Theory and evidence”, Journal of Economic Behavior & Organization, Vol. 71, No. 2, pp. 221-232.

Coon, C. S. (1946): “The Universality of Natural Groupings in Human Societies”, Journal of Educational Sociology, Vol. 20, No. 3, pp. 163-168.

Cordes, C., Richerson, P. J., McElreath, R. and Strimling, P. (2008): “A Naturalistic Approach to the Theory of the Firm: The Role of Cooperation and Cultural Evolution”, Journal of Economic Behavior & Organization, Vol. 68, No. 1, pp. 125-139.

Diamond, J. (2005): Collapse. How Societies Choose to Fail or Succeed, New York: Viking-Penguin.

Dunbar, R. I. M. (1993): “Co-Evolution of Neocortex Size, Group Size and Language in Humans”, Behavioral and Brain Sciences, Vol. 16, No. 4, pp. 681-735.

Dunbar, R. I. M. (2008): “Cognitive Constraints on the Structure and Dynamics of Social Networks”, Group Dynamics: Theory, Research, and Practice, Vol. 12, No. 1, pp. 7-16.

Eibl-Eibesfeldt, I. (1997): Die Biologie des menschlichen Verhaltens, Weyarn: Seehamer Verlag.

Elsner, W. (2012): “The Theory of Institutional Change Revisited. The Institutional Dichotomy, Its Dynamic, and Its Policy Implications in a More Formal Analysis”, Journal of Economic Issues, Vol. 41, No. 1, pp. 1-43.

Elsner, W. (2017): “Complexity economics as heterodoxy: Theory and policy”, Journal of Economic Issues, Vol. 51, No. 4, pp. 939-978.

Elsner, W. and Schwardt, H. (2014): “Trust and arena size: expectations, institutions, and general trust, and critical population and group sizes”, Journal of Institutional Economics, Vol. 10, pp. 107-134.

Elster, J. (1983): Explaining Technical Change. A Case Study in the Philosophy of Science, Cambridge, UK: Cambridge University Press.

Epstein, J. and Axtell, R. (1996): Growing Artificial Societies. Social Science from the Bottom Up, Cambridge, MA: MIT Press.

Fehl, K., Van der Post, D. J. and Semmann, J. (2011): “Co-evolution of behaviour and social network structure promotes human cooperation”, Ecology Letters, Vol. 14, No. 6, pp. 546-551.

Fehr, E. and Fischbacher, U. (2003): “The nature of human altruism”, Nature, Vol.425, No. 6960, pp. 785-791.

Forsyth, D. R. (2006): Group Dynamics, Belmont: Thomson Wadsworth.

Fu, F., Hauert, C., Nowak, M. A. and Wang, L. (2008): “Reputation-based partner choice promotes cooperation in social networks”, Physical Review E, Vol. 78, No. 2, pp. 026117.

Furman, J. (2017): “Productivity Is Slowing and Inequality Is Growing. Productivity, Inequality, and Economic Rents”, http://evonomics.com/productivity-is-slowing-inequality-is-growing-heres-whats-causing-it/; retrieved April 24, 2017.

Gintis, H. (2004): “The Genetic Side of Gene-Culture Coevolution: Internalization of Norms and Prosocial Emotions”, Journal of Economic Behavior & Organization, Vol. 53, No. 1, pp. 57-67.

Gladwell, M. (2000): The Tipping Point, Boston: Little, Brown and Company.

Glaeser, E., Laibson, D. and Sacerdote, B. (2002): “An Economic Approach to Social Capital”, Economic Journal, Vol. 112, No. 483, pp. F437-F458.

Hardin, G. (1968): “The Tragedy of the Commons”, Science, Vol. 162, No. 3859, pp. 1243-1248.

Hein, G., Silani, G., Preuschoff, K., Batson, C. D., and Singer, T. (2010): “Neural responses to ingroup and outgroup members' suffering predict individual differences in costly helping”, Neuron, Vol. 68, No. 1, pp. 149-160.

Heinrich, T. (2018): “A Discontinuity Model of Technological Change: Catastrophe Theory and Network Structure”, Computational Economics, Vol. 51, No. 3, pp. 407-425.

Heinrich, T., Schwardt, H. (2013): “Institutional Inertia and Institutional Change in an Expanding Normal-Form Game”, Games, Vol. 4, pp. 398-425.

Henrich, J. (2004): “Cultural Group Selection, Coevolutionary Processes and Large-scale Cooperation”, Journal of Economic Behavior and Organization, Vol. 53, No. 1, pp. 3-35.

Henrich, J. (2016): The Secret of Our Success, Princeton, NJ: Princeton University Press.

Henrich, J., Boyd, R., Bowles, S., Camerer, C., Fehr, E., Gintis, H. and McElreath, R. (2001): “In Search of Homo Economicus: Behavioral Experiments in 15 Small-Scale Societies”, American Economic Review, Vol. 91, No. 2, pp. 73-78.

Henrich, J., McElreath, R., Barr, A., Ensminger, J., Barrett, C., Bolyanatz, A., Cardenas, J. C., Gurven, M., Gwako, E., Henrich, N., Lesorogol, C., Marlowe, F., Tracer, D. and Ziker, J. (2006): “Costly Punishment Across Human Societies”, Science, Vol. 312, pp. 1767-1770.

Herrmann, B., Thöni, C. and Gächter, S. (2008): “Antisocial Punishment Across Societies”, Science, Vol. 319, pp. 1362-1367.

Hodgson, G. M. (2000): “From micro to macro: the concept of emergence and the role of institutions”, in: L. Burlamaqui et al. (eds.), Institutions and the Role of the State, Cheltenham, UK, Northampton, MA: Elgar, pp. 103-126.

Horiuchi, S. (2015): “Emergence and Collapse of the Norm of Resource Sharing around Locally Abundant Resources”, Journal of Artificial Societies and Social Simulation, Vol. 18, No. 4, pp. 7.

Jansen, A. S., Van Nguyen, X., Karpitskiy, V., Mettenleiter, T. C. and A Loewy, A. D. (1995): “Central command neurons of the sympathetic nervous system: basis of the fight-or-flight response”, Science, Vol. 270, No. 5236, pp. 644-646.

Janssen, M. A., Kohler, T. A. and Scheffer, M. (2003): “Sunk-Cost Effects and Vulnerability to Collapse in Ancient Societies”, Current Anthropology, Vol. 44, No. 5, pp. 772-728.

Kesternich, M., Lange, A. and Sturm, B (2014): “The impact of burden sharing rules on the voluntary provision of public goods”, Journal of Economic Behavior and Organization, Vol 105, pp.107-123.

Kiehl, K. A., Smith, A. M., Hare, R. D., Mendrek, A., Forster, B. B., Brink, J. and Liddle, P. F. (2001): “Limbic abnormalities in affective processing by criminal psychopaths as revealed by functional magnetic resonance imaging”, Biological Psychiatry, Vol. 50, No. 9, pp. 677-684.

Knickmeyer, R., Baron-Cohen, S., Raggatt, P., Taylor, K. and Hackett, G. (2006): “Fetal testosterone and empathy”, Hormones and Behavior, Vol. 49, No. 3, pp. 282-292.

Levine, J. M. and Moreland, R. L. (1990): “Progress in Small Group Research”, Annual Review of Psychology, Vol. 41, pp. 585-634.

Lorenz, K. (1974): On Aggression, Boston, MA: Houghton Mifflin Harcourt.

Mantzaris, A. V., Basset, D. S., Wymbs, N. F., Estrada, E. et al. (2013): “Dynamic network centrality summarizes learning in the human brain”, Journal of Complex Networks, Vol. 1, pp. 83-92.

Marlowe, F. W. (2005): “Hunter-Gatherers and Human Evolution”, Evolutionary Anthropology, Vol. 14, pp. 54-67.

Mayr, E. (1991): One Long Argument: Charles Darwin and the Genesis of Modern Evolutionary Theory, Cambridge, Mass.: Harvard University Press.

McBrearty, S. and Brooks, A. S. (2000): “The Revolution that Wasn't: A New Interpretation of the Origin of Modern Human Behavior”, Journal of Human Evolution, Vol. 39, No. 5, pp. 453-563.

McCain, R. A. (2014): Reframing Economics. Economic Action as Imperfect Cooperation, Cheltenham, UK, Northampton, MA, USA: Elgar.

McElreath, R., Boyd, R. and Richerson, P. J. (2003): “Shared Norms and the Evolution of Ethnic Markers”, Current Anthropology, Vol. 44, No. 1, pp. 122-129.

Meija, J. (2018): “The Network Formation Origin of Tribal Societies”, Documento CEDE, No. 33.

Mukhopadhaya, K. (2003): “Jury Size and the Free Rider Problem”, Journal of Law, Economics, & Organization, Vol. 19, No. 1, pp. 24-44.

Nishi, A., Shirado, H., Rand, D. and Christakis, N. (2015): “Inequality and visibility of wealth in experimental social networks”, Nature, Vol. 526, No. 7573, pp. 426.

Norenzayan, A. and Heine, S. J. (2005): “Psychological Universals: What Are They and How Can We Know?”, Psychological Bulletin, Vol. 131, No. 5, pp. 763-784.

Olson Jr, M. and Zeckhauser, R. (1967): “Collective goods, comparative advantage, and alliance efficiency”, in: Issues in Defense Economics, NBER, pp. 25-63.

Ostrom, E. (2000): “Collective Action and the Evolution of Social Norms”, Journal of Economic Perspectives, Vol. 14, No. 3, pp. 137-158.

Pacheco, J. M., Pinheiro, F. L. and Santos, F. C. (2009): “Population structure induces a symmetry breaking favoring the emergence of cooperation”, PLoS Comput Biol, Vol. 5, No. 12, pp. e1000596.

Povey, R. (2014): “Punishment and the potency of group selection”, Journal of Evolutionary Economics, Vol. 24, No. 4, pp. 799-816.

Raine, A. and Yang, Y. (2006): “Neural foundations to moral reasoning and antisocial behavior”, Social Cognitive and Affective Neuroscience, Vol. 1, No. 3, pp. 203-213.

Rasmus, J. (2016): Systemic Fragility in the Global Economy, Atlanta, GA: Clarity Press.

Reuter, M., Frenzel, C., Walter, N. T., Markett, S. and Montag, C. (2011): “Investigating the Genetic Basis of Altruism: The Role of the COMT Val158Met Polymorphism”, Social Cognitive and Affective Neuroscience, Vol. 6, No. 5, pp. 662-668.

Richerson, P. J. and Boyd, R. (2005): Not by Genes Alone: How Culture Transformed Human Evolution, Chicago: The University of Chicago Press.

Richerson, P. J., Collins, D. and Genet, R. M. (2006): "Why Managers Need an Evolutionary Theory of Organizations", Strategic Organization, Vol. 4, No. 2, pp. 201-211.

Richman, B. D. (2016): "An Autopsy of Cooperation: Diamond Dealers and the Limits of Trust-Based Exchange"; http://scholarship.law.duke.edu/faculty_scholarship/3594/, retrieved April 25, 2017.

Rilling, J. K., Gutman, D. A., Zeh, T. R., Pagnoni, G., Berns, G. S. and Kilts, C. D. (2002): "A Neural Basis for Social Cooperation", Neuron, Vol. 35, pp. 395-405.

Robson, A. J. and Kaplan, H. S. (2003): "The Evolution of Human Life Expectancy and Intelligence in Hunter-Gatherer Economies", American Economic Review, Vol. 93, No. 1, pp. 150-169.

Rong, Z. and Wu, Z. X. (2009): "Effect of the degree correlation in public goods game on scale-free networks",Europhysics Letters, Vol. 87, No. 3, pp. 30001.

Runciman, W. G. and Sen, A. K. (1965): "Games, justice and the general will", Mind, Vol. 74, No. 296, pp. 554-562.

Santos, F. C., Pinheiro, F. L., Lenaerts, T. and Pacheco, J. M. (2012): "The role of diversity in the evolution of cooperation", Journal of Theoretical Biology, Vol. 299, No. 0, pp. 88-96.

Sawaguchi, T. and Kudo, H. (1990): "Neocortical Development and Social Structure in Primates", Primates, Vol. 31, No. 2, pp. 283-289.

Setterfield, M. (1996): "Hysteresis and Uncertainty. Complementary or competing visions of evolving economic systems?", in: Pressman, S. (ed.), Interactions in Political Economy, London, New York: Routledge, pp. 133-148.

Simon, H. A. (1962): "The Architecture of Complexity", Proceedings of the American Philosophical Society, Vol. 106, pp. 467-482.

Simon, H. A. (1991): "Organizations and Markets", Journal of Economic Perspectives, Vol. 5, No. 2, pp. 25-44.

Singer, T. and Lamm, C. (2009): "The social neuroscience of empathy", Annals of the New York Academy of Sciences, Vol. 1156, No. 1, pp. 81-96.

Singer, T., Seymour, B., O'Doherty, J. P., Stephan, K. E., Dolan, R. J. and Frith, C. D. (2006): "Empathic neural responses are modulated by the perceived fairness of others", Nature, Vol. 439, No. 7075, pp. 466-469.

Smith, A. (1759): The Theory of Moral Sentiments, Edinburgh: Millar, Kincaid, and Bell.

Solari, S. and Gambarotto, F. (2014): "Territorial Rooting as an Element of Well-Being", Review of Social Economy, Vol. 72, No. 4, pp. 504-522.

Soltis, J., Boyd, R. and Richerson, P. J. (1995): "Can Group-functional Behaviors Evolve by Cultural Group Selection? An Empirical Test", Current Anthropology, Vol. 36, No. 3, pp. 473-494.

Sugiarto, H. S., Chung, N. N., Lai, C. H. and Chew, L. Y. (2015): "Socioecological regime shifts in the setting of complex social interactions", Physical Review E, Vol. 91, pp. 062804.

Tainter, J. A. (2003): The Collapse of Complex Societies, New York, Cambridge, UK: Cambridge University Press.

Tainter, J. A. (2006): “Archaeology of Overshoot and Collapse”, Annual Review of Anthropology, Vol. 35, pp. 59-74.

Tomasello, M. (1999): “The human adaptation for culture”, Annual Review of Anthropology, Vol. 28, pp. 509-529.

Tomasello, M. (2009): Why We Cooperate, Boston: MIT Press.

Torgler, B., Schmidt, S. L. and Frey, B. S. (2006): Relative Income Position and Performance: An Empirical Panel Analysis, FEEM Working Paper, Vol. 39, New Haven, CT, USA: Yale Center for International and Area Studies.

Toth, A. L. and Robinson, G. E (2007): “Evo-devo and the evolution of social behavior”, Trends in Genetics, Vol. 23, No. 7, pp. 334-341.

Traulsen, A. and Nowak, M. A. (2006): “Evolution of cooperation by multilevel selection”, Proceedings of the National Academy of Sciences, Vol. 103, No. 29, pp. 10952-10955.

Turchin, P. (2003): Historical dynamics: why states rise and fall, Princeton, NJ: Princeton University Press.

Turchin, P., Currie, T., Turner, E. and Gavrilets, S. (2013): “War, space, and the evolution of Old World complex societies”, Proceedings of the National Academy of Sciences, Vol. 110, No. 41, pp. 16384-16389.

Veblen, T. B. (1899): The Theory of the Leisure Class: An Economic Study of Institutions, New York: Macmillan.

Warneken, F., Tomasello, M. (2009): “The roots of human altruism”, British Journal of Psychology, Vol. 100, No. 3, pp. 455-471.

Weiss, H. and Bradley, R. S. (2001): “What Drives Societal Collapse?”, Science, Vol. 291, pp. 609-610.

Wilson, D. S., Ostrom, E. and Cox, M. E. (2013): “Generalizing the core design principles for the efficacy of groups”, Journal of Economic Behavior & Organization, Vol. 90S, pp. S21-S32.

Witt, U. (1998): “Imagination and Leadership - The Neglected Dimension of an Evolutionary Theory of the Firm”, Journal of Economic Behavior and Organization, Vol. 35, No. 2, pp. 161-177.

Witt, U. and Schwesinger, G. (2013): “Phylogenetic footprints in organizational behavior”, Journal of Economic Behavior & Organization, Vol. 90, pp. S33-S44.

Zenou, Y. (2012): “Networks in Economics”, CEPR Discussion Papers, No. 9021, appeared in: International Encyclopedia of the Social and Behavioral Sciences,

Zhou, W.-X., Sornette, D., Hill, R. A. and Dunbar, R. I. M. (2005): “Discrete Hierarchical Organization of Social Group Sizes”, Proceedings of the Royal Society B, Vol. 272, pp. 439-444.

# Imprint

**Bremen Papers on Economics & Innovation**

Published by
University of Bremen, Faculty of Business Studies & Economics,
Institute for Economic Research and Policy (ierp)
Max-von-Laue-Straße 1, 28359 Bremen, Germany

**Editors**

Prof. Dr. Christian Cordes
Evolutionary Economics
Phone: +49 (0)421 218 66616, e-mail: c.cordes@uni-bremen.de

Prof. Dr. Dirk Fornahl
Regional and Innovation Economics
Phone: +49 (0)421 218 66530, e-mail: dfornahl@uni-bremen.de

Prof. Dr. Jutta Günther
Economics of Innovation and Structural Change
Phone: +49 (0)421 218 66630, e-mail: jutta.guenther@uni-bremen.de

Prof. Dr. André W. Heinemann
Federal and Regional Financial Relations
Phone: +49 (0)421 218 66830, e-mail: andre.heinemann@uni-bremen.de

Prof. Dr. Torben Klarl
Macroeconomics
Phone: +49 (0)421 218 66560, e-mail: tklarl@uni-bremen.de

**Bremen Papers on Economics & Innovation #2004**

Responsible Editor: Prof. Dr. Christian Cordes



ISSN 2629-3994