

# Institutional Resilience and Economic Systems: Lessons from Elinor Ostrom's work

Paul Dragos Aligica

George Mason University, Mercatus Center, Email: [daligica@gmu.edu](mailto:daligica@gmu.edu)

Vlad Tarko

George Mason University, Economics Department, Mercatus Center

## ***Abstract***

The comparative economic systems literature rarely mentions the topic of resilience. We reconsider the functional and performance criteria used in comparative institutional analysis, drawing several important lessons from the contributions of 2009 Nobel Prize in Economics co-recipient, Elinor Ostrom: the effects of alternative institutional arrangements and social norms; the problem of “highly optimized tolerance” to specific sources of risk; and polycentricity as a possible structural solution to sustainability problems. Resilience is more than mere “absorptive capacity” or “speed of recovery”: it depends on innovation and creative socio-cultural adaptations made possible by the flexibility of a polycentric institutional arrangement.

***Keywords:*** *institutional theory, socio-ecological systems, institutions, comparative economic systems, vulnerability, institutional design, polycentricity*

## INTRODUCTION

The increasing salience in the public debate of the economic and environmental crises themes have brought to the limelight the problem of how societies cope with the challenges posed by natural catastrophes, social and political disruption and economic shocks. The capability of social systems to withstand deep turbulence, to survive shocks and to ensure the continuity of their most basic functions has been revealed and reaffirmed as fundamental. Yet, although the relevance of the issue is unequivocal, economics and political science have yet to cope with the challenge. Fields such as comparative politics or comparative economic systems have very few things to say when it comes to the topic of resilience. There are entire literatures on various facets, elements and features of social systems or on performance evaluation standards such as efficiency, growth, freedom, equality etc. (Gregory and Stuart, 1999). The list of these “systemic functions”, “performance areas” and “system performance criteria” may vary from author to author but the core elements are always present in one form or another. Frederic Pryor (1985: p. 32) lists six performance indicators: economic growth, economic stability, dynamic efficiency, static efficiency of production, consumer sovereignty, and an equitable distribution of income and wealth. But he notes that the list is open and other indicators may be added to it: a low level of unemployment or underemployment; a high degree of economic security; a lack of exploitation; or a low degree of concentration of economic power etc. In the same vein, M. Bornstein (1994) outlines a set of criteria that comprise the following: The level and the rate of growth of output; the composition of output; single period (“static”) and inter-temporal (“dynamic”) efficiency; stability of output, employment, and prices; economic security (including security of income and/or of employment); equity and equality of opportunity; economic freedoms of consumption, property and occupational choice. Other functional criteria and indicators may be derived from these but for the purposes of this discussion the point is not so much about what is on the list but about what it is neglected or missing. It is very interesting that although the importance of resilience is obvious, as Gregory and Stuart (1999: p. 47) has put it, “the ultimate test of an economic system is its long-term viability” in most discussions of comparative economic systems, the problem of resilience has failed to become an object of active and intense interest for research. Nonetheless,

resilience is a fundamental condition for the very existence of a system and indeed, for its performance.

To find more consistent contributions, one needs to step outside the mainstream social sciences, in an interdisciplinary area emerging at the boundary between social and environmental sciences. The interest in the topic has taken many forms but one of the most significant research directions has started to converge around notions such as “institutional resilience” and “institutional robustness”, and correlate concepts such as “institutional adaptability” or “institutional vulnerability”. The institutional resilience and adaptability theme has received a great boost in 2009, when Elinor Ostrom, one of the key authors leading the effort to develop and apply this perspective, has received the Nobel Prize in Economics for her contribution to the study of governance and institutional arrangements. Yet, despite the potential for an increased salience of the theme, its integration in mainstream political economy remains more a desideratum than a reality.

The objective of this paper is to illuminate and draw attention to Ostrom’s contribution in this regard and to show how Ostrom’s work opens the way for incorporating the theme of resilience in comparative economic systems and institutional analysis. With this end in view, the article will discuss several important lessons regarding resilience as they emerge from the work of Ostrom and her associates: (1) The structure and functioning of institutional arrangements are the key to resilience both with respect to natural disaster challenges and with respect to endogenous social-economic challenges. (2) Social rules are the basic constitutive unit of institutional arrangements and, as such, they represent the conceptual backbone of resilience analysis and design. (3) Institutional design focusing on efficiency only often leads to a system of rules with “highly optimized tolerance” (HOT) to specific sources of risk, evaluated in the light of previous experience and data. But focusing exclusively on efficiency often misses the point because, while efficiency can only be assessed in terms of *risk*, the system is also vulnerable to wider problems of *uncertainty*. Hence, a trade-off between efficiency and resilience often exists and needs to be considered. (4) Resilience is more than mere “absorptive capacity” or “speed of recovery”. Resilience is a function of innovation and creative socio-cultural adaptation, and alternative systems of rules vary in their ability to be conducive to

innovation and adaptation.

The article also argues that the notion of resilience needs to be further developed. We encourage a conceptualization that goes beyond the current emphasis on the “socio-ecological” facet, (i.e. only on the relationship between natural resources and the social system). The concept of resilience can and should be understood and developed in more general terms, by taking a closer look at the forces and factors that are endogenous to the social and economic system. Institutions matter. The social-institutional facet is crucial even within the current conceptualization of resilience defined within the socio-ecological systems (man-nature interaction) framework but even more so when it comes to endogenous socio-economic dynamics. The key corollary and the key point of interest is that both approaches, in order to be meaningful, require, sooner or later, the employment of a certain type of social theory whose conceptual structure is best suited to capture the intricate dimensions of adaptability in social systems. This social theory is institutionalism, a middle range theory that has in E. Ostrom one of its main promoters.

## INSTITUTIONS: KEY TO ANALYZING RESILIENCE

In most cases, the discussions about resilience are currently articulated as part of a larger interest in the relationship between human societies and their natural environment. As such, they are based on the concept of a social-ecological system (SES). Indeed, the existence of human society involves a constant interaction between, on one hand, its cultural and institutional arrangements, and, on the other hand, its physical environment. Society relies on the physical environment, transforming it into usable resources (food, raw materials and energy). The cultural and institutional arrangements are not just mediators of human interactions; they also determine the more or less efficient way in which the environment is being utilized. Thus, it is understandable why for many authors dealing with the issue of resilience, society and nature are seen as intertwined and the distinction between natural systems (biophysical processes) and social systems (rules and institutions and systems of knowledge and ethics) is considered arbitrary (Berkes and Folke, 1998; Berkes et al., 2003; Carpenter et al., 2001; Folke, 2006; Ostrom, 2008).

Yet, the concept of institutional resilience, by its very nature, focuses on the human (or social) aspect of the human-environment relation (Adger, 2000). As such, it includes not just questions and concerns regarding resources or natural shocks, but *all* possible sources of instability, including endogenous economic, political and cultural shocks. It is thus important to keep in mind that “the resilience of institutions is based on their historical evolution and their inclusivity or exclusivity, trust norms and networks” and that “the cultural context of institutional adaptation, different knowledge systems, are central to the resilience of institutions” (Adger, 2006).

With that in mind, let us note that resilience can be defined in numerous ways and the subtle variations of definitions under which the notion is presented in the literature may be puzzling. Yet, some underlying unity exists in this diversity. The following general, but under-operationalized, definition can be utilized to provide an introductory perspective to the matter: *Institutional resilience is the ability of a social system (society, community, organization) to react and adapt to abrupt challenges (internal or external) and/or to avoid gradually drifting along destructive slippery slopes.*

To make this definition more useful, further elaboration is needed. On the one hand, are those authors that see resilience as the ability of a system to maintain itself near or close to an equilibrium state. This “close to equilibrium” school of thought advances from two slightly different angles: the “absorption capacity” perspective and the “speed of recovery” perspective (Holling et al., 1995; Walker et al., 2004). On the other hand are those that think that the discussion of resilience should be about the “behavior of dynamic systems far from equilibrium” (Gunderson, 2000). A far from equilibrium situation is not necessarily chaotic, but may be a “steady state”, i.e. a state of constant change in which some structural features nonetheless remain invariant. Under this approach, one is focusing more on the idea of adaptability to challenges. Change is seen as necessary. Last but not least, the literature emphasizes that the resilience of a system is also determined by the way it manages to avoid slippery slopes towards catastrophic thresholds. A socio-ecological threshold is defined as a point in the relation between a society and its environment beyond which a very hard to stop, accelerating degradation in the standard of living occurs. The society can move toward such a point without significant losses in its standard of living; yet, once the threshold is reached, degradation becomes

rapid and profound (Walker et al., 2004).

In all of the above, the inclusion of socio-institutional factors is implicit. However, even a quick overview reveals that the concept of resilience can be understood in even more precise terms, by taking a closer look at the challenges posed to the stability and continuity of a system by socially endogenous factors alone. This move obviously requires an extension of the concept to cover situations that may be overwhelmingly social, not biophysical. Threats to institutional order may be social in their origins and manifest themselves socially; they may have no “natural”, biophysical causes. Situations in which social factors set into motion chains of events, rather than the interaction between society and its natural environment. Also, one should not consider solely social-ecological thresholds of degradation, but also the fact that similar thresholds may exist purely in the social-institutional realm as well, as authors like Olson (1982) or Tainter (1988) have highlighted. Examples of such socially and politically endogenous cases can involve both sudden changes (Tilly, 1993; McAdam, Tarrow and Tilly, 2001; Tilly and Wood, 2009) and gradual changes (Olson, 1982; Giugni, McAdam and Tilly, 1999). In all these situations, the discussion concerns solely internal social factors that set into motion chains of events, rather than causes from the natural environment.

This is the context in which one should read the argument of Jassen, Anderies and Ostrom claiming that the connection between political-economic aspects and the ecological aspects is a two-way street. While ecological challenges can impact the social-economic reality, threats to SESs can also come as a result of social and economic factors (Jassen, Anderies and Ostrom, 2007: pp. 310-1):

SESs face both predictable and well-understood variation as well as unpredictable temporal and spatial variation of social and natural variables. ... [W]e broaden the original ecological definition to include a broader range of disturbances and variability, such as changes in regulations concerning property rights or subsidies, the autonomy of local resource users to govern a local resource, the preferences of producers or consumers, local commodity prices and wage rates, transportation costs between producers and markets (e.g., creation of paved roads), fluctuations of commodity prices on the global market, and so on.

The argument draws the attention of SES scholars to the social-institutional factor (see also Berkes and Folke, 1998). One cannot give a complete account of social-ecological resilience without considering institutional factors. In fact SES authors were aware that vulnerability and resilience research needs to look at something more than the “external shocks and stresses experienced by the social-ecological system, the response of the system, and the capacity for adaptive action” (Adger, 2006). What Ostrom does is to open full way for social sciences in resilience analysis. In taking this argument a step further, and introducing the institutionalist logic into the equation, Ostrom and her collaborators open up a line that leads sooner or later to a robust institutionalist perspective.

The institutionalist perspective means more than simply “institutions matter”. To understand the subtle approach it entails, let us take the example of the relationship between technology and resources (a crucial relationship for resilience studies). The key idea is that the technologies that impact a society’s relation to nature are created as the result of incentives inherent in that society. Nature’s challenge is roughly constant, but people tend to innovate more in times and areas where there are political and economic conditions and incentives for making the innovations. Once a relevant innovation is made, a new domain of nature becomes a resource. Whether something is a “resource” or not is thus technologically induced. Technology advances faster in certain social-institutional environments (Kahn, 2009; Simon, 1995; 1998; Kling and Schulz, 2009).

The point is very important as modern societies’ solution to the law of diminishing returns in regard to its resources (Samuelson and Nordhaus, 2001: p. 110; Reisman, 1996: pp. 67-71) is one of the key factors that determine their long term continued existence, without a serious decline in prosperity or in population. When it comes to non-renewable and non-super-abundant resources, such as those involving mining or agriculture in societies with rising populations, sustainability is usually not possible (or large scale recycling is economically inefficient) and has to be substituted by constant innovation and adaptation (Simon, 1995; 1998; Johnson, 2000; Ruttan, 2002; Rogner, 1997). Thus, in order to survive and prosper, they all have to adopt institutional frameworks that favor fast enough rates of innovation. The metaphor of the Red Queen seems apt: one has to run faster in order to avoid falling behind, a society has to constantly innovate just in order to maintain its standard of living as it

is. A decline in innovation below a certain threshold unavoidably leads to collapse, as the society loses its ability to adapt to the evolving situation in which the non-renewable resources on which it relies become scarcer and scarcer. An institutional arrangement that inhibits innovation is an institutional arrangement that on overall and on the long run undermines resilience.

IN the light of all of the above our ability to analyze the process of adaptation by which societies fit their institutions to new challenges (rather than focusing on mere steady-state sustainability) become crucially important. The institutional aspect is essential in assessing the long term resilience of a society, and, ultimately is an issue dealing with (1) the incentives people face in alternative systems of rules, and (2) the incentives various members of society face to try to change the rules in order to get higher individual payoffs, even if this implies an overall loss for society as a whole or long term vulnerability (Ostrom, 2008). Ostrom's work thus reminds us that the problem of institutional resilience goes beyond the parameters set up by the standard socio-ecological discussion and invites us to transcend them. Of course, the continued existence of a social system depends on it having a productive relation to its natural environment. But one should also not reduce the entire discussion to it. Both resilience and vulnerability have a complex social-institutional facet, in addition to the environment-related one.

## HIGHLY OPTIMIZED TOLERANCE

Ostrom's overall approach to resilience and vulnerability is intrinsically connected with the development of the mathematical concept of "robustness". This is best illustrated by the Anderies, Jassen and Ostrom (2004) article that elaborates the notion and applies the approach to robustness developed by physicists Carlson and Doyle (1999; 2002) to the analysis of the social phenomenon in case. The central idea, what Carlson and Doyle have called "highly optimized tolerance" (HOT), provides a rigorous grounding for approaches pivoting on the concept of robustness.

Carlson and Doyle arrived at the notion of HOT by studying one of the main issues in complexity theory, namely the "power laws". As a matter of empirical observations, it has been noted that many complex phenomena (e.g. wealth distribution in modern societies, the stock price variations over time,



the size and frequency of forest fires, the number of species extinction, the size and frequency of automotive traffic jams, air traffic delays etc.) are governed by power laws, instead of normal Gaussian distributions (Bak, 1996; Mandelbrot and Hudson, 2004). This is significant for two reasons: First, unlike Gaussian distributions, power laws allow for (often very large) differences between the statistical mean and mode, e.g. the total wealth divided by population is not same as the wealth that most individuals have. Second, the probability of large departures from the most probable event can be much larger than in case of Gaussian probability distributions. This is important because disaster planning often focuses on distributing prevention resources predominately for preventing the most probable events.

In regard to resilience and robustness, the matter of interest is the possibility of resource destruction due to some uncertain events, e.g. the case of a resource, a forest, and of an uncertain event, forest fires. The two economic variables are the *yield* obtained from the resource and the *cost* of preventing the destruction of the resource. The problem of interest is to maximize yield, under the constraint of one's budget for prevention. The problem has been approached in two steps. Prior to Carlson and Doyle, it was merely analyzed what happens in the absence of any form of resource design optimization, i.e. ignoring the possibility of reorganizing the resource (e.g. setting up fire-brakes in certain areas of the forest). The cost of prevention did not enter the analysis in this case. Under this simplifying no-design assumption, the analysis leads to the following conclusion: Yield increases as the resource density increases, but as the resource density increases, the probability of accidents also increases.

There is thus a critical point in regard to resource density where yield is maximal. It turns out, however, that, due to the interconnectivity of various sites at which the resource is located, at this critical point in regard to overall resource density, the probability distribution of the size and frequency of resource destruction is a power law – thus, very large, even system-wide, accidents can happen with a much larger probability than one would expect from a Gaussian probability distribution. In other words, it means that if the system naturally evolves toward maximizing yield, it also evolves, as a side-effect, toward increased vulnerability.

Carlson and Doyle (1999) add to this picture the possibility of resource design optimization and consider the cost of prevention as an additional economic variable, apart from yield. Resource design optimization allows for far greater yields than the no-design scenario, because the designer (either conscious human engineer or natural selection in a cultural evolution scenario) can set up preventing devices that address the most probable causes of accident. In Carlson and Doyle's analysis, the budget for prevention is spent predominantly for addressing the *expected damage* (i.e. the product between the cost of damage and its likelihood). Consequently, the system becomes (1) increasingly complex as various preventing devices are set up, (2) more efficient (higher yield), and (3) optimized to address very specific sources of risk.

The name "highly optimized tolerance" refers to this type of optimization that is relative to specific sources of risk, but which creates vulnerabilities in regard to other, unforeseen sources of uncertainty: "[O]ptimizing yield will cause the design to concentrate protective resources where the risk of failures are high, and to allow for the possibility of large rare events elsewhere" (Carlson and Doyle, 1999: p. 1416). The reason why Carlson and Doyle refer to "*large* rare events" is because they have also obtained power laws, in accordance with the empirical observations.

The HOT perspective leads to the idea of "robust-yet-fragile": the system is designed to tolerate better specific sources of risk and its complexity increases precisely by developing features that help it cope with those sources of risk and danger. Nonetheless, via this precise same process, the system develops weak-points that open up the possibility of "cascading spread of damage due to the seemingly innocuous breakdown of individual parts", thanks to its complex interconnectivities (Carlson and Doyle, 2002: p. 2540).

Adopting this perspective in the social realm has obvious strengths (Anderies, Jassen and Ostrom, 2004; 2007). First of all, it provides us with a clear and simple mechanism by which social-institutional complexity gradually increases. Why do norms and rules get created in the first place? The answer provided by HOT is that they are prevention devices designed to help society cope with various kinds of uncertainty. For example, Ostrom and her collaborators describe numerous cases of

this type of institutional design in regard to common pool resources where one of the main forms of uncertainty is due to the possibility of free riders (Ostrom, 1990; Ostrom, Schroeder and Wynne, 2003; Ostrom, Gardner and Walker, 1994; Berkes and Folke, 1998; Gibson, McKeen and Ostrom, 2000; Ostrom et al., 2002). As the HOT perspective implies, the specifics differ from case to case.

For example, one has to adopt different kind of rules when free riding involves cutting wood from a forest as compared to the case when free riding involves overharvesting fish from the ocean. While the *function* of those rules may be the same in both cases, their *content* necessarily differs. Thus, if, for instance, one finds a community that has successfully dealt with the free riding problem in regard to its forest (e.g. by privatizing the forest into different individual parcels), it does not mean that one would be successful by simply transposing these successful rules to a fishermen community suffering from overharvesting (privatizing the ocean into parcels may not be workable because fish move from place to place). The fishermen community would thus have to develop its own rules for dealing with its specific form of uncertainty. This is a very simple example, but, once we have understood that social-institutional complexity comes about via the HOT process, we understand that the point holds to an even greater extent in the case of more complex issues.

The HOT perspective leads to a different perspective on social-institutional complexity, hinting at the importance played by most rules and norms in maintaining the system, even when their specific role is not easily recognizable. The hidden nature of this complexity is due to the fact that each layer of organization in the system has specific details that are important for its robustness, but which are not immediately obvious to the untrained eye: at each layer, “we expect to encounter a new structure which is crucial to the robustness and predictability of the system” (Carlson and Doyle, 1999: p. 1413).

Identifying these critical structures is a daunting task of an often overwhelming difficulty. According to Constanza, Low, Ostrom and Wilson (2001) the main source of hubris in institutional design is due to not properly recognizing the multi-scale nature of social systems and of failing to properly set the scale of the analysis. They identify two main sources of institutional failure, “missing or failed

institutions, and second, with scale mismatches among institutions” (p. 11):

1. *Missing Institutions*: human institutions do not exist at the appropriate scale or have not established effective controls of ecosystem stocks and flows. This typically results in open access systems and resource degradation.
2. *Scale Mismatches*: potentially effective institutions exist at the appropriate scales, but the following must be considered: A. *Missing Connections*: decision making linkages between scales are ineffective. B. *Incorrect Scale of Information*: decisions are based on information aggregated at the wrong scale, even though information may exist at the appropriate scale.

Avoiding these problems is extremely difficult, which is why experts engaged in institutional design often fail even when they have the best of intentions and rely on the best available scientific data. Ostrom and collaborators have indeed documented many interesting cases in which long lasting institutional systems (e.g. the irrigation systems in Bali or traditional transhumance in India) have been “reformed” with the best intentions in mind, only to tragically discover later the importance played by various rules that were thought to be mere traditional relics with no real utility (Ostrom, 1990; Ostrom, Gardner and Walker, 1994; Boettke, 1996). As Ridley (1996: p. 233) put it: “all sorts of commons problems are readily and frequently managed in sensible, virtuous, sustainable ways by local people who entirely lack the pretensions to be trained economists. Conversely, it becomes obvious that it is the very trained experts who often undo, destroy and wreck sensible arrangements for managing commons.”

The reason why this happens is that experts think in terms of optimizing the system of rules to the previously documented sources of risk, unavoidably missing the bigger picture of uncertainty, while traditional rules often incorporate a much longer historic experience. Moreover, experts often underestimate the difficulty of the comparative assessment of institutional arrangements: institution *I* may be essential for the proper working of the system, but it may also rely on the presence of other supporting institutions *J*, *K*, ...; introducing *I* in a system that lacks *J*, *K*,... leads to disappointing or even counterproductive results. For example, clear property rights are in many ways a critical

institution, and European agriculture relies on them. However, introducing formalized property rights over farm land in some areas in India had led to blocking transhumance over those terrains, which, as it turned out, played a neglected function of fertilizing the soil.

To use Daniel Dennett's terminology, social order relies on "free-floating rationales": "a set of reasons that were appreciated by, thought out by, and rendered explicit by *no one*" (Dennett, 1984: p. 24, emphasis in the original). As he put it, "[t]he subtlety and deviousness of this thinking-without-a-thinker is often more than a match for the thinking we thinkers do" (p. 24) (see also Dennett, 1995). This idea has a long history dating back at least to Edmund Burke's "wisdom without reflection" (Sowell, 2002: p. 41) and to Adam Ferguson's recognition that many facets of social order are "the result of human action, but not of human design" (Hayek, 1967). Dennett credits Kant for the idea (in his *Grounding for the Metaphysics of Morals*). Economics also has a long history of appreciating the issue, going back to Adam Smith, although at present the matter seems to be somewhat neglected. For instance, Menger (1883) differentiated between "social phenomena which are products of the agreement of members of society, or of positive legislation" (p. 145) and "organic" social phenomena, which are "unintended results of historical development", such as "language, religion, law, even the state itself, ... markets, ... money, and numerous other social structures ... where we cannot properly speak of a purposeful activity of the community as such directed at establishing them ... [n]or can we speak of such activity on the part of the rulers" (p. 146). Hayek built upon Ferguson and Menger and wrote that "[n]ot all knowledge ... is part of our intellect" (1979: p. 157): "man has certainly more often learnt to do the right thing without comprehending why it was the right thing, and he still is often served better by custom than by understanding". Customs "are as much indispensable foundation of successful action as is our conscious knowledge". The entire Ostromian project is part of this tradition in social theory, but it has further advanced the matter in many ways in terms of rigor and operationalization.

Indeed, the HOT underlying the approach of Ostrom and her associates, provides a more precise approach to resilience by framing the issue as a costs-and-benefits problem. Introducing an institutional arrangement (set of rules), aimed at addressing a particular kind of uncertainty, is not free.

The monitoring and enforcement process requires resources (time, people, information processing, and capital) and it creates certain opportunity costs (prevents some productive activities that would happen in the absence of those rules). One might be tempted to say that an institutional device is good if these costs are lower than the societal benefits. But this is often just an empty statement. It is not always the case that a consensus exists about what “societal benefits” should be considered. Moreover, when one focuses on describing what happens rather than prescribing what should happen, one has to adopt the public choice perspective and recognize that the benefits that matter may not actually be the overall social benefits (however we define them), but benefits obtained by the group of actors that has the upper hand in the institutional design process. In other words, one should never forget the relationship between a particular institutional arrangement and the interests of those who do the institutional designing. As we’ll see, this type of public choice approach provides a very strong argument in favor of local self-governance and polycentricity as mechanisms for insuring that the overall “societal benefits” take indeed the front seat. Moreover, this perspective also provides an argument in favor of constitutional meta-rules.

Considering the importance played by details, one may ask in what sense we can still attempt to have a general theory. As Carlson and Doyle (1999, p. 1413) put it: “If we accept the fact that most real complex systems are highly structured, dominated by design, and sensitive to details” then “it is fair to ask whether there can be any meaningful theory of complex systems”. That is to say “are there common features, other than power laws, that the complicated systems ... share that we might hope to capture using simple models and general principles?” When we adopt this perspective on robustness in the social-institutional sphere, this question translates into a quite familiar one: To what extent can we have institutional recipes for success that can be transplanted from one region to another, from one system to another, and replicate the desired performance? Or to put it differently, how can one use the success stories as valid sources of inspiration, without falling into the trap of “blueprint thinking”? To answer this question is the ongoing challenge posed by Ostrom’s work.

## SOCIAL RULES AND POLYCENTRICITY

One of the most important contributions of Ostrom's work is her extensive and systematic focus on rules as basic units of analysis in institutional theory and in institutional design. A discussion on institutions is in fact a discussion of rules. Rules are the basic unit of analysis because "[t]he opportunities and constraints individuals face in any particular situation, the information they obtain, the benefits they obtain or are excluded from, and how they reason about the situation are all affected by the rules or absence of rules that structure the situation" (Ostrom, 2005: p. 3). Rules are also the basic operational element in building or supporting resilience.

In this context "rules" are defined as "shared normative understandings about what a participant in a position must, must not, or may do in a particular action situation, backed by at least a minimal sanctioning ability for noncompliance" (Ostrom and Hess, 2007: p. 50). The emphasis on "normative" is important. We're not talking merely of observed social regularities, but of regularities that people actively maintain by punishing transgressors, they are "prescriptions that humans use to organize all forms of repetitive and structured interactions including those with families, neighborhoods, markets, firms, sports, leagues, churches, private associations, and governments at all scales" (Ostrom, 2005: p. 3).

Because resilience is not something static but a matter of adaptability, in order to be able to assess the resilience and adaptability of a society one must first understand the mechanisms by which societies in general change their rules. Ostrom (2005; 2008) draws our attention to the fact that these mechanisms are quite complicated, involving interactions between the top-down actions of governing authorities and the bottom-up workings of groups and individuals.

An additional source of this complexity is the fuzziness of the distinction between formal and informal rules: Some rules are formalized but are not enforced, or are not enforced in a universal fashion, due to lack of legitimacy, improper incentives among government officials, corruption, lack of resources, incompetence, the interpretability of rules etc. Conversely, some other rules are informal but act as if they were formal. "It is always a challenge to determine what the rules structuring patterns of

interaction are. Formal rules may exist in writing but not be followed or even known to the participants. In doing effective field research, one has to determine the ‘rules-in-use’ by the participants if one wants to understand behavior and outcomes” (Ostrom, 2008: p. 56). In order to make steps further in analyzing the problem of robustness and adaptability, we need hence a rigorous model for describing rules and norms (this was provided by Crawford and Ostrom, 1995, also included in Ostrom, 2005). Moreover, as details are important when judging robustness, the model has to be easy to operationalize. A crucial task is to determine what the rules-in-use actually are. These must be distinguished from the rules-in-form, which are “merely written in administrative procedures, legislation, or a contract and not known by the participants or enforced by them or others” (Ostrom and Hess, 2007: p. 50). Unlike those, “rules-in-use are generally known and enforced and generate opportunities and constraints for those interacting” (Ostrom and Hess, 2007: p. 50; see also Crawford and Ostrom, 1995).

But irrespective of the theoretical sophistication, the basic observation on which Ostrom built her approach is simply that the creation and governance of resilient institutional arrangements seems to rest on a paradoxical foundation. In a hierarchical organization, monitors and enforcers need to be monitored and sanctioned if they fail to fulfill their duties, and the second layer of monitors and enforcers also needs to be monitored, and so on. As Kasper, Streit and Boettke (2012: p. 32) put it, institutions are “man-made rules which constrain people’s (possibly arbitrary and opportunistic) behaviour in human interaction”, they “are the formal and informal ‘rules of the game’ ... institutions are shared in a community and are always enforced by more or less established social sanctions for violators of the rules”. This creates an apparent paradox. At each layer of monitoring and enforcement, there exists a possibility of failure, either due to personal interests of the parties involved, due to lack of legitimacy, or due to errors and lack of information. The more complicated the hierarchical system, the more inefficient overall monitoring and enforcement becomes. Solving the problem is a necessary condition for a resilient and stable system. Ostrom’s advances a possible structural solution: local self-governance and polycentricity.

Ostrom’s work on these lines has not been speculative or purely theoretical, but empirical. She has



shown that local self-governance may alleviate or even solve many problems by creating a circle of rules rather than a linear hierarchy. For instance, in a group of agents where the agents themselves take turns at being monitors, the self-interest problem is diminished to manageable levels because the monitor will now have a vested interest in making sure that the rules are followed. Or, even if the monitors are hired from outside the community, and the complexity of the system thus increases by involving more people, the monitors would still have the desire to uphold the rules in order to satisfy the demand of those who pay them. It is always important to consider the incentive structure of those responsible for rule design, monitoring and enforcement (Ostrom, 2005: p. 260- 265):

Most long-surviving resource regimes select their own monitors, who are accountable to the appropriators or are appropriators themselves and who keep an eye on resource conditions as well as on harvesting activities. ... The community creates an official position. In some systems appropriators rotate in this position so everyone has a duty to be a monitor. In other systems, all participants contribute resources and they jointly hire monitors. With local monitors, conditional operators are assured that someone is generally checking on the conformance of others to local rules. Thus, they can continue their own cooperation without constant fear that others are taking advantage of them.

Systems that depart at great lengths from local self-governance tend not only to lack legitimacy, but also to be rife with corruption, rent-seeking and wide-spread inefficiencies (Ostrom and Ostrom, 2004). For example, the study of irrigation systems in Nepal has found that “[a] substantial difference exists ... between the systems that have been designed, built, and maintained by farmers as contrasted to the systems designed by government engineers” (Ostrom, 2005: pp. 260-1). The difference in outcome is due to the difference in the incentives structure in the two cases. On one hand, “the boundaries of irrigation systems developed by farmers tend to be conservative so that those who make the system work are more assured to get water”. On the other hand, “[t]he boundaries of those systems constructed by government agencies ... are frequently demarked as part of donor-funded projects. ... The more farmers placed within the service boundary of the system, the higher the benefits that can be reported”. Consequently, farmers on government systems “are more likely to steal water and less

likely to contribute resources to maintenance”. Involvement of users in the governance mechanisms, in this case in defining the boundaries, proves to be very important for assuring efficient use of the resource.

That being said, it is important to stress that not all problems are best solved at local level. Consequently, one also needs other, larger scale, solutions to the problem of assuring that the rules-in-form are as much as possible also the rules-in-use. This is the point where the concept of “polycentricity” is introduced (Ostrom, 2005: pp. 281-6; see also Aligica and Tarko, 2012). Polycentricity means, first of all, applying the same logic of local self-governance to a larger level. Ostrom notes that local communities often spontaneously organize in larger associations in order to deal with larger issues and that such associations, when they exist, are usually more efficient than centralized solutions provided by government. A second dimension comes from creating a working relationship between local communities and higher level (central) government mediate conflicts between local communities, act as a catalyst for the formation of associations between communities, facilitate information sharing among different communities, protect individuals and minorities, provide help in emergency cases, but abstain from interfering under normal conditions etc. Ostrom roughly defines policentricity as “a system where citizens are able to organize not just one but multiple governing authorities at differing scales” (Ostrom, 2005: 183). These “governing authorities” or “units” are not necessarily top-down state institutions, but they can also be voluntary associations created for the purpose of addressing various issues facing the community: “users of each common-pool resource would have some authority to make at least some of the rules related to how that particular resource will be utilized”. It is thus essential that these units don’t fall in a strictly defined top-down hierarchical organization, but instead have “considerable independence to make and enforce rules within a circumscribed domain of authority for a specified geographical area”. Depending on the specific problem they are designed to address, “some units are general-purpose governments while others may be highly specialized”. It is important to note that the optimal scale for solving various problems differs, and thus a fixed, quasi-universal-purpose administrative body at a given scale, would necessarily be inefficient. “Because polycentric systems have overlapping units, information about

what has worked well in one setting can be transmitted to others who may try it out in their settings. ... [W]hen small systems fail, there are larger systems to call upon – and vice-versa.” (Ostrom 2005: 183)

Ostrom emphasizes several factors that determine the optimal size of the administrative unit: (1) Hayekian knowledge problems, (2) legitimacy problems leading to inefficient rules and enforcement problems (the governing authority may be perceived as lacking full legitimacy and thus the rules-in-form will end up differing from the rules-in-use), (3) economies of scale considerations (as she notes, [Ostrom 2005: p. 278], sometimes a larger-scale government, such as the US Geological Survey, may be in a better position to do data gathering in a cost-effective fashion), and, last but not least, (4) properly securing individual rights in order to create an environment of safety and predictability. This last factor can involve both top-down abuses of power, against which federalist mechanisms are useful (V. Ostrom, 1991; Weingast, 1995), but also “problems associated with local tyrannies and inappropriate discrimination” which “can be addressed by larger, general-purpose governmental units who are responsible for protecting the rights of all citizens and for the oversight of appropriate exercises of authority within smaller units of government” (Ostrom, 2005: p. 183).

As Ostrom notes (2008), the research done by her and her team has “repeatedly found that resource users, who have relative autonomy to design their own rules for governing and managing common-pool resources, frequently achieve better outcomes than when experts do this for them” (p. 48). These “better outcomes” are partly the consequence of the fact that self-governing and polycentric societies are better at enforcing their rules. But it is also partly a consequence of the fact that such societies create better rules. For a non-equilibrium, adaptation-focused perspective on resilience, it is of crucial importance that the society is able to easily generate good rules for dealing with its challenges and that it is able to reform its rules when they become outdated.

To sum up, a focus on rules as units of analysis reveals an entire set of problems crucial for the resilience of an institutional system. The focus on rules allows us to follow the logic revealed by the “grammar of institutions” (Crawford and Ostrom, 1995) and to identify critical aspects related to the

monitoring, enforcement and legitimacy of institutional arrangements. Within this approach, polycentricity is providing a framework for understanding the arrangements that might offer solutions that improve the resilience of a system. Polycentricity creates the conditions for the legitimacy of rules and for mechanisms assuring that the rules-in-use are not radically different from the formal laws. Furthermore, it also creates the conditions for the evolution of rules, i.e. for adaptability.

## RESILIENCE VIA ADAPTABILITY, POLYCENTRICITY AS THE FRAMEWORK FOR ADAPTABILITY

Ostrom's perspective is built on and implies an entire "vision" or "social theory" of institutional performance. The Bloomington school of institutional analysis created by Elinor and Vincent Ostrom is an attempt to contribute to a 'revolution' in the social sciences and has found itself in the middle of the major social sciences debates of the twentieth century and, at the same time, has tried to transcend them by presenting itself as a comment and an extension of a 500-year-old intellectual tradition preoccupied with the relation between spontaneous dynamics of social order, and rule-guided behavior and rule systems. The basic idea is that to discuss, analyze and assess resilience and vulnerabilities along these conceptual lines, one has to start with a bottom-up perspective, focusing on social self-organization and emergent phenomena of social and economic systems, rather than on a top-down perspective which assumes that all relevant information is known to a central authority which also has all the relevant means of social design and control at its disposal.

The classic bottom-up self-organizing social system is of course the market. The insight that a market is an information processing "machine", having the price system at its core (Hayek, 1945), is a crucial inspiration for the Ostrom approach to other self-organizing social phenomena. The market can be understood as a "social computer" that solves the giant coordination problem of allocating scarce resources to their "optimal" uses (O'Driscoll, 1977; Axtell, 2003; Miller and Page, 2007). Ostrom's perspective recognizes the power of the market model, but it also recognizes its limits. Consequently, alternative systems of rules are to be created in order to fulfil the two tasks that the price system fulfils in the areas where markets exist: aggregating preferences and guiding entrepreneurial activities toward "optimal" uses of resources. These alternative systems of rules, informal and formal, can be seen as

market-like phenomena which don't fit the classical distinction between market and state (Ostrom, 1994). The preference aggregation via the price system is replaced by collective choice arrangements that determine the specific content and nature of the rules and norms. The market itself is only a special case of this and it is often one of the components of the social system to be analyzed. Moreover, "efficiency" is not the only normative criterion to be considered, others, such as fairness, participation rate or, as we have argued earlier, resilience can be equally important. But, overall, the system has to be able to aggregate information, provide feed-backs, give the right incentives for innovation and, generally speaking, use social rules effectively for problem solving purposes.

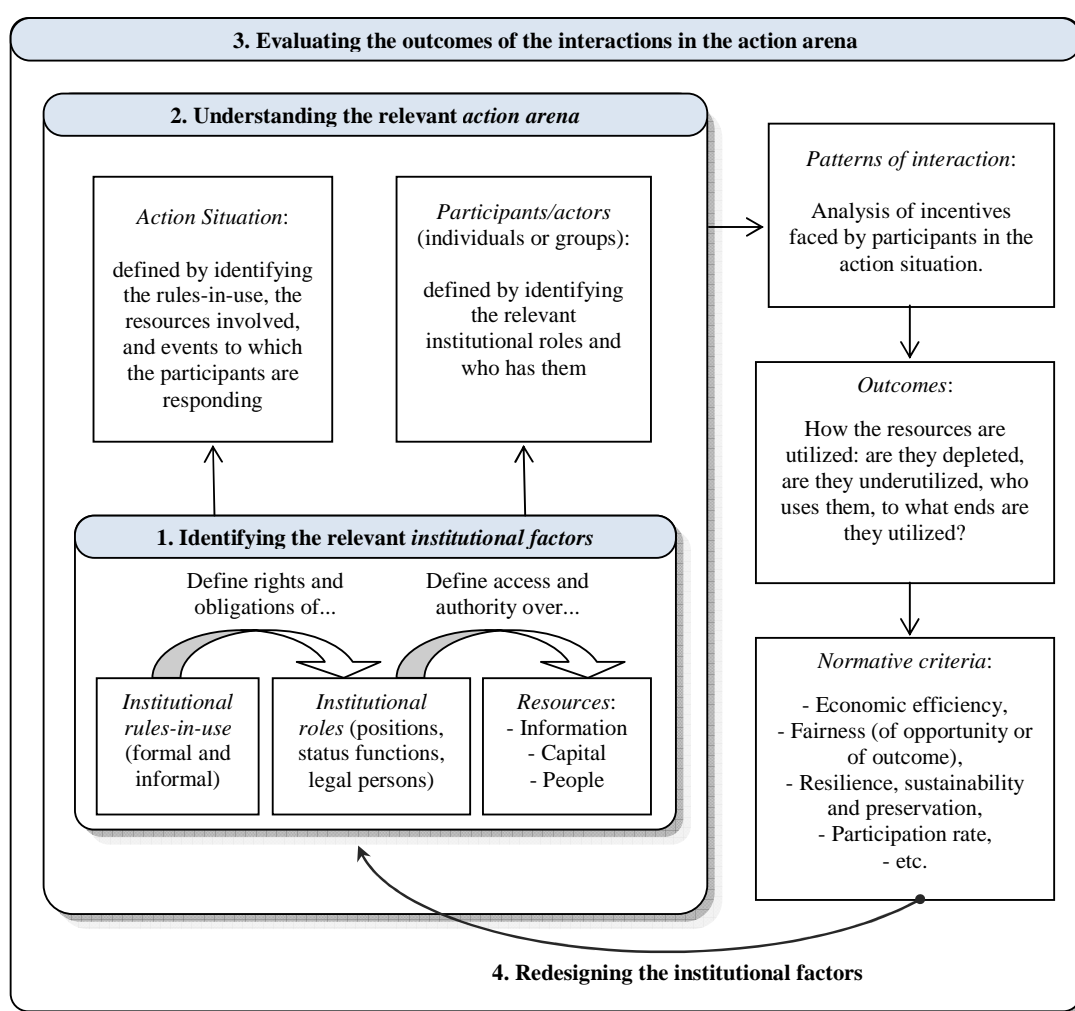


Figure 1. The Institutional Analysis and Development (IAD) framework (Ostrom et al., 2012: p. 51)

One of the main successes of the Bloomington School has been to develop the "institutional analysis

and development” (IAD) framework (Ostrom and Ostrom, 2004; Ostrom, 2005; 2008) that could be applied to a variety of social and economic systems. Figure 1 presents the basic outline of this framework, which allows us to understand the interactions between the bottom-up evolution and the top-down institutional design. It is an approach in which the logic of human action and rule guided behavior is used in a modular way to unpack and conceptual reconstruct the structures and functions of social; and economic systems.

The purpose of the evaluation is to analyze what happens within an action arena and to compare the result of this analysis with a set of normative goals. The evaluation process is possible only after having defined the action arenas. If this is not done, the evaluation will be impressionistic and will lack rigor. The evaluation is a three-step process:

- 1) One must first identify the possible and the likely *patterns of interaction* between the participants within their action situation. The likelihood of various courses of action is determined by analyzing the participants’ incentive structures – the opportunities they have and the cost of various courses of action. This is analyzed relative to their likely goals.
- 2) The second step of the evaluation involves the assessment of the specific aggregate *outcomes* resulting from the patterns of interaction.
- 3) Finally, the last step of the evaluation involves a *normative input*. Ideally, this should be the only place where normative matters enter the picture. Many normative criteria can be considered important and used to evaluate the outcomes, and some tradeoffs between them may be necessary. Resilience is one possible normative criterion. Others can be economic efficiency, fairness, participation rate etc. and the traditional comparative economic systems literature has extensively dealt with them. Nonetheless, as already explained, resilience has a special place as all other concerns become moot if a collapse of the entire system occurs.

The end result of the evaluation process is the attempted redesign of some of the institutional factors, such that the normative criteria are better satisfied. The main problem of course is that the redesign of the institutional factors is not done by omniscient, impartial and benevolent agents, but by self-

interested actors who try to change the rules and attributes of various institutional positions in the direction that most benefits them, while coping as best as they can with their limited knowledge. Also the redesigning is best understood as being done by (some of) the participants in the action arena, rather than by some outside actor. This allows us to fully incorporate public choice concerns into the analysis (Ostrom and Ostrom, 2004).

Ostrom was eager to stress the importance of the fact that the variation of rules and norms is often the result of rational design, rather than mere randomness, and that there often are meta-rules (such as constitutions) about how the rules are to be changed (Ostrom, 2008: p. 58). While evolution by blind variation and natural selection only tinkers with existing designs, rational variation based on imagination and innovation can involve radical redesigns. It is noteworthy, however, that such redesigns also pose a challenge to resilience. As Ostrom notes (2008: p. 57),

[g]iven the logic of combinatorics, it is impossible for public officials or for direct beneficiaries to conduct a complete analysis of the expected personal benefits or broader performance of all of the potential rule changes that could be made by the individuals served by a self-organized resource governance system trying to improve its performance. A similar impossibility also exists for biological systems – they evolve.

We cannot thus assume a purely rational and utilitarian process of institutional design and, consequently, it is necessary to understand more precisely how this evolutionary process of institutional reform works. The emphasis on the value of social experimentation and bottom-up innovation, and thus of maintaining institutional variety and a certain level of local self-governance, is strongly correlated to the skepticism toward the viability of overly ambitious top-down rational institutional constructions. That is to say that understanding the limits of social engineering, when it comes to resilience of social-ecological systems, is a critical element for the institutional design of these systems. Resilience is thus a much more complex and sophisticated phenomenon than we are inclined to think when we are following the simple logic of commonsense or the simplistic logic of the standard, social-engineering perspectives.

## CONCLUSIONS

An overview of Elinor Ostrom's work and of the lessons that could be learned from it, suggests that although in studying resilience one may develop a rather sophisticated comparative and analytical framework that could travel well between cases and systems, when it comes to an applied approach, there is no universal set of formalized rules that gives optimal results everywhere. Resilience – be it seen as social-ecological or institutional – has no universal formula. In diverse conditions, depending on context, different sets of rules work best (Ostrom, 2005: pp. 274-5). Consequently, one must focus not so much, in technocratic fashion, on identifying an assumed ideal set of rules, a “blueprint”, to be implemented everywhere (Ostrom, 2005: p. 276). Instead, one has rather to switch attention to the meta-level and focus more on the socio-political process of rule-design. While there can be no blueprints at the *operational level*, there are “design principles” as Elinor Ostrom has called them, at the *collective choice level* – i.e. the level of the rules about how people should interact when trying to institute or reform the operational level rules and about which functions the operational rules need to play. Creativity and innovation in developing and reforming such rules are thus the key. Some socio-political processes are better than others at the task of identifying the best rules for their society's specific context in the shortest amount of time and thus to ensure the resilience of the system in different circumstances.

The main idea is that thinking of resilience and vulnerability is thinking of rule and institutional design processes that deliver certain levels of adaptability, because they are likely to allow the system to incorporate new pieces of information quickly when conditions change and to adjust in function of those pieces of information. In other words, a built-in flexibility of the system, flexibility based on rules and knowledge processes, not on force, command and rigid and mechanical structures. Polycentric governance provides the conditions to find solutions to the resilience puzzle by (1) creating the conditions for bottom-up experimentation and competition and providing public goods at the appropriate levels set up by economies of scale; (2) creating safeguards against error by allowing local governance systems to rescue the system when higher-up agencies mess up and allowing the higher governance levels to help local communities when they are affected by disproportionate



(endogenous or exogenous) shocks; and (3) creating safeguards against corruption and exploitation by, on one hand, preventing “local tyrannies” and, on the other hand, keeping the authority of the central government in check by the authority of the local levels. Such insights and the theoretical apparatus involved in advancing the arguments not only puts institutional theory in the position to contribute to a better understanding of the dynamics of social-ecological systems but also invite a reconsideration of the theories dealing with the functional and performance criteria used in institutional and comparative economic systems analysis.

## REFERENCES

- Adger, W. Neil. 2000: Social and Ecological Resilience: Are They Related? *Progress in Human Geography*, 24(3): 347-364.
- Adger, W. Neil. 2006: Vulnerability. *Global Environmental Change*, 16(3): 268-281.
- Aligica, Paul Dragos and Boettke, Peter. 2009: *Challenging Institutional Analysis and Development: The Bloomington School*. Routledge.
- Aligica, P. D., & Tarko, V. 2012: Polycentricity: From Polanyi to Ostrom, and Beyond. *Governance*, 25(2): 237-262.
- Axtell, Robert. 2003: Economics as Distributed Computation, in *Meeting the challenge of social problems via agent-based simulation*, Terano, T., H. Deguchi, K. Takadama (eds), Springer.
- Bak, Per. 1996: *How Nature Works: The Science of Self-Organized Criticality*. Copernicus.
- Berkes, Fikret and Carl Folke, eds. 1998: *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge University Press.
- Berkes, Fikret, J. Colding, and Carl Folke (eds): 2003. *Navigating Social–Ecological Systems: Building Resilience for Complexity and Change*. Cambridge University Press.

- Boettke, P. J. 1996 [2001]: Why Culture Matters: Economics, politics, and the imprint of history. In P. J. Boettke, *Calculation and Coordination* (pp. 248-265). New York: Routledge.
- Bornstein, Morris. 1994: *Comparative Economic Systems: Models and Cases*, 7th edition. Boston: Irwin, Inc.
- Carlson, J.M. and Doyle, John. 1999: Highly optimized tolerance: A mechanism for power laws in designed systems. *Physical Review E*, 60(2): 1412-27.
- Carlson, J.M. and Doyle, John. 2002. Complexity and robustness. *PNAS*, 99(suppl. 1): 2538-45.
- Carpenter, S.R., Brian Walker, Jassen Anderies and N. Abel. 2001: From metaphor to measurement: resilience of what to what?. *Ecosystems* 4: 765-781.
- Committee on the Human Dimensions of Global Change, National Research Council; Elinor Ostrom; Thomas Dietz; N. Dolsak; Paul Stern; S. Stonich; E.U. Weber. 2002: *The Drama of Commons*. National Academies Press.
- Crawford, Sue and Elinor Ostrom. 1995: A grammar of institutions. *American Political Science Review*, 89(3): 582-600.
- Dennett, Daniel C. 1995: *Darwin's Dangerous Idea*. New York: Simon & Schuster.
- Dennett, Daniel C. 1984: *Elbow Room: The Varieties of Free Will Worth Wanting*. The MIT Press.
- Dietz, Thomas, Elinor Ostrom and Paul Stern. 2003: The Struggle to Govern the Commons. *Science*, 302(5652): 1907-12.
- Folke, Carl. 2006: Resilience: The emergence of a perspective for social-ecological systems analyses. *Global Environmental Change*, 16(3): 253-67.
- Gibson, Clark, Margaret McKeen and Elinor Ostrom. 2000: *People and Forests. Communities, Institutions, and Governance Politics, Science, and the Environment*. MIT Press.
- Giugni, M., McAdam, D., & Tilly, C. (Eds.). 1999: *How Social Movements Matter*. University of

- Minnesota Press.
- Gregory, Paul R. and Robert C. Stuart. 1999: *Comparative Economic Systems: 6th (Sixth) Edition*.  
Houghton Mifflin
- Gunderson, Lance. 2000: Ecological Resilience: in Theory and Application. *Annual Review of Ecology and Systematics*, 31: 425-39.
- Gregory, Paul R., and Robert C. Stuart. 1999: *Comparative Economic Systems*. Boston: Houghton Mifflin Co.
- Hayek, Friedrich A. 1945: Use of Knowledge in Society. *American Economic Review* 35(4): 519-30.
- Hayek, Friedrich A. 1967: The result of human action, but not of human design. In *Studies in Philosophy, Politics and Economics*, London: Routledge and Kegan.
- Holling, C.S.; D.W. Schindler, Brian Walker and Johnathan Roughgarden. 1995: Biodiversity in the functioning of ecosystems: an ecological synthesis. In *Biodiversity Loss: economic and ecological issues* edited by Charles Perrings, Karl-Göran Mäler, Carl Folke, C.S. Holling and Bengt-Owe Jansson, 44-83. Cambridge University Press.
- Janssen, Marco, John Anderies and Elinor Ostrom. 2004: A framework to analyze the robustness of social-ecological systems from an institutional perspective. *Ecology and Society*, 9(1): 18.
- Janssen, Marco, John Anderies and Elinor Ostrom. 2007. Robustness of Social-Ecological Systems to Spatial and Temporal Variability. *Society and Natural Resources*, 20(4): 307-22.
- Janssen, Marco, Oran Young, Frans Berkhout, Gilberto Gallopin, Elinor Ostrom and Sander van der Leeuw. 2006: The globalization of socio-ecological systems: An agenda for scientific research. *Global Environmental Change*, 16(3): 304-16.
- Johnson, Gale. 2000: Population, Food, and Knowledge. *The American Economic Review*, 90(1): 1-14.
- Kahn, Herman. 2009: *The Essential Herman Kahn: In Defense of Thinking*. Paul Dragos Aligica and

- Kenneth R. Weinstein, eds. Lexington Books.
- Kasper, W., Streit, M. E., & Boettke, P. J. 2012: *Institutional Economics: Property, Competition, Policies Second Edition*. Edward Elgar.
- Kling, Arnold and Nick Schulz. 2009: *From Poverty to Prosperity: Intangible Assets, Hidden Liabilities and the Lasting Triumph over Scarcity*. Encounter Books.
- Mandelbrot, Benoit and Richard Hudson. 2004: *The (Mis)behavior of Markets: A Fractal View of Risk, Ruin, and Reward*. Basic Books.
- McAdam, D., Tarrow, S., & Tilly, C. 2001: *Dynamics of Contention*. Cambridge University Press.
- Miller, J.H. and S.E. Page. 2007: *Complex Adaptive Systems: An Introduction to Computational Models of Social Life*. Princeton University Press.
- O'Driscoll, Gerald P. 1977: *Economics as a Coordination Problem: The Contributions of Friedrich A. Hayek*, Sheed Andrews and McMeel.
- Olson, Mancur. 1982: *The Rise and Decline of Nations: Economic Growth, Stagflation, and Social Rigidities*. Yale University Press.
- Ostrom, Elinor. 1990: *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press.
- Ostrom, Elinor. 1994: *Neither Market Nor State: Governance of Common-Pool Resources in the Twenty First Century*. International Food Policy Research Institute.
- Ostrom, Elinor. 2005: *Understanding Institutional Diversity*. Princeton University Press.
- Ostrom, Elinor. 2008: Developing a method for analyzing institutional change. In *Alternative Institutional Structures: Evolution and Impact* edited by Sandra Batie and Nicholas Mercuro, 48-76. Routledge.
- Ostrom, Vincent 1991: *The Meaning of American Federalism: Constituting a Self-Governing Society*.

- ICS Press.
- Ostrom, E., Chang, C., Pennington, M., & Tarko, V. 2012: *The Future of the Commons: Beyond Market Failure and Government Regulation*. London: Institute of Economic Affairs.
- Ostrom, Elinor and Charlotte Hess. 2007: *Understanding Knowledge as a Commons: From Theory to Practice*. MIT Press.
- Ostrom, Elinor and Vincent Ostrom. 2004: The quest for meaning in public choice. *American Journal of Economics and Sociology*, 63(1): 105-47.
- Ostrom, Elinor, Larry Schroeder and Susan Wynne. 2003: Analyzing the Performance of Alternative Institutional Arrangements for Sustaining Rural Infrastructure in Developing Countries. *Journal of Public Administration Research and Theory*, 3: 11-45.
- Ostrom, Elinor, Roy Gardner and James Walker. 1994: *Rules, Games and Common-pool Resources*. University of Michigan Press.
- Pryor, Frederic L. 2005: *A Guidebook to the Comparative Study of Economic Systems*. Cambridge: Cambridge University Press.
- Reisman, George. 1996: *Capitalism: A Treatise on Economics*. Jameson Books.
- Ridley, M. 1996: *The Origins of Virtue: Human Instincts and the Evolution of Cooperation*. Penguin.
- Rogner, H.-H. 1997: An assessment of world hydrocarbon resources. *Annual Review of Energy and the Environment*, 22: 217-62.
- Ruttan, Vernon. W. 2002: Productivity Growth in World Agriculture: Sources and Constraints. *Journal of Economic Perspectives*, 16(4): 161-84.
- Samuelson, Paul and William Nordhaus. 2001: *Microeconomics, 17th edition*. McGraw Hill.
- Simon, Julian, ed. 1995. *The State of Humanity*. Blackwell in association with the Cato Institute.
- Simon, Julian. 1998: *The Ultimate Resource 2*. Princeton University Press.

- Sowell, T. 2002: *A Conflict of Visions: Ideological Origins of Political Struggles*. Basic Books.
- Tainter, J. A. 1988: *The Collapse of Complex Societies*. Cambridge University Press.
- Tilly, C. 1993: *European Revolutions: 1492-1992*. Blackwell.
- Tilly, C., & Wood, L. 2009: *Social Movements, 1768-2008* (2 ed.). Paradigm.
- Walker, Brian; C.S. Holling, Stephen Carpenter and Ann Kinzig. 2004: Resilience, adaptability and transformability in social–ecological systems. *Ecology and Society*, 9(2): 5.
- Weingast, B. 1995: The Economic Role of Political Institutions: Market-Preserving Federalism and Economic Development. *Journal of Law, Economics, and Organization*, 11(1).