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

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Comparative economic systems literature deals extensively with 'systemic functions' and 'performance criteria' such as growth, efficiency and equity but rarely mentions the topic of resilience. This paper focusses on the issue of resilience while drawing several important lessons from the contributions in this respect of 2009 Nobel Prize in Economics co-recipient, Elinor Ostrom: The effects of alternative institutional arrangements and social norms as a source of both resilience and vulnerability; the problem of 'highly optimized tolerance' to specific sources of uncertainty; polycentricity as a possible structural solution to sustainability problems. A key point is that resilience is more than mere 'absorptive capacity' or 'speed of recovery': it depends on innovation and creative socio-cultural adaptations made possible by flexible and polycentric institutional processes. That has important implications for the ways we define and assess institutional performance and institutional design.

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INTRODUCTION

The increasing public salience of themes related to economic, political and environmental crises has marked the contemporary public debate and 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 dedicated to various facets, elements and features of social systems or to performance evaluation standards such as efficiency, growth, freedom, equality etc (Gregory and Stuart, 1999a, b). 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 (2005, p. 32) lists the following 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. Other indicators may be added to it: a low level of unemployment or underemployment; a high degree of economic security; a low degree of concentration of economic power; a lack of exploitation 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; equity and equality of opportunity; economic freedoms of consumption, property and occupational choice. Similar lists of functional criteria and indicators are a trademark of the comparative economic systems literature but for the purposes of our discussion the point is not so much what is on such list but what has been neglected, what constantly fails to make the list. It is very interesting that although it is so obvious that ‘the ultimate test of an economic system is its long-term viability’ (Gregory and Stuart, 1999a, b, p. 47), the problem failed to become an object of active and intense research interest. 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. There one could find that 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’, ‘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, its integration in mainstream political economy still 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 implicitly 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 introduce a set of important insights regarding resilience as they emerge from the work of Ostrom and her associates, will present them systematically, and will explain their significance. The article is organized around the following key insights: (1) Institutions are critical because the structure and functioning of institutional arrangements are the key to social and economic systems' resilience both with respect to natural disasters and endogenous social-economic developments. (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 only on efficiency 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. 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 underlying argument of the article is that the notion of resilience needs to be further developed and that better methods to operationally deal with it are needed. It encourages a conceptualization that goes beyond the current emphasis on the 'socio-ecological' facet, (ie 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 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 having Ostrom as one of its main promoters.



INSTITUTIONS: KEY TO ANALYZING RESILIENCE

In most cases, discussions about resilience are currently based on the concept of a social-ecological system (SES), modeled as an interaction between, on one hand, a society's cultural and institutional arrangements, and, on the other hand, its physical environment. Indeed, a 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, norm, institutions and knowledge processes) is considered largely arbitrary (Berkes and Folke, 1998; Berkes *et al.*, 2003; Carpenter *et al.*, 2001; Folke, 2006; Ostrom, 2008).

Janssen, Anderies and Ostrom describe the connection between political-economic aspects and the ecological aspects as 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 (Janssen *et al.*, 2007, pp. 310–311):

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; Adger, 2000). The point is that one cannot give a complete account of social-ecological resilience without considering institutional factors. Vulnerability and resilience research depends on more than just the 'external shocks and stresses experienced by the social-ecological system', because 'the response of the system, and the capacity for adaptive action' depends on the existing institutions (Adger, 2006). Ostrom's institutional approach fully brings social sciences into resilience analysis in a way that allows us to account for the fact that, as noted by Adger (2006), 'the resilience of institutions is based on their historical evolution and their inclusivity or exclusivity, trust norms and networks' while 'the cultural context of institutional adaptation, different knowledge systems, are central to the resilience of institutions'.



The concept of institutional resilience thus focuses on the human (or social) aspect of the human–environment relation and 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. 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. Let us detail the relevance of institutions for those three components: (1) reaction ability, (2) adaptability, and (3) avoiding slippery slopes.

(1). As far as a society’s reaction ability is concerned, resilience can be understood from an equilibrium perspective. An SES is resilient if it is capable to successfully resist sudden, unexpected environmental changes. Authors refer either to the ‘absorption capacity’ (ie the size of the shock with which the system can successfully cope) or to the ‘speed of recovery’ from a given shock (Holling *et al.*, 1995; Walker *et al.*, 2004). Both the absorption capacity and the recovery speed are relative to the pre-existing situation, which is conceptualized as a state of equilibrium. This approach can be extended to cover situations that may be overwhelmingly social, rather than natural. Threats to institutional order may be social in their origins and manifest themselves socially.

For example, if we compare earthquake effects in Chile and Haiti (Lovett, 2010), we see that although Chile was hit by an earthquake 500 times more powerful than Haiti, it suffered about 300–400 times fewer deaths (several hundred rather than a 230,000). Chile thus had a much larger absorption capacity. As an example of the relevance of institutions for the speed of recovery perspective, we can point out that – as an entire series of studies demonstrated – various towns hit by Katrina had varying recovery rates depending on the nature of their pre-existing social networks (Chamlee-Wright and Storr, 2009a, b; 2010a, b). From this equilibrium perspective, a system is resilient if its institutions provide the tools for social cooperation that allow for a quick and effective response to possible challenges.

(2). The deeper concept of resilience deals with adaptability and the ‘behavior of dynamic systems far from equilibrium’ (Gunderson, 2000). Complex social systems are in a state of constant change, but, nonetheless, some of their structural features – institutions – remain invariant over a longer period of time than exogenous shocks, government policies and private contractual agreements (Williamson, 2000). Under this approach, one is focusing more on the idea of *adaptability* to challenges and on the extent to which institutions foster such adaptability, rather than a return to a pre-



existing state of equilibrium. For example, markets are generally considered to be resilient to shocks created by creative destruction. Due to the price system and to competition, the unemployment caused by the initial disruption is dissipated as people re-qualify and businesses discover how to use the disruptive innovation to reduce their costs. The response to the shock thus occurs *within* the existing institutional framework, rather than require a significant change to the rules. The non-equilibrium perspective stresses that change is not only unavoidable, but also necessary.

First, the non-equilibrium approach is *unavoidable* as long as change is endogenous and everlasting (North 1994). What makes change endogenous and everlasting is the fact that people do not just passively obey the existing rules, but they also actively try to change those rules (Leeson and Boettke, 2009). Implementing a particular solution changes the structure of incentives, including the incentives to change the game: 'As soon as one design has proved itself in one environment, innovations in strategies adopted by participants or changes in the environment in which humanly designed system is in operation will produce unexpected results' (E. Ostrom, 2005, p. 255). As such, the equilibrium concept 'can be difficult to apply to systems in which some components are consciously designed' and one has to consider 'endogenous processes within a given system of interest and ... address normative considerations associated with incentives and decisions' (Janssen and Anderies, 2013).

Second, change is also *necessary* for a complex social system to be resilient because some resources are not renewable and all extractive technologies are subjected to diminishing returns (Reisman, 1996, pp. 67–71). A sedentary agricultural society simply cannot maintain its standard of living without constant innovation in new technologies. This is an even more pressing matter if the population is growing, in which case agricultural productivity also needs to be increased just to maintain its current level of wealth. In order to survive and prosper, modern societies have to adopt institutional frameworks that favor fast enough rates of innovation. Technologies that impact a society's relation to nature are also created as the result of incentives inherent in that society. Whether something is a 'resource' or not is also technologically induced and technology advances faster in certain social-institutional environments (Kahn, 2009; Simon, 1995, 1998; Kling and Schulz, 2009). An institutional arrangement that inhibits innovation or does not secure it at a fast enough rate is an institutional arrangement that undermines resilience. This is an economic version of the 'Red Queen principle' (van Valen, 1973): a society has to keep running, just to remain in place.

(3). Last but not least, the resilience of a system is determined by its ability 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 and social complexity feed each other. The society can move towards such a point without significant losses in its standard of living and yet, once the threshold is reached, degradation becomes rapid, profound and hard to stop (Walker *et al.*, 2004; Diamond, 2005).

Once again, 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 *et al.*, 2001; Tilly and Wood, 2009) and gradual changes (Olson, 1982; Giugni *et al.*, 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.

The concept of resilience goes hand in hand with the opposite idea of ‘collapse’ (Tainter, 1988; Diamond, 2005). Tainter (1988, p. 38) defines it as a process that results in a ‘rapid, substantial decline in an established level of complexity’:

A society that has collapsed is suddenly smaller, less differentiated and heterogeneous, and characterized by fewer specialized parts; it displays less social differentiation; and it is able to exercise less control over the behavior of its members. It is able at the same time to command smaller surpluses, to offer fewer benefits and inducements to membership; and it is less capable of providing subsistence and defensive security for a regional population. It may decompose to some of the constituent building blocks (e.g., states, ethnic groups, villages) out of which it was created.

Seen from a development economics perspective, ‘collapse’ is a sudden reduction in the extent of the market, leading to a reduction in division of labor, and, as a consequence, to a reduction in productivity and prosperity. Considering that the extent of the market is determined by the definition, monitoring and enforcement of property rights, collapse is always an institutional event – a shock to the functional and structural configurations of institutional arrangements.

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) becomes crucially important. The institutional aspect is essential in assessing the long-term resilience of a society, and, ultimately it 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 having a productive relation to its natural environment. But one should also not reduce the entire discussion to that relationship. Both resilience and vulnerability have a complex social-institutional facet, in addition to the environment-related one. It is important not only to conceptualize it but also to explore how it operates as a key variable in the equation of systemic performance. This highlights the importance of understanding the mechanisms by which institutions operate on the resilience-vulnerability axis as well as the process by which institutions change. The next section describes the 'HOT' model, which explains why a society that optimizes its rules to past challenges tends to inadvertently create previously inexistent vulnerabilities. Consequently, one may get a better sense of why there exists a trade-off between efficiency (computed with estimates of risk) and resilience (which also incorporates concerns about uncertainty) and why that tradeoff is so important.

HIGHLY OPTIMIZED TOLERANCE

Ostrom's overall approach to resilience and vulnerability is intrinsically connected with the development of the mathematical concept of 'robustness'. One of the clearest illustrations of this approach is provided by Janssen *et al.* (2004) who elaborated and applied the concept to the analysis of complex environmental issues. The article uses as a vehicle the approach to robustness developed by physicists Carlson and Doyle (1999, 2002).

In their complexity theory studies Carlson and Doyle arrived at the notion of 'HOT' by studying the 'power laws'. Many complex phenomena (eg 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 etc) are not governed by normal Gaussian distributions but by power laws (Mandelbrot and Hudson, 2004; Bak, 1996). This is significant for two reasons: First, unlike Gaussian distributions, power laws allow for considerable differences between the statistical mean and mode, for example the total wealth divided by population is not same as the wealth that most individuals have. Second, they allow for as larger probability of big departures from the most probable event. This is important because disaster planning often focuses on distributing prevention resources predominately for preventing the most probable events.

In regard to social-ecological resilience and robustness, the matter of interest is the possibility of resource destruction due to some uncertain events, for example 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. If one allocates the budget for prevention according to the *expected damage* (ie the product between the cost of damage and its likelihood), 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 exactly 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 a system that is designed to tolerate better specific sources of risk and that has its complexity increased precisely by the development of features that help it cope with those sources of risk and danger. Nonetheless, while building robustness the system also creates weak-points. Those vulnerable points create 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 (Janssen *et al.*, 2004, 2007). First of all, it illuminates how 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 risk. As Tainter (1988, p. 37) notes, '[c]omplex societies are problem-solving organizations, in which more parts, different kinds of parts, more social differentiation, more inequality, and more kinds of centralization and control emerge as circumstances require'. Ostrom and her collaborators identify and discuss an entire series of relevant cases in which the uncertainty generating element is free riding (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).

The specifics will differ from case to case. Different kind of rules are adopted when free riding involves cutting wood from a forest than when free riding involves overharvesting fish from the ocean. The *function* of those rules is the same in both cases, but the *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 (eg 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). Each community has to develop its own rules for dealing with its specific problem and form of uncertainty. HOT reveals thus the contextual and social-institutional complexity of the challenge.

The institutional details that fulfil a particular function are not easily to isolate and analyze, as they may have evolved due to some forgotten historical contingencies. At each layer of organization, ‘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 (eg the irrigation systems in Bali [Lansing, 1991, 2012; Lansing and Kremer, 1993] or traditional transhumance in India [Chakrabarti, 2011]) 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 (Hayek, 1967, 1979; 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’.

And thus we come to a crucial point: 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. Traditional rules, on the other hand, 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 (Chakrabarti, 2011). Similarly, the property titles development strategy proposed by de Soto may backfire (Kerekes and Williamson, 2008; Williamson, 2010). Property titles work as development tools only as long as there is a working judicial system and a relatively non-corrupt government. Otherwise, the existence of property titles still does relatively little to entice banks to provide investment funds (as it takes them a long time to go through a dysfunctional judicial system in order to recuperate the collateral when a loan is not paid back), and property titles make tax collection easier, which can have adverse development effects.

The study of fisheries around the world has led to interesting insights. The history of some of the US fisheries reveals how state interventions can be both beneficial and deleterious. The Maine lobster fisheries were severely depleted in the 1920s, as local communities were failing in their attempts to effectively manage the fisheries. The state threatened some of fisheries with closure and 'supported informal local enforcement efforts' (Ostrom, 1999). As a result, '[b]y the late 1930s, compliance problems were largely resolved and stocks had rebounded'. More recently, the informal local organizations were transformed into formalized councils with democratic local elections and formalized authority over specified geographical areas. This had the unexpected beneficial consequence of being 'followed, almost immediately, by the creation of an informal council of councils to address problems at a greater than-local scale'. This highlights something that surprises many: that cooperation between communities with respect to large-scale problems can often emerge in a bottom-up fashion if the institutional prerequisites for such cooperation are available.

Another interesting example is that of Washington state Pacific salmon fisheries. Prior to mid-1970s, they were centrally managed and they faced a typical knowledge problem: the 'centrally regulated system had focused on aggregations of species and spent little time on the freshwater habitats that are essential to maintain the viability of salmon fisheries over the long term' (Ostrom, 1999, p. 40). A major court decision in the mid-1970s granted to



'Indian tribes that had signed treaties more than a century before' the right 'to 50% of the fish that passed through the normal fishing areas of the tribes'. Consequently, '[t]his has required the state to develop a "co-management" system that involves both the state of Washington and the 21 Indian tribes in diverse policy roles related to salmon'. The incentives at the local level were thus changed. Individual tribes were assured that free-riding by other tribes was not going to be tolerated, which favored conservation efforts, and the co-management system gave individual tribes an important economic stake in the resource, which incentivized them to solve the aforementioned knowledge problem.

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'. Can we expect any 'common features ... 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'?

The key idea that allows us to address this problem is to move the discussion from the 'operational level', where unbridled complexity reigns, to the 'collective choice level' describing the rules by which people interact in their attempts to design the proper 'operational-level' rules. In other words, although the sustainable solutions to various concrete problems are highly specific and context-dependent, social systems that are good at discovering the sustainable solutions are all organized in a similar fashion. Thus, the solution to the problem of resilience is to be found at the collective choice level. The next section sets the stage for understanding Ostrom's 'design principles'. In order to understand how and why certain collective choice arrangements are more effective than others at engendering cooperation towards finding sustainable solutions in a wide variety of contexts and as a response to a wide variety of challenges, one needs to understand how the social rules work and the institutional mechanism that favors the evolution of social rules in a resilient direction.

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 of 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. Because of the importance of adaptability, one must try to 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. Yet, these mechanisms and processes pivoting on rules are at the very core of the resilience of a social system.

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 non-compliance' (Ostrom and Hess, 2007, p. 50). The emphasis on 'normative' is important. 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). These rules are thus not simple descriptions of behavioral regularities, 'shared strategies' that people are commonly observed to employ (Crawford and Ostrom, 1995; Bicchieri, 2005, chapter 6). It may very well be the case that, strictly speaking, a rule is never fully followed and obeyed, but, nonetheless, it still guides human interactions and expectations by laying out a desideratum. This works hand in hand with the fact that penalties tend to be gradual: bigger contraventions and repeated contraventions receive a larger penalty, while small or occasional contraventions may be forgiven or receive only symbolic penalties.

Moreover, these rules are not necessarily formal. Many rules-in-form remain only on paper, are not enforced by sanctioning, and, thus, end up having little effect on social outcomes. It is the actual rules-in-use that determine the social outcomes: '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). As details are important when judging robustness, it is crucial to determine what the rules-in-use actually are. The rules-in-form 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).

Once again, the challenge in unlocking the rules-resilience nexus is how to possibly deal such complexity without either being completely overwhelmed by it or adopting some oversimplified perspective that pretends this complexity does not exist. One way to try to solve this challenge is by switching one’s attention from the static problem of mapping and categorizing the existing rules-in-use to the dynamic problem of understanding the process of their emergence. As Buchanan (1999) put it, ‘order is defined in the process of its emergence’. Bicchieri (2005) notes the same, when she writes that ‘[t]he problem of social order, its origin and maintenance, has traditionally been associated with the existence of pro-social behaviors’, but ‘a central question becomes how to model the emergence of those behavioral patterns that keep a society together’ (p. 214).

It is precisely this approach that Ostrom adopts, by focusing on the process of enforcement, which provides the key to understanding the emergence, evolution and persistence of social rules. As Kasper *et al.* (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’.

The basic observation on which Ostrom’s approach to the evolution of rules is built is 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 fulfil their duties, and the second layer of monitors and enforcers also needs to be monitored, and so on. This creates an apparent paradox. At each layer of monitoring and enforcement, there exists a possibility of failure, either due to personal interests and opportunism 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. But pushing the problem of enforcement at higher and higher levels makes both information transaction costs and incentive problems worse. Thus, solving the dilemma of enforcement by postulating a benevolent and informed third-party enforcer is not realistic. As such, as North (1991, pp. 55–56) pointed out, ‘the dilemma that is posed by impersonal exchange without effective third-party enforcement is central to the major issues of development’. Ostrom’s solution to this dilemma is to look in the opposite direction, towards the details of 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, pp. 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.

The way to understand the general dynamic at work is to model the production of rules as an example of co-production, rather than team-production (Parks *et al.*, 1981; Aligica and Tarko, 2013). In case of co-production, the members of the production team are also consumers of the good, and thus they have a vested interest in producing a quality good, while in case of team-production the production team produces solely for some outside consumers. Team-production requires third-party monitoring and enforcement in order to prevent shirking by team members (Alchian and Demsetz, 1972). By contrast, overly hierarchical organizations of co-production processes bring in third parties who lack the intrinsic vested interest in the quality of the good, and thus tend to make matters worse, rather than better. If rule production is indeed an example of co-production, the focus needs to be on keeping the production of rules at the most local possible level. Because of the monitoring paradox in hierarchies, 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. 260–261). 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.

This being said, it is important to stress that not all problems are best solved at local level. The optimal scale depends on the nature of the issue. 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 and with it the most distinctive feature of the Ostromian approach to resilience and to social systems governance, in general (Ostrom, 2005, pp. 281–286; see also Aligica and Tarko, 2012). Polycentricity means, first of all, applying the same logic of self-governance to a larger level. As in the example given earlier of Maine lobster fisheries, 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. Second, as the Indian tribes example given earlier showcases, it is important that the relationship between local communities and higher level (central) government succeeds in mediating conflicts between local communities, acts as a catalyst for the formation of associations between communities, facilitate information sharing among different communities. Third, the polycentric arrangement is also designed to protect individuals and minorities and provide outside help in emergency cases, but abstain from interfering under normal conditions.

Ostrom roughly defines polycentricity as 'a system where citizens are able to organize not just one but multiple governing authorities at differing scales' (Ostrom, 2005, p. 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, p. 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. Leeson (2011) further develops the underlining theory explaining the conditions under which systems of rules are self-enforcing, and concludes that the closer a society is to a system of overlapping voluntary clubs, the more reliable and less exploitive the rules are (ie they are not arbitrarily changed to fit special interests with access to power), the more we can expect for public



goods to be provided at the efficient scale, and the more flexible the rules are with respect to adapting to new challenges.

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 the process of their emergence, persistence and adaptation allows us to follow the logic revealed by the ‘grammar of institutions’ (Crawford and Ostrom, 1995) and identify critical aspects related to the monitoring, enforcement and legitimacy. Within this approach, polycentricity is providing a framework for understanding which arrangements 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, that is for adaptability. As emphasized in the previous section as well, the key insight is that there are no simple general solutions to those problems. The problem of resilience includes issues such as having rules that are flexible enough that they can cope with uncertainty and unexpected challenges, but fixed enough that they set up a credible institutional environment that people can trust; and finding the proper scale at which public goods are provided and information is gathered. Such issues only have context-specific solutions. Consequently, to the extent that general principles exist they are at the collective choice and constitutional level. The next section moves to the last stage of the argument and discusses these general ‘design principles’ and why polycentricity acts as a framework 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 and their colleagues 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. At the same time, it has tried to transcend the debate 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. The focus should be on social self-organization and the emergent phenomena is the social and economic systems’ evolution, rather than on a top-down perspective that 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.

Ostrom stresses the importance of the fact that in the evolutionary process of institutional change the variation of rules and norms is often the result of rational design, rather than mere randomness (Ostrom, 2008, p. 58). The process of evolution by blind variation and natural selection tinkers randomly with existing designs. On the other hand rational variation based on learning and innovation can involve redesigns by deliberation and choice. It is noteworthy, however, that such redesigns also pose a challenge to resilience. They may have unintended consequences or may lead to dead ends; hence, the importance of institutional diversity and the emphasis on the value of social experimentation and bottom-up innovation. Maintaining institutional variety and a certain level of local self-governance, is prudent. One needs to be skeptical towards 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 SESs, 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.

A typical and well-studied bottom-up self-organizing social system is the market. The notion that a market is an information processing 'machine', a 'social computer' that solves the giant coordination problem (Hayek, 1945; O'Driscoll, 1977; Axtell, 2003; Miller and Page, 2007) is a crucial inspiration for the Ostrom approach to other self-organizing social phenomena. Ostrom's perspective recognizes the power of the market model, but it also recognizes its limits. The concept of polycentricity is a generalization of the idea of beneficial emergent orders (Aligica and Tarko, 2012). Given that not all emergent phenomena are positive (eg from traffic jams to Schelling's segregation model to asset bubbles), it is important to map out the conditions under which emergence is likely to lead to desirable outcomes. Polycentricity attempts to do this, although, arguably, much more work is still necessary. The market is a special case of polycentricity characterized by individual goals and individual decisions, free entry and exit, private information, non-territorial organizations, and a framework of rules imposed from the outside. However, numerous other polycentric arrangements are possible (Figure 1). The logical structure of polycentricity (Aligica and Tarko, 2012) aims at providing a more rigorous basis for applying the concept to empirical studies, by mapping the features that need to be followed and the way in which they fit together as a coherent arrangement.

A polycentric arrangement aims at providing the institutional framework in which alternative systems of rules can be created in order to fulfil the two

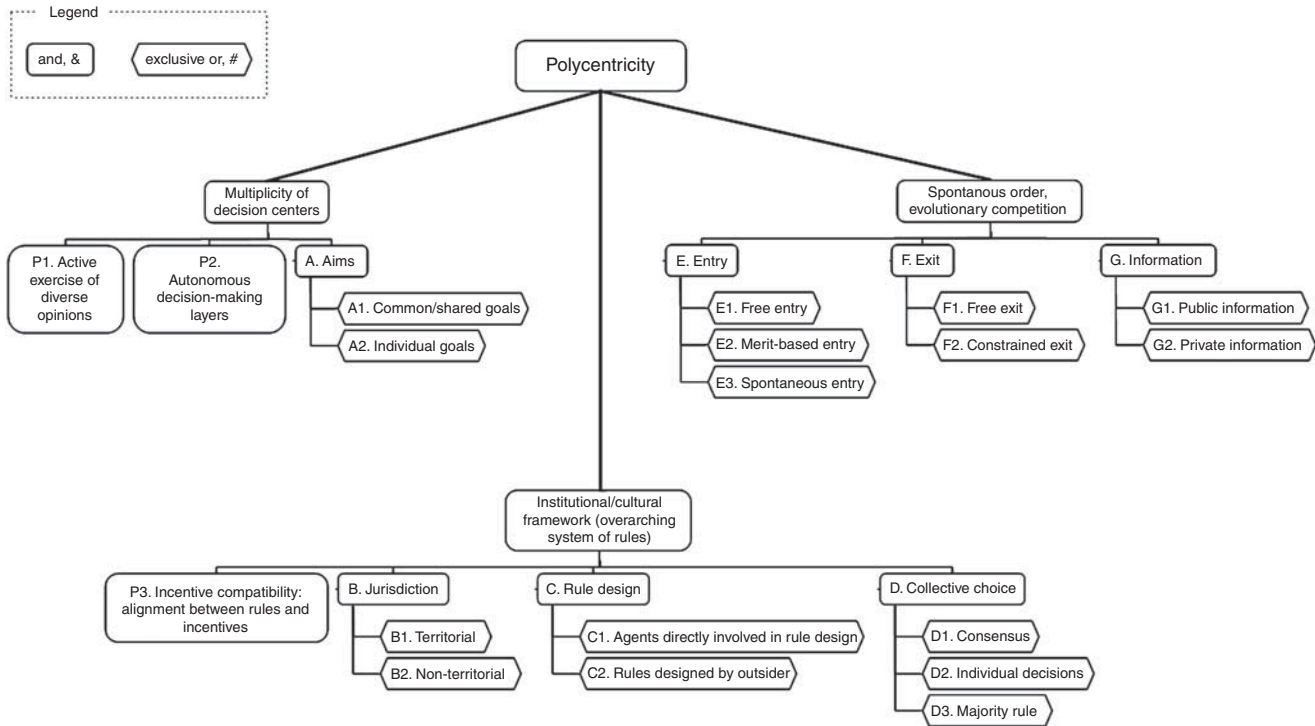


Figure 1: The logical structure of possible polycentric systems (based on Aligica and Tarko, 2012)



tasks that the price system fulfils in the areas where markets exist: aggregating preferences and guiding entrepreneurial activities. These diverse institutional arrangements, informal and formal, can be seen as functional equivalent coordination phenomena that elude the standard distinction between market and state (Ostrom, 1994). Collective choice arrangements and processes are used to fulfil the same tasks of preference aggregation executed on markets via the price system. The systems of rules have the task of aggregating information, providing feed-backs, shaping the right incentives for decision and innovation. In brief a multi-layered complex system of social rules generates structures and processes geared towards social problem-solving.

Polycentricity is the component in E. Ostrom's 'design principles' that facilitates adaptation. These 'design principles' are a set of institutional heuristics that have been shown empirically (1990, 2005; Ostrom *et al.*, 1994) and theoretically (Wilson *et al.*, 2013) to promote resilience. The design principles hold that successful *property rights systems* are characterized by: (1) clearly specified and generally known resources boundaries and institutional roles (who is allowed to do what); (2) effective monitoring against free-riding; (3) graduated sanctions against offenders; (4) the fairness/meritocratic social function of the property system in establishing a proportionality between one's effort (costs) contributing to the resource and the benefits gained from the resource. At the *collective choice level*, regarding the manner in which decisions about operational-level rules are adopted, the design principles recommend: (5) conflict resolution mechanisms generating outcomes perceived as fair; (6) at least a certain level of self-governance (rules are not imposed by an outsider); (7) the collective choice arrangements need to be effective, in the sense that they approximate the calculus of consent optimality (Buchanan and Tullock, 1962), for example by means of the 'generality norm' (Buchanan and Congleton, 1998; Wilson *et al.*, 2013). At the *constitutional level*, regarding the rules for changing collective choice arrangements, the design principles recommend: (8) subsidiarity and nested structures, such that knowledge problems are minimized, and the harmony between the incentives involved in rule design and the incentives involved in rule monitoring and enforcement is maintained.

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. 274–275). 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 collective choice and constitutional levels and focus more on the socio-political process of rule-design. While there can be no blueprints at the operational level. Yet, there are ‘design principles’ as Elinor Ostrom has called them, at the higher levels. 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 bottom line 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 SESs but also invite a reconsideration of the theories dealing with the functional and performance criteria used in institutional and comparative economic systems analysis.

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