

Modeling Evolutionary Institutional Change in Social-ecological Systems: An analytical framework

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Abstract

A wide range of methods has been successfully employed for evaluating the performance of static alternative institutions. It is much more challenging to study institutions if these are considered to be dynamically changing. Some experimentalists and modelers have recently started to endogenize institutions, i.e., they allow rules to be changed dynamically by experimental subjects or simulated agents. Focusing on social-ecological system analysis, we review the literature in this field. We show that institutions can be understood as hierarchically nested, with some higher-level institutions necessarily remaining exogenous to any empirical model. We propose a pragmatic approach to address the matter. Specifically, we develop a guiding list of nine questions, seeking to assist empirically working scholars. Viable institutional alternatives, institutional status quo, constitutional rules, and costs of institutional change are among the important variables to be considered in empirical work. The list aims at ensuring transparency in communicating trade-offs faced when designing economic experiments or agent-based models with institutional change in social-ecological systems analysis.

Keywords: Agent-based Modeling; Evolution; Experiments; Institutions; Methods

1 Introduction

Institutions are at the core of many questions in the social sciences. It is now widely acknowledged that they play a key role in the development of economic systems (North 1990; Ostrom 1990; Acemoglu et al. 2012). With some success, a broad set of methods has been employed to study the impact of institutions on economic performance empirically (Beckmann & Padmanabhan 2009). Careful case study analysis (Ostrom 1990), economic experiments (Ostrom et al. 1994), or econometric and historical analysis (Acemoglu et al. 2012) are among the many methods used for static institutional analysis.

Much less is known about the change of institutions, however. Although a wide range of theoretical concepts exists in this field (Bromley 1989; North 1990; Knight 1992; van Bergh & Stagl 2003; Greif & Laitin 2004; Hodgson 2004; Aoki 2007; Kingston & Caballero 2009), applied work is still relatively rare, because of the dynamic and complex relationships involved that do not naturally lend themselves to the methods commonly used in economics (Alston et al. 1996; Hodgson 2004; Ostrom 2008; Schlüter 2010). Recently, it has been argued that economic experiments (cf. Rommel 2014) or agent-based models (e.g., Janssen & Ostrom 2006a; Smajgl et al. 2008, 2010) can be used to model the evolution of institutions. Ontologically, these methods are compatible with the Darwinian (meta-)framework of evolutionary economic change proposed by Hodgson & Knudsen (2010) and allow for complex interactions of agents, institutions, and their environment.

Without appropriate methods, theories cannot be tested, compared, and developed, and we acclaim the strengths of experiments and agent-based models (ABM) for advancing our empirical knowledge of institutional change. It is even much needed to consider endogenous

institutional change in ABM if scenarios develop over longer time periods and hence change is likely to occur (Smajgl et al. 2008, 2010). Yet, it is also important for us to point out that even if some institutions are made endogenous to the model, at some stage, there is always a higher-level institution that is exogenous to the experimental subject or simulated agent. In both, experiments and ABM, researchers still rely on critical assumptions regarding these institutions. For example, if experimental subjects or agents are allowed to change rules as part of the experimental game or ABM, it has to be explained to participants, or modeled as part of an ABM, what the underlying (constitutional) rules for changing a particular rule are. Rules may change by an individual's (e.g., the most powerful member of a group) decision or through democratic votes of various kinds (e.g., simple vs. absolute majority vs. unanimity). In addition, the institutional status quo, the point of time, available alternative institutional options, etc. may all matter for outcomes.

We propose a pragmatic approach to this problem. Assumptions on (exogenous) higher-level institutions should be empirically grounded and documented in a transparent manner. We show that Elinor Ostrom's concept of multiple levels of institutional analysis provides a useful starting point for such an endeavor. Based on this framework, we develop a guiding list of questions aimed at assisting social scientists interested in evolutionary institutional change. This heuristic eases the explication of decisions that are often made only implicitly in empirical work.

The paper is structured as follows. First we review the empirical literature on experiments and agent-based models that involve endogenous institutional change through experimental subjects' or agents' choice. We then introduce Elinor Ostrom's framework of multiple levels of institutional analysis. On this basis we derive a set of questions for experimentalists and

modelers seeking to run an experiment or to develop an ABM. In a final section we summarize our work and conclude.

2 Empirical Applications: Experiments and Agent-based Models with Endogenous Institutions

2.1 Economic Experiments

Economic experiments can be distinguished by the underlying concept of institutions and institutional change. In a structure–agency typology three viewpoints can be identified (Rommel 2014). Firstly, in treatments, experimentalists can manipulate the rules of the game in order to compare behavioral differences under varying institutions. In this approach, institutions function as structures that constrain and enable the choice set of agents. Secondly, variations in experimental framing or the subject pool can be used to study the impact of (internalized) norms on behavior. In this approach, institutions are part of the agent’s internal belief system. Thirdly, institutions may be an endogenous variable under investigation in a particular experiment. Subjects may be allowed to change the rules within a given environment (Rommel 2014). This third approach has perhaps been best described by Botelho et al. (2005, p.1; Emphasis in the original):

[I]nferring preferences from the outcome of play under different institutions is a difficult, if not impossible, task. The solution to this problem is to *expand the experimental design to allow subjects to directly choose which institution they would prefer to operate under.*

The idea behind this is to endogenize institutions, if these institutions are an important aspect of the empirical question under investigation:

If subjects in the field have mechanisms by which they can avoid, lobby or self-select into or out of institutions, we must consider the effects of those margins of choice before drawing conclusions about which institutions are best. Another way to express this is to consider if the laboratory environment that takes a particular institution as fixed is correctly modeling the naturally occurring environment in it's [sic!] salient features, if that environment includes ways in which subjects can endogenously opt out of that institution. (Botelho et al. 2005, p.4)

Only recently have scholars started to take up this idea in empirical applications, often focusing on the (endogenous) evolution of sanctioning and reward systems (e.g., Sutter et al. 2010; also see Putterman 2014 for a review) or the emergence of self-crafted rules for collective natural resource management (cf. Rommel 2014).

There are many ways in which experimental subjects could alter existing institutions of such experiments. Most commonly, in a vote, participants are asked to select their favorite option from a set of pre-defined institutional alternatives. The option which is preferred by the (simple) majority of participants is then implemented in the next round of repeated play. An example is the common pool resource game by Janssen et al. (2013) in which subjects appropriate trees from an open access forest. In a second stage of the game, participants can agree on a change in rules. They can choose between (1) random allocation of harvesting rights, (2) rotating allocation of harvesting rights, or (3) a limit in harvesting rights that is monitored and – in case violations occur – sanctioned with some given probability.

Participants can vote for one of the rules, and the rule with the highest number of votes becomes implemented in the next round of the game.

The experiments of Janssen et al. (2013) have been conducted in villages of Colombia and Thailand. Otto and Wechsung (2014) transfer a similar experimental protocol to rural China. On the one hand, such replications in other context are desirable to allow for the (cross-cultural) comparison of experimental results. On the other hand, it can be questioned whether the pre-selection of rules to endogenously choose from is applicable across arguably different empirical contexts. We are well aware of the fact that economic experiments involve simplifications of actual decision environments. Narrowing down the set of available options is essential for causal interference and for analyzing experimental data. Yet we believe that more care is needed to document (necessary) simplifications. Field experiments usually involve context-specific framing, because it “is not the case that abstract, context-free experiments provide more general findings if the context itself is relevant to the performance of subjects” (Harrison & List 2004, p.1022). Chinese, Colombian, and Thai farmers who participate in the experiments should be familiar with and able to relate to the experimental tasks. This also concerns the set of rules to choose from. One should always ask and document whether the proposed rules are viable options in the specific empirical context. More importantly, in any positive analysis, it will also be crucial to consider voting mechanisms that are different from the conveniently used democratic referendums if institutions do not actually change democratically.

2.2 Agent-based Models and Endogenous Institutions

An ABM consists of agents, an environment, and interactions between them. ABM are employed for answering a wide range of questions spanning from the natural to the social sciences, and they are often used to model human-environment interactions or social-ecological systems (An 2012). In an ABM, agents’ behavior is subject to rules defined by the

modeler, and so far only few empirical applications struggle with endogenizing institutions into ABM, although this field has been identified as promising (Janssen & Ostrom 2006b, p.4). Increasingly, economic experiments are used to develop empirically grounded ABM (e.g., Bravo 2011; cf. Janssen & Ostrom 2006b), and sometimes software environments resembling ABM are used in lab experiments (Janssen et al. 2008; Appel et al. 2010), but with few exceptions (Janssen et al. 2008) modeling endogenous institutional change does not yet appear on the agenda.

Most ABM of coupled human and natural systems with an explicit institutional focus test the change of regulations and policies, including subsidies and taxations, land use restrictions, or government regulations (An 2012). According to the authors' knowledge, however, neither of these has so far endogenized constitutional change.

For example, Manson (2006) builds an ABM of land use change, where communal land management councils as collective entities (*ejidos*) are modeled with the rule set of the IAD framework (cf. Ostrom 2005) and provide land use controls and allocation rules for households. Households are the main actors, equipped with a land use decision module that is impacted by institutions. Institutions, including *ejidos*, markets, and conservation programs, are modeled as "institution-agents." However, the institutional change from communal ownership and allotment via *ejidos* towards private land ownership, which happened during the 90s, is modeled by two alternative scenarios, and is thus not endogenized, but studied by comparing differences in static institutions.

Unlike these models of social-ecological systems, ABM of collective decision making processes have been developed more explicitly in the political sciences, where explicit

constitutional alternatives are tested and even compete against each other, resembling endogenous institutional change.

Kollman et al. (1997) develop an ABM of sorting behavior to test the Tiebout (1956) theory and to identify the most efficient political institutions. The authors analyze how different political institutions aggregate individual choices and affect social outcomes. The empirical context is the provision of local public goods or policies, such as community swimming pools or smoking restrictions. The tested political institutions include direct party competition with winner-take-all characteristics, proportional representation with the number of seats representing the votes, but also democratic referenda. In each time step, citizens “vote with their feet” and move to their preferred jurisdiction. Citizens relocate according to their preferred local policy positions. Policy positions change according to citizens’ preferences. The authors find that, unexpectedly, direct party competition or proportional representation perform best, because they encourage citizens to enter a phase of experimentation with frequent relocations to other jurisdictions.

McGann et al. (2002) develop a computational model to study differences in electoral rules. Various empirically observable voting behaviors and results are replicated under varying voting regimes. Contingent on the particular electoral system, voting results may be more or less biased against the median voter’s preferences. Although this model is not a typical ABM – because it does not involve interaction of agents – it highlights the importance of constitutional rules for determining outcomes of collective decision-making processes.

In the above-cited cases, discrete structural alternatives of institutions have been tested that could be endogenously chosen by agents. Smajgl et al. (2010) develop an ABM of irrigating farmers with a shared water stock, where agents are equipped with a decision heuristic that

also involves causality learning. More interestingly for our case, a rule generation module based on the grammar of institutions is developed (Crawford and Ostrom 1995). When agents start to become unsatisfied, not achieving their aspiration level that is based on previously experienced profits, they start to develop rules of what all agents must or must not do with regard to the water stock. The syntax is simplified, excluding for example rule breaking, but the possible combinations of water extraction limits are endogenously developed. Each unsatisfied agent evaluates the potential success of the rules she generates, and if potentially profitable, communicates the rule to all other agents. If in a given period more than half of the population is unsatisfied with its individual profit level, one of the proposed rules will be randomly drawn. The main contribution is to demonstrate how agent heterogeneity and environmental complexity lead to a dynamic development of new norms and rules. The key message is that general conclusions from simplified ABM for real world stakeholders may be misleading without a proper understanding of the endogenous formation of institutions. This is especially important in cases where ecological systems and policy regimes are changing quickly, for example in the case of climate change.

Both, economic experiments and ABM with endogenous institutional change are compatible with the ontology of evolutionary economics (cf. Hodgson 2004). Conceptually, one major difference between the two methods lies in the role of human subjects. In experiments, behavioral outcomes are observed; in ABM, agents are modeled on the basis of behavioral assumptions.

3 Structuring Institutional Analysis

3.1 Elinor Ostrom's Multiple Levels of Institutional Analysis

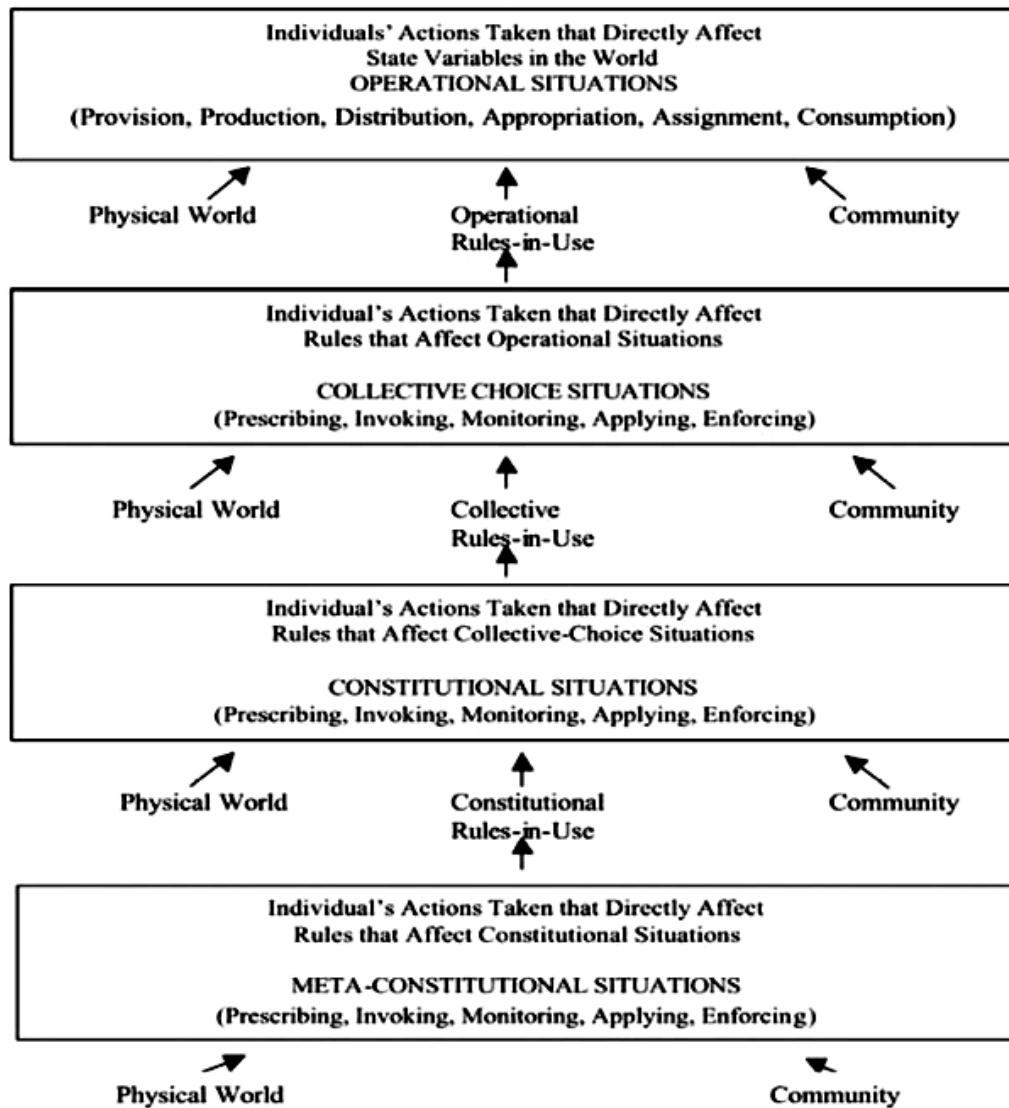
A central notion put forward in the work of Elinor Ostrom is the concept of nested games and the idea of decomposing multiple levels of institutional analysis (Kiser and Ostrom 1982). As far as institutional change is concerned, Ostrom points out that:

All rules are nested in another set of rules that define how the first set of rules can be changed. [...] What can be done at a higher level will depend on the capabilities and limits of the rules at that level and at a deeper level. Whenever one addresses questions about *institutional change*, as contrasted to ongoing actions within institutional constraints, it is necessary to recognize that:

1. Changes in the rules used to order action at one level occur within a currently “fixed” set of rules at a deeper level.
2. Changes in deeper-level rules usually are more difficult and more costly to accomplish, thus increasing the stability of mutual expectations among individuals interacting according to the deeper set of rules. (Ostrom, 2005, p.58; emphasis in the original)

In other words, rules can never be fully endogenized. Some deeper-level rules always need to be fixed (i.e., exogenized) by assumption. Although the decision to consider four levels is arbitrary, it is conceptually useful to distinguish multiple levels of institutional analysis (Fig. 1).

Figure 1: Multiple Levels of Institutional Analysis



Source: Ostrom 2005, p.59

The figure shows the hierarchical structure of the various levels of institutional analysis. While most experiments in the context of common-pool resources are concerned with appropriation, provision, or investment dynamics at the operational level, few experiments have been explicitly designed to cover a collective choice sequence, where subjects make explicit collective decisions, for example on appropriation limits. The collective choice

sequence can comprise a variety of voting mechanisms, and many have already been tested in the laboratory or field. In this case, subjects make a decision on how to decide at the operational level. But the collective decision process itself, comprising of a set of institutions, is given. If even the voting mechanism is decided upon by subjects or agents, an endogenous constitutional choice level would be reached. So far, the available set of voting mechanisms is designed by the researcher, and only a few experiments have allowed for open institutional design by the subjects.

An interesting anecdote has been reported for the appropriation CPR game designed by Marco Janssen and his colleagues (2008). In this game, subjects operate in a patchy environment and harvest resources. Stochastic re-growth of resources depends on the state of adjacent fields. To ensure anonymity and prevent communication, players are physically separated by booths in the lab. In one instance, however, subjects started to coordinate – and to limit – their harvests through the acoustics of keyboards/mouse clicks, which enabled coordination in the lab environment. A (slow) rhythm prevented over-exploitation of the resource and ensured the equal distribution of tokens. Subjects implicitly subscribed to a collective rule of simultaneous harvests. This rule also led to the implicit subscription to a constitutional rule of equal distribution. Yet, this is probably the only possible alternative, given the available information to each subject and coordination on acoustic signals. At the same time, the anecdote demonstrates that culturally or socially determined (fairness) norms that are exogenous to the laboratory environment play a role for experimental play.

This case also neatly demonstrates that neither collective nor constitutional choices must be necessarily the result of a design intended by the experimenter. Quasi-constitutional rules can endogenously emerge through variations in daily operational decisions. These rules emerge

by choice, but it is often the implicit, tacit, or subliminal acceptance or rejection of certain operational actions via norms that shape quasi-constitutional rules. Even a collective choice level implicitly assumes a collective decision forum. For example, Kimmich (2013) has shown how such institutions can emerge decentrally in an “Ecology of Games,” via the multiple interactions of only two players.

To avoid a normative bias towards conscious, explicit, and hierarchical decision making procedures, one may extend the Ostrom framework by the four level framework proposed by Williamson (2000) that explicitly accounts for norms and culture as part of the institutional change process.

4 A Guideline for Designing Experiments or Agent-based Models with Endogenous Institutions

In the development of empirically grounded economic experiments and ABM, researchers face decisions on how to translate on-the-ground realities into models. Ideally, the basis of these decisions should be carefully documented. A well-developed culture of model documentation exists in the ABM community and various protocols have been developed for this purpose (e.g., Grimm et al. 2006). Likewise, experimentalists are used to laying open experimental instructions and procedures. However, in the development of empirical models of evolutionary institutional change many critical decisions are faced that are not explicitly covered in the standard procedures. We believe that these need to be documented and that such documentation can successfully build upon the existing culture of openness and transparency in the two methodical communities.

4.1 Asking Questions

Consider the following hypothetical example of a pastoralist community. Members of the community may allow everyone to place a certain number of cattle on a common pasture. At some point in time the distribution of cattle may have been relatively equal and for simplicity it has been agreed upon that everyone receives the same amount of grazing time. Over time inequality may develop, and pastoralists with a larger herd may ask for more time on or a larger proportion of the pasture. For example, they may call for a new rule that sets grazing time into a linear proportion to herd size. If such a decision situation is modeled and investigated as an economic experiment or ABM, several assumptions need to be made.

The following list of questions aims at assisting empirically working scholars. The first two questions are more fundamental in that they generally address the role of deliberate human action to alter an existing institution. Subsequent questions go into the particular properties of institutional change:

(1) How do institutions change in a specific empirical context? Institutions may emerge and change spontaneously and do not necessarily need to be the result of deliberate human action (cf. Vatn 2005, Chapter 8; Kingston & Caballero 2009). In such cases there is no role for experimental subjects or agents to deliberately change an institution. Further, if the empirical time horizon is very short, it may also be reasonable to assume exogenous institutions.

(2) Who changes a particular institution? Is it the parties affected or is it an external agent? Perceived legitimacy of a new rule can differ substantially depending on the way it is implemented. In particular, exogenously imposed rules typically perform worse than endogenously chosen rules (cf. Dal Bó et al. 2010). If institutions are imposed on the affected parties, experiments or ABM may be useful to evaluate institutional performance of

alternative institutional options as has been done by much of the classic work in the field (cf. Rommel 2014). Yet, agents then may not have a role in institutional change themselves.

(3) If rules are changed by the parties affected, which members of the group are eligible to change these rules? Not necessarily all people affected by a change in rules, may also be eligible to change them. For instance, leaders or elected personnel may decide on new rules, rather than all people affected.

(4) What is the mechanism of change? If only one person is involved in changing a rule, are there limits within which this person operates? Is this person known to everyone and do reputational concerns play a role? If more than one person is involved, how is the decision reached? Is there open communication an anonymous vote or some other type of mechanism? Which types of majorities are needed? For instance, is a unanimous agreement needed or does the simple majority suffice to alter an existing institution?

(5) What is the point of departure for institutional change? If a particular institution is already in place, the status quo is likely to determine people's perception of what is legitimate (cf. Kingston & Caballero 2009). For instance, Liebig and Rommel (2014) show that the status quo rule affects perceptions of what is or what is not a socially accepted behavior. Under different status quo rules, not only behavior is likely to differ; also the willingness to accept new rules may be driven by the institutional status quo. Consequently, otherwise equal systems may evolve quite differently, depending on the institutional set-up at the start.

(6) What are viable institutional alternatives? If an institution changes through human agency, what are the alternatives considered by those who intend to develop a new or change an existing rule? Where do these alternatives come from and how many are there? Smajgl et al. (2010) nicely demonstrate how even the rule-finding process can be endogenized, but the

building blocks and conceptual structure of institutions is still developed by the modeler. In referenda, a list of alternative institutions is needed to select from.

(7) What are the costs and benefits of institutional change, who bears the costs, and who benefits? If a new institution is established, this may entail costs of changing existing rules. There may be initial costs for setting up a new institution; fixed and variable costs of running the new institution may also change. For instance, a new system may be needed to monitor and enforce a new rule. It is also important to know who has to bear how much of this cost and who may benefit from the new institution.

(8) What is the frequency of change? Are rules subject to frequent change or do institutions hardly ever change? For rules that change in greater frequency, it may be more realistic to assume familiarity of experimental subjects or artificial agents with the task of developing and setting-up a new institution. This question is also closely related to the time horizon (1) and the question of deliberation (2).

(9) Finally, one needs to consider the dynamics of change. Change at one level may affect change and preferences in “adjacent action situations” in complex ways (Kimmich 2013). New institutions may steer unforeseen change at other levels. The ABM by Kollman et al. (1997) nicely demonstrates how the presence of multiple jurisdictions and respective linked action situations completely changes the performance of different constitutional rules.

4.2 An example

To provide an example, we would like to demonstrate how the heuristic list can be used in the aforementioned case of a hypothetical pastoralist community. Suppose one is interested in understanding how pastoralists adjust rules on who is eligible to graze for how much time.

For this purpose an economic experiment or ABM with endogenous institutions could be considered. Table 1 lists the questions from above and provides some (hypothetical) answers.

Table 1: An Example

Question	Answer
(1) Deliberate institutional change?	No spontaneous change involved; decisions designed/crafted by humans
(2) Exogenous or endogenous change?	Endogenous; community designs own rules and these are recognized by higher-level authorities
(3) Who decides?	All herders having at least five cattle are allowed to decide.
(4) Mechanism?	Everyone is allowed to propose new rules in a general assembly. After a short discussion, an election is held. At least one quarter of the eligible members have to be present in the general assembly. An absolute majority is needed for a new rule to become effective.
(5) Current rule?	Currently, everyone is allowed to let up to 50 cattle graze for three months per year on the common pasture independent of individual herd size.
(6) Institutional alternatives?	The member that proposes the new rule has a large herd. He believes that he deserves more time on the common pasture. He has heard that in a neighboring village grazing times are proportionate to herd size. In this village, everyone is allowed to spend three days per cattle on the pasture. The costs of implementation are equally shared.
(7) Costs & benefits of change and distribution	For monitoring and enforcing the proportional rule, higher variable costs occur. A plan has to be set up. It is foreseen that guards are employed

who receive a small compensation for their services. For some families such guarding activities are a welcome additional income source.

(8) Frequency of change? Rules of this kind do not change very often. In the village under investigation, rules have been altered only twice over the past 50 years. Yet, people can relate to the problem and understand the idea of institutional change.

(9) Dynamics? If the rule is changed from “fixed grazing” to “proportionate grazing” effects on outcomes are expected to be large. In particular the distribution of wealth may change tremendously. The previous rule has prevented the accumulation of wealth in the hands of a few herders. With the new rule some herders may become more wealthy and powerful. As a consequence, they may seek for alternative income sources, and they may leave the community (which has implications on who is eligible to participate in institutional change). Wealthier herders may also use their resources to impose rules that further aggravate inequality. Finally, this might also affect answers to questions 1–7 if the research was to be repeated in the future.

Source: own design

In the presented example, an economic experiment with endogenous institutional choice would be feasible. For instance, one could develop a modified version of a common pool resource game. After each round of “grazing” in the game, a voting could be held considering proportionate grazing as an institutional alternative to fixed appropriation. The effect of heterogeneity in herd sizes, initial rules, or alternative voting (constitutional) rules could be considered as treatments. The complex dynamics and possible effects of a change in rules on

future developments could be picked up in post-experimental debriefing workshops or group discussions (Lopez 2008), and the institutional design process could be left to the group itself and the discussion protocols analyzed qualitatively afterwards. One could imagine a design where an institutional design stage is not explicitly modeled, but left to the endogenous decision of the agents or subjects and thus find out, if, when, how, and under what circumstances subjects decide to propose new rules. The how question is crucial, because it entails hints on which constitutional rules for the collective choice level are taken.

5 Discussion

It is in principle desirable to design empirically grounded experimental games as close to field contexts as possible. It is also important, however, to keep such games simple enough to be understood by participants. Likewise models should be parsimonious. Experiments are conducted to test hypotheses on human behavior, given a certain interaction pattern and potential framing. Data analysis requires that the underlying models are relatively simple. Our guideline should, thus, not be misunderstood as a call for more complexity or realism in experimental games or ABM. Simplifications and abstraction of real phenomenon is inherent in all model building. In this process, researchers face trade-offs between parsimony and realism, and our list should rather function as a tool to *communicate* decisions taken in the course of model development. Smajgl et al. (2010), for example, take the constitutional choice level as given, implementing a simple majority rule. The main focus is on endogenous collective choice rules, emerging from the interactions, and the quasi-constitutional rules that are given by the flexibility of the grammar of institutions. Critical here is the assumption that with a majority of agents being unsatisfied, institutional change is happening in the model. In this and similar cases, our list could help to explicate choices, also with the aim to reflect

upon possible extensions of a model, for example to extend the degree in which agents deliberately decide for particular institutions.

In complex field contexts, other methods or mixed methods designs (cf. Poteete et al. 2010) could be better suited to address additional issues, as demonstrated by best practice in economic field experiments (Prediger et al. 2010; Werthmann 2011) or ABM (Voinov & Bousquet 2010). A main lesson is that rules should be well documented. Deeper level rules change at a slower pace. Consequently, agents of change may be less experienced with crafting such rules. This needs to be taken into account in empirical applications. Specifically, one should carefully consider whether it can be reasonably assumed that agents are the drivers of change and that they can relate to the task of crafting institutions at deeper levels.

Our framework is adapted to a particular set of ideas in the experimental economics and ABM communities. It can be understood as a more specific methodical complement to the more general frameworks of Ostrom (2005) or Williamson (2000). As far as particular rules are concerned, it may also be useful to decompose single rules using frameworks for the analysis of single institutions (Crawford & Ostrom 1995). It will be critical to clearly distinguish between the structural aspects of external sanctions and rewards and the agent-centered ideas of internalized norms – or so-called delta parameters – in empirical work (cf. Schlüter & Theesfeld 2010).

6 Summary and Concluding Remarks

Empirical work on institutional change is difficult, and few methods are suited for addressing empirical questions of dynamically changing institutions. Lately, experimenters and agent-based modelers have started to endogenize institutions. In this paper we have shown that institutions are hierarchically nested and that some deeper-level institutions necessarily

remain exogenous to any model. In model development it is important to carefully document the empirical basis of a model. For this purpose we have designed a list of guiding questions directed at the study of institutional change. We believe that protocols generated by such a list fosters transparency of empirical work very much like the ODD protocol (Grimm et al. 2006) and similar initiatives did for the more general assumptions underlying model development.

Our guideline also offers a fresh perspective on the field and is, as we believe, helpful for identifying promising future research areas. It becomes apparent that constitutional rules – i.e., rule on how to change rules – are a much overlooked issue in applied work. Although experiments sometimes compare endogenously chosen and exogenously imposed rules, little is known about the perceived legitimacy and performance of endogenously chosen institutions under different constitutional rules (e.g., absolute vs. simple majority). By the same token, we believe that the costs and benefits of changing institutions should receive more attention. In current experiments, for instance, changing and running alternative institutions comes at no cost. Introducing such costs into experimental work under varying status quo rules, may yield new insights on the persistence of “inefficient” institutions.

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