Trust and Arena Size. Expectations, Trust, and Institutions Co-Evolving, and Their Critical Population and Group Sizes.

Elsner, Wolfram and Schwardt, Henning

Universität Bremen

2012

Trust and Arena Size.

Expectations, Trust, and Institutions Co-Evolving, and Their Critical Population and Group Sizes

Some Clarification in a More Formal Perspective[1]

Wolfram Elsner[2] and Henning Schwardt[3]

Abstract

We develop a formal approach to the emergence of institutionalized trust in the context of the evolution of cooperation, with a particular focus on the relevance of the size dimension of this process. While trust in general has been widely investigated, as has the size dimension of structural emergence, both have rarely been analyzed together in an integrated approach to the co-evolution of institutions, trust, and the size of their populations and carrier groups. This then also helps explaining general(ized) trust.

In a game-theoretic set-up, we determine critical levels of expectations as a factor facilitating the emergence of institutionalized cooperation in an arena, or population, facing the typical, ubiquitous, and everyday social decision situation of the Prisoners' Dilemma (PD). The latter may be solved through the evolution of institutionalized cooperation, as is well known. Critical levels of expectations (to meet a cooperative agent) and arena size turn out to be interdependent, and supporting the emergence of institutions of cooperation, under a particular set of agency capacities and after a minimum critical mass has been established.

Further, a carrier group, or platform, emerges under further conditions. It encompasses only a part of the larger population, indicating a maximum critical mass of cooperators (a meso-size) that can be sustained in a population, under an additional set of agency capabilities, particularly partner selection (whether the PD has been solved or not).

Once cooperation has been established as the prevalent behavioral pattern in a number of platforms, its habituation as an institution may lead to a contingent perception of trustworthiness of agents. Habituated cooperation, its generalization, spillover or transfer across platforms, in combination with the perceived trustworthiness of others may lead to an increasing general trust level in the larger population. The approach chosen thus allows identifying critical factors of general trust among strangers in a larger population even in one-shot interactions.

Finally, the significant differences observed in actual general-trust levels among countries, highly correlated with their macro performances, thus can be explained from the countries' different (and mainly 'inner') size conditions in the deep structures of their interaction arenas and resulting platforms (rather than just total population size), contributing to the persistent varieties of capitalism.

Keywords: cooperation, group size, habituation, trust
JEL codes: B52, C73, D83

---

[1] This paper has been presented in a session at the annual conference of the European Association for Evolutionary Political Economy (EAEPE) in Vienna 2011. The authors are grateful to the discussants in that session, particularly to Alex Lascaux, Klaus Nielsen, and Paolo Ramazzotti.
[2] Corresponding author: Institute for Institutional and Innovation Economics, University of Bremen, Germany. Hochschulring 4, 28359 Bremen. +49 421 218 666 11. welsner@uni-bremen.de.
[3] iino, University of Bremen, Germany. schwardt@uni-bremen.de.

1 Introduction

In this paper, we develop a formal approach to the emergence of institutionalized trust in the context of the evolution of cooperation (EoC) (e.g., Axelrod 1984/2006; Lindgren 1997; Ostrom et al. 1994; also Schotter 1981) with a particular focus on its size dimension. Institutionalized trust and cooperation at smaller sizes then will become a critical factor for more 'general(ized) trust'.

In a game-theoretic (GT) set-up, we can determine critical levels of expectations as a factor facilitating the emergence of an institution of cooperation in a population facing the typical, ubiquitous and everyday social decision situation of the Prisoners' Dilemma (PD). Critical levels of expectations and arena (population) size then turn out to be interdependent.

A carrier group (or platform) then will coevolve as a further condition for the establishment of cooperation. This carrier group encompasses only a part of the larger population, indicating a minimum critical mass necessary for the emergence of cooperation in our set-up as well as a maximum critical mass of cooperators that can be sustained in a population.

That smaller sizes support the emergence of cooperation and social norms in general has been well-established in the literature (e.g., Dejean et al. 2009; Wells 2010; Henrich et al. 2004; also already Olson 1965).

The anthropological and behavioral literature dealing with cultural group selection, however, has argued against the GT approach of the EoC that it basically can explain only small-scale cooperation based on long-run interaction, while in the real world humans do cooperate both in large-scale populations and one-shot interactions, i.e., cooperation among strangers (see, e.g., Henrich 2004; Boyd, Richerson 2005). Henrich (2004, 7-10), in a much discussed state-of-the-art article, deploys (somewhat ad-hoc like) different payoff-based, conformist, and punishment-based intra-group mechanisms that, however, do not necessarily explain high levels of intra-group cooperation but also might easily work in favor of a culture of general defection. These together appear just equivalent to the GT folk theorem, where many equilibria superior to the maximin of common defection may become possible under trigger strategies with credible threat of punishment.

So while group selection mechanisms appear perfectly complementary to a GT approach embedded in an evolutionary-institutionalist interpretation (EIGT, see Elsner 2012; also Hodgson, Huang 2012; see more below), and even appears perfectly apt to GT modeling, GT (particularly EIGT) may also do the job for the intra-group development of cooperation.

And while also the generalization of institutionalized trust and cooperation into one-shot encounters in large populations still is a common ground of theorizing and modeling among 'naturalistic' approaches (biology, anthropology, psychology), 'old' evolutionary institutionalism, and EIGT, it will be our GT-based argument here that some 'meso' group (or platform) size (i.e., platforms sizes below the whole population) is both a necessary and supportive condition for large-scale one-shot cooperation. The inner size structures of populations, and related issues like reduced turbulence (e.g., less 'migration'), thus, explicitly arises as a critical variable explaining high levels of general cooperation and macro-performance – and in the last instance it may even be policy relevant for generating effective system structures.

We will also try to show that and how particular expectations and agency capabilities are logically required, step by step, and coevolve to facilitate effective cooperating meso platforms that in turn make up for a cooperating large-scale population.

A GT approach requires and provides a clear understanding of the institutional conditions that are assumed at the outset (a shared perception of a problem and of the actions of other agents, a 'common knowledge of rationality' (CKR), the general 'rules of the game').

Their identification then allows separating additional factors that increasingly enable a process of trust emergence and, indeed, to gradually extend the set of factors we include.

In fact, the transfer from an individual arena/platform process with its particular ‘local’ trust to further platforms, as the condition for the emergence of some more general trust existing in the whole population (and then perhaps being transferrable from one arena to another), requires embedding the GT formalism in proper qualitative verbal process stories (see, e.g., Dosi, Winter 2000; Hodgson, Huang 2012), relevant for real-world settings with their strong uncertainty and ambiguity, where trust plays a non-trivial role for the agents (also, e.g., Güth, Kliemt, 2010; Grüne-Yanoff, Schweinzer 2008; Six 2005, 2-3).

Farrell (2009, 13ff.) and many others (e.g., Khalil 1994; Lazaric, Lorenz 1998; Nooteboom 2002) have rightly criticized that in rational choice and conventional GT approaches to trust cooperative patterns can be interpreted as responding to expectations regarding others’ choices on a purely short-run payoff-determined basis only, whereas true trust entails expectations of agents going against their immediate payoff-based interests, even when they feel they may get away with it – an ‘enlightened self-interest’ by the agents who have learned to overcome a myopic culture. A similar criticism might be formulated against all approaches that do not (1) provide a methodological locus for presupposed social rules and institutions and (2) allow for a theoretical space for particular human capabilities and agency capacities to be introduced at proper stages in the logical argument (see also, e.g., Möllering 2006, 32ff.; Rose 2011, 158ff.).

The very nature of (the reputation of evidenced) trustworthiness as the foundation for trust thus concerns agents’ refraining from actions that would afford them a short-run, one-shot advantage to the disadvantage of others. With this, the habituation of a cooperative behavioral pattern as part of its institutionalization, interpretable by other agents as trustworthy behavior, becomes crucial to the process, removing trust from simple calculus and pointing towards transdisciplinary research (employing, in the last instance, evolutionary economics, psychology, biology, neuroscience, anthropology, …). Particularly, a spillover into general trust cannot be explained solely in a formal and calculus-focused approach (e.g., also, Coriat, Guennif 1998; Ulsaner 2002). And once cooperative behavior has become institutionalized, the expectational effect is cumulatively strengthened (Mengel 2009); just as trustful behavior may stimulate trustworthy responses (e.g., Pelligra 2011), introducing notions of circular causation that would further support the mechanisms identified here.

Thus, when developing such embedded GT modeling to explain emerging and co-evolving ‘contingent trust’, local and global, we have to methodologically consider and properly determine the

- pre-existing cultural givens supposed and required for formal modeling and to avoid logical deficiencies;
- logical loci to introduce further human capacities, such as learning, habituation, generalization and other agency capabilities such as memorizing, monitoring, reputation building and using reputation chains, and particularly partner selection;
- disciplinary boundaries of economics, particularly in cases like learning, habituation and semi-consciousness, or memory and monitoring capacities.

In particular, we will claim that some cooperative behavior learned in specific arenas is a necessary step towards the emergence of more general trust (see also, e.g., Binmore 2006, 2011; Acemoglu et al. 2010), a conjecture that finds support from empirical approaches showing a set of specific cooperative behaviors preceding more general trust (see, e.g., Yamagishi et al. 2005; Inglehart, Baker 2000; but also the ‘naturalistic’ perspective: Henrich 2004, on psychology and culture-genes interaction). To allow for a meaningful notion of trust, we will argue that repeated specific cooperative behavior needs not only to become habituated over time, but eventually needs also to be transferred to, and generalized into other particular situations and into the general public of the whole population as well, and be reflected in the formation of related beliefs by agents (also, e.g., MacFayden 2006; McKnight, Chervany 2006).

Corresponding processes are of course by no means predetermined in their course. The setup for the size dimension of institutions of cooperation will show that the emergence of cooperation is facilitated by smaller population and group sizes. Even then cooperative behavior eventually spilling over into increasing levels of trust is only one of different possible directions that the emergence of behavioral patterns may take. Particularly, even if established in different smaller groups or platforms (or networks, reflecting the famous 'bonding' social capital, according to Putnam 2000, pp. 22-24), its transfer to other interaction arenas and platforms and into the whole population (the 'bridging' social capital, according to Putnam) may or may not happen. This a priori openness would generally require considering a whole variety of levels of institutionalized cooperation and related trust in different groups (see also, Aoki 2007; Pelligra 2011; Henrich 2004). Reflected in the present approach, however, is, for the sake of simplicity, just a combination of two levels from which trust has been approached, the micro-level with the habituation of behavior by individuals, and the 'normatized', or institutionalized notion of trust as relevant on a higher level of aggregation (also, e.g., Nooteboom 2002).

In this paper, we therefore complement, as mentioned, what Henrich (2004) and others have presented in their discussion of the possibilities of large-scale cooperation. Based on the observation that this phenomenon is seen in human groups to a degree not found in any other animal species, he argues that specific human and cultural factors are likely candidates for explanations. The mechanisms he identifies as likely candidates are based in human sociality, and so the necessity for a move beyond just short-run payoff-based arguments for real-world agents is underlined here.

Behavioral patterns that are embodied in such institutional guidelines are not consciously followed, as conformism and punishment would suggest, but habitually applied once they have emerged as the dominant correlated patterns of behavior. In the following, habituation and semi-conscious behavior will become more important still. Cooperative behavior will have to be repeated and repeatedly experienced before analogous behavior can be expected to emerge in arenas that have not been touched by such experiences thus far. This divorces the longer term maintenance of patterns of behavior from too narrow individualist decision-making.

Thus, the wide variety of levels of general trust in different countries as documented by the so-called World Value Surveys, could be accounted for in an EIGT framework not only due to its generally ex ante undetermined outcomes (see also, e.g., Aoki 2001) but also through the different levels of inner size (platform) structures (and often also general population size). The overlapping, meso-sized carrier platforms of institutions and trust that we eventually arrive at indeed apply to real-world institutional phenomena. The widely noted correlation between levels of trust and macroeconomic performance (see, e.g., Rose 2011, 171-2; Knack, Keefer 1997; Malul et al. 2010; Maskell 2004) and the continuing discussions of Varieties of Capitalism, i.e., the distinct dynamics and functioning of national economic systems in their deep interaction structures, even across apparently similar economies, situate the co-emergence of increased levels of general trust and platform sizes at the heart of economic research.

We continue (2) with the everyday relevance and ubiquity of the social dilemma structure and of the emergence of institutionalized cooperation and its cultural, 'informational', and 'expectational' givens. In the following sections, we (3) discuss the single-shot PD supergame (SG) solution; (4) identify the emerging (co-evolving) size-dimension of arenas for institutionalized cooperative behavior in populations; and (5) investigate the co-evolution of carrier-group size, platform-specific (local) trust, and institutionalized cooperation, based on further agency mechanisms. Finally, we (6) consider the generalization of trust across platforms into whole populations. Conclusions are offered in the final section.

2 Shared Knowledge, Beliefs, and Expectations in a Game-Theoretic Setting – and Embedding Formalism in a Real-World Perspective

GT settings are, of course, not without any priors. Even non-cooperative GT settings that, if embedded in an overall prudent research setting, may be considered a rather lean formal approach with the promise of a considerable analytical explanatory net gain, do require considerable 'cultural' givens. Among those givens are a common understanding among agents of the rules of the game, some (common) degree of completeness of the information set, some commonality in terms of correct mutual comprehension of each other's actions, and the 'CKR' mentioned ('I know that you know that I know that … I/you behave rationally'). We may interpret these givens as establishing some initial set of subjective expectations about how the others may act.

Even provided these givens, however, the eventual outcomes in games with more than one Nash Equilibrium (NE) cannot be generally predicted; any one of the possible NEs may result, depending on initial conditions and/or on a resulting process. In order to determine a NE, agents have to form expectations about which strategy choices of the other(s) seem most likely. If we want to make predictions in such a setting, we already have to refer to some beliefs of agents about others' behaviors. Thus, some social rules or institutions have to be assumed preexisting that allow agents to formulate such expectations (and, correspondingly, external observers to make forecasts). For analyses that have to deal with more than a unique and predetermined stable outcome, the embedding of the GT formalism into broader socio-economic settings becomes helpful or even crucial in order to more thoroughly understand the subject (see, e.g., Schelling's focal points: Schelling 1960).

Such a framework is especially interesting when the problem is not one of simple coordination only, where coordination is in everyone's immediate interest (difficult as these may already be in populations, especially if interests regarding which of the different NEs is preferable, differ). If problem-structures are involved that must be captured as social dilemma problems, where individually optimal myopic decisions lead to a socially inferior NE, agents will have to find a Pareto-superior solution to a particularly 'wicked' collective-decision problem. For agents in a population and in long-run processes, this will have to involve the emergence of an institutional solution that enables cooperative behavior (despite the ubiquitous one-shot incentive to defect, to free-ride and exploit, which continues to be present for real-life agents) that would offer reasonable assurance or trust about others' likely cooperation.

These two distinct basic problem structures, coordination games and dilemma games, are related to a classic definition of social rules (to solve a coordination game) that work without an endogenous sanction (as it is in everyone's immediate and myopic interest to act coordinated), and social institutions (to solve a dilemma game) that require the sacrifice of the myopic maximum, habituation and 'semi-consciousness', and therefore do not work without the threat of sanctions to bring about cooperation (for the terminology, see, e.g., Schotter 1981).

The social dilemma is a ubiquitous and everyday problem structure of decentralized individualistic economies, and the more so the more pronounced a myopic culture is given at the outset (a 'worst-case' starting point in the following). In fact, every single simple transaction (including any 'market' transaction) is embedded in such a potential wider social dilemma, with ubiquitous opportunities to free-ride and exploit the other(s) and any of their cooperative behaviors, whether already collectively institutionalized or not. Such defection would undermine potential expectations of cooperation and the potential joint (broader, collective) and long-run improvement that mutual cooperation would allow for.

If an instrumental (problem-solving) institution does not yet exist, its establishment may be difficult, given that in that case warranted prevalent expectations would point to others' non-contribution. But even if such an institution of cooperation already existed, under certain conditions favoring myopic and overly individualistic behavior again, incentives to exploit others' cooperative behaviors, and thus the institution as such, may return. In this way, institutional systems may be fragile and vulnerable to relapses, i.e., institutional breakdowns.

Returning to the more formal aspects, as is well-known, a dilemma problem cannot be solved by the rational agents of conventional GT analysis. The problem-structure has to be transformed first. One possibility for doing this is the repeated play of the same basic game. The indefinite repetition of the problem, requiring a somewhat stable environment, allows for a process that we may interpret as corresponding to a cumulative learning process and is a first step towards the possibility to realize superior results. The agents then have to repeatedly play the resulting SG in order to become able to consistently coordinate on a cooperative behavioral pattern within a larger group. A superior result can be realized on a sustained basis when many agents adopt cooperative behavioral patterns and a stable (strategy-) environment results.

Such repetitions lend themselves to a better understanding of processes of institutional emergence in a population, either interpreted as the result of decision-processes by agents revising and updating their individual game plans, i.e., individual learning, or considered as an outcome of a replication process ('selection') on a somehow diversified population, in which certain types of behaviors gain an advantage (path-depending on the initial structure). Both perspectives eventually lead to stable outcomes that permit interpretations from an evolutionary-institutional perspective and can serve as the foundation for a broader view on social phenomena when we leave the narrow analytical framework of a GT representation.

Real-world agents continue facing dilemma situations, even if they may not recognize them as such any longer, due to their habituated and 'semi-conscious' institutionalized cooperative behavior, or to their acceptance of such an institutional framework as 'naturally' given or even an abstract 'norm' (which has become somewhat removed over time from the original problem). This is one of the instances where the assumptions of the formal model and the difficulty of transferring its results to real-world questions, becomes important: Whereas the formal solution entails changing the problem-structure the agents face, for the real-world agents the problem-structure will not be changed per se, but the agents will be supported in better dealing with the problems, amongst other things by the factors that the formal analysis helps to point to. In fact, for real-world agents, a solution of dilemma problems can only work as a learned, habituated, and semi-consciously applied social behavioral institution.

Still, the mechanisms and factors that can be identified as supporting the emergence of institutionalized cooperation in a formal setting do help us understand the emergence of cooperation in real-world situations. But we have to consider how we can transfer the formal results to real-world settings, in this case, to complement the formal result by a proper understanding of the institutions and the related framing of expectations that inform agents' decisions.

Following the identification of factors that enable an institutionalized Pareto-superior outcome, we will argue that we can build on the results obtained to consistently and transparently integrate trust into the argument, in a first step by building on favorable expectations of future behaviors of others that go against their immediate payoff-based interests, i.e., expectations regarding the others' trustworthiness. These expectations will eventually co-evolve as semi-conscious responses to habituated behaviors that have emerged over time from the learned or differentially replicated ('selected') cooperative behavior existing in large parts of the real social sphere.

3 A Prisoners' Dilemma 'Single-Shot' Perspective and the Role of Expectations

In PD-SGs, in fact, a substantial (in fact, an infinite) number of stable outcomes (strategy combinations) exist that allow for an improvement of results above the outcome achievable when just sticking to the dominant strategy of the underlying one-shot game. There are well-known proofs for that, collected as the 'folk theorems' (Friedman 1971). In order to keep the analytical structure to a manageable magnitude we draw on the results of Axelrod (1984/2006) and some research on PD-SGs in population contexts (Nowak, Sigmund 1992; Lindgren 1997; Mailath, Samuelson 2006), showing that there are some basic characteristics of strategies that have proven to lead to an overall rather successful performance when compared in different and even evolving strategy-environments. These characteristics include non-aggressiveness (not defecting first), and the willingness to retaliate against defection by others, coupled with forgiveness, the willingness to return to cooperation after having punished an opponent. The simplest practical representation of such a strategy has come to be called tit-for-tat (TFT): In a SG, start cooperating (the strictly dominated strategy in the underlying one-shot game) and then mirror your opponent's prior move in all future decisions. Hence, we limit the perspective to TFT and All-D ('always defect') in the following. The related PD-SG payoffs are given in Figure 1 below.

The time horizon of the agents (as to be learned, habituated, and acquired as a culture) is reflected in the value of the discount parameter δ. If the time horizon is too short (future payoffs are discounted at too high a rate, δ is too small), the dilemma structure will be maintained, and All-D will be the strictly dominant strategy choice, the repetition notwithstanding. If, however, the time horizon is long enough (future payoffs are valued sufficiently highly), the decision situation will be transformed into a coordination problem, as TFT becomes a best answer to itself. If TFT is a best answer to itself, a credible threat of sanctioning exists against defection through which cooperative behavior can be enforced. The result is a coordination game in which an unequivocally optimal behavior no longer exists (as All-D will remain a best answer to itself).

$$A = \begin{pmatrix} \frac{a}{1-\delta} & d - c + \frac{c}{1-\delta} \\ b - c + \frac{c}{1-\delta} & \frac{c}{1-\delta} \end{pmatrix}$$

Figure 1 –PD-SG Payoffs for TFT and All-D (with b>a>c>d).

The condition that has to be fulfilled for allowing that transformation is the well-known single-shot condition (Axelrod 1984/2006):

$$(1) \qquad \delta > ! \frac{b-a}{b-c} \ .$$

It is derived from the comparison of the discounted current capital values of infinite geometric series of payoffs attainable under different game plans, specifically the comparison of TFT/TFT and All-D/TFT payoffs (as illustrated in Figure 1), showing under which condition of futurity, or expectations (i.e., the size of δ, given the strength of the dilemma in the payoff structure, represented by $(b-a)/(b-c)$), TFT becomes a best answer to itself.

Note that the discount factor includes the probability, existing in any given interaction, to meet the same agent again next interaction, thus futurity. In fact, δ consists of two components, the discount rate (time preference) *r* and the (subjective) expectation, or (objective, experienced) probability, depending, *p* that the interaction between two agents continues in the SG:

$$(2) \qquad \delta = \frac{p}{1+r} \; .$$

The condition of inequality (1) has been the standard solution for a PD-SG environment (for more detailed considerations within a population approach, see below), with a responsive cooperative strategy involved and expectations as a critical factor. The single-shot condition is thus the deterministic and static logical condition for the institution of cooperation contingent on expectations (embodied in the strategy TFT) to result as a possible NE.

Note that the related definition of an institution is a social rule for the decision/ behavior of individual agents for the solution of PD-SGs that has gained, through a process of social learning and 'semi-conscious' habituation, a general approval so that it can inform agents about proper problem-solving behavior and mutually consistent expectations about that, particularly about the fact that with unilateral defection other agents will also deviate in the future, so that all will be worse off than with rule-conforming behavior (the endogenous sanction mechanism).

If the single-shot condition is fulfilled, the problem for the agents is to coordinate. This is still a problem to be solved, but a different one from the dilemma; and one that agents are capable of solving. Coordination on the (Pareto-superior) best answer pairs may eventually emerge. Still, that additional (superior, cooperative) NE does not guarantee that agents will actually be coordinating on it. For instance, agents might not change their behavior of initially choosing the defection strategy, if they are sufficiently risk-averse and want to protect themselves from other agents not changing their behavior.

For real-world agents, learning about the importance of the future, and the consequences today's behavior can have once future interactions are taken into account, is thus a first important step to be taken, and in many instances a necessary condition for cooperative behavior to emerge (for another possibility, see the discussion of agency mechanisms below in Section 5).

Generalizing the formal framework somewhat further, we may say that the belief has to emerge that the other player(s) will adopt a cooperative behavior pattern; or, in a population setting, that a sufficient number of other agents will adopt a cooperative behavior pattern, something that might be reflected by the metaphor of a contrât social (Rousseau 1762), explicit or tacit, or some related public (policy) assurance (Sen 1967), so that agents do not have to protect themselves against others' potentially exploitative behavior by continuous own defection.

4 A Population Perspective, 'Arena' Size, and 'Critical Minimum Mass'

4.1 A Population Perspective

We can approach emerging cooperative behavior in a population through explicitly considering population size, or the size of the arena, in which interactions take place. Still, expectations and resulting expected payoffs, now integrating both population (arena) size n and the number of cooperators in the population (the later emerging platform) k, i.e., expectations (experienced or not) regarding the ratio k/n, remain the driver of the process. We continue with games played by two types of, now randomly matched, players. The expected payoffs then depend on the probability of meeting either TFT-cooperators or All-D-defectors, agents' strategy choices therefore depend on their expectations regarding the prevalence of certain types, or likelihood of strategy-choices, in the population from which their interaction partners are drawn. (As can be easily appreciated here, the argument can be rephrased in terms of evolutionary game theory, including mixed strategies or even a replicator mechanism. However, as expectations of agents, and accordingly taken decisions, are a crucial part of our argument at this point, it is quite appropriate to present the point in terms of more conventional GT.)

The population payoff functions describe the expected payoffs from those interactions:

$$(3) \qquad \pi^e_{TFT} = \frac{k}{n}\frac{a}{1-\delta} + \frac{n-k}{n}\left(d - c + \frac{c}{1-\delta}\right)$$

and

$$(4) \qquad \pi^e_{All-D} = \frac{k}{n}\left(b - c + \frac{c}{1-\delta}\right) + \frac{n-k}{n}\frac{c}{1-\delta} \ .$$

Figure 2 shows their graphical representation, for a situation when the single-shot condition is fulfilled by the whole population.

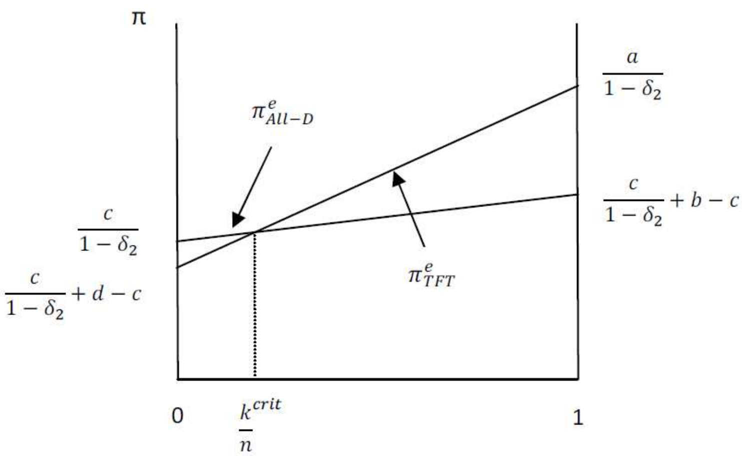

Figure 2 – Payoff Schedules of a PD-SG Played Pair-wise in a Population.

4.2 Enlarged Agency and the 'Critical Minimum Mass'

The intersection of the payoff schedules then gives the share of cooperators in the population, for which TFTs' expected payoffs are equal to those of All-Ds'. This 'minimum critical mass' of cooperators now depends on both the value of the discount factor and the relative arena size *k*/*n*. The larger future expectations (δ) are, the lower the share of cooperators required for TFT to become the superior strategy needs to be, as can easily be derived from setting (3) > (4):

$$(5) \qquad k^{crit}(n) = \frac{n(c-d)}{\frac{a-c}{1-\delta} + 2c - b - d} \ .$$

We may assume here that agents are aware of the possibility of improvement above the results of repeated mutual defection, if a sufficient number of agents are willing to change behavior starting from an initial All-D equilibrium. How might agents come to start cooperation? They start diversifying their behavior motivated by repeated frustration in the repeated dilemma. Meeting repeatedly, particularly with an indefinite end (that at least is beyond the practical time horizon of agents), may allow for such a process to start. Even if they were not aware of the superior results from mutual cooperation, but rather were just frustrated by always aspiring to *b* and always receiving *c* only, they might start experimenting, out of a general 'instrumental' motivation to improve their conditions or simply curiosity (the instinct of workmanship, or idle curiosity according to Veblen, e.g., Veblen 1899, 1914).

Real-world agents, who would follow these motivations, however, may not be too risk averse, nor too envious of others' results, as they run the risk of ending up receiving even less than they currently have, but at least having somewhat less than the other one at the end of the day (being exploited at least once by their less innovative interaction partner). Their 'rationality' still implies being indifferent towards the others' payoffs.

Still, such search, experimentation, and diversification may generate the minimum critical mass necessary for establishing an environment in which cooperation in fact will become the superior choice for all.

The already mentioned 'social contract', or some other form of 'general assurance' (mentioned above) that other agents will indeed choose (TFT-) cooperation as well, also may support a change that alters the predominant choice in a population, as an assurance that enough agents choose TFT would eventually make it the preferable choice for the rest as well if this assurance can have an impact on the formulation of expectations of the agents. Thus, in sum, evolving expectations are a crucial aspect in this set-up.

This shows that it is

- the agents' expectations, and their learned, and then habituated, institutionalized and culturally 'embedded' perspective, 'futurity' or time horizon, combined with
- the relative size k/n of the initial carrier group of cooperation in the arena under consideration, the minimum critical mass, of the emerging institution, based upon
- some specific, enlarged agency capability for behavioral innovation

that matter, and will be shaped by their prior assumptions, beliefs, and expectations and their interaction experiences. Initial expectations thus will be adapted over time and eventually solidified, habituated and institutionalized, until they can be assumed to shape behavioral choices without the agents being consciously aware of them every time they face a certain decision problem.

In fact, expectations and relative size, based on extended agency, will have to co-evolve in the process of the emergence of the institution of cooperation.

4.3 Expectations Across a Series of 'Rounds' With Random Partner Change, and Their Dependence on 'Arena' Size and Cooperators' Share

We may further formalize population and group sizes through a series of SGs, where we will refer to one SG in such a series as a round. Rounds are characterized by random partner changes between each two of them. Agents then may remember their previous partner across such rounds, as well as their strategy choices in the last interaction.

Should they be paired with the same interaction partner again in the following round, this would constitute the continuation of the previous one for them. This possibility can be reflected in the discount factor valid across rounds, introducing a slight change in the case of indefinite SGs (while it would make no difference for a definitely infinite SG).

The probability of meeting the same agent again (after a round has ended) is $1/n$. The overall discount parameter (δ_2) to calculate the overall value of interacting with a given other agent then depends on the probability that the SG continues, plus the probability that this is not the case, i.e., the round ends but the next round is played with the same agent, is given by:

$$(6) \qquad \delta_2(n) = \frac{p}{1+r} + \frac{(1-p)}{(1+r)}\frac{1}{n} \ .$$

For p<1, an indefinite SG, the size dimension becomes relevant as the current value of interactions depends also on the population size – the smaller the population is, the higher the expectation of 'meeting again'. δ_2 will approach $p/(1+r)$ in the case of increasing n (diminishing probability 'to meet again'), and $1/(1+r)$ in the case of decreasing n (increasing probability 'to meet again'). The smaller the population, the larger the discount factor is, and, with this, the present value of an infinite series of payoffs from interactions within and across SG rounds, for a given incentive structure. Put the other way around, interactions get more valuable in smaller populations for given values of p.[4]

This becomes clearer when we put k as a function of n, just as in the above case of single SGs (i.e., comparing (3) and (4)), with the slightly differently conceived δ_2):

$$(5') \qquad k^{crit}(n) = \frac{n(c-d)}{\frac{a-c}{1-\delta_2}+2c-b-d} \ .$$

Dividing by n, we can derive an expression giving the critical share κ of cooperators, necessary for cooperation to deliver higher expected payoffs, as

$$(5'') \qquad \kappa^{crit}(n) = \frac{(c-d)}{\frac{a-c}{1-\delta_2}+2c-b-d} \ .$$

(5'') shows that κ is a decreasing function of n. This means that the value of k is not changing proportionally to that of n, but more than proportionally, as the minimum share is a function of overall size due to the n in δ_2. Consequently, the intersection of the payoff schedules in Figure 2 is shifted to the left when population size is decreasing, all else equal: In smaller populations you actually need a smaller share of cooperators, a smaller minimum critical mass, making it relatively easier to establish a cooperative environment, because the value of interactions with cooperators increases. Formally, the logic of the equation shows that the expectation (δ_2) and relative size (k/n) need to co-evolve, as the equation cannot be solved for δ_2 and κ simultaneously.

[4] If we would assume further agency capacities, particularly partner selection opportunities (see below on this capacity), we might consider agents to tend to stick to their 'known' partners (if not strictly the same) and to make counter movements against increasing turbulence and mobility given in increasing populations, in order to keep their expectations high and uncertainty moderate, attempting to keep interactions with agents within a peer group n_i, with $n_i<n$. Such phenomena might explain counter movements towards local networking, clustering, and 'glocalization' or regionalization, even re-nationalization among agents in a globalizing and increasingly turbulent world. Such attempts of agents can also be reflected in an increasing p, where agents would strive to conserve interactions with partners they already know. Also, lab experiments have shown that agents indeed try to reduce net complexity through active selection and active building of neighborhoods (see, e.g., Harmsen-van Hout et al. 2008), and that high network effects can informally be attained by groups constituted through the selective interactions of individuals (e.g., Tucker 2008; Spiekermann 2009).

5 Alternative Agency Mechanisms: The Co-Evolution of 'Platform' Size, Trust, and Institutional Cooperation with Partner Selection

We can further extend the model describing expectations and expected payoffs, and their co-evolution with relative size of populations and the carrier groups of institutionalized cooperation, by considering other agency mechanisms – monitoring, memory, and reputation chains. These new capacities would permit that agents exchange information regarding others' earlier behaviors, which then becomes useful when we additionally permit some partner selection.

In this case, agents may not just form an idea about the composition of the population in general (*k*/*n*) but also about some other agents' earlier behavior. These capabilities can enhance the capacity to establish a cooperative environment. The payoff functions in this case can be formulated as follows:

$$\text{(7)} \qquad \pi^e_{TFT} = \left(\frac{k}{n}\right)^{\alpha}\frac{a}{1-\delta_2} + \left(1-\left(\frac{k}{n}\right)^{\alpha}\right)\left(d-c+\frac{c}{1-\delta_2}\right)$$

and

$$\text{(8)} \qquad \pi^e_{All-D} = \left(\frac{k}{n}\right)^{\frac{1}{\alpha}}\left(b-c+\frac{c}{1-\delta_2}\right) + \left(1-\left(\frac{k}{n}\right)^{\frac{1}{\alpha}}\right)\frac{c}{1-\delta_2}\ .$$

The peer-group of the agents is still the whole population; however, the probabilities of meeting certain types of agents can be improved above their general prevalence in the whole population (which is *k*/*n*). Cooperative agents will be able to identify, select, and interact with their kind with a higher probability than they would under random matching (cooperative agents have a reason to reject interactions with known defecting agents, which is not the case the other way around). This will improve the results they can achieve beyond the results of random matching.[5] Monitoring, memorizing and using a reputation chain can be considered informational preconditions for selecting agents.

Assume that in the process of search, experimentation and behavioral diversification motivated as described above, cooperators start to select agents (on such agency capacities, see, e.g., Davis 2007, 2008; Dolfsma, Verburg 2008; Leydesdorff 2007). It is supposed that the cooperative agent has some capacity to reject interaction with a known defector.

The exponent α in equts. (7) and (8) above represents the strength of the new agency mechanisms. As $0<\alpha<1$, the smaller α, the more pronounced the effect of these agency capacities in favor of cooperators. In effect, this may enable cooperators to realize larger gains already for low numbers of cooperators in a population. In this way the intersection of the payoff schedules shifts further to the left so that the minimum critical mass requirement for emerging cooperation decreases further (k^{crit} will shift to the left in the graphical illustration).

Cooperative behavior could also be established this way in populations when the underlying dilemma is not solved, when δ_2 is not large enough to ensure the transformation of a dilemma problem into a coordination problem in a SG. The reason for this is that partner selection enables them to pick agents as interaction partners that have been cooperating before, and are memorized and/or have been monitored and/or have gained some reputation as cooperators (for the value of reputation see, e.g., Dasgupta 1988; Mailath, Samuelson 2006). Figure 3 shows a graphical illustration of the payoff schedules, when such agency mechanisms are allowed for, in a population for the case that the underlying dilemma is not solved (for the shape of the expected payoff schedules, check the derivatives that will give

[5] As indicated in footnote 2, partner selection may also be considered equivalent with an agency capacity to increase *p* in δ and δ_2, and in this way extend any PD-SG ('round') at the expense of partner change, 'mobility', and 'turbulence'.

you $\pi^e(k/n)' > 0$ and $\pi^e(k/n)'' < 0$ for TFT-players and $\pi^e(k/n)' > 0$ and $\pi^e(k/n)'' > 0$ for All-D-players).

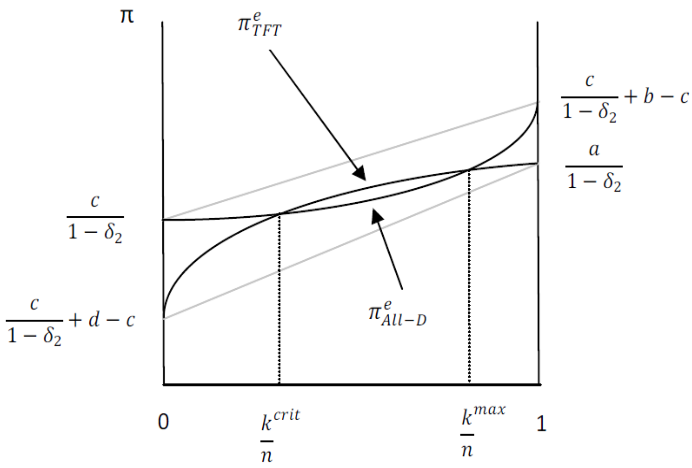

Figure 3 – Population Payoff Schedules with Partner Selection of Cooperators (when the Basic Dilemma is *Not* Solved) – and the Exhaustion of Such Capacity: The 'Maximum Critical Mass'.

But still, the agents cannot know every agent in the whole population, and thus, with new and unknown upcoming interaction partners, the capacity to reject an interaction partner does not help with a view on selecting 'known' cooperators all the time. Particularly, information may also get thinner, more unclear, uncertain, and fuzzy, especially if related through third actors and ever longer reputation chains are deployed.

Alternatively, if they knew about every agent, we could assume that not every interaction can be refused, but only some of them, a limited partner selection capacity. In any case, meetings with All-D players cannot always be avoided and some defection is rational in this setting.

In a setting as illustrated in Figure 3, therefore, two stable equilibria emerge, an All-D population as before, and the mixed population at the second intersection $(k/n)^{max}$. This maximum share of cooperators sustainable under given parameters can be conceived of as a meso-level carrier group for the institution, the emerging final and stable platform of settled cooperative interaction (for the conception of meso-economics, see, e.g., Elsner, Heinrich 2009, 2011).

In real-world situations, of course, agents are not given pure-strategy types, always behaving the same way, but may show both cooperative and defective behavior, depending on the constellation of the critical factors elaborated here. This is reflected by the formal interpretation, where the upper equilibrium at $(k/n)^{max}$, rather than designating a clear-cut cultural or strategy structure of the population (where All-D would be considered a social rule and thus a 'culture', too), is equivalent to a mixed strategy played by all agents in the population.

In all, agency mechanisms such as monitoring, memory, and reputation, in connection with partner selection, provide another possibility to achieve results that are superior to those of mutual defection, even if the underlying dilemma is not solved in the SG. When the dilemma is transformed into a coordination problem plus partner selection working, the necessary minimum share of cooperators is simply further reduced relative to the same situation without those agency mechanisms.

More information about others' behaviors thus increases the chances for the establishment of generally cooperative behavior in a population. And agency capacities such as partner selection, thus, are working in equivalent ways as sanctioning in the earlier single-shot perspective, which has also been well-known in lab experiments and behavioral economics for long (for extra sanctioning and face-to-face communication in the PD played in the lab, see, e.g., the classic of Ostrom et al. 1994).

As we have seen, contingent expectations are a critical and co-evolving factor of an emerging institution of cooperation in a particular-population arena and carrier-group platform or a particular interaction area of that population. But how could this spill over into a culture of more general trust across all themes, arenas and platforms of a population?

6 Problem-Solving Trust in Different and Overlapping 'Meso'-Sized Platforms, and Their Transfer and Spill-Over into 'General Trust': Different Cultures Explained

As we have seen, cooperative behavior can emerge more easily, for a given incentive structure, when

- interaction arenas and required minimum critical masses therein are relatively smaller and
- expectations to meet a cooperative agent are higher and the culturally acquired time horizon is longer.

These results hold independently of whether we approach the question from a perspective of active choice of strategies or of a selection of behavioral traits through a replicator, even though the specific interpretations would vary according to the set-up, as it is of course conceivable that behavioral predispositions are emerging within the individual agents and thus are selectable, laying the foundation for later habituated cooperative behavior in other areas.

The co-emergence of expectations in particular arenas or thematic areas of arenas is only one major step in the transfer of the model setting and findings to real-world problem-situations. Agents in individual (thematic) platforms that have emerged have to form more general ideas about how others will behave when they choose their actions beyond the individual platform. The understanding for the process playing out therefore needs to be complemented by additional considerations more closely formulated with an eye on real-world agents. We already have discussed additional assumptions and mechanisms (search and experimentation, non-enviousness, risk-taking, 'workmanship', 'curiosity', memory, monitoring, reputation building and partner selection), introduced in a logical sequence, that may support the process in real-world situations and bring the formal argument and setting closer to the real world.

We now assume that every agent is interacting with many different others in different, potentially overlapping arenas or thematic areas in one arena (may be playing more than one game at a time). Arenas/thematic areas may overlap in terms of interconnected interdependence structures, geography, and agents (same population and overlapping parts of a population). Beyond that, different arenas/areas may be characterized by different types of problem structures. Finally, even the same two agents in the same situation may be interacting in different problem structures with different behavioral results simultaneously.

However, once a particular cooperative environment has been established in a critical minimum number of possibly overlapping emerged platforms, agents may follow the general learned behavioral pattern, i.e. a critical minimum mass of institutionalized cooperations, habitually not only on each platform, but may accomplish a transfer or spillover of institutionalized behavior and trust embedded therein into other specific arenas and eventually into a more general habituation and thus into the broader setting of the whole population made up of all specific areas and emerged platforms. The institutionalization of cooperative behavior results in an embedding of trustworthiness as a desirable character trait into the value structure of the population. This, eventually, can account for the establishment of a generally trustworthy behavior in the population and a reflection of this in generalized trusting attitudes. This may spill over to a generalized trust to meet a cooperator in the population in any next interaction, even in areas and situations that are not covered by those in which the cooperative behavior originally emerged.

Such a process may rely partly on an 'internalization of norms' that Gintis (2003) has identified as an 'important prosocial psychological mechanism', supporting the sustainability of cooperative behavior patterns. Increasing levels of general trust may then be observed in geographically and culturally defined populations (typically nations and regions, both sub- and supra-nationally). Modern psychology, anthropology and behavioral sciences are currently working on the details of such habituation/transfer/generalization and/or respective behavioral 'selection', be it on an individual basis or as forms of group selection among groups that have differentially succeeded to develop critical levels of cultures of cooperation (see, e.g., Boyd, Richerson 2005,; Henrich 2004; Dunbar 2011; Henrich, Boyd et al. 2004).

Elsewhere, we have argued that phenomena of diverging trust and performance levels in various areas may indicate considerable systemic differences in the 'tacit' and 'disguised' 'deep' interaction structures of countries, such as their different 'inner' size structures as a potential critical factor (see, e.g., Elsner, Heinrich 2009; also, e.g., Christoforou 2010; Dakhli, de Clercq 2004).

7 Conclusions

In this paper, we have offered a way to approach trust in a formal, directly-interdependent, i.e., EIGT framework. This framework puts trust in the context of institutional emergence, the co-evolution of favorable expectations regarding others' cooperative behavior in a problem-solving process. As a typical and ubiquitous real-world complex common and collective (i.e., both individual and social) decision structure the PD-SG has been used. In this way, we have largely argued in the theoretical area defined by Schotter, Axelrod, Lindgren and many others. One particular advantage of that approach is that we can show that and how expectations are a critical factor of a co-evolutionary solution and a crucial step on the way to capturing general trust. The setting helps to define minimal requirements that have to be met for expectations to be sufficient for inducing cooperative behavior in agents and thereby to outline conditions supportive of the emergence of cooperative behavior in groups. We have then referred to the habituation and institutionalization of such behavior as the pre-condition for its transfer to other platforms and the foundation for a generalized trustworthiness as the condition needed for supporting the emergence of elevated levels of general trust.

This paper focuses specifically on investigating trust in the context of another basic critical factor, namely, size. The emergence and general role of trust thus reflects a most basic real-world interrelation, i.e., the institutionalization of trust and the inner size structure of real socio-economies, or their deep structure in terms of interaction arenas and their established system of platforms carrying institutions. We share this conclusion with another well-known ontological approach to 'micro-meso-macro' (see Dopfer, Foster, Potts 2004). But we know also from real-world surveys that general trust largely differs and even diverges among apparently similar and adjacent national economies. So we are also in the middle of ongoing discussions of the persistence of the diversity of capitalisms.

The non-cooperative GT context, in methodological terms, enables us to clearly make distinctions between the minimum set of cultural givens that we assume already at the outset, such as some basic beliefs and some common knowledge about and understanding of a situation. The methodological advantage of the approach is extended in the sense that we are able to identify stepwise further agency requirements to add to the initial set of givens at different stages in the pursuit of the logic of the question.

The approach thus also enables us to apply a terminology depending on the specifics of a social dilemma problem as compared with a more simple coordination problem. Important here is that we must, and can, distinguish between social rules of coordination and social institutions of cooperation and show that the latter require a particular set of further agency capacities. Among these emerge issues such as habituation, semi-conscious behavior, and generalization of interactively learned behavioral properties. In an evolutionary perspective, embracing modern behavioral and complexity sciences from biology through anthropology to economics and systems theories, we would have to more explicitly deal with the process of diversification and selection of such behavioral traits, in this way perhaps integrating the naturalistic and the EIGT approaches on the issue of group selection. In an evolutionary-institutional interpretation of non-cooperative GT (EIGT), in particular, we would have to deal with the dissection and the embedding of the related folk theorem of dilemma solving.

More generally, the methodological advantage of that approach appears to be the clear requirements coming up to embed its formalism in a broader process story and thus combine formal analysis with verbal and qualitative theorizing and conceptualizing. In evolutionary economics, we are facing the particular problem of bringing together the different ends and paradigmatic cultures of (original) evolutionary-institutional economics (OIE) and an evolutionary-institutional interpretation of GT, on which Hodgson and Huang have elaborated recently (Hodgson, Huang 2012; see also Elsner 2012 for more references in that field).

Using the formal steps of our investigation as a structure, we start with the well-known single-shot perspective of solving a PD by transforming it into a coordination game through repetition. Here, expectations to meet the same agent again in the future and related agency capacities, among them an acquired and learned culture of broad 'recognized interdependence' (for the Veblenian/OIE tradition of this, see, e.g., Bush 1999) and long-term futurity (on this, in the OIE tradition, e.g., Commons 1934) are critical factors.

In a second step we have introduced a population perspective, adding the minimum-critical-mass condition that together with population size, expectations, and particular further agency capacities (experiencing frustration, developing search and experimentation, workmanship, curiosity, innovation …) may solve the problem. By conceptualizing a series of PD-SGs with random partner change in a population among such rounds we integrate population size as a critical factor in expectations, showing that smaller population size is a favorable factor for emerging institutionalized cooperation, particularly through the supra-proportional decrease of the minimum-critical-mass requirement (see also, e.g., Henrich 2004, 8 f.).

We then introduce more particular agency capacities, namely the ability to collect more information on specific individual agents through memory, monitoring, and building reputation and making use of the reputation chain, in order to increase the chance to meet a cooperator rather than the same agent as before. Beyond learning about (k/n), the resulting capacity to select an interaction partner, or reject one, to some degree, then further supports emerging cooperative behavior in a specific arena. Partner selection (preferential grouping) here becomes a critical agency capacity.

While cooperators may increase their relative success fairly quickly at early stages of the interaction process when the additional agency mechanisms are permitted, their *c*ooperative advantage is eventually exhausted as marginal gains decrease and discounted payoffs establish a firm upper limit. We have illustrated that not only the minimum-critical-mass requirement for the emergence of cooperation further decreases but also that the emerging platform size of cooperation has an upper limit below the size of the whole arena population (i.e., a meso-size) when the underlying dilemma of the one-shot problem cannot be transformed in the repetition of the game. Cooperation may come into being more easily given additional agency capacities but may also have its limits, where defection becomes the rational and superior strategy.

In another step, one might introduce the ability of agents to even build their individual peer group structure (reducing the population n to some specific n_i), which may further improve (k/n) to (k_i/n_i), with $(k_i/n_i) > (k/n)$, in a process leading to distinct neighborhoods in a population. A reduction of the overall n may, however, only lead to the reduction of the minimum-critical-mass requirement in our set-up, as the problem to be solved by the agents remains the same in substance independently of the number n or n_i of agents involved. And one might argue about whether just smaller, tighter groups are indeed a promising step towards the establishment of an increased level of generalized trust. For a different dynamic in the process, at this point we would have to introduce defined neighborhood (including migration) structures that the agents themselves can shape to some degree.

The structuring of a population in order to ease the emergence of cooperative behavior patterns at less complex interaction levels, in order to serve as the foundation for a farther reaching general cooperation, is a result that seems to be shared even with what we can derive from the naturalistic approaches (e.g., Henrich 2004).

In a final step, we generalize trust, learned and practiced in a critical minimum set of individual arenas and substantial areas and then emerging meso-sized platforms. The process of generalization, spill-over, or transfer into more and further individual arenas might help the further diffusion of a cooperative culture in which trustworthy behavior becomes established as a part of an overall value-system and is shown and spilled over habitually. Further habituation then helps explain (only verbally, though, in this paper) the emergence of what nowadays has become the topical issue of general trust in a number of platforms, usually distinguishing a geographically defined national or regional culture. Many individual institutionalized constellations of cooperation may combine into a predominant culture of cooperation; which they have to for the positive results of general trust to be accessible to a larger group.

For a transfer of those theoretical findings to real world settings, we turned to the surprising persistence of varieties of capitalisms, mirrored by different and diverging levels of general trust and macro-performance, as the real-world proof of the pudding of our conjecture. Macro-performance is intimately connected to general trust in different shapes and both need to be explained by investigating the 'deep' interaction structure of socio-economies, particularly the co-evolution of expectations and the inner size structure of their overlapping arenas and platforms, localities, settlement structure, associations, clubs, unions, formal organizations, informal participation opportunities, decentralized state agencies, migration conditions, etc.

The approach presented here could be further extended by defining a structured neighborhood for the agents. More elaborated models would need to be approached by computer simulation (for an attempt at this, see, e.g., Elsner, Heinrich 2011). Also, an important aspect we have not included so far, but that lab experiments have shown to be important in real-world settings, is n-person games, in which agents punish defection even when they were not harmed as a direct result of this defection (e.g., Ostrom et al. 1994; Binmore 2006). The move to n-player games can be expected to underline the problems identified in our set-up, and the solution mechanisms that can be derived, though, and offer a further strengthening of the need for institutional frameworks within which problem-solving behavior patterns are encouraged and supported. Still, n-player set-ups would conceivably allow the identification of additional factors supporting the emergence of cooperative behavior in populations.

Finally, the naturalistic inter-group selection perspective (as represented, e.g., by Henrich 2004) could be integrated into the EIGT perspective through analogous GT modeling with partner selection and related agency capacities.

References

Acemoglu Daron, Kostas Bimpikis, Asuman E. Ozdaglar, 2010, Dynamics of Information Exchange in Endogenous Social Networks, MIT Department of Economics Working Paper No. 10-13.

Aoki, Masahiko, 2001, Toward a Comparative Institutional Analysis, The MIT Press, Cambridge MA, London UK.

Aoki, Masahiko, 2007, Endogenizing Institutions and Institutional Change, Journal of Institutional Economics, 3.1, 1-31.

Axelrod, Robert, 1984/2006, The Evolution of Cooperation, Basic Books, New York (rev. ed. 2006).

Binmore, Ken, 2006, Why Do People Cooperate?, Politics, Philosophy, and Economics, 5.1, 81-96.

Binmore, Ken, 2011, Natural Justice, Oxford University Press, New York et al.

Boyd, Robert, Peter J. Richerson, 2005, The Origin and Evolution of Cultures, Oxford University Press, New York et al.

Bush, Paul D., 1999, Art. ‘recognized interdependence.’ Encyclopedia of Political Economy, ed. by Phil A. O’Hara, London, New York: Routledge, Vol. 2, 963-4.

Christoforou, Asimina, 2010, Social Capital and Human Development: An Empirical Investigation Across European Countries, Journal of Institutional Economics, 6.2, 191-214.

Commons, John R., 1934, Institutional Economics. Its Place in Political Economy, 2 Vols., New York: Macmillan, [1934], New Brunswick, NJ, London: Transaction Publ., 1990.

Coriat, Benjamin, Samira Guennif, 1998, Self-Interest, Trust and Institutions, in: Nathalie Lazaric, Edward Lorenz (eds.), Trust and Economic Learning, Edward Elgar, Cheltenham, Northampton, 48-63.

Dakhli, Mourad, Dirk de Clercq, Human Capital, Social Capital, and Innovation: A Multi-Country Study, Entrepreneurship and Regional Development, 16, 107-128.

Davis, J.B., 2007. Complexity theory's network conception of the individual, in: Giacomin A., Marcuzzo, M.C., (Eds.), Money and Markets. A doctrinal approach. Routledge, Abingdon, UK, New York, USA, pp 30-47.

Davis, J.B., 2008, Complex Individuals: The Individual in Non-Euclidian Space, in: Hanappi G., Elsner, W., (Eds.), Advances in Evolutionary Institutional Economics: Evolutionary Mechanisms, Non-Knowledge, and Strategy. Edward Elgar, Cheltenham, UK, Northampton, MA, USA.

Dejean, Sylvain, Thierry Pénard, Raphael Suire, 2009, Olson’s Paradox Revisited: An Empirical Analysis of File-Sharing Behavior in P2P Communities, Economics Working Paper Archive (University of Rennes 1, University of Caen) 201105, Center for Research in Economics and Management (CREM), University of Rennes 1, University of Caen and CNRS.

Dolfsma, Wilfred, and Verburg, Rudi, 2008, Structure, Agency and the Role of Values in Processes of Institutional Change, Journal of Economic Issues, XLII.4, 1031-54.

Dopfer, Kurt, Foster, John, Potts, Jason, 2004, Micro-meso-macro, Journal of Evolutionary Economics, 14, 263-79.

Dosi, Giovanni, and Winter, Sydney G., 2000, Interpreting Economic Change: Evolution, Structures and Games, LEM Working Paper Series 2000/08, Pisa, Italy.

Dunbar, R.I.M., 2011, Constraints on the evolution of social institutions and their implications for information flow, Journal of Institutional Economics, 7.3, 345-71.

Elsner, Wolfram, 2012, The Theory of Institutional Change Revisited. The Institutional Dichotomy, Its Dynamic, and Its Policy Implications in a More Formal Analysis, Journal of Economic Issues, XLVI.1, 1-43.

Elsner, Wolfram, and Heinrich, Torsten, 2009, A simple theory of ‘meso’. On the co-evolution of institutions and platform size – With an application to varieties of capitalism and ‘medium-sized’ countries, Journal of Socio-Economics, 38.5, 843-58.

Elsner, Wolfram, and Heinrich, Torsten, 2011, Towards 'Meso'-Economics. On the Coevolution of Institutionalized Coordination, 'Platform' Size, and Performance, in: S. Mann (ed), Sectors matter! Exploring Mesoeconomics, Berlin, Heidelberg, New York: Springer.
Elster, Jon, 1989, The Cement of Society. A Study of Social Order. Cambridge Univ: Pr., Cambridge et al.
Farrell, Henry, 2009, The Political Economy of Trust: Institutions, Interests and Inter-Firm Cooperation in Italy and Germany, Cambridge University Press, Cambridge et al.
Friedman, James W., 1971, "A non-cooperative equilibrium for supergames", Review of Economic Studies 38.1, 1–12.
Gintis, Herbert, 2003, The Genetic Side of Gene-Culture Coevolution: Internalization of Norsm and Prosocial Emotions, Journal of Economic Behavior and Organization, Journal of Economic Behavior & Organization, 53.1, 57-67.
Grüne-Yanoff, Till, Paul Schweinzer, 2008, The Roles of Stories in Applying Game Theory, Journal of Economic Methodology, 15.2, 131-146.
Güth, Werner, Hartmut Kliemt, 2010, (Un)Bounded Rationality in Decision Making and Game Theory – Back to Square One?, Games, 1.1, 53-65.
Harmsen-van Hout, M.J.W., Dellaert, B.G.C., and Herings, P.J.J., 2008, Behavioral Effects in Individual Decisions of Network Formation, Maastricht Research School of Economics of Technology and Organizations, RM/08/019.
Henrich, Joseph, 2004, Cultural group selection, coevolutionary processes and large-scale cooperation, Journal of Economic Behavior & Organization, 53.1, 3-35.
Henrich, Joseph, Boyd, Richard, Bowles, Samuel, Camerer, Colin, Fehr, Ernst, and Gintis, Herbert, 2004, Foundations of Human Sociality. Economic Experiments and Ethnographic Evidence from Fifteen Small-Scale Societies, Oxford Univ. Pr., Oxford et al.
Hodgson, Geoffrey, Kainan Huang, 2012, Evolutionary Game Theory and Evolutionary Economics: Are They Different Species, Journal of Evolutionary Economics, 22.2, 345-366.
Inglehart, Ronald, Wayne E. Baker, 2000, Modernization, Cultural Change, and the Persistence of Traditional Values, American Sociological Review, 65.1, 19-51.
Khalil, Elias, 1994, Trust, in: Geoffrey M. Hodgson, Warren J. Samuels, Marc R. Tool (eds.), The Elgar Companion to Institutional and Evolutionary Economics L-Z, Edward Elgar, Cheltenham, Northampton, 339-346.
Knack, Stephen, Philip Keefer, 1997, Does Social Capital Have an Economic Payoff? A Cross-Country Investigation, Quarterly Journal of Economics, 112.4, 1251-88.
Lazaric, Nathalie, Edward Lorenz, 1998, Introduction: The Learning Dynamics of Trust, Reputation and Confidence, in: Trust and Economic Learning, Edward Elgar, Cheltenham, Northampton, 1-20.
Leydesdorff, Loet, 2007, The Communication of Meaning in Anticipatory Systems: A Simulation Study of the Dynamics of Intentionality in Social Interactions, Vice-Presidential Address at the 8th Int. Conf. of Computing Anticipatory Systems, Liège, Belgium, Mimeo.
Lindgren, Kristian, 1997, Evolutionary Dynamics in Game-Theoretic Models, in: The Economy as an Evolving Complex System II, ed. by W.B. Arthur, S.N. Durlauf, and D.A. Lane, Reading, MA, USA: Addison-Wesley, 337-67.
MacFayden, Alan J., 2006, Beliefs in Behavioral and Neoclassical Economics, in: Morris Altman (ed.), Handbook of Contemporary Behavioral Economics – Foundations and Developments, M.E. Sharpe, Armonk NY, London, UK, 183-201.
Mailath, George J., Larry Samuelson, 2006, Repeated Games and Reputation: Long-Run Relationships, Oxford University Press, New York et al.
Malul, Miki, Mosi Rosenboim, Tal Shavit, Costs of Mistrust between Ethnic Majority and Minorities: Evidence from Israel, Review of Social Economy, LXVII.4, 447-464.
Maskell, Peter, 2004, Learning in the Village Economy of Denmark. The Role of Institutions and Policy in Sustaining Competitiveness, in: P. Cooke, M. Heidenreich, and H.J. Braczyk (eds.), Regional Innovation Systems (2nd edition), Routledge, London, 154-185.
McKnight, D. Harrison, Norman L. Chervany, 2006, Reflections on an Initial Trust-Building Model, in: Reinhard Bachmann, Akbar Zaheer (eds.), Handbook of Trust Research, Edward Elgar, Cheltenham, Northampton, 29-51.

Mengel, Friederike, 2009, Conformism and Cooperation in a Local Interaction Model, Journal of Evolutionary Economics, 19, 397-415.
Möllering, Guido, 2006, Trust: Reason, Routine, Reflexivity, Elsevier, Amsterdam et al.
Nooteboom, Bart, 2002, Trust – Forms, Foundations, Functions, Failures and Figures, Edward Elgar, Cheltenham, Northampton.
Nowak, Martin A., Karl Sigmund, 1992, Tit for Tat in Heterogeneous Populations, Nature, 355, 250-252.
Olson, Mancur, 1965, The Logic of Collective Action: Public Goods and the Theory of Groups, Harvard University Press.
Ostrom, Elinor, James Walker, Roy Gardner, 1994, Rules, Games, and Common-Pool Ressources, University of Michigan Press, Ann Arbor.
Pelligra, Vittorio, 2011, Intentions, Trust and frames: A Note on Sociality and the Theory of Games, Review of Social Economy, LXIX.2, 163-187.
Putnam, Robert D., 2000, Bowling Alone – The Collapse and Revival of American Community, Simon and Schuster, New York.
Rose, David C., 2011, The Moral Foundation of Economic Behavior, Oxford University Press, New York et al.
Schelling, Thomas, 1960, The Strategy of Conflict, Harvard University Press, Cambridge and London.
Schotter, Andrew, 1981, The Economic Theory of Social Institutions, Cambridge University Press.
Sen, Amartya, 1967, Isolation, Assurance, and the Social Rate of Discount, The Quarterly Journal of Economics, 81.1, 112-124.
Six, Frédérique, The Trouble With Trust – The Dynamics of Interpersonal Trust Building, Edward Elgar, Cheltenham, Northampton.
Spiekermann, K.P., 2009. Sort out your neighbourhood. Public good games on dynamic networks. Synthese, 168, 273-294.
Sugden, Robert, 1986, The Economics of Rights, Co-operation, and Welfare, Basil Blackwell, Oxford and New York.
Tucker, C., 2008, Social Interactions, Network Fluidity and Network Effects, NET Institute Working Paper No. 08-30.
Ulsaner, E. M., 2002, Religion and Civic Engagement in Canada and the United States, Journal for the Scientific Study of Religion, 41.2, 239-254.
Veblen, Thorstein B., 1899, The Theory of the Leisure Class, McMillan, New York.
Veblen, Thorstein B., 1914, The Instinct of Workmanship and the State of the Industrial Arts, McMillan, New York.
Wells, Philip A., 2010, Shrinking the Internet, New York University Journal of Law and Liberty, 5.2, 531-580.
Yamagishi, Toshio, Satoshi Kanazawa, Rie Mashimi, Shigeru Terai, 2005, Separating Trust from Cooperation in a Dynamic Relationship – Prisoner's Dilemma with Variable Dependence, Rationality and Society, 17.3, 275-308.