THESIS ON ECONOMICS H17

Structural Solutions to Social Traps: Formal and Informal Institutions

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TUT PRESS

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Dissertation was accepted for the defence of the degree of Doctor of Philosophy in Economics on April 28, 2010

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Defence of the thesis: June 17, 2010

Declaration:

Hereby I declare that this doctoral thesis, my original investigation and achievement, submitted for the doctoral degree at Tallinn University of Technology has not been submitted for any academic degree.

Kaire Põder

ISSN 1406-4782
ISBN 978-9985-59-993-8

MAJANDUS H17

Sotsiaalsete lõksude strukturaalsed lahendid: formaalsed ja mitteformaalsed institutsioonid

KAIRE PÕDER

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INTRODUCTION[1]

The aim of the current overview is to present the connecting features of the four essays which constitute the doctoral thesis. All four published articles are united under a common name, **"Structural solutions to social traps: formal and informal institutions,"** because they all study institutional solutions to conflict situations, where individual interactions will not reach to the Pareto efficiency. Although each separate article is dedicated to a relatively different set of problems, they all are seeking for solutions to social dilemmas faced by societies or communities. The articles demonstrate how informal institutions, strategic action and evolution of organizations and institutions can solve cooperation problems.

Although game theory is becoming an orthodox part of economics' curriculum, it is still challenging to use games for explaining macro adjustments in society, or to show how micro choices can affect the macro structure. Although it is already known from Smith (1776) that there are systems where individuals neither intend, nor need to be aware of aggregate results – today it is almost common knowledge among economists that there is wide range of such situations (e.g. Schelling (1978) describes situations from marriage to biological evolution). At the same time there is no guarantee that individual choices will automatically lead to the desired social results. For example, Prisoners' Dilemma (PD) describes situations where individuals are trapped into bad choices. What mechanisms that will help individuals out of these lock in situations is a fascinating question. For the economists this can be as important as the question about sources of long term growth, or it can be that these questions partially are the same.

The main contribution of the thesis is the demonstration of different possibilities where institutions change the structure of the game so that social traps can be avoided. In addition, the articles are building a bridge between economics and the neighboring social sciences – most significantly anthropology and cultural sociology. Although this link must not be confused with economic imperialism that some economists (Tullock 1972, Becker 1976) have promoted. The aim of these articles is not the quantification of social episodes, but looking for the areas where modeling can help explain social phenomena where market mechanisms are not present. In studying institutions these parsimonious models can explain institutional or cultural phenomena as complementary mechanisms to the markets. At the same time the dialogue with neighboring social sciences over the validity of the results can be a fascinating area for future research.

Institutional research has gained more and more appreciation since North's (1990) book. Nowadays institutional research is far from the peripheries of economics. North received the Nobel Prize in 1993. Recently in 2009 the Nobel committee awarded Ostrom and Williamson the Nobel Prize for their analyses of economic governance, areas that almost overlap with the analyses in the current theses. In

[1] Publication of this thesis is granted by the Doctoral School in Economics and Innovation created under the auspices of European Social Fund.

general the New Institutional Economics seeks to explain political, historical, economic and social institutions such as government, law, markets, firms, social conventions, etc. in terms of the Neoclassical economic theory. More particularly the following articles are interested in institutions which may help solve certain cooperation problems.

Three articles out of the four use historical narratives, thus the work of Avner Greif (summarized in a 2006 book) has had a great influence on this work. Greif (2006) seeks for the efficient organization that entails the establishment of institutional arrangements and property rights that create an incentive to channel individual economic effort into activities that bring the private rate of return close to the social rate of return. Institutionalists, like Greif or further back in time North and Thomas (1973) and Williamson (1985), believe that if a society does not grow it is because there are no incentives provided for economic initiative. Institutions shape incentives. We, like many other institutionalists, believe that using the methods of economics can contribute mainly to the research of self-enforcing institutions. Although it is also vital to show that in some cases external enforcement is unavoidable, or at least is unavoidable under current technology. However our main contribution is the demonstration that there are some unique examples of institutions that solve the problems of social traps. To place our research in comparative perspectives, it is important to mention that Ostrom (1990) shows similar results in the management of commons in the case of Spain and the Philippines. As already mentioned, Greif et al. (1994) showed similar results in the case of merchant guilds as does our case of the Tallinn Merchant Guild. Our pure public good provision story is in close dialogue with the Coase (1974) article, but reaches different conclusions, although there has been periods in Estonian history where lighthouses were almost purely privately provided. Also shown in Põder (2009) is that cooperation can be easily broken in the case of open and random connections. Although the classics (Axelrod 1984) confirm that evolution of cooperation is possible, the hesitant results are presented running theoretical models by Rapoport (1988) or Okada (1993) and by field studies of Hammerstein (2003) or Le and Boyd (2007).

The four published articles are:

(1) **How to Catch a Seal? The Study of Rational Norms of 19th Century Island Communities in Western Coast of Estonia.** (2006), published in *CEU Political Science Journal*, 1(2), 2-14;

(2) **Credible Commitment and Cartel: The Case of Hansa Merchant in the Guild of the Late Medieval Tallinn.** (2010a), published in *Baltic Journal of Economics*, 10(3), Spring, xx-xx;

(3) **The Lighthouse in Estonia: Provision Mechanism of 'Public Goods'**[2], (2010b), published in *Discussions on Estonian Economic Policy,* ed. Matti Raudjärv; Berliner Vissenschafts Verlag GmbH; pp. xx-xx;

(4) **The Evolution of Non-cooperative Behaviour: The Case of Post Transitional Estonia**. (2009), published in *Baltic Journal of Management*, 4(3), 301-317.

The first article (Põder 2006) demonstrates the importance of social norms in situations where individual self-interest based choices create Pareto inefficient final allocations. The article argues, that in the case of pre-regulatory environment, at least two alternative solution concepts assuming moderate others-regarding individuals and repetitive interaction satisfy empirical tests. Social norms are also stated as being institutional solutions to the *tragedy of commons*. The most common of them were: (a) taboos, mythological restraints or "regulations" on the usage of resources; (b) secrecy, information restriction fixing the access of the non-group members; (c) fixing the access by formal traditions. All common norms were related to reciprocal behavioural settings between the group members: (a) equal distribution of the resource (fish, sea-mud, sales' revenue); (b) equal right to access the common resource (sea, seashore, lake, river, port). Reciprocity is not the sufficient condition for solving the *tragedy*, it is rather necessary for any trust based community behaviour. The empirical facts are collected from anthropological studies, memories and interviews conducted by the author. The test communities were all small, relatively close, Swedish speaking units situated in Estonia's small islands, such as Ruhnu, Vormsi and Hiiumaa.

The second article (Põder 2010a) shows how coordination problems were historically solved by the evolution of organizations, indicating the role of merchant guild in the medieval city-state. The current paper explains the role of the guilds in the late medieval city-state using an extensive form game. The article states that merchant guilds created growth by generating trade by a credible commitment to honest trades. In this case, the guild as an institution (or organization) enforced a reputation mechanism that made sanctions through punishment of shirked merchants a credible threat. During later periods guilds performed as rent-seeking organizations or cartels. The historical empirics or narratives are concentrated on one specific historic case – Tallinn (one of the most important city-states in the east-trade) from the end of the14th century until reformation in the 1520s.

The third article (Põder 2010b) focuses on ownership structures in the provision of public goods. Overall the question: Is the private body able to provide lighthouse service? is answered by using historical study and extensive form games. Empirics came from the history of Estonian lighthouses starting from the Hansa times and ending after World War II. Mainly archive and secondary sources are used, for

[2] The shorter version of the article will also be published (2014) The Lighthouse: Historic analytic narrative on the provision of 'public goods' in Estonia. *Transformations in Business and Economics*, Vol. 13, 2(32), March edition, xx-xx.

showing the institutional evolution of ownership structures and moreover it is shown that pure private provision has not existed during any of the periods. However this argument is not supporting Government provisions of public goods financed by public revenues, rather the minimal (not to say optimal) set of institutions provided by government to help private provision is looked for.

The fourth article (Põder 2009) uses interviews to collect data about strategic behavior of individuals who belong either to small or large networks. Simulations are used to give a theoretical explanation to why certain strategic behavior is justified. For a theoretical framework evolutionary game theory is used. Unfortunately there are infinite strategies which in repeated games satisfy folk theorem, thus our solution – *group segregation strategy* – is only one possible way to screen out efficient strategies. In general the article shows that in small regular networks, with limited amount of connections, cooperative norms dominate and in large networks individuals use a *group segregation strategy* – inner circle benefits from reciprocal cooperation, and in random connections individual rationality prevails.

The current paper has the following structure. The first part explains the common set of problems in all essays – social dilemmas, followed by a short overview of the two essential dilemmas: provision of public goods and utilization of commons. This section also provides the necessary pre-knowledge readers may need before turning to the articles. Then, in the second part solution concepts and possible solutions to the traps through evolution of informal and formal institutions are discussed. The third part introduces a relatively non-conventional method in economics – analytical narratives. Also the role of a "plain man" in macro processes like the creation of institutions or common perceptions is discussed and criticism to the method is given. Finally the summary will show the role of all these common frames in different essays presented in the doctoral dissertation and also discusses the main conclusions of the four presented articles.

Acknowledgements

I am grateful to my supervisors Kaie Kerem and Alari Purju for their patience and support. Also to Balasz Varadi for introducing the analytic narratives approach and being optimistic about interdisciplinary research; and Karsten Staehr for his support during 'giving-up periods'. Thanks to the following kind people – Killu Paldrok, Inga Kaha, Kati Tillemann, Mare Randveer and Joshua Jacobson – who valiantly tackled my written language. And my gratitude to fellow PhD students for their comments and valuable insights, especially to Peeter and Mari. Most of all, Eeri, Uku, Jana and Karl, sorry for your having a mother and a wife with academic ambitions.

1. THE PROBLEM

All four essays that constitute the doctoral dissertation have a common set of problems. In all cases the search is for Pareto improvements in the situations where individual decisions will not provide Pareto efficient allocations. Such situations can also be called social dilemmas or traps.

1.1. Social traps

The "Catalogue of social mechanisms" (Munck 2001) allows to translate agent specific choice situations into more generalized game forms, specifying actors, their choices, and the payoffs associated with possible outcomes. This catalogue of ready made normal form games usually consists of two basic types: *prisoners' dilemma* (PD) and coordination games. The latter can be in the form of: a *battle of sexes*; *assurance* or *stag hunt*; *chicken*; and *pure coordination* (all names are conventional).

Social dilemmas or traps are situations where individual rationality leads to collective irrationality – if individually rational behaviour will lead to a situation in which everybody is worse off than they might have been otherwise. In the PD individually rational behaviour will harm all participants compared with cooperative behaviour. Thus social dilemmas or traps can be called interpersonal (or international) cooperation problems, where individually rational behaviour may not lead to the best aggregate outcome. It is also important to understand that in social traps individuals may even recognize that they are trapped into bad or even catastrophic actions and how these actions contribute to a calamitous outcome, but they are unable to do anything about it. That's why PD illustrates the most often discussed social problem, where each individual has a dominant strategy which leads to the deficient equilibrium. Dominant strategy is the best answer independent from the respective behaviour of other group members. Thus in the case of dominant strategies the social trap is self-explanatory – everybody's rationality will lead to the non-cooperative disastrous outcome.

		II C	II D
I	C	$b; b$	$d; a$
	D	$a; d$	$c; c$

Figure 1. Prisoners' dilemma

In Figure 1, symmetric normal form games represent individual players' choice between hypothetical "cooperative" (C) and "defective" (D) actions. The preference ordering of the payoffs is given in alphabetical order $a \succ b \succ c \succ d$. Eliminating dominated actions we get the Nash equilibrium payoff profile $(c; c)$. In

the PD the cooperative payoff profile $(b; b)$ is preferred to the equilibrium payoff profile $(c; c)$ by all the players, thus the outcome is not Pareto efficient. PD has certain properties: first, dominated actions exist; second, eliminating dominated actions will give us Pareto inferior outcome; third, unilateral deviation from Nash equilibrium is costly. Thus rationality will lead us to the trap.

The catalogue of social mechanisms has mapped many social situations. In Figure 2 section (a) illustrates *pure coordination*; section (b) *battle of sexes*; section (c) *stag hunt* and section (d) *chicken*. All payoff profiles are representing numerical preference order $3 \succ 2 \succ 1 \succ 0$. In all four examples there is no dominated action, and each game has the property of multiple equilibria.

		II	
		R	L
I	R	2; 2	0; 0
	L	0;0	1; 1

(a) pure coordination

		II	
		A	B
I	A	2; 1	0; 0
	B	0;0	1; 2

(b) battle of sexes

		II	
		S	R
I	S	3; 3	0; 2
	R	2; 0	1; 1

(c) stag hunt

		II	
		D	C
I	D	0; 0	3; 1
	C	1; 3	2; 2

(d) chicken

Figure 2. Coordination games

In *pure coordination* there are two possible actions, the most often used example is driving in the "left" (L) or "right" (R), and there are two Nash equilibria $(1, 1)$ and $(2, 2)$, the latter is strictly Pareto-better. The problem is defined by a trap – how to reach the Pareto-better equilibrium. The asymmetric *battle of sexes* game, where coordination gives a bigger advantage to one player, also has two Nash equilibria $(2, 1)$ and $(1, 2)$. Both equilibria are Pareto efficient, thus the coordination problem becomes which equilibrium to choose or whom to benefit. The *stag hunt* game, where the set-up originates from Rousseou (Skyrms 2004), which allows individuals to go after the "stag" (S) or the "rabbit" (R); has similar properties to a *pure coordination* game. There are two Nash equilibria $(3, 3)$ and $(1, 1)$, one of them is strictly Pareto-better. Deviation from the Pareto efficient Nash equilibrium unilaterally is not resulting in a huge utility loss. The anti-coordination game "*chicken*" has two Nash equilibria (3, 1) and (1, 3), both of them are Pareto efficient. Anti-coordination characteristic shows that symmetric coordination (2, 2) can also result in a Pareto efficient result, but in the case of individual choice there is a risk to end up with the worst outcome (0, 0).

In coordination games players are trapped in risky choices, because the outcomes of the game are uncertain and players may end up with worse outcomes. Morris et al. (2002) showed that if we knew cardinally measured payoffs, then our decisions are highly dependent on the decision rules we consider rational. Having no information about other player preferences, we still can estimate our rational responses just by making predictions about other player behaviour. If players are risk neutral, then optimisation of expected utility (EU) will give us one interpretation of rational behaviour. Using the *stag hunt* game with the payoffs

given in Figure 2 (c), we can calculate the expected utilities in Figure 3. Let us assume that the estimation of the subjective probabilities give us a decision rule. If we estimate the probability of other player choice to go after the "stag" and it is less than 0.5, then our rational response is to go after the "rabbit". Meaning that the expected utility from strategy R is bigger than the corresponding utility form strategy S ($EU_R > EU_S$), and if our subjective estimate is more than 0.5 then it is rational to go after the "stag" ($EU_S > EU_R$).

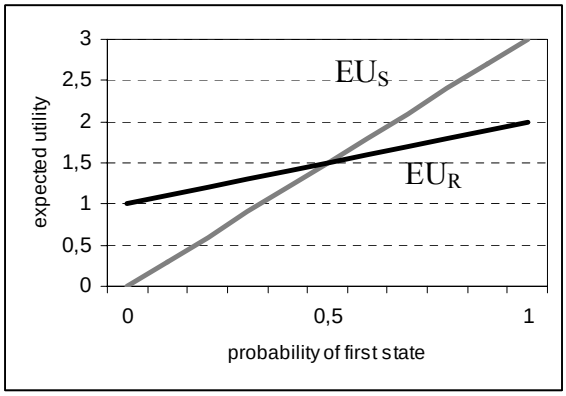

Figure 3. Estimating the expected utilities in the *stag hunt* game

It is assumed that individuals are rather risk averse, the degree of risk aversion is private information, thus risk aversion only affects the cardinal utilities, but will not affect the preference ordering in general. For example using the utility function of the risk averse player $u(\pi) = \pi^{1/2}$, where π is the payoff. Then the rational response function jumps from "stag" to "rabbit", if we estimate the subjective probability of other player to go after "stag" is less than $\frac{1}{\sqrt{3}-\sqrt{2}+1} \approx 0.76$. Thus risk aversion will just affect the payoff profiles (or the probability to end up with Pareto-best outcomes), not the general setting or the game.

Knowing the payoffs of the other player allows us to use the same rational choice rule – expected utility maximization for estimating rational action of the second player (mixed equilibrium). In the current symmetric setup, both risk neutral players will jump from "stag" to "rabbit" if they expect that the other player's probability of going after the "rabbit" is more than half. Mixed strategy equilibrium is thus (0.5; 0.5) – a result that is sometimes called total randomization. The latter indicates that we actually don't have a "smarter" choice rule than just tossing a coin. Meaning that in the case of total randomization we are trapped again, and the expected payoff approach does not help us out of the problem.

It can be argued that simultaneous decision making is not reflecting a real choice situation. In reality there is always some sequence of actions or some pre-

knowledge about other player(s) previous choices. Thus in many situations extensive form games can be used instead of normal forms. Assuming a slightly different setup of the game or adding the history of the game we can amend the PD game presented in Figure 1 so that the first player makes her choice in the first stage of the game, after this it becomes common knowledge and the second player then makes his move in the second stage of the game. The game is represented in Figure 4, cardinal utilities are used so that a=3; b=2; c=1 and d=0.

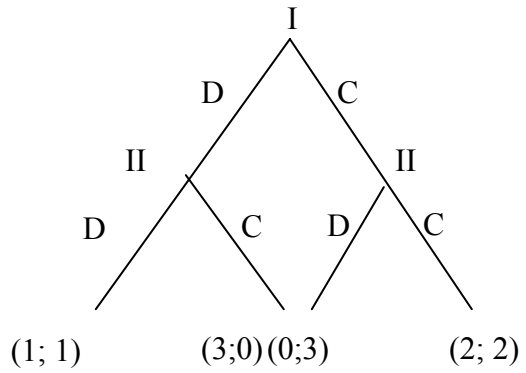

Figure 4. Extensive form Prisoners' dilemma

Backward induction is the solution concept and this shows that in the second stage the player will, independently from the history of the game, choose D. Thus the first player will also choose D in the first stage and the game ends up with the payoff profile (1; 1). Consequently it is evident that in this case changing the game structure (adding history) will not help players out of the trap, however this is important to mention that this is not true in the case of coordination games. The same result can be obtained by thinking about strategies. In the first stage the player has only two strategies – to play C or D. However in the second stage the player already has four strategies: always play D; always play C; replicate first player's action (play C then C is chosen in the first stage and play D then D is chosen in the first stage); and repeal first players action (play C then D is chosen in the first stage and play D then C is chosen in the first stage). In this case adding more "strategic thinking" to the game will not improve the results – there is only one subgame perfect Nash equilibrium (SGPNE), this is strategy profile (D; DD). I will return to the strategies in Subsection 1.4. in the case of repetitive games to show the possibilities to solve the traps.

Public goods and common resources

Many social traps can be described through an incentive problem in the PD setup – well known examples are public goods and common pools. In the case of public goods which have two distinctive characteristics: "non-excludability" and "non-rivalry" (Samuelson 1954). The "invisible hand" fails because of incentive problems or the problem of "free riding", where it is individually rational not to contribute to the provision of some public good. The statement is supported by Olson's (1965) argument of the logic of collective action. According to this logic the costs of provision are compared with possible benefits. Hence, we are confronted with prisoners' dilemma – in the large scale collective contributions all of us might receive large net benefits if we all contribute, but none of us may have any interest in contributing. In the case of public goods all that somebody contributes according to the additional utility (marginal utility – MU) and costs related with provision (marginal costs – MC), will also create utility to other community members, which on aggregate can be called marginal benefits (MB). Thus the total benefits from the provision of public goods are bigger than the cost of provision (MU + MB > MC), meaning that the total benefits from someone's contribution are only partially consumed by them. This positive externality problem will state that individual contributions will stay smaller than socially optimal (MU+MB=MC), or as in the case of extreme free riding people do not contribute at all.

The important aspect of the creation of public benefits is the technology that transforms private contributions into public goods. Thus net benefits for us are dependent on the production function which characterizes technology. How much contribution is needed for the provision of public benefits is the question of technology. The technological change can also make exclusion of non-contributors possible or cheaper. The latter can make people responsible for the consumption of public goods; such as, infrastructure or common access natural resources. The same is possible in the small groups where the cost of public control is low. Thus net benefits and costs of contributing are largely dependent on group size. Also different incentives can affect the provision of public goods. For example in an Olsonian framework the cooperation can be enforced by incentives. Social selective incentives (Olson 1965) can be important in small groups. In large *n* PD-games, social incentives are not supporting the enforcement of the provision of public goods, thus punishing schemes are needed for non-contributors. However global public goods, such as pollution control or nuclear supervision, are hard to provide through the market mechanism. The possibility of individual organised efforts, like Greenpeace or other NGOs, can be the ambition of other studies. Põder (2006) searches for the mechanism that solve the problems in the small scale, although international trade in medieval times (Põder 2010a) and provision of lighthouses (Põder 2010b) are analysing more complicated cases.

In the case of commons where the supplier of the good is usually "Nature"; the situation is the reverse – everybody has the incentive to use the resource as much

as possible, if the provision of this resource is free from charge. The infamous metaphor of the tragedy of the commons is used for showing that over-utilisation of resources is an imminent result in the case of common pools. The common pool problems, usually citied from Hardin (1968), have long lasting historical roots and many civilisations are struggling for solutions. For example Aristotle states: "There is further drawback of common ownership: the greater the number of owners, the less the respect for the property. People are much more careful of their own possessions than of those communally owned; they exercise care over public property only so far as they are personally affected" (II book of the Politics: 59). Hardin's description of the herders' dilemma comes approximately two millenniums later: "At the point when the carrying capacity of the commons was fully reached, a herdsman might ask himself, "Should I add another animal to my herd?" Because the herdsman owned his animals, the gain of doing so would come solely to him. But the loss incurred by overloading the pasture would be "communized" among all the herdsmen. Because the privatized gain would exceed his share of the communized loss, a self-seeking herdsman would add another animal to his herd, and another. Reasoning the same way, so would all the other herdsmen. Ultimately, the common property would be ruined" (Hardin 2004). To formalise Hardin let us assume a "rational polluter" who clearly prefers a pure nature to a polluted one. Benefits from the beauty are defined by B and the cost of not polluting by c. Our consumer faces free possible states of world: s_1, s_2 or s_3. s_1 is the state where natural resources are public goods, so the pollution created by one individual will be absorbed by nature itself. s_2 is the state where our consumer "breaks the tie" causing the tragedy of commons; and the final state (s_3) is the "polluted world" where our consumers polluting or not has a marginal effect. Our "rational polluter" faces the following choice alternatives: to pollute (D) or not to pollute (C). The situation can be summarized in a Table 1.

Table 1. Polluter's dilemma

	s_1	s_2	s_3
D	B	0	0
C	B-c	B-c	-*c*
	p_1	p_2	p_3

Calculating the expected utility (EU), assuming different probabilities, p, to the different states of the world, we get:

$$EU(D) = p_1 B \text{ and } EU(C) = p_1(B-c) + p_2(B-c) - p_3 c\,.$$

The optimal strategy is to cooperate (weak domination) if $p_1 B - p_1 c + p_2 B - p_2 c - p_3 c \geq p_1 B$ is satisfied, and this leads to the final condition for cooperation $p_2 B \geq c$. The probability of the second state of the world to happen is relatively close to zero, thus the "rational polluter" has only one rational action – to pollute. In Hardin's example herdsmen do not think strategically, but our "rational polluter" does, to make states of nature dependent on

the other players' actions. This allows to translate "the tragedy" into the PD game. Then the gains are dependent not only on the size of the herd, but also the total amount of animals in the pasture and the number of herdsmen.

The tragedy is not originating from the indivisibility of the benefits, differently from public goods; rather the individual benefits can not be shared or divided. The tree I cut, the fish I catch, the mushrooms I gather are not available to others. Thus the carrying capacity – is there as much and as good left – is the main concern. Is there as much and as good left is dependent not only on the replenishment rate of the common resource, but also on the group size utilizing the resource and on the choices of the group members. The smaller the group the more easily observable is the cost and source of externality, which allows the internalization of externalities with lower costs (Demsetz 1967).

1.2. Coordination problems – the weakest link and total randomization

Pure coordination games are assumed to be solved by tacit consent (terminology borrowed by Locke), where the term is not used in his original meaning, rather by tacit consent we indicate that the Pareto efficient payoff profiles are achieved simultaneously without any external coordination (Schelling 1960). This personal consent to choose activities which will lead to Pareto efficient outcomes is confirmed by many experimental results. Although if we calculate the expected utility from the *pure coordination* game, represented in Figure 4, then the Pareto efficient outcomes are more probable than non Pareto efficient ones. Probabilities indicate that the equilibrium payoff profile (2, 2) will be achieved with the probability $\frac{4}{9}$ (see Figure 5), which is less than a half, but clearly more probable than the Nash equilibrium payoff profile (1, 1). Actually the pure coordination game can be substituted by the choice of the lottery $L = \{0, 1, 2; \frac{4}{9}, \frac{1}{9}, \frac{4}{9}\}$, the expected utility (EU) of the lottery is 1, thus for risk-neutral or risk-loving players any type of institution that will enforce cooperative action profile $\{B, B\}$ is not giving additional utility. Although all risk types are winning from the institutional arrangement that will enforce action profile $\{A, A\}$. Even all the institutions that will enforce $\{A, A\}$ without costs, with some probability $r > 0$ and $\{B, B\}$, with probability $(1-r)$, will be optimal. If we admit that any external enforcement of coordination is costly (c), then the EU from the lotteries are less transparent:

$$L_1 = \{0, 1, 2;\ p - 2pq + q,\ pq,\ (1-p)(1-q)\} = \{0, 1, 2; \tfrac{4}{9}, \tfrac{1}{9}, \tfrac{4}{9}\} \Rightarrow EU(L_1) = 1$$

$$L_2 = \{1-c,\ 2-c;\ (1-r),\ r\} \Rightarrow EU(L_2) = (1-r)(1-c) + r(2-c).$$

This indicates that the probability of the enforcement of the payoff profile $\{A, A\}$, r, must be relatively large for a high cost environment and can be relatively small in a low cost environment. Thus the tacit consent argument or high cost argument is often used to justify the non-intervention scheme under the current set-up.

	A $q = \frac{2}{3}$	B $(1-q) = \frac{1}{3}$
A $p = \frac{2}{3}$	2, 2	0, 0
B $(1-p) = \frac{1}{3}$	0, 0	1, 1

Figure 5. Pure coordination and assigned probabilities

The Rousseau (1762) game has the "weakest link" property, because the coordination is sustained only if everybody compels to the coordinated activity. The "weakest link" property can characterize those social settings, where group effort determines the total payoff of every group member. The "weakest link" property can be generalized by using the so called minimum effort coordination game (Van Huyck et al. 1990); where players can choose the effort levels (*e*) and *e* is accompanied by effort result and effort costs ($c < 1$). Figure 5 will characterize a 2×2 simplified game matrix, but the result will also hold when there are more players and more effort levels; so then, a player's effort is denoted by e_i, $i = 1,...,n$, payoffs are:

$$\pi_i(e_1,...,e_n) = \min\{e_1,...,e_n\} - c_{e_i}, \quad i = 1,...,n \,.\, 2-2c, 2-2c$$

	1	2
1	$1-c, 1-c$	$1-c, 1-2c$
2	$1-2c, 1-c$	$2-2c, 2-2c$

Figure 6. Minimum effort coordination game

In the Van Huyck et al. (1990) experiment the participants were able to choose between 7 different effort levels, payoffs were linear functions of the individual effort and the lowest effort (distance between them divided by two, *c* was a half). Van Huyck et al. (1990) reported the results which showed that efforts declined dramatically, with the final period clustered at the equilibrium which was the worst of all, showing that individuals are not able to coordinate their efforts to the highest level. Of course when the cost of the effort was reduced (the structure of the game thus modified to the pure coordination) the higher effort was achievable. For example, if $c = 0$, then effort 1 is dominated by effort 2 and eliminating weakly dominated strategies provides us only one equilibrium action profile $\{2; 2\}$. Goeree and Holt (2000) showed that despite the fact that the Nash equilibrium is

theoretically not dependent on the size of the effort costs, in experiments the low cost environment gave more opportunities for high effort than the opposite. A similar theoretical explanation is given by Harsanyi and Selten (1988), when they introduced the notion of risk dominance. The setup in Figure 6 illustrates this concept of risk dominance. When both players are choosing efforts 1, the cost of a unilateral deviation to 2 is just the cost of extra effort, *c*, which is referred to as the deviation loss. Similarly, the deviation loss from the action profile $\{2; 2\}$ is $1-c$, since unilateral reduction of effort reduces the payoff by 1, but saves the marginal cost of effort *c*. If the deviation loss from the low effort equilibrium is greater than that from the high effort equilibrium, the low effort equilibrium will be the solution of the game. Thus if $c > 1-c$, meaning that $c > \frac{1}{2}$, then the low effort equilibrium prevails. Meaning that the results of the games (like in mixed strategies) are not only dependent on preference orderings, but also the cardinal utility values are important for finding the solutions in coordination dilemmas.

It should be emphasized that coordination is not a matter of guessing what the "average man" will do. One is not, in tacit coordination, trying what another will do in the objective situation; one is trying to guess what the other will guess one's self to guess the other to guess, and so on ad infinitum (Schelling 1990:92-93). So the question is where these expectations about the other player's optimal behaviour are coming from. If we just assume that all players are rational, then expected utility maximization can indicate more probable action profiles. Expectations can result from the history of the game as Arganziano and Gilboa (2005) show. History can be expelled in the form of perceptions, routines, norms, habits etc. Some historical institutions become formal, some stay informal, in some cases organizations are formed instead of using the "invisible hand". But all such institutions bear certain characteristics: they transfer information or lower the cost of choosing the "good equilibrium". At the same time every such routine needs games to be repeated, or at a minimum some kind of information about previous stages should be revealed. Thus the most common trait for seeking for the solutions is to consider that games are played over and over again.

1.3. Iterated games and strategies

Although there is no theoretical solution concept that will lead players out of social traps, there is still the theoretical possibility that rational self-interested agents manage to cooperate in long-term relationships. When agents interact only once, we saw, they have an incentive to deviate from cooperation. In a repeated interaction, however, any mutually beneficial outcome can be sustained as an equilibrium. However, it can be rational to prefer current consumption to the future one. Thus repetitive interactions may need discounting. If the discount rate (which is smaller than 1) is denoted by δ and each period utility by *u*, then the total utility from game (G) is defined $G = 1u + \delta u + \delta^2 u + ... = u + u\delta(1 + \delta + \delta^2 + ...)$.

$\delta G = \delta u + \delta^2 u + \delta^3 u + ... = u\delta(1 + \delta + \delta^2 + ...)$ and $G - \delta G = u$, then consequently $(1-\delta)G = u$, meaning that total utility can be expressed as:

$$G = \frac{u}{1-\delta}.$$

Total utility from an infinitely repeated game is just assuming that the game will never end (or at least players are not aware of the end of the game). In this case there are many rational strategies; practically all solutions which satisfy folk theorem are possible. Folk theorem states that all solutions which satisfy *minimax* (minimize maximum loss) are rational. In Figure 7, there is a simple PD game, with payoffs from Figure 1 respectively *a*=3; *b*=2; *c*=1 and *d*=0. According to folk theorem all strategies which allow one stage payoff, stay at least to the level of 1 or higher to satisfy the rationality condition.

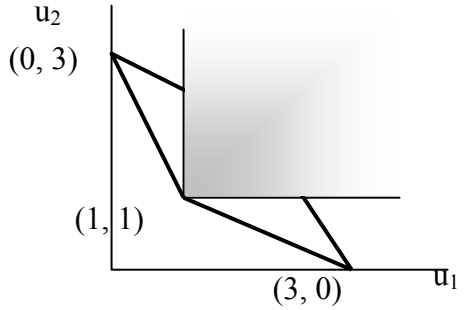

Figure 7. Graphical representation of the PD game and *minimax*

In this game (2, 2) or a cooperative strategy is a possible outcome because it satisfies the folk theorem. As mentioned, there is a huge number of such strategies, thus we introduce four of the most commonly referred ones:

Always cooperate (all C). According to this the player will always choose cooperative (C) independently from strategies played by others;

Individual rationality (all D). Opposite to previous strategy this time rational player will always choose the dominant action, in a PD type of game this is D;

Trigger grim (Friedman 1971). Initially, a player using the grim trigger will cooperate, but as soon as the opponent defects (thus satisfying the trigger condition), the player using the grim trigger will defect for the remainder of the iterated game. Since a single defect by the opponent triggers defection forever, grim trigger is the most strictly unforgiving of strategies in an iterated game.

Tit-for-tat (introduced by Rapoport in Axelrod's tournaments (Axelrod 1984)). A player using this strategy will initially cooperate, then respond in kind to an opponent's previous action. If the opponent previously was cooperative, the agent is cooperative. If not, the agent is not.

If these four strategies are facing each other and for simplification instead of infinitely repeating they play for 100 stages then G_i are shown in the "tournament table 2".

Table 2. Tournament of the four strategies

	All C	*All D*	*Trigger grim*	*Tit-for-tat*
All C	200	0	200	200
All D	300	100	102	102
Trigger grim	200	99	200	200
Tit-for-tat	200	99	200	200

Both *tit-for-tat* and *trigger-grim* earn cumulatively 699 points and beat both *all D* (604 points) and *all C* (600 points). According to the results, it may be said that facing partners like these it is important to have a strategy that is not only cooperative but also retaliatory. Being forgiving (like *tit-for-tat*) can also have some benefits in the case when we meet players who play even more complex strategies which allow cooperation in the future.

In a slightly more complex setting it can be asked –in the world where each next stage of the game gives us less utility compared to today's outcome is a cooperative strategy (e.g. *tit-for-tat*) also a good choice? Using payoff profiles from Figure 7 and assuming that the other player will follow *tit-for-tat*, we can compare the total utility from playing *tit-for-tat* or individually rational *all D* as*:*

$$G_{allD} = 2 + 2\delta + 2\delta^2 + ... = \frac{2}{1-\delta}$$

$$G_{tft} = 3 + 1\delta + 1\delta^2 + ... = 2 + \frac{1}{1-\delta}$$

Tit-for-tat is a subgame perfect Nash equilibrium (SGPNE) if:

$$2 + \frac{1}{1-\delta} > \frac{2}{1-\delta} \text{ or } \delta > \frac{1}{2}.$$

Only the last condition makes the treat – reciprocity – credible. Similarly the threat "never forgive", in the case of *trigger-grim*, becomes credible only when the discount factor satisfies the condition above. The latter means that we are not extremely impatient or indifferent about the future.

Smith and Price (1973) and Smith (1982) demonstrated how strategies can be used analyzing animal conflict behavior. Smith amended existing strategic choices and assumed that strategies are rather inherited behavioral patterns (can also be applied to culturally determined behavior), meaning that even if a game is iterated the players are not able to change their culturally (or by genotypes) determined strategies. Smith's major conclusion was that the equilibrium is determined by *evolutionary stable strategies* (ESS). ESS is a strategy which, if adopted by a

population of players, cannot be invaded by any alternative strategy. An ESS is an equilibrium refinement of the Nash equilibrium, showing that if it is fixed in a population it is sufficient to prevent mutant strategies from successful invasion. Assume that two types of players "normal" (who has learned from their parents or inherited "normal behavior") and "mutant" play the game described in Figure 8. "Normals" play X and "mutants" for some reason Y. If we assume that the probability of meeting a mutant is *p* then the payoffs will depend on the size of both populations.

	X	Y
X	2; 2	0; 0
Y	0; 0	1; 1

Figure 8. *Pure coordination* game and cultural selection

The payoff of the "normal" player from a one-stage game is:

$$2(1-p)+0\cdot p=2-2p$$

and a "mutant's" payoff is:

$$0\cdot(1-p)+1p=p\,.$$

Consequently if there are less than $\frac{2}{3}$ mutants from the entire population, then "normals" will prevail and X is ESS. We may also think the other way around and assume that Y-players are "normal" and X-players are mutants. Then the payoff of a "normal" player must satisfy the condition $1-p>2p$. Thus if $p<\frac{1}{3}$, then Y is ESS. Changing the payoff profiles so that $\{Y,Y\}$ will also give (0, 0), then only X is ESS.

If the entire population plays *tit-for-tat* and a mutant arises who plays *all D*, then the mutant will be eliminated, and therefore *tit-for-tat* is ESS, but only in respect to these two strategies. If *all C* is introduced then the population of *tit-for-tat* is no longer ESS. The *all C* behaves identically to *tit-for-tat* and they will not be eliminated. However, even though a population of *all C* and *tit-for-tat* can coexist, in case of an attack by the group of *all D*, the selective pressure is against *all C* and in favor of *tit-for-tat*.

Consequently it is demonstrated that there are difficulties in applying solution methods to iterated games where large strategy spaces are allowed. Although we may have gained some confidence that cooperative solutions are possible in iterated games, but there is still a lot of uncertainty about the mechanisms which may explain how equilibrium strategies emerge. Assuming that strategies are something inherited (culturally of biologically) can make the picture a bit clearer. Põder (2009) shows one possibility how an economist can use integrated research strategy for enriching theoretical models with empirical insights. The latter opens the discussion about research methods in the field of games and, moreover, about the alternative solutions of the games and the possibilities of using empirics in games.

2. SOLUTIONS

We saw that the rational choice rule in a game theoretic context is specified by the elimination of dominated strategies, or by the Nash equilibrium (sub-game perfect Nash equilibrium). In "the catalogue," technical solutions lead us to the traps, thus alternative "solutions to the traps" are looked for. Most of the literature is dedicated on arguments pro or contra Hobbesian *Leviathan* (Hobbes 1660). The first track favours state regulation – opponents trust tacit cooperation. The latter provides the following theoretical solutions to the social dilemma: affecting the motivation of actors (motivational solutions), changing the structure of the situation (structural solutions) and through the strategies of the actors (strategic solutions) (Swedberg 2001:317). In motivational solutions people have different orientations to social dilemmas (the approach of the social psychologists), and people can be casted into different categories (individualists, cooperators, competitors). The basic solution to social dilemmas, from this perspective is to change the aims of the individual (so the solution concepts change). Structural solutions involve, for example, a change of rules of the game by changing rewards or punishments related to the game, which allows players to change their behavior toward more cooperation. In strategic solutions it is assumed that the actors remain egoistic – but also that they are aware that it is in their own interest to behave in an altruistic or cooperative manner. I am not considering motivational solutions; as they are just misinterpretations of human behaviour, which argue, that individuals are not selfish, or at least they take into considerations payoffs of the other individuals. Rather I consider the possibility of taking into account other players' benefits, and also human *rationell* to change the rules of the games, meaning that I rely in strategic solutions in free of the four articles. Only one article – Põder (2009) – uses strategic action.

Also communication, widely discussed in experimental literature (Orbell et al. 1990, 1988), is not considered to be a solution in *n*-persons' PDs, and despite the common argument – that if people communicate before choices are made then the probability to play cooperatively is higher (Dawes 1991) - I have the reason to believe that instead of the miracle of communication in PD setup communication is just "cheap talk". Although in coordination games, such as *pure coordination* or *stag hunt*, the communication can be efficient (Devetag, 2001) or having a historical case can help as well. If the Knigthian uncertainty about others' contributions is present, then communication may help to estimate the subjective probabilities of the players, but this is only the case under total randomization. For example in *battle of sexes* games, "cheap talk" as a form of communication can be used for coordination. Cooper et al. (1989) showed that communication can help coordinating only when the announced choices of the players matched, if not, individuals made a choice according to their preferences. So communication is not the easy way out of coordination traps. Prisbrey (1991) showed that fixed pairs can rely on past performance and with high probability switching from one coordinated

equilibrium to another. This kind of alternation can be interpreted as a special form of reciprocity where nice behaviour in one round is rewarded by a nice response in the next. Repetitive situations, including reciprocal behaviour, are discussed in subchapter 2.2.

2.1. Institutions as structural solutions

Changing the rules of the game by restricting choice or changing the payoff structure is the structural solution to the game. Structural changes in the rules of the game can either determinate choice, eliminate individual freedom to choose, or change the incentive structure of the individuals.

How is the initial one-off coordination or cooperation solution achieved? Even though social ties make most of the interactions in relatively close communities repetitive, the evolution of cooperative morals is difficult to explain. Cooperation is the outcome we want to achieve, but "cooperation" will make "defection" the best strategic response in the PD structure. Thus the institution of penalizing non-cooperation is needed for the enforcement of cooperation. This leads us back to the initial setup of PD and penalizing non-cooperation is just the second degree PD. However, cooperation once achieved can be a self-enforcing result of social learning in repetitive situations. If we assume individual rationality, then in a repeated environment we should also rely on the human ability to develop rational institutions for solving social traps. Young (1998) characterizes an evolutionary development of a social norm: customary property rights; idea of equality of distributions and governing norms.

The establishment of a convention in the parable may thus be identified with the emergence of a stable customary property-rights' rule. The customary property rights' rule is a self-organising order that emerges out of interactions between self-interested, incompletely informed individual agents. Once established, it is self-enforcing in the Nash equilibrium sense: a state from which neither player will have any incentives to unilaterally deviate. They are neither aided by a neutral third party (like Walrasian auctioneer) who mediates information regarding player's marginal preferences in the form of prices, nor a benevolent and omnipotent government who can calculate and enforce an efficient Nash equilibrium externally. Despite all these odds against them, they can spontaneously find a self-enforcing rule to their own advantage (Aoki 2001:39).

Once cooperation is achieved in small groups, such as families or in the case of kinship, it will then become a steady state for the community. Thus institutional arrangements do not have to include a third party, as Arrow already stated in 1971:

> It is a mistake to limit collective action to state action […] I want to [call] attention to a less visible form of social action: norms of social behaviour, including ethical and moral codes. I suggest as one possible interpretation that they are reactions of society to compensate for market failure. It is useful for individuals to have some trust in each other's word. In the absence of trust, it would become very costly to arrange for alternative sanctions and guarantees, and many opportunities for mutually beneficial cooperation would have to be forgone (Arrow 1971:22).

Believing that rational actors can develop rules or institutions that will change the initial setup of the game or constrain players or benefit cooperative action is a belief shared by many authors in the new institutional economics, although we have to bear in mind that altering payoffs or the structure of the game can also, under changing historical circumstances, "lock-us-in" to the inefficient path of dependent institutions (North 1990). Stable and close relations between the members of the society are needed for cooperation – as these "individuals have shared the past and expect to share the future" (Ostrom 1990:88). Will these historically developed norms in a stable environment lead us to cooperation in the long run, or conversely lock-in defection, is the question of main interest.

"Institutions are the rules of the game in a society, or more formally, are the humanly devised constraints that shape human interaction" (North 1990:3). Those "humanly devised constraints" have the property of changing the rules of the game, by altering the incentive structure; this indicates that the payoff structure is changed. This Northean tradition, where institutions are considered "the rules of the play," enables to show that institutions are determining Pareto efficient equilibria in the games where players are trapped in bad outcomes. At the same time the emergence of these institutions, or the change of these institutions, is difficult to model and explain. The articles do not aim to explain dynamic change; therefore, all the models presented are static.

2.2. Social norms

Elster (1989) shows that social norms can have multiple functions, one of them is "to act as a constraint on rationality" (Elster 1989:102). Norms may not be individually rational or individual outcome oriented. There exist many incentives for obeying norms, not only sanctions. Mutually beneficial norms are self-enforcing. In many cases the enforcement of the norm is basically costless because disapproval allows the internalization of sanctions, like feeling of shame and guilt, which reduce the cost of compliance. Using Posner (1997) division of norms based on enforcement systems we divide norms into three categories: norms enforced by traditions; self-enforcing sanctions or rewards; metanorms enforced by expressions of disapproval. Our classification is the following:

First, norms can be "taboos" prohibiting certain actions and thus limiting individual freedom to choose. All "taboos" are negative constraints on actions – they prohibit something. This characteristic makes taboo different from moral or ethical codes. Taboos are believed to be historical fundament for religious and political systems – the founding coordination devices, which had encumbered human learning (Cassirer 1999:160). That is why "taboos" can also create a *status quo* environment, where social learning is slowed down. Thus "taboos" can be considered the forefathers of more complicated norms, religious and other belief systems and moral codes. Through impedance this kind of norm will make cooperation the only possible action by tying our hands. If norms are embedding individual actors into regularities, which are often justified by historical

knowledge, then these norms can be called “laws of nature”. This kind of communal wisdom can lead to the aggregate benefits because the enforcement costs are basically infinitely small.

Second, norms can reward “good” behaviour or punish misbehaviour. These kinds of norms can directly or indirectly affect the payoff profiles of the game, thus enforcing Pareto efficient payoff profiles without limiting the choices of the players. These norms are self-enforcing, as conforming to the norm is rewarding. Conformation to self-enforcing norms, by definition, is almost costless to the society, thus self-enforcing property is one of the normative characteristics of the norms I am after. Self-enforcing can be at first glance a strange behavioural or belief system, like “hating outsiders” or “wearing group specific dress”, but I will show that these beliefs can maintain social order or to help sustain common resources.

Third, I analyze metanorms that enforce cooperative behaviour. “A metanorm is based on the willingness to punish not those who violate norms, but those who fail to punish the violators” (Axelrod 1997:41). The behavioural definition used by Axelrod (1997:47) states that “a norm exists in a given social setting to the extent that individuals usually act in a certain way and are often punished when seen not to be acting this way”. The metanorm must act like a credible threat, to enforce the norm. In the initial setting of the Axelrod punishment fails to be credible.

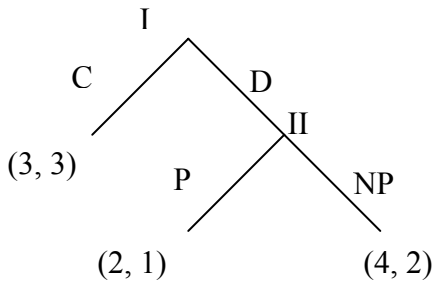

Figure 9. Punishing game

Figure 9 is describing the “Axelrod punishing game”; where the first player chooses to “cooperate” (C) or “defeat” (D) and the second cooperative player over “punishing” (P) or of “non-punishing” (N). Punishing somebody is costly. This game has only one sub-game perfect Nash equilibrium: (4, 2). Consequently the first player is defeating, and punishing is not a credible threat. This means that if individuals are not embedded into norms, which will guarantee that people see punishing as at least as good or even the preferred outcome to non-punishing, then the outcome of the game will not alter from one stage PD. So individuals have to leave cost-benefit analysis behind for norms to function efficiently. Historical evidence may lead us to think, that our emotions are maybe evolved to enjoy the harassment of others, and this leads us back to the first classification where the emotions support rational decision making by reducing the cost of punishment.

The general idea of norms to be functional, is that the norm should be self-enforcing and coercive enforcement of the laws based on norms is not a great help, without supporting mechanisms. Axelrod (1997) also considers the other supporting mechanisms of the norm; such as, dominance of one group over another or individual drive for reputation. "Contract, treaties, alliances, and membership in social groups all carry with them some power and impose obligations upon individuals" (ibid, 57). The setup of the metanorm predicts that we need some coercion to make people punish other people, but it is also difficult to achieve without evolutionary morality or without some external force.

2.3. Organizations

Contracterian tradition, starting from Hobbes and Locke, had stressed the human ability to cooperate and create more or less alienated forms of agency which will enforce cooperation. An alienating agency can be called an organization, or in some cases also external institutions. If the choices are enforced and coordinated by an external institution, then the individual choice dilemma is solved, but the cost of enforcement has to be carried out by individuals. This cost of enforcement is mainly an opportunity cost from losing the efficiency from spontaneous action – meaning "new institutional economics tradition" organizations are not considered institutions, but bodies which may help to enforce rules if these are not self-enforcing. Even then, in some circumstances limiting individual choices can be beneficial – in such cases we may be interested in voluntarily giving up our freedom to some organization. As we saw in the case of PD and metanorms, the enforcement can in some cases be difficult without some coercion. An organization can be such a coercive agency. Again like in the case of institutions, the most interesting cases are those where coercion is just a credible threat and thus enforcement costs are minimal, like in the case of merchant guild (Põder 2010a).

However, we cannot forget that even markets do not function without costs. The tradition of transaction cost economics stretches from Coase (1937) to Williamson (1985). Today not only the costs of using the price mechanism, as a main contribution of Williamson (1985), are specified under the term transaction costs, but also costs of internal organization. The greater the uncertainty the more difficult it is to use "competitive markets" due to high transaction costs. Thus organizations or hierarchies emerge. Of course the drawback of the latter is that they create cost of bureaucracy and low-powered incentives that we saw in coordination games. Thus most of the transaction cost literature in institutional studies concentrates on the discovery of the borders of the firm, meaning that they seek for the "quantity of transactions" within the firm. Therefore, the cost of low incentives or bureaucracy matter. In contrast, I am seeking for an organization as a power affecting the behaviour of individuals (or incentives) in a positive way (via credible threat). According to the transaction cost tradition I show that an organization is a complement to the markets, not a substitute.

2.4. Evolution of cooperation – change and learning

If we want to believe in cooperation as tacit consent, we have to bear in mind that consent is an evolutionary solution. In an evolutionary set-up a repetitive nature of the games allows players to understand that they are trapped into bad outcomes. This allows individuals to choose strategic responses to repetitive traps, and these strategies can lead to cooperation; where deviation from Pareto efficient allocations can be punished in the next stage, enforcing cooperation by threats. In the well known and optimistic book Axelrod (1984) convinces us that:

> The beginning of the story is that cooperation can be started even in a world of unconditional defection. The development cannot take place if it is tried only by scattered individuals who have virtually no change to interact with each other. However, cooperation can evolve from small clusters of individuals who base their cooperation on reciprocity and have even a small proportion of their interaction with each other (Ibid, 21).

Although there are many strategic solutions which satisfy the folk theorem, Axelrod (1984) delivers stories that convince the audience that one strategy – *tit for tat* – based on reciprocity and retaliation, is winning over all the others. Axelrod (1990:21) states that "a strategy based on reciprocity can thrive in a world where many different kinds of strategies are being tried, […] the end of the story is that cooperation, once established on the basis of reciprocity, can protect itself from invasion by less cooperative strategies". Thus Axelrod is convinced that "the gear wheels of social evolution have a ratchet" (ibid, 21). Mutual cooperation will be achieved because *tit-for-tat* is "winning" all other possible strategies. As shown in Section 1.4., *tit-for-tat* always starts with cooperation. Axelrod (1990) shows that "it paid to be nice [and] being the first to defect is costly" (ibid, 43). Thus the desirable properties of the strategy profile are: nice, forgiving and retaliatory. Mutual cooperation can emerge in a world of egoists "without central control by starting with some cluster of individuals who rely on reciprocity" (ibid, 69).

The theory of biological evolution is based on the struggle for life and survival of the fittest. Evolutionary theory of cooperation explains the evolution of cooperation, the survival of the fittest strategies. So the cooperation that "is common between members of the same species and even between members of different species" (ibid, 89), is an evolutionary result. Morals can be a product of the evolutionary result as well. Morals as an equilibrium strategy for promoting cooperation should have the same "good characteristics" as *tit-for-tat* – forgiving, nice and retaliatory. The last characteristic is worth emphasizing – as always cooperation is the outcome we want to achieve, but this is not achievable by being just forgiving and nice, our moral has to be also penalizing. The strategy "always cooperate" will make the strategy "always defect" the best strategic response. The "moral man" must make a credible threat of penalizing to make us cooperate.

Of course change from Pareto inefficient allocation to cooperative outcomes can be driven in part by underlying dynamics of adjustments and in part by idiosyncratic shocks. The latter will typically operate more quickly than the first. Institutions once established can lock people into the established ways of thinking

that are hard to undo. But as we will see in Põder (2009), in the case of huge shocks of the whole system, like political and economic transition, the change of mentality can be quicker than expected, meaning that established institutions can be undone, and over time they are. I will not study the shocks itself, rather the changes of human behavior they constitute by altering the rules of the games. Learning is the key feature here. Learning for adaptation can take part in the form of natural selection (used in evolutionary games); imitation (for example memetics); reinforcement (confirming one's own past performance); best strategic reply (choosing strategies). Of course the process itself is difficult to explain, because empirically we are able to survey only the results of the processes. Thus the reader will not see and unfortunately not able to follow the process of adjustment, but see one possible way of explaining the role of moral codes or social norms or voluntarily created organizations.

3. THE METHOD

Rational choice methodology defines the economic approach used in the current dissertation. This methodology, or the optimization "exercises," can be divided into many sub-sections; such as optimization under constraint, choice under uncertainty, and game theory. The game theory is one of many. So despite the name, the game theory is a tool not a theory for studying human choices in micro perspectives.

3.1. Analytic narratives

Game theory has been very influential in some parts of social sciences; for example microeconomics, political science, and international relations. In microeconomics it had become a usual and integrated part of the explanations in firm theory and in welfare economics. In other disciplines it is also considered an important part of rational choice methodology (Schelling 1992). At the same time there are in some sub-fields considerable criticism toward game theories' ability to handle empirical phenomena (Elster 1989, Riker 1990, Swedberg 2001). The most widespread criticism – persons often don't know what game they are in or whom they are playing for until they have already played – is related to the explanatory ability of the theory. Even when "players" know about their own position, they may be unclear as to whom, if anybody, they are playing against, and what is the framework or network of possible movers. To meet the challenge or rather to exhibit these shortcomings – find counterfactuals – many researchers are turning to the experimental games. However, certain historical branches of institutional economics are trying to find conformation and imply games to social contexts. So the school of new institutional economics also advocates stories. The tradition of

using narratives exists in some branches of social sciences, but has been very limited in mainstream economics. However, the challenge is to introduce the possibilities of using analytic narratives in studying a wide range of empirical phenomena.

The analytic narrative is a combination of rational choice, game theoretic deductive logic and historical-anthropological or qualitative study. Narratives are not used, like historians or anthropologists usually do, for describing ethnical and cultural ideologies building up people's identities, rather *vice versa*. In my research narratives are used not for analysing actors' identities, ideologies and their perceptions, but actors' identities, ideologies and perceptions are used for explanatory purposes – to show that these ideological perceptions were solutions to some collective action problems or other problems created by individualistic preferences based choices. The analytical part of the narrative is coming from the analysis of choice rules and payoffs of the individuals using rational choice. Bates et al. (1998:10) proposes that "…it [analytic narrative] combines analytic tools that are commonly employed in economics and political science with the narrative form, which is more commonly employed in history". What is meant to be a narrative and analytic is explained – "Our approach is narrative; it pays close attention to stories, accounts, and context. It is analytic in that it extracts explicit and formal lines of reasoning, which facilitate both exposition and explanation" (Bates et al. 1998:10). Games are used to make the framework comprehensive, anthropological and ethnographical sources are mixed with personal interviews to provide information for reliable narrative building.

> We identify agents; some are individuals, but others are collective actors, such as elites, nations, electorates, or legislatures. By reading documents, labouring through archives, interviewing, and surveying the secondary literature, we seek to understand the actors' preferences, their perceptions, their evaluation of alternatives, the information they possess, the expectations they form, the strategies they adopt, and the constraints that limit their action (Bates et al. 1998:11).

In the following four studies narratives are coming from different sources: people's memories from collected interviews or written sources; historical studies; and archive documents. Stories are combined from the information of those multiple sources. The framework, using non-cooperative game theory, makes the narrative analytic.

In general it may be said that an analytic narrative is constructed as follows: First, the analyst immerses herself in the details of the particular episode to be narrated constructing a story out of these elements. Second, the analyst formulates a rationalistic theory or theoretical model that fits this story. Finally the model is crafted and fitted to the available data.

3. 2. Microapproach – small players constitute change

In all our games the players are individuals (in one case also households, but it is assumed that they act as one unit). Why do I think that individuals' choices and behavior can influence history by changing the formal or informal structure of society? I believe that customs and norms can be thought of as equilibria in games, but is it true that they arise through the accretion of many uncoordinated decisions, or do they arise through concerted and deliberate action of a few key people (Young 1998:145)? Obviously it would be absurd to claim that they arise only in the former manner. I suspect that influential actors often get credit for things that were about to happen anyway. Even if major players do sometimes matter, they may be minor relative to the scale of the social institutions under consideration (socially acceptable behaviors, informal rules etc). Change is driven in part by small individual variations that tip expectations into a new equilibrium, and in part by the concerted actions of influential individuals and groups. I emphasize the role of the small players or the so-called plain man, while not denying the importance of the larger ones.

The approach of the game theory is associated with the tendency to ignore much of the complexity of cultural and political phenomena by stripping actors from their desires, beliefs and spontaneous emotional reactions (Green and Shapiro 1994). However I am using "off the shelf" models for problem formulation – the solutions based on stories is the contribution made in the current work. Still the justification of the applicability of rational choice approach has to be given. Methodological individualism is built on the assumption that people usually do what they believe is likely to have the best outcome. In this concept, individual actions will constitute different outcomes, which can be listed by subjective preference ranking. For constructing games we first need to understand who the players are. Then understand their opportunity sets and possible beliefs over preference ordering. Individual rationality in those settings has always been the target of criticism. We use the definition of rationality that sometimes is indicated as narrow rationality. According to Hardin (1982:10) rationality means "efficiency in securing one's self-interest". Not everything can be explained by narrow self-interest, but it allows in making the distinction between the ends and means of the decision-making individual.

> Economic analysis thus consists of two major steps: discovery of the ends a decision-maker is pursuing, and analysis of which means of attaining them are most reasonable. […] The term rational is never applied to an agent's ends, but only to his means (Downs 1957:4-5).

So by using the term rationality, we accept that our ends are reasonable only to ourselves and our subjective preferences are ordering all possible "goods" for us. Thus rationality is not contradictory to alternative orderings of the possible outcomes. The cultural approach of historical institutionalism is stressing that "the individual's rationality is bounded by the individual's worldview" (Hall and Taylor 1996:939). Claiming that the individuals' worldview or mind-maps not only affect their preference ordering, and this also constructs their understanding of the

possible strategies available to the other player(s), is not contradictory to the narrow rationality. Thus the choice is to use empirical evidence for constructing case specific games, which will reflect the choice situations individuals were facing. However Hall and Taylor (1996) go even further and argue that institutions create our identities, self-images and preferences, which contradict the new institutional economics, where individual players create institutions according to their preferences. This "chicken and egg" problem can partly be solved by defining institutions. I define institutions according to North (1990:3): "Institutions are the rules of the game in a society, or more formally, are the humanly devised constraints that shape human interaction". In my framework I will separate players' opportunity sets from "humanly devised constraints", assuming that institutional constraints to be the result of some social trap. The latter means that individual payoffs from institutionalized rules must overweigh the alternative arrangements. We acknowledge that in many cases there is difficulty in deducing informal institutions from opportunity sets, and this can be considered, not the methodological disadvantage, but rather a lack of case specific knowledge.

3.3. Criticism

There is a wide range of critical remarks about using narratives, memoirs or interviews in research (e.g. problems with deep context and problems with a small *n*). We will only partly touch these remarks, but instead focus on the criticism over using analytic narratives in studying institutions. We will also not discuss the classical Friedman (1953) question – how precise a description of the reality the model or the underlying assumptions must be, although this trait of criticism is elaborated by Elster (2000). It also has to be kept in mind that the pioneering work is only first published in 1998 and the methodology is more or less in the developing phase and so is also a criticism.

Critical remarks can start with the classics that institutional research uses too general definition of institutions, thus almost anything could be defined as an institution, and that is why the institutional studies have an ambition to understand how the whole world functions (Clark 2007). Generality has an opportunity cost – testability. The lack of historic sources does not allow systematic empirical testing of the hypotheses advanced. Therefore using narratives is not overcoming the problems of armchair theorizing; rather it uses single events to generalize over large sets of issues. Bates et al. (2000a) answers the critique by stressing that unique events are too important to leave aside, and particularly game theory is a perfect means to study these events. Even if this is so, it will not relax the problem of a small *n*.

In addition Parikh (2000) mentions that in the case of most of the examples, narratives are not well presented. Even more, Elster (2000) considers an approach inclined towards tautological explanations and argues that the framework itself is flawed or, at best, premature. Bates et al. (2000b) confirm that the method is in an infant phase and, moreover, this is not a brand new method under development.

Rather they (Bates et al. 2000a) are systematizing, making explicit and labeling – what others also attempt. Of course the question remains – is the method "good enough" for getting further from the developing phase? During the last ten years there has not been an expansionary growth of research using analytic narratives. In the Social Science Research Network from out of more than two hundred thousand articles, twelve are indicated under analytic narratives, but there are of course a number of papers using game theory and stories without explicitly calling the method an analytic narrative. It may be that being good at both – learn enough about phenomenon to be able to see the possibility to use formal modeling and being good enough in formalizing game – is not an easy task for the researcher who has no interdisciplinary feedback.

It is also stressed (Kiser and Welser 2007) that analytic narratives that keep many structural factors of the analysis external, may actually suit to analyze a relatively narrow range of social situations. The scope conditions where the rational choice based game theory can be used are limited in uncertain situations – in the case of wars and revolutions; or in the case where the number of the main actors is limited. Of course it may be argued that all these arguments can be incorporated into the game.

The most severe criticism is arguing that in many cases results are nothing that we do not already know (Clark 2007). Narratives do not allow the demonstration of universal recommendations or any policy recommendations. Clark (2007) states: "[They argue] that everything depends on the specific cultural and historical context. There are no universal recommendations" (Clark 2007: 729). Also Levi (2002) calls the ability to make generalizations the Achilles' heel of the method. At the same time Bates et al. (1998:234) writes "… whereas the specific game may not be portable […] they may yield explanations that can be tested in different settings". The presumption today in social science research is that the authors will provide those test themselves. However, seldom is the level of knowledge as deep as it is in the original case. Thus writes Levi (2002:16), "The comparisons can be done by other area specialists, historians, and others who must conquer languages, archives and other sources to acquire in-depth authority over the subject matter". That is why it can be said that the demonstration of generalisability may rest on a larger community of scholars.

Finally it may be said that although it is stressed in Bates et al. (1998) that this method is meant to bridge the gulf between the methodological procedures of historians and those of political scientists and economists, our impression from Clark (2007) and Dessler (2000) is that from neighboring discipline's prospectives there is a remarkable dislike toward institutional economics in general and analytic narratives in particular. It can be that incorporating institutions into economics by using game theory will make institutional economics more mainstream, confirming again economic imperialism.

SUMMARY

The methodological similarities and differences of the four articles that constitute the doctoral dissertation are summarized in Table 3 below. The four articles that constitute the doctoral dissertations are using a similar methodology for studying the social phenomena called cooperation. The fist article is describing how various institutionalized social norms solved social traps in the 19th century communities in Estonia's small islands. The second article is explaining the role of the Tallinn merchant guild in the flourishing late medieval Hansa trade. And the third article is confronting Coase's (1974) ideas by studying the Estonian lighthouse system throughout four centuries up until World War II. The final paper is analyzing a change in individual behavioral patterns after transition in the early 1990ies. In all cases the research method used is called analytic narratives, which can be considered one specific type of combined research design where qualitative research is enriched with deductive modeling. However narratives are collected and constructed using different data collection methods: secondary historic sources, archive sources, personal memoirs, and interviews.

Table 3. Comparison of articles

		Method						
	Article	**Data collection**	**Number of observations**	**Type of game**	**Players**	**Type of problem**	**Type of solution**	**Solution design**
1	Põder 2006	Personal memoirs	5 cases (about different social norms)	Normal form; extensive form	Households	Tragedy of commons	Social norms	Nash equilibrium (sub-game perfect Nash equilibrium)
2	Põder 2010a	Secondary historic sources, archive documents	Case (100 years) in history	Extensive form	Merchants, guild member	Coordination problem	Organisation (credible threat)	Sub-game perfect Nash equilibrium
3	Põder 2010b	Archive sources, secondary literature	4 periods in history	Extensive form	Ship, lighthouse, state	Public good provision	Publicly provided rewarding mechanism	Nash equilibrium (sub-game perfect Nash equilibrium)
4	Põder 2009	Interviews	20 individuals	Iterated normal form	Individuals	Cooperation in the network	Segregation strategy	Simulations

All articles present different possibilities in using analytic narratives in research design. The analytic portion pre-requires the problem to be "translated" into the language of economics – for this, typical set-ups of the prisoners' dilemma (also other normal form games) or extensive form games are used. In the first article households are playing the tragedy of commons game and have different social norms to change the game structure. In the second article merchants are unable to solve coordination problems without organizational (guild) enforcement. In the third paper lighthouses and ships are trapped in a detrimental equilibrium – only state provided help in administration of light dues and other state provided rewards

help them out of the trap. And finally, we show the change of optimal strategy due to alternation of network rules, which was the economic transition in the early 1990ies. Solution design in each case is dependent on model set-up. Qualitative data are used for indicating players, payoff profiles and the structure of the game. At the same time qualitative data or the narrative is not something that can simply be taken off the shelf, this is a result of the research. Research can be based on different data collection methods – in some cases secondary literature or archive studies had to be enriched with interviews, to improve the pre-knowledge about the choice specific situation.

Despite the criticism that the study of small *n* (or unique case) has not enough degrees of freedom for falsification, the hypotheses that historical studies using analytic narratives has not only contributed in studying historical institutional frames, it also allows the making of generalizations (and even some policy recommendations). The articles test and find verification to following statements:

(1) Small close communities (from 40-500 members) are able to solve social traps (like under-provision of public goods and tragedy of commons) by complementary informal institutions (Põder 2006);
(2) Merchant guilds enforced reputation mechanism that made sanctions through punishment of shirked merchants a credible threat and thus guilds were helping promoting growth by increasing trade volumes in medieval Hansa (Põder 2010a);
(3) Pure public goods can be privately provided under a publicly provided institutional system. This institutional system may differ, but it is a combination of property rights, legal order and financial support (Põder 2010b);
(4) In random networks, cooperation is overruled by an alternative strategy according to which individuals will treat a small group of individuals in a cooperative manner and others in a self-regarding manner (Põder 2009).

All the articles show that individuals are able to cooperate or to establish institutions for enforcing mutually beneficial cooperation. In general it can be said that all the articles agree upon certain statements that (a) social traps can be overcome by small closed communities by creating different complementary informal institutions; (b) in larger networks or in case of random connections players need some sort of external assistance for solving social traps; (c) this external assistance can also be an organization (that will internalise external costs). Also evident is that many anthropological-cultural phenomena can be considered as a rational response to certain community specific social trap (Põder 2006). These models will help us understand some even nasty cultural phenomena (like ostracism, secrecy, hiding information) and also will cast some light into the dynamics – how the change in the structure of the game will tip expectations into new equilibrium (Põder 2009).

Of course I agree that change of institutions is not a rapid procedure and thus under circumstances (after change of economic climate, technology or political transition) these can also be unbeneficial or even hazardous. Also it may happen

that for the players there is intrinsic logic (vested interests) that keep institutions that may be beneficial only to a narrow range of people in existence, such as guilds turning into rent seeking institutions after the end of the flourishing era of the Hansa (Põder 2010a). Also as it is in the case of informal institutions, being embedded into tradition can slow down the change (Põder 2006). The more informal and embedded into traditions players are, the more difficult the alteration is. Still, I believe change is happening, gradually and slowly.

All of the models are composed following the game specific logic – the normal form game is used to explain institutional rules solving social traps; the extensive form games are used to explain the role of institutions in a historical context, evolutionary games are implied to the transition period. It is a methodological dispute – are game and stories feasible for giving explanations over such a wild screen of phenomena like medieval society, pre-regulatory communities, transition and operation principles of lighthouses. I do think that in all cases stories enriched with methodological dispute will convince the reader that methodology provides something that can not be achieved by historical methods alone or just by qualitative studies. Similarly this concept is implied to formal modelling alone.

The normal form game – like Prisoner's dilemma – is a "traditional" way of explaining specific problems in creating Pareto efficient allocations. The normal form game allows describing a certain set of problems – like public good provision, tragedy of commons or coordination problems – using a simple analytical "language". Translating problems into the language of games (normal, extensive or strategic) allows us also to seek for solutions using the same analytic "language". Structural solutions to the games require some sort of logic that changes the rules of the games. The question is – are players themselves able to change the rules of the game, or do they need some sort of alienated body for this? Põder (2006) shows that in the case of common pool problems the reciprocal relationships were the necessary condition for the cooperative behaviour, and all social norms were based on reciprocity. Also it is shown (Põder 2009) that opening up will destroy some cooperative behaviour. So it may be said that cooperative behaviour is a fragile equilibrium, despite the fact that the dynamics of the evolution of social norms is not studied, it can be said that small closed communities are able to solve social traps. In a more open community some sort of alienated institution – like a guild, public rewarding or punishing systems (laws) – is needed for enforcing cooperation. At the same time a guild is a relatively close substitute of an informal reciprocity based institutions found in Swedish communities on Estonia's small islands. Nowadays promotion of the third sector or civil society, has similar traits – reciprocity based, not alienated (bottom-up) institutions for solving social traps. Also the question remains – are trapped individuals able to create such institutions? The answers, like our studies have shown, are dependent on the characteristics of the specific dilemma. Local (close community) dilemmas can be solved, but the need for external enforcement in the case of less consolidated communities, is found. At the same time this external enforcement must not ultimately be committed via the *state*. A historical example –

the Hansa – where trade and economic growth were created not using political states or state granted arrangements, but merchant guilds (Põder 2010a), can convince us. Merchant guilds and *kontors* were organizations that successfully enforced trust and avoided cheating, thus inter-city trade between more than fifty cities was possible (Põder 2010a). Also it is shown (Põder 2010b) that even in the case of pure public goods; state provision (government provision financed from general state revenues) is not necessary. In certain cases it is possible to solve social traps only by defining (and protecting) private property and contract rights. In other cases more is needed – some sort of rewarding institutional system must be provided by the state (Põder 2010a). How much government intrusion is needed depends on path dependent institutional matrix and also from technology which will define cost and also revenue mechanisms for the private bodies (Põder 2010a).

The current thesis contributes to further research in three areas: (a) interdisciplinary comparative studies; (b) institutional studies concentrating on substitutes and complements to the market mechanism; and (c) methodological discussion over the analytical narratives. An especially fascinating area for further research is the limits of the markets in a small society. What can be an efficient mechanism for public good provision? How can we avoid the tragedy of commons? What is the role of non-profit organizations in supporting or undermining market mechanisms? All these questions remain challenging despite many of the numerous researches in the field. How much can historic analyses help us to answer such questions? Even the latter may be a topic for future research.

And finally the hope is that this research is not undermining the idea, especially during the periods of recession where people are not overoptimistic about market based social order, that market mechanisms have certain valuable characteristics that is hard to obtain by alternative mechanisms. These are Pareto efficiency, distributional neutrality (nobody will determine who has the privilege to get certain goods) and decentralized use of information and other scarce resources.

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Appendix 1

HOW TO CATCH A SEAL? THE STUDY OF RATIONAL NORMS OF 19TH CENTURY ISLAND COMMUNITIES IN WESTERN COAST OF ESTONA[1]

Kaire Põder

Abstract

This paper states that small communities are able to solve the tragedy of the commons by consent over social norms which change the structure of social trap games. I argue that social traps, which are caused by rational human behavior, thus have informal institutional solutions. I show that individual benefits from cooperation and costs of enforcement of social norms are dependent on group size – community management can be effective when the community is small. The discrete cut which divides communities into small and large is between 50-400 players. My cases are communities which are situated on the islands and islets on the western coast of Estonia. The analytic narratives, composed by using historical material from 19th century until the Second World War, indicate that institutional complementarities for effective community management not only avoided social traps, but also differed by communities.

INTRODUCTION

Social dilemmas are situations in which individual rationality leads to collective irrationality – everybody is worse off than they might have been otherwise. Thus social dilemmas or traps are interpersonal cooperation problems. The most common examples of social traps are public goods and common pools and in the literature of game theory, the analysis is concentrated around 'off-the-shelf' game types where social traps can be characterized by the prisoners' dilemma. The prisoners' dilemma, an infamous game type, shows that individual rationality doesn't have to lead to a Pareto efficient outcome. In the prisoner's dilemma, both players have the dominant strategy not to cooperate, thus individual rationality leads to worse-off outcomes compared to a coordinated outcome. The result has led

[1] Current article is reprinted by the permission of CEU Political Science Journal. Full paper also available at Social Science Reserarch Network, (eJournal) *Law, Norms and Informal Order*. (www) http://papers.ssrn.com/sol3/papers.cfm?abstract_id=897644.

to the common belief that in these cases there is need for external institutions for coercive coordination. This mainly takes the form of state regulation. The general notion from the literature[2] is that individuals "could achieve little or nothing without the help of government" in the case of provision of public goods like the environment.

However partly distancing ourselves from rational choice literature we can find several contradictions that demonstrate a human ability to cooperate. The different trains of thought are established by experimental psychologists[3]; game theoretic experiments by Axelrod[4], and group specific studies by Ostrom[5]. All these allies challenge the original dilemmas by relaxing various assumptions of the original problem. First, it sets the relevance of self-regarding individuals under suspicion. Second, it shows the evolution of cooperation as the strategic result. Third, it demonstrates that the human ability to cooperate in communities depends on the ability to set up efficient institutions. All three trains of thought share one important aspect – they are optimistic about the human ability to cooperate. Although the methodological questions need further elaboration, I will rely on a structural approach, showing the human's ability to set up more or less efficient institutions.

I state that common coordination dilemmas, which are caused by rational human behavior, have institutional solutions. I will show that individual benefits from cooperation and costs of enforcement are dependent on group size; community management can be effective only if the community size is relatively small. I will also show that in my cases, the discrete cut that divided communities into two separate leagues is between 50-400 players.

My argument that small communities were able to solve the tragedy of the commons by social norms has the ambition to connect an orthodox rational choice method with interdisciplinary empirical tools building up an analytic narrative. An analytic narrative is a combination of rational choice game theoretic deductive logic and historical-anthropological study. The analytical part of the narrative comes from analysis of choice rules and payoffs of the individuals using rational choice. Bates[6] proposes that "[…] it [analytic narrative] combines analytic tools that are commonly employed in economics and political science with the narrative

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[2] Russell Hardin, *Collective Action* (The John Hopkins University Press. Washington, 1982), 15.

[3] For an overview see Peter Brann and Margaret Foddy "Trust and the Consumption of Deteriorating Common Resource," *The Journal of Conflict Resolution*, Vol. 31 No 4 (1987): 615-630 and David Goetze, "Comparing Prisoners' Dilemma, Commons Dilemma, and Public Goods Provision Designs in Laboratory Experiments," *The Journal of Conflict Resolution* Vol. 38 No 1 (1994): 56-86.

[4] Robert Axelrod, *The Evolution of Co-operation.* (London. Penguin Books, 1990/1984).

[5] Elionor Ostrom, *Governing the Commons: the Evolution of Institutions for Collective Action* (Cambridge: CUP, 1990).

[6] Robert Bates, Avner Greif, Margaret Levi, Jean-Laurent Rosenthal, Berry Weingast "Introduction" in *Analytic Narratives*. (Princetion University Press, 1998), 10.

form, which is more commonly employed in history." Interviews and historical material support the analytic model giving material for an empirical test.

My cases come from the end of the 19th century and the beginning of the 20th century. These communities were relatively closed groups, counting from few to several thousand members. These communities were situated on the north-west cost of Estonia. Most distinct communities were situated on the island of Vormsi, the peninsula of Noarootsi, the island of Ruhnu, the islets of Pakris, the islet of Saarnaki, and some other villages on the island Hiiumaa. In history, this had been a Swedish speaking district. Swedes have lived on the islands and on the shore areas for many centuries, and most of them moved to the coastal areas of Estonia right after 1334. Some islets started to be inhabited later. Almost all Swedish inhabitants from Vormsi, Ruhnu and Pakris left their homes during 1943-1944, being afraid of Soviet occupation. Approximately 8000 Estonian Swedes escaped to Sweden during the Second World War. The last inhabitants left Pakries in 1965 and Saarnaki in 1973.

The contribution of this paper is twofold – first it shows that there are cross cutting differences in the size of community, dividing communities into successful cooperators and unsuccessful ones and second that institutional complementarities for solving coordination dilemmas differed by community, meaning that communities dependent on size had to impose a different mix of informal institutions for community management. These institutions set restrictions on self-interested behavior for the common good. The most common of them were related to fixing the size of community or setting the boundaries for access to common pools. For constructing the argument, the formal framework is given first and further enriched, and it will finally be compared with the findings from the theoretical and empirical literature.

1. THE MODEL

Hobbes'[7] statement that "Every man is Enemy to every man, […] and the life of man [in the state of nature] is solitary, poor nasty, brutish and short" is an infamous description of the competitive-conflict environment individual actors create and maintain without institutional limitations. The Hobbesian metaphor describes the problems anthropologically individualistic actors face in a community. Social dilemmas or traps are situations in which individual rationality leads to collective irrationality. In coordination dilemmas, the Pareto dominant action profiles may tacitly be chosen by community members, but if there is no Pareto dominance then uncertainty remains. We will see that structural solutions, which change the payoff profile, can be the efficient result for solving social or coordination traps like the

[7] Thomas Hobbes, *Leviathan* (Cambridge: CUP, 1991/1651).

tragedy of the commons or provision of public goods. This game theoretic model is built up and followed by the discussion of possible structural solutions.

Many social traps can be described through incentive problems – well known examples are public goods and common pools. In the first case, the incentive problem of 'free riding'[8] will be the result of rational behavior. The statement is supported by Olson's[9] argument of the logic of collective action. According to this logic, the costs of provision are compared with possible benefits. Hence, we are confronted with the prisoners' dilemma; on the large scale of collective contributions, all of us might receive large net benefits if we all contribute, but none of us may have any interest in contributing. We will see that the effect of net benefits and costs of contributing are largely dependent on group size. In the case of commons, where the supplier of the good is usually 'Nature', the situation is reversed – everybody has the incentive to use the resource as much as possible, if the provision of this resource is free of charge. The infamous metaphor of the tragedy of the commons is used for showing that over-utilization of resources is an imminent result in the case of common pools. The tree I cut, the fish I catch, the mushrooms I gather are not available to others. Thus the carrying capacity – are there as many high-quality goods left available – is the main concern. If there is as much and as good-quality product left is dependent not only on the replenishment rate of the common resource, but also on the group size utilizing the resource and the behavior of the group members. As Demsetz[10] explains, the smaller the group, the more easily observable is the cost and source of externality, which allows the internalization of externalities with lower costs. The replenishment rate is the natural characteristic of certain good; the group behavior is not the result of some natural law, but choices of the actors. If everybody prefers "using the resources" to "not using the resources" then we find again the prisoners' dilemma to be the best ready-made analytical setup for classifying and structuring the analysis of the tragedy of the commons.

Let us assume that the problem is defined by the prisoners' dilemma, where preference ordering over possible outcomes is determined in alphabetic order $a \succ b \succ c \succ d$ and the Nash equilibrium or the equilibrium of dominant strategies was $(c; c)$, which was Pareto inferior compared to cooperative payoff profile $(b; b)$. It is evident that in the case of repetitive interactions not only preference ordering matters but also the relative difference between the payoffs. We have seen already that cooperative benefits (b) are dependent on the technology where technology will determine the optimal number of individuals for certain procedure, thus total benefits for the group are defined by $B(n)$ where equal

[8] For original source see Paul Samuelson, "The Pure Theory of Public Expenditure," *Review of Economics and Statistics* 36 (1954): 387-89.

[9] Mancur Olson, *The Logic of Collective Action: Public Goods and the Theory of Groups* (Cambridge MA: Harvard University Press, 1965).

[10] Harold Demsetz, "Toward a Theory of Property Rights," *The American Economic Review* Vol 57 No 2 (1967): 347-355.

distribution of benefits will grant every agent individual benefit $b(n) = \frac{B(n)}{n}$. We also know that $\frac{d(B(n)/n)}{dn} > 0$ when adding additional individual will increase the average product of the group and when group is growing over the point $\frac{d(B(n)/n)}{dn} = 0$, the average product of the group will decrease.

Enforcement of any kind of cooperative arrangement has its costs. Thus if individual rationality does not lead us to the cooperative Pareto superior outcomes, then enforcing these outcomes has certain costs (*E*). We assume the average enforcement costs to be function of number of players (*n*) and some external parameter (*x*). The characteristics of the enforcement function

$$e(n, x) \text{ are, where } \frac{\partial e(n,x)}{\partial n} > 0 \text{ and } \frac{\partial e(n;x)}{\partial x} = const .$$

Assuming equal distribution of the costs each member has the share, the enforcement costs per member will be defined by $e(n,x) = \frac{E(n,x)}{n}$. We can set up the enforcement game of creating the institution of internal authority as a extended form game, where in the first stage players will choose between agreeing (action A) or not agreeing (action ~A) over the enforcing a cooperative institutional arrangement. Mutual agreement in the first stage will result in a payoff profile $\{b(n) - e(n,x); b(n) - e(n,x)\}$ in case of two players (see figure 2.1), and in a prisoner's dilemma in case of unilateral or bilateral disagreement. We assume that mutual agreement is a precondition of creating cooperative arrangement, thus every agent has a veto right.

There is one subgame perfect Nash equilibrium (SGPNE) in this game if $c > b(n) - e(n,x)$, meaning that average total benefits from cooperation don't exceed Nash equilibrium payoffs. In this case the agreement over internal authority is not achieved as a self-enforcing result of the internal authority game, and the overall result will stand – communities will fall into social traps. But if

$$c < b(n) - e(n,x), \qquad (2.1)$$

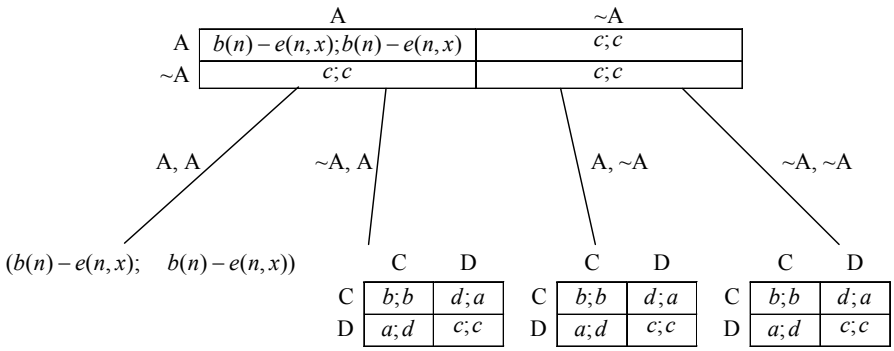

Figure 1-1: Internal authority game

then there are two Nash equilibria and only one SGPNE – in the first stage all players will choose action A and game will be over, with the payoffs $b(n)-e(n,x)$ to everybody. Analytical result suggests that agreement over internal authority can be the self-enforcing result, if certain conditions are satisfied. In figure 2.2 the graphical representation of enforcement cost functions and cooperation benefit functions are given. Assuming that condition (2.1) is satisfied, the optimal group size $n^*(e,b)$ can be determined, also there is certain range of n where cooperative arrangements are SGPNE of the internal authority game.

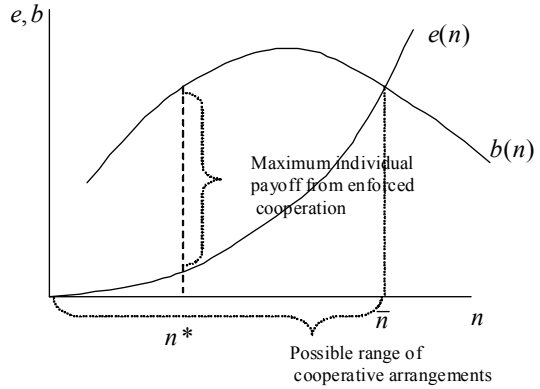

Figure 1-2: Group size and the determinacy of cooperative payoff

In the Figure 1-2 one possible range of cooperative arrangements are determined assuming $c=0$, which is possible in several settings, but rather exceptional. Thus cooperation enforcing arrangements are self-enforcing solutions to the iterated prisoners dilemma, if the amount of players will not exceed certain level (in Figure 1-2 it is indicated by $\bar{n}$). The importance of group size in arranging and enforcing

cooperation has been widely discussed by the theoretical train started from Olson[11] and continued by Hardin[12]. Hardin states that

> The number of people included in the decision unit is crucially important. As the size of a colony approaches 150, individual Hutterites begin to undercontribute from their abilities and overdemand for their needs. The experience of Hutterite communities indicates that below 150 people, the distribution system can be managed by shame; above that approximate number, shame loses its effectiveness[13].

For Hardin cooperation in large groups is questionable because group-coherency is the determinant of the cooperation, in large groups "Nonangelic members will corrupt the angelic" and any cooperation is hard to achieve, in our informal institution game if condition (1.1) is satisfied the result will not hold, because enforcing cooperation is beneficial to every single player. Our communities in Aiboland are different by size, and the number of agents differs as well, thus we see here the ideal natural experiment, where many similar external conditions (perceptions, language, traditions) are combined with different agency relationships, different costs of exit and different sizes of the communities. We saw that in Olsonian framework the group size matters, because any increase in group size will result in the loss of the degree of direct control. Maintaining the control – sharing the costs and benefits equally – is important to our internal authority game as well for avoiding free riding.

In Figure 1.2 the enforcement costs and also net benefits from cooperation were represented as the function of the group size *ceteris paribus*. I defined enforcement cost as a function of n and x , so e is dependent not only on group size n, but also parameter x, which can be defined as the inverse measure of the coherence of the group. The inverse coherence of the group is assumed to be determined by the costs of entry and exit. Thus $x(c_x;c_e)$, where c_x indicates cost of exit and c_e cost of entry. Where $\frac{\partial x}{\partial c_x}, \frac{\partial x}{\partial c_y} < 0$, meaning that the costs of enforcement is increasing when group is less coherent (x is relatively large), indicating that there are low costs of exit to and entry from the community.

The question now arises as to where this 'rule', which will not allow choosing actions leading to Pareto inefficient outcomes, is coming from? Contractarian tradition starting from Hobbes and Locke has stressed the human ability to cooperate and create more or less alienated forms of agency that will enforce cooperation. Hardin[14] 14 argues that normative social-evolutionary theories justify

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[11] Olson, *The Logic*; Mancur Olson, *The Rise and Decline of Nations: Economic Growth, Stagflation, and Social Rigidities* (New Haven and London. Yale University Press, 1982).

[12] Hardin, *Collective Action*; Russell Hardin, *One for All. The Logic of Group Conflict*. (Princeton University Press: Princeton New Jersey, 1995).

[13] Gerrett Hardin, "The Tragedy of the commons," (www) Http://www.econib.org (The Library of Economics and Liberty 21/12/2004).

[14] Russell Hardin, "Economic Theories of the State," in *Perspectives in Public Choice*, ed D. Mueller (Cambridge: CUP, 1997).

coercive institutions but do not explain their development. Explanatory evolutionary theories started from Axelrod face relatively similar problems. Even though social ties make most of the interactions in relatively close communities repetitive (which is definitely true in the communities in this study), the evolution of cooperative morals is difficult to explain. Cooperation is the outcome we want to achieve, but "cooperation" will make "defection" the best strategic response. Thus, the institution of penalizing noncooperation is needed for the enforcement of cooperation. However, cooperation once achieved can be a self-enforcing strategy. If we believe in individual rationality, then in a repeated environment we should also believe in the human ability to develop rational institutions for enforcing cooperation. Arrow states that:

> It is a mistake to limit collective action to state action […] I want to [call] attention to a less visible form of social action: norms of social behavior, including ethical and moral codes. I suggest as one possible interpretation that they are reactions of society to compensate for market failure. It is useful for individuals to have some trust in each other's word. In the absence of trust, it would become very costly to arrange for alternative sanctions and guarantees, and many opportunities for mutually beneficial cooperation would have to be forgone[15].

Believing that rational actors can develop rules as institutions for solving coordination dilemmas is an attitude shared by many authors in the new institutional economics tradition, although in many cases one instead finds that changing circumstances can 'lock us in' to inefficient but path dependent institutions[16] because for any kind of cooperation, stable and close relations between the members of the society – "individuals have shared the past and expect to share the future"[17] – are needed. Whether these norms will lead to cooperation or to locked-in defection is the main question of interest. Elster[18] shows that social norms can have multiple functions, and one of them is "to act as a constraint on rationality"[19]. This kind of norm will make cooperation the only possible action by tying our hands. Other types of norms can lower the enforcement costs of cooperation by embedding individual actors into regularities often justified by historical knowledge. These norms can also be called 'laws of nature', where communal wisdom leads to aggregate benefits. Norms can also change individual payoffs by incorporating costs of shame or guilt into the game. We will see later that the communities in this study used different mechanisms or norms according

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[15] Kenneth Arrow, "Political and Economic Evaluation of Social Effects and Externalities" in *Frontiers of Quantitative Economics* ed. M. Intriligator (Amsterdam: North-Holland, 1971), 22.

[16] Douglass North, *Institution, Institutional Change and Economic Performance* (England. Cambridge University Press. 1990).

[17] Ostrom, *Governing the Commons*, 88.

[18] Jon Elster, "Social Norms and Economic Theory," *The Journal of Economic Perspectives* Vol 3 No 4 (1989): 99-117.

[19] Elster "Social Norms", 102.

to circumstance – ostracizing, hating, 'sending away', 'tying hands', relying on 'laws of nature', etc – for minimizing the costs of enforcement.

2. EMPIRICAL EVIDENCE

The cases in this study are communities situated on the western coast of Estonia (see Appendix 1), and the cases are historical. In Table 1, a historical overview of the demographics is given. The decision-making units or actors are farmsteads or heads of the farmsteads, meaning that the size of the community is only an indirect measure of the total number of players. By community, the size of the farmstead differed. In Ruhnu, the extended form of the family was called *hiskap*, where usually three generations lived together, making the average size of the farmstead approximately 5 members. In Pakris there were together approximately 100 farmsteads. In the bigger communities the number of farmsteads exceeded 400.

Table 1: Approximate number of players and external authority

Community	Number of players	External authority
Hiiumaa	~900	Strong
Noarootsi	~600	Strong
Vormsi	~400	Moderate
Pakries	~100 (in two islands)	Moderate
Ruhnu	~50	No

In Ruhnu and Pakries there were no external institutional constraints on the players; all institutions were internal and rather informal. A complex set of institutions is evident with the people of Ruhnu (similarly in Pakries), which consisted of a mixture of property rights, communal norms, 'laws of nature', and internal authority. The group size and lack of external institutions supported by the high costs of exit led this community to a unique basket of institutions for community management. In other cases, Baltic nobility remained the main landowners and the major economic force in the provinces until 1917, even though they lost their exclusive right to ownership of large estates in 1866.

Having stated that we are interested in case specific knowledge – how institutions could solve the social traps – we turn to the analytical part of the paper. First the general framework for effective community management is developed by using extended form games. Later we will turn back to the narratives to look for the supportive and contradicting evidences of two comparative examples – large and small communities.

2.1. Efficient Community Management in Ruhnu

In Ruhnu, due to language, geographical, and technological conditions, the cost of exit from society has been relatively high. Also, we have to take account that in Ruhnu, the most valuable asset of the individual was their freedom from dues to the Baltic landlords. All these particularities increased the cost of exit (c_x) and thus decreased the enforcement costs. The group size was relatively small, indicating that cost of enforcement in this community has been relatively low. The cost of entry, which will also affect the total cost of enforcement, will be discussed. By examining the institution of internal authority in Ruhnu, one can see that internal authority – norms, which were considered to be 'laws of nature', ownership structure granting envy free endowments, and agency relationship with the ruler – granted effective enforcement and made collective benefits SGPNE for the players.

Governing institutions in Ruhnu – local village rules called the Law of the Village – had no specific and well-defined written codes. This unwritten code of conduct was mentioned by some available sources[20] as a main institution governing the every-day activities of the people of Ruhnu. This set of regulation did not only define property rights, the system which has lasted in this original form for at least 300 years; it also coordinated all main activities on the island: hunting, boat building, boat laundering, fishing, and community management. There are two interesting aspects of the Law of the Village for the enforcement problem in question – ownership rights and the 'democratic' form of community management called *Loandskape*.

Private property rights were as minimal as possible in Ruhnu. Land was so-called semi-private, meaning that *hiskaps* had the right of usage of the land, not the right of selling and buying the property. The division of the land was called the slice system[21], which gave to each *hiskap* a slice of the land in all possible fields of equal quality. This equalization of initial and final allowance likely created envy-free preconditions in the case of equal manpower per hiskap. Even this was more or less achieved. Klein[22] illustrates the relationships of the *hiskaps* by bringing in a letter from 1887 that describes the movement of a son Jakob from Benas *hiskap* to the new *hiskap* of Mass, which in unlikely circumstances stayed without a master.

> Jakob Benas who has moved to Mass, is satisfied with the part he has got, and people of Benas are satisfied with what they have given. Meat is equally distributed by people, also the fish. Five buckets of potatoes were given to Mass at the same day. After this Jakob got his father's fishing-nets. Rye and barney was equally divided and from the seal leathers and foots Jakob got three pairs, he also got one towel, two buckets of malt, two old cows and one young, two old sheep and one young […].

This transcript shows that usage rights instead of property rights applied not only to the land, but also to other valuables – even persons. If some *hiskap* had more

[20] Gösta Selling, "Eessõna," in *Elu Ruhnul*, ed J. Steffenson (Tallinn: Olion, 1994); Jakob Steffenson, *Elu Ruhnul* (Tallinn: Olion, 1994); Ernst Klein, *Runö* (Sweden: Uppsala, 1924).
[21] Steffenson, *Elu Ruhnul*; Selling, "Eessõna".
[22] Klein, *Runö.*

'human resources' than others, redistribution of 'human resources' was made. Every 'human resource' had usage rights on the property according to his functions in *hiskap*. Reallocation of manpower of 'human resources' kept the final endowments equal, to create a more or less envy-free community.

We have seen that *hiskaps* had to a great extent given up their rights to a local community –*Loandskape*. Klein explains that *Loandskape* is beyond any hiskap only when the hiskap is endangering the efficiency of community management: "As far as *hiskap* itself can manage well its duties in front of members and neighbors, local community has no rights to interfere to the family management […], but for example if *hiskap* happens to be without a male successor, then local community will decide who will take over the responsibilities of the *hiskap* master, without hurting any other *hiskaps*"[23].

The ownership system of Ruhnu on one hand has some similarities to Polanyi's[24] 'world of no greed', where the principles of behavior are primarily associated with reciprocity and equalizing redistribution, but on the other hand social relationships did not dominate over economic or productive relationship; rather the opposite was true. Close social ties were a solution to coordination problems, as will be shown later. Socializing – social claims and assets – was not an overweighting effective coordination reason, because the group sizes for different economic activities differed. Some activities were not governed by norms at all because of difficulties of surveillance, and in these cases individual arrangements dominated. However, in political philosophy, an envy-free society is sometimes considered to be the epitome of the optimal social arrangement;[25] the difference is magnificent between total equalization in Ruhnu and Dworkinian relative prices or market mechanism-based equally valuable holdings. Dworkinian thought experiments justify social insurance in individualistic society; in Ruhnu, we find an envy-free, allocation-based communitarian arrangement, which is a rather rational arrangement in close impersonal exchange societies that maximize collective gains without any trade.

Norms-based management indicates that 'laws of nature' are the least costly enforcement mechanisms. It was mentioned by Klein[26] and Steffenson[27] that there was not any kind of surveillance mechanism or bureaucracy present. Similarly to Hobbesian laws of nature," the basis of these laws was rationality of cooperation. Many times Steffenson stresses that these laws were not god-given, but rather inherited from wise ancestors, which points towards an evolutionary and path dependent institution. There were no sources available about any punishment related to breaking the laws. It was mentioned by Steffenson that the island had a special house which could be called a prison, but this was never used, and finally

[23] Klein, *Runö*,120.
[24] Karl Polanyi, *The Great Transformation . The Political and Economic Origins of Our Time* (Boston: Beacon Press, 1944).
[25] Robert Dworkin, "What is Equality?" *Philosophy and Public Affairs* Vol 10 No 3 (1981).
[26] Klein, *Runö.*
[27] Steffenson, *Elu Ruhnul.*

broke down. Due to the high cost of exit, and as we will see later, the high costs of entry, we may assume that compliance with norms was achieved though social incentives. Social ties were important for enforcing cooperation. The threat of ostracism is definitely an important incentive-creating scheme.

Our players in the small community in Ruhnu had adjusted to the technological, geographical, and natural conditions, creating cooperative institutions for enforcing the cooperation. Due to the high exit and entry cost of the close environment and the small number of players, they had no difficulty in maintaining cooperation as SGPNE. Evolutionary adjustment processes for creating efficient institutions for solving social traps had taken place for centuries. The main determinants of institutions created were the number of players, costs of exit and entry, and technological constraints. These parameters have stayed relatively constant over a long period in history.

2.2. Failures – Hiiumaa and Vormsi

Although in Hiiumaa and also in Vormsi most peasants from previous Swedish settlements were free from serfdom, they rented their land from landlords. Payment was made mostly in the form of money, but in some cases natural rents were also settled. In Saarnaki islet, where exchange transactions were rare, fish rent was paid. In many cases in Vormsi, natural rent was customized as well. In Vormsi, the slice system in ownership of land was abolished already in the middle of 19th century.

Hiiumaa was mainly owned by Duke Ungern-Stenberg. The local masters acted as the agents of the Duke. The Master of Kõpu, Peeter Reikmann, wrote in his memoirs that local masters acted as supervisors and also as a local authority. "[my] task was to maintain law and order not only on the territory of the manor, but also in the village"[28]. He also describes his duties as the middleman between local renters solving quarrels without engaging official authorities, thus avoiding costs of going to court. This external agency was partially implemented due to historical agency relationships, partly, and I claim, due to players' rationality not to cooperate. To support my claim, I have to rely on historical documents that will shade some light on the community management failures in Hiiumaa and Vormsi.

In the year 1889, Duke Ungern-Stenberg announced to the public (local renters and peasants) that they cannot use lands and forests of the state for cattle herding:

> The forests of Hiiumaa have a lot of detriments due to fires, worms and storms, […] the growing plants have been trembled and eaten by sheep and other animals, after this the sand and soil will start to curl due to strong winds and, thus the herding in the forest of Suuremõisa and Kõrgesaare is prohibited. […] I let my people to survey and examine that all these who allow animals to walk and eat in the forests, will be punished by the strictest means[29].

[28] Peeter Reikmann, "Mälestusi Ungru mõisast," *Läänemaa Muuseumi Toimetised* IV (2000): 113-128.

[29] Bernhard Tuiskvere "Eesti Metsadest Möödunud Sajandil," *Eesti Mets* 7 (1939).

This public decree shows that forests under common access were suffering from exploitation and over-utilization, which is a universal feature of common pools under public access. In these areas, approximately 900 families lived, a group size which has a remarkable network size for an impersonal exchange economy. The similar problem with forest management was described in Vormsi by Meikar[30]: "The wood shortage started in the 17th century, which led to the regulation of wood usage – the limits of cutting the forest were established by local landlords, also two forest wardens were assigned. Selling of the forest by peasants was prohibited in 1766." The same source certifies that effective laws and regulations helped and over-utilized forests ceased to exist and starting from the middle of the 19th century, the forest of Vormsi was described as a beautiful pine tope, and the shortage of the wood was considered to be a past experience[31]. This shows that at least in case of the commons in the communities of Vormsi and Hiiumaa, external authority had to set rules and regulations to avoid the trap. Were other social traps also present?

In Vormsi, there is another source available that describes local community relationships before 1873 when priest Lars Österblom was sent to the island to establish religious morality and norms for the people who lived 'worse than the animals.' Tuttar and Dahl[32] say that according to a local peasant, drinking was the most common coordinated activity. There was no more coordination, but instead there was stealing from others and from the landlords, and beatings and quarrels were common. From the same source, the description of the sources of monetary income explain that in manor corn husking, what lasted throughout the year, all peasant guards and workers stole even more they could carry. During the nights manor forests were stolen and sent to Haapsalu. Similar events are described as folk jokes in the case of Hiiumaa, where local forest warden stole manor wood and let others steal as well[33] or as folk stories such as one told by Ant Peterson in 1875, according to which local peasants were cheating the masters[34].

There were some documents assuring some cooperation between community members, but this cooperation was the consequence of the scarcity of resources rather than effective community management[35]. The first description of local cooperation comes from Vrager[36] who describes the foundation of Kärdla fishermen society in 1898. Similar societies or associations were functioning in

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[30] Toivo Meikar "Vormsi saare metsade ajaloost," *Läänemaa Muuseumi Toimetised* IV (2000): 29-44.
[31] Meikar,"Vormsi Metsadest".
[32] Hendrik Tuttar and Dahl "Ärkamise aeg," *Eesti Baptismi Ajalugu* I (Tallinn: E.B.K. Seltsi väljaanne, 1929).
[33] Elmar Vrager, *Hiiumaa ja Hiidlased: Ülevaade Saarest ja Rahvast* (Toronto: Estoprint, 1971).
[34] Selma Lätt, *Eesti Rahva Naljandid* (Tallinn: Eesti Riiklik Kirjastus, 1957).
[35] Arved Luts, "Mõnda kalandusest Läänemaa randades kuni 1940. aastani," *Läänemaa muuseumi toimetised* III (1999): 89-104.
[36] Vrager, *Hiiumaa*.

Noarootsi[37]. In Vormsi from 1880 to 1890 there were almost one or two fishing drag-nets shared by six families in every village. Often boats were also common property. All these collective arrangements in Hiiumaa, Vormsi and Noartootsi were cooperative ventures, sharing the properties of firms. However, the impersonal exchange economy – which decreased the cost of exit by establishing trade relationships and allowed economic relations based on a division of labour - increased the enforcement costs of cooperation. With the population increase in Vormsi, the old norms-based management was quickly abandoned. If we trust the source, then the transformation period from community-based management to an impersonal exchange environment was not smooth. Transformation of the 'noble savages' to 'individualistic optimizers' had taken place in Vormsi during the second half of the 19th century. I have shown that this break was caused by an increase in group size and evolution of impersonal exchange economy, which allowed individual to function without a supportive network and thus decreased the costs of exit from the society.

In large groups, community management failed because the net benefits from cooperation were small or even negative in the case of enforcement costs in an impersonal exchange environment. Condition (1.1) was not satisfied and the internal authority game thus has only one SGPNE – everybody will "not agree" (~A) during the first stage, which will lead to the "defection" (D) and the equilibrium payoff profile $\{c; c\}$ in the second stage. The narratives have shown that group size may have an impact on the net benefits of cooperation, but we have not been able to show that number of players (n) has a causal relation with the ability to establish cooperative ventures, because in all success cases an impersonal exchange environment was also present, which will diminish coherence of the group and increase parameter x. But we will see that some cooperative arrangements between members of the smaller units, mainly villages or islets (Saarnaki), remained customized until the Soviet occupation in 1944.

2.3. Institutions for size management

We have seen that group size is a core characteristic of creating institutions for solving coordination dilemmas. Ostrom[38] and Bardhan[39] have shown that groups often find a way to manage access to common pools, and those arrangements are found to be surprisingly robust. Ostrom proposes that successful communities are marked by clearly-defined boundaries – "Individuals or households who have the rights to withdraw resource units [from the commons] must be clearly defined, as must be the boundaries itself"[40]. Cases collected by Ostrom, such as the village of Töbel in Switzerland, Hirano, Nagaike, and Yamanoka villages in Japan, the city of

[37] Luts, "Kalandusest Läänemaal".
[38] Ostrom, *Governing the Commons*.
[39] Pranab Bardhan, "Analysis of Institutions of Informal Cooperation in Rural Development," *World Development* 21:4 (1993): 633-39.
[40] Ostrom, *Governing the Commons,* 91.

Valencia, and others, all share fundamental similarities. These similarities include stable membership, close relationships, and interrelated generations. Ostrom also states that "extensive norms have evolved in all of these settings that narrowly define 'proper' behavior [and] the specific operational rules in these cases differ markedly from one another"[41]. The same result – remarkable differences in institutions solving the same difficulties by communities – has also been shown by Richerson[42].

I will consider three different cases where entry conditions were set by different mechanisms. The first case is Saarnaki, an islet with only four families, where the rule of fixing the size was set in quantitative terms – the carrying capacity of the isle was 16 adults. The second case is Ruhnu, where common resources did not meet the carrying capacity, thus access was allowed if and only if the newcomers conformed to local 'laws of nature'. In the third case, the community members had no authority to setting the boundaries, thus the 'institution' of hate and secrecy emerged.

Our first case is Saarnaki (territory of 1.3 square kilometers), which originally belonged to the Duke Ungern-Stenberg, but the people living on the islet considered themselves to be the owners of the islet[43]. The territory of Saarnaki allowed each family to have domestic animals according to their needs, not for taking to the market. In addition to private arable land, common land was divided into private zones. Trespassing was allowed, pastures for grazing the herd were considered to be private, and for effective land management fences were built or child-shepherds kept the animals in their zones. Zones were established also on the coast line, and due to a shortage of wood, every tree trunk or log washed ashore was extremely valuable. Also sea weeds, used for bolstering soft furniture and matrices, were gathered from the coastline, dried, and sent to the mainland, which was an important source of income for locals. 'Privatization of the commons' is a well-discussed cooperative arrangement in solving traps[44]. But not all resources could have been privatized – a social network had to be maintained for cooperative activities like fishing, maintaining the forest, and grinding in the windmill. Several resources were also impossible to privatize, like berries, mushrooms, wild birds (like in the case of Ruhnu), and fish. The reasonable argument is that privatization of all commons was not socially reasonable due to the nature of the resources. The size of the islet limited the carrying capacity of the natural resources, so an institution enforcing optimal consumption is the rational response to the natural conditions.

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[41] Ostrom, *Governing the Commons*, 88.

[42] Peter Richerson; Rob Boyd; Brian Paciotti, "An Evolutionary Theory of Commons Management. Draft," in *Institutions Managing the Commons*, ed. P. Stern (chap. 3 forthcoming, 2001).

[43] Elmo Saarnak, "Interview by author," tape recording (Estonia, Hiiumaa, Emmaste:2005).

[44] Harold Demsetz, "Toward a Theory of Property Rights," *The American Economic Review* Vol 57 No 2 (1967): 347-355; David Schmidtz, "The Institution of Property," *Social Philosophy and Policy* Vol 3 No 4 (1994): 42-62.

This institution – a rule which fixed the amount of inhabitants – was enforced. In Saarnaki there had been an unwritten law that the carrying capacity of the islet is 16 adults, called 'the rule of 16'. On the islet there were four families, meaning that in the families there could not be more than four adults, meaning the grownup children had to leave. Taking into account that each family had at least four or more children, the rule setting seemed to be vital for sustaining the quality and quantity of resources left for the next generation.

The second case is again Ruhnu, the island which had developed and maintained a perfectly adjusted network of institutions for community management, and has even more to offer for testing the credibility of my claim. The fact that in Ruhnu nobody was forced to leave the community signals that the carrying capacity of the island was not met. There was no competition between locals and outsiders, indicating that technological constraints and high transaction costs dominated over the scarcity of the resource. Also everybody, including outsiders, had equal rights to hunt, without any division of land or seashore into private zones.

Despite the fact that there were no ill feelings towards outsiders, according to the statistical sources, only five Estonians lived on the island in 1934. According to Steffenson, there was only one Estonian man, who married on the island and had several wives during the first Estonian Republic. Steffenson writes:

> Sometimes it happened that somebody had to marry a girl out of Ruhnu, and then men sailed to other territories, where Estonians lived, to seek for the wife. Only one Estonian man married on the island, he had to live for many years on the island, before he was taken as a part of the community. He had to learn the language and customs before he received 'full citizenship' and became a member of the St Magdalena congregation[45].

Compared to wives, husbands had certain social functions as the head of the *hiskap*: participating in the village meeting, voting, seal hunting, boat building, and participation in other cooperative arrangements – which demanded not only technical skills but also conformation to the already discussed 'laws of nature'. Becoming a 'citizen' of the Ruhnu and member of *Loandskape*, the collective decision institution, was vital for efficient community management. We call this size management institution 'quarantine', which set the norms for newcomers: don't accept outsiders till they conformed.

In the current example, institutions played a different role than in the previous examples. As long as the size of the community is not approaching the size where it can endanger cooperation by increasing the cost of enforcement or lowering the benefits from cooperation, the size of community will not matter in case of marginal changes. In case of marginal changes, it is important for the community to ensure that the newcomer is conforming to existing norms. The institution of quarantine distributes the cost of entry so that it will be carried only by the newcomer, thus maximizing the possible aggregate benefits for the 'local' players.

[45] Steffenson, *Elu Ruhnul*, 128.

Our third case, Hiiumaa, set up different kinds of 'institutions' of hatred and secrecy. Similar dependent 'institutions' can be found in many communities from different cultures, social norms, ethnical roots, etc. Cultural evolutionary theorists explain this feature by path dependency. This tribal social instinct hypothesis as a basis of cooperating with insiders and distrusting outsiders is even believed to be built into our genes due to social selective learning which causes these cultural imperatives[46]. Following a similar path, the evolution of cultural symbolically marked groups distinguished by folk costumes or 'wearing of common colors' is considered by LeVieil[47] , where 'colors' stress the difference between insiders and outsiders. Despite many alternative explanations the simplest – hating outsides will not hurt players, but has probabilistic benefits by keeping intruders out – is discussed in this section. These uncertain benefits can be endorsed by informing intruders about the attitudes of the locals. The norms, where the functional role of the community has been the establishment of this difference, are shown by Hardin[48]. He argues that it is inappropriate to call these norms community norms as they are rather "norms of particularism, difference and exclusion"[49] . It is clear that membership can give certain benefits in case of a fixed supply of some natural resources – for example in the case of commons. Also assuming that the community has some preliminary coordinating devices in the form of informal institutions, any new member will threaten the existing comfort, familiarity, or easy communication inside the group.

The other mechanism in 'not-so-complex' societies for playing social games is hiding information. The 'secret' mushroom gathering places or berry picking places are common to many Estonian communities.

> In other cases, the sea is legally defined as common property, open to all, but various means of restricting access have developed. […] One is secrecy, not making public the information and knowledge necessary to successful exploitation of sea resources[50].

Typically the exploitation of resources or other negative aspects like a worsening social climate "rife with secretiveness, lying, avoidance, and general suspicion" is stressed[51]. Here I argue something different – hiding information could be a norm, a rational behavior to avoid common traps. Information hiding or secrecy can be interpreted as one form of institution that will limit access to public resources and help to solve social traps. In these cases, members of society can accept the norm

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[46] Richerson et al, "Commons Management".
[47] Dominique LeVieil, . "Territorial Use-Rights in Fishing (Turfs) and the Management of Small Scale Fisheries: The Case of Lake Titicala (Peru)," (Ph.D. diss., University of British Columbia, 1987).
[48] Hardin, *The Logic of Group Conflict.*
[49] Hardin, *The Logic of Group Conflict*, 74.
[50] Paul Durrenberger and Gisli Parsson, "Ownership at Sea: Fishing Territories and Access to Sea Resources," *American Ethnologist* Vol 14 No 3 (1987), 510.
[51] Andersen in Durrenberger and Parsson, "Ownership at Sea," 510.

without harming the social network, but at the same time benefits from limiting access can outweigh social costs.

This work shows that different institutions for governing commons will be developed under different natural and communal conditions. In Saarnaki, where the natural resources were maximally utilized by a small number of players, the vital institution of the 'rule of 16', was developed. The main problem of this small community was the internal control of the group size. In Ruhnu, where common resources allowed marginal increase of the users, a different rule – quarantine – was developed. In open access communities, where communities were not able to set boundaries to common resources, 'institutions' of hatred and secrecy developed. These institutionalized attitudes toward outsiders may also be seen as solutions to the management of commons, although it must be admitted that they might have also been socially harming. Although in the case of a fixed supply of natural resources, keeping intruders out is not only individually rational, but also collectively beneficial when we face the tragedy of the commons.

CONCLUSIONS

My argument that small communities were able to solve coordination dilemmas by developing different social norms is supported by empirical evidence. I have shown that the most important determinant of cooperative institutions was the size of the group. Group size determines not only the costs of enforcement of cooperative morals, but also the expected cooperative benefits. Other exogenous variables affecting the costs of enforcement are related to group cohesion, which can be indicated by the costs of exit and entry. Table 2 summarizes the case-specific knowledge and clearly indicates that an impersonal exchange relation is not the main cause of failure of effective community management. Instead, impersonal exchange relations decrease the costs of exit and affect the costs of enforcement.

Table 3: Summary

Community	**Costs of enforcement (*e*) dependent on the coherence of the group (*x*)**	**Number of players (*n*)**	**Effective community management**	**Impersonal exchange relations**
Hiiumaa (in general)	High costs small coherence	~900	-	+
Hiiumaa (specific cases)	low costs considerable coherence	~30	+	+
Vormsi	Relatively high costs relatively small coherence	~400	-	+ -
Ruhnu	low costs considerable coherence	~50	+	-
Saarnaki	low costs high coherence	4	+	-

Thus I suggest that the discrete cut of community size to make community management effective is between 50 and 400 players. In these cases the players were extended families or farmsteads, so the size of the communities is much larger depending on the size of the farmstead. In Ruhnu the effective size of community was below 300 members, and in Hiiumaa and Vormsi, the cases of failure, communities exceeded 2000 members.

A basket of interrelated institutions for effective community management in Ruhnu shows that the enforcement cost of collective action can be embedded into different setups of norms. This coordination 'miracle' consisted of institutions of property rights, 'laws of nature', and village meeting *loadskape*. The equal distribution of initial endowments and the redistribution of final endowments were the important characteristics for symmetrical representation of benefits. This relatively extraordinary natural experiment shows that institutions do not exist in a vacuum and their complementarities are as important for mutual understanding as single factors. The slice system was effective only when supported by a redistribution of manpower; rules-based community management was only effective in case of equal endowments; and an institution of quarantine was needed only when the rest of the institutions were effectively enforced.

Our failure cases have shown that institutions do not exist in vacuum. External institutions shape individual payoffs through incentive schemes, allowing for the creation of so-called double morality – in-group relations differ considerably from relations between the groups or between the players and external authority. The most valuable finding has been the institutional arrangement which can be called private zones. This partial privatization of common resources was effectively enforced by small groups, although large group common-pool management failed.

I have shown that the size of the community in not exogenous under certain conditions. In all cases, natural boundaries more or less help the communities to increase the costs of entry. However, when size matters, communities were able to develop different institutions for setting up additional boundaries. In the islet of Saarnaki, where natural resources met the carrying capacity, the size of the community was detrimental. The institution of 'the rule of 16' was enforced by tacit consent. This institution fixed the maximum number of inhabitants who had access to common pools. In Ruhnu where the scarcity of the resources did not set considerable constraints on the group size, the community management system consisted of a complicated mixture of institutions demanding conformity from newcomers. Thus the institution of quarantine was the optimal evolutionary result, which forced newcomers to conform. In open-access communities, where players were not able to control entry by setting boundaries, different informal norms of 'hatred' and 'secrecy' were the evolutionary results. It has also been shown that a personal exchange environment has an important impact on the cost of enforcement of collective arrangements. The lack of a market economy accompanied with redistributive and equalizing mechanisms led to the creation of an envy-free society.

Thus Polanyi's 'world of no greed'[52] gave rise to the specific mixture of institutions, but maintaining the high costs of exit and entry made the group coherent. This argument is also supported by Olson's logic about social selective incentives and symmetrical organization[53] . The collection of cases presented by Ostrom shows the successes and failures in common pool management[54]. She stresses the factors which contribute to the probable failure: a large number of farmers, diversity of cultural backgrounds, unequal initial endowments, lack of control, and no affiliation[55]. In the cases presented in this work, it was shown that most preconditions are sustained but the cultural background precondition can be relaxed. Also, the meaning of a large group can be specified by arguing that the cross-cutting difference must be between 50-400 farmers.

It was also shown that some informal institutions do not have to be socially optimal, like in the case of hating outsiders or keeping secrets. However, these are still rational responses in choice-specific situations. North is famous for indicating the threats of being locked in to inefficient but path dependent institutions[56]. Unfortunately the natural experiment examined here does not allow for examination of the sustainability of these institutions. Ruhnu would have had a perfect experimental stage for testing the impact of impersonal exchange relations on existing institutions, but we can only say that the institutional mixture in Ruhnu had marginal changes already during the opening up in the 1920s. Also more information is needed to study the transition period of Vormsi from an impersonal to a personal exchange economy in the middle of the 19th century.

The current study has contributed to the wide range of literature about individuals' ability to cooperate without external coercive enforcement. Two works highlight the issues related to the field. First, Hardin argues that norms and conditional strategies can be possible solutions to social traps without a coercive state[57]. The second argument is that the state destroys the very elements of the community, like common beliefs or norms, direct and complex relationships between members, and reciprocity. I believe that the Aiboland case study, following Hardin's footsteps, shows that complementarities of norms and systems interrelating external and internal institutions can be a fruitful path for further studies. It would be interesting to see the emergence of alternative smaller cooperative formations in case of failure of cooperative large communities, like clans, social groups, or other frameworks. Also, the alternative hypothesis that external authority destroys community norms could be tested further. For the enthusiasts who share the opinion that interdisciplinary studies will enrich the quality and quantity of academic work, the latter should be an encouraging message.

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[52] Karl Polanyi, *The Great Transformation. The Political and Economic Origins of Our Time* (Boston: Beacon Press, 1944).
[53] Olson, *The Logic of Collective Action.*
[54] Ostrom, *Governing the Commons.*
[55] Ostrom, *Governing the Commons*, 166.
[56] North, *Institutions*.
[57] Hardin, *Collective Action;* Hardin, *The Logic of Group Conflict.*

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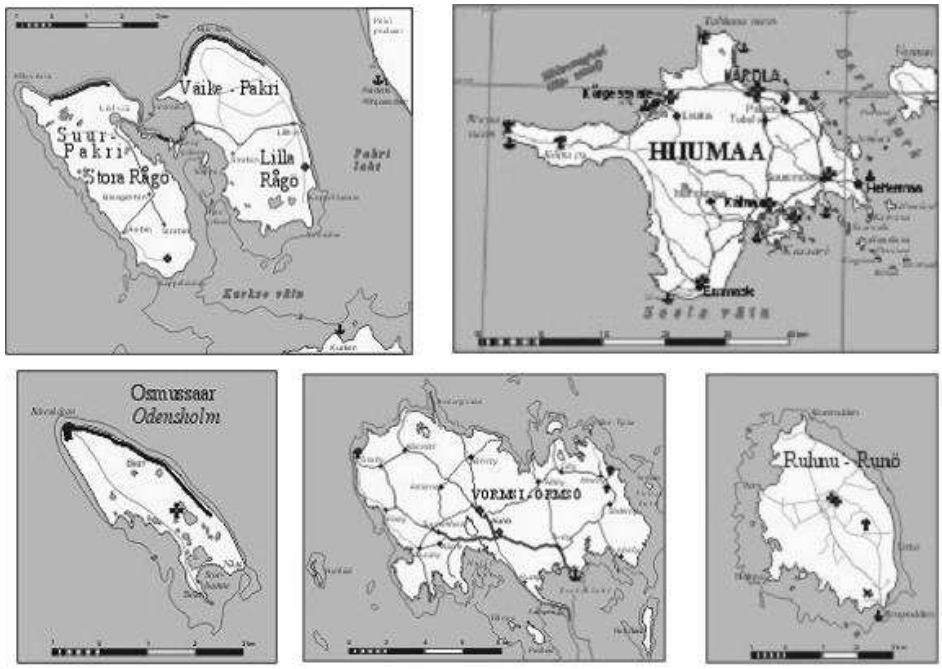
Appendix 1: Map of the area



Appendix 2

CREDIBLE COMMITMENT AND CARTEL:

THE CASE OF HANSA MERCHANT IN THE GUILD OF THE LATE MEDIEVAL TALLINN[1]

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Abstract

The paper contributes to the ongoing debate of institutional research in economics and methodological debate over plausibility of using analytic narratives in social sciences in particular. Using single historic case we argue that in Tallinn by and large merchant guild was solving a commitment problem in Hansa and organisation-institution of guild was meant for efficient enforcement of inter-city trade. We show that this argument holds in late-medieval period by using extensive form punishment and sanctioning game. Also we argue that after the breakup of Hansa, guilds turned into protectionist and rent-seeking cartels.

Keywords: economic history, credible commitment, analytic narratives, reputation mechanism, Hansa

JEL Classification: C72, D81

I. INTRODUCTION

Current paper contributes to the ongoing debate about the role of the guilds in late medieval city-state, and most of all to the institutional research using the analytic narrative. First we state that territorial craft guilds efficiently solve coordination problems in early times of the Hansa[2] and are thus economic growth enhancing

[1] Current article is reprinted by the permission of Baltic International Centre for Economic Policy Studies (B.I.C.E.P.S). I like to thank Zane Cunska from B.I.C.E.P.S for the assistance.

[2] The word Hansa (hanse, hense) has German roots, originally used in the sense of warrior band, later means tribute paid by merchants, sometimes group of merchants abroad (Dollinger 1970:xix). Here Hansa indicates inter-city union or federation of cities.

organizations, partly substituting missing markets. The second argument is that merchant guilds create growth by generating trade by credible commitment to honest trade. In this case a credible threat is created through "reputation mechanism". The third argument is that later periods – starting from the declining era of the Hansa – guilds started to perform as rent seeking organizations or cartels. The historical empirics or narratives are concentrating on one specific case – one of the most important city-states in east-trade – Tallinn (known in history as Reval).

Institutions are rules of the games, writes North (1990). Institutions set the standards, structure the society and limit our freedom. The study of institutions seeks to answer at least two questions: why institutions are needed, and how institutions are enforced. In our paper, the governance of the medieval town through institutional framework is investigated. We ask why guilds are needed, whom they benefited, and how they structured the medieval world. Neither economists nor historians completely agree upon the role of the market in the medieval society. Moreover, the question of institutions as substitutes of or complements to the markets is still open to debate. We intend to show that institutions can be both market-, trade- and growth- supporting, as well as restricting.

Medieval society appreciates *the status quo*. The appreciation of a static world including the relevant symbols, social structure and social norms, can be expected in societies where the uncertainty and risks prevail. The fostering of *the status quo* was enforced through social structure, where materialistic well being was not an objective, rather a social status related privilege (Le Goff 2000: 308). However there is an exception: European economic growth between the tenth and the fourteenth centuries was facilitated by the "commercial revolution of the Middle Ages" – the re-emergence of Mediterranean and European long-distance trade (Lopez 1976). This European growth was not a general phenomenon but was rather geographically concentrated to the "clubs" of city-states (in Italian and other Mediterranean cities) and inter-city unions (e.g. the Hansa).

Starting from the Cliometric "revolution" in 1950s, economic historians began to utilize econometrics for assessing the functioning of markets in many historical episodes, but altering the methodology to study case-specific or comparative institutions is relatively new. In most literature about medieval Tallinn, the statement about prosperous international trade during Hansa is made without much formal testing. However, as Greif (1995) asserts,

> the neo-classical approach to the study of institutions through economic history established that contrary to the claims of traditional historians, it is not true that the governance of exchange markets is a very recent phenomenon. Furthermore, by revealing the economic rationale beyond various contractual relations and patterns of ownership it lends to support to the Coasian view of non-market institutions as substitutes to the markets (Greif 1995:5).

The New Institutional Economics attempts to explain even more, to show "why institutions that produce poor economic (and political) performance can persist" (North 1993:12). In most cases, economic outcomes depend on efficient

institutional change. Most intensively studied historical institutional tracks are property rights, and institutions which enabled technological change. In medieval studies, North and Thomas (1973) investigated the spectacular economic expansion in the late medieval period. Greif (1995) assures that many questions which remained then unanswered demanded a methodological improvement or change, which was provided by clear concepts of institutions and game theory.

> Organizations are non-technologically determined constraints (other than expectations) that impact behavior by introducing a new player (the organization itself), changing the information available to players, or changing payoffs associated with certain actions. The court, the regulator, the credit cooperative, the credit bureau, the firm, and the merchant gild are examples of such organizations (Greif 1995:8).

In game theory we are after organizations which are self-enforcing. This makes the multiple equilibria games fascinating tools which can be enriched with historical data. The multiplicity and indeterminacy of equilibria in strategic situations indicate that the details of the historical context are potentially important in the selection of institutions, the implications of a particular institution, and institutional path dependence (Greif 1995:9). In order to construct such an enriched game theoretic model, it is vital to capture the choice-specific details of the historical situation. In ideal cases, we need a micro level study for model specification. Historical institutional studies using microeconomic or game-theoretic tools have a relatively short history. In Greif's (1989, 1993) analysis of "Maghribi traders", the contractual relations between merchants and their overseas agents in the eleventh-century Mediterranean trade are analyzed, to show how to motivate merchants to participate in sanctions when necessary. The created institution can be called *a coalition*, and it made reciprocal information transmission and collective punishment self-enforcing. Similarly, Milgrom et al (1990) have argued that the use of merchant courts in the Champagne Fairs during the twelfth and thirteenth century can be analyzed as an institution that created proper incentives for gathering information, honoring agreements, and reporting disputes. All these were lowering the transaction costs and allowing reliance of markets. There are also other game theoretic studies for example Greif (1998) analyses the agency relations in the twelfth-century Genoa, showing the rationality of the creation of inter-clan cooperation and enforcement of external governance institutions called *the podestá*. Using an infinitely repeated complete information game Greif et al (1994) examined the operation of an organization that enabled late Medieval rulers to commit to the property rights of alien merchants. This study is particularly of our interest, because it uses the merchant guild as an example of a particular organization that supported multilateral reputation mechanism. Multilateral reputation mechanism can potentially overcome the commitment problem at the efficient level of trade, but only when there exists an organization with the ability to coordinate the responses of all merchants to abuses against any merchant (Greif 1995:18). Greif (1995:748) also states that the argument concerns merchant guilds and not craft guilds. In the latter, the "common knowledge" or monopolization argument (e.g. Hickson and Thompson

1991, Gustafsson 1987, Ekerlund and Tollisson 1981) still holds. We may say that the literature provides evidence of growth enhancing and retarding institutions or organizations.

Our methodology is the analytic narrative. The analytic narrative is a combination of rational choice based game and historical-anthropological or qualitative study. Our narrative combines various sources of historic material. Compared to Scandinavian and German merchant guilds, there are some unique documents about Tallinn merchant guilds available, but there is no comprehensive study. Thus the synthesis of the narrative has value in itself. This of course opens us to criticism, if the narrative is not well presented. However we are sure that case of Tallinn is too interesting to leave aside. And in this study the historic narrative is used for explanatory purposes – to show that the guild was solution to the collective action problem. The analytical part of the narrative derives from the analysis of choice rules and payoffs of the individuals using an extensive form game.

The paper proceeds as follows. Section II reports the relevant pre-knowledge about Hansa's history. Our case cover approximately 100 years, from the foundation of the merchant guild in approximately 1363, until the closing of the Novgorod office in 1478. Section III introduces the problem of credible commitment. Then, in section IV we propose the model of the agency which enforced unilateral sanctions as credible threat. Later we discuss the historic context in the case of the Tallinn merchant guild, showing that gild was the only mediator of the trade and the threat to punish was accompanied to the guild's regulations. Finally, we follow the guild's further development into a rent-seeking institution. The last section concludes the paper by considering the subsequent history of the decline of Hansa, proposes a course for further studies including elaboration of theoretical framework from the neighboring disciplines.

II. INTRODUCTION TO THE NARRATIVE: THE HANSA

Long distance trade in the late medieval Europe was based on the exchange of goods through different towns or fairs located in geographically or politically favorable places. Yet the gains from trade were insecure not only because of the technological constraints (North and Weingast 1989), but also because of many political and institutional constraints: wars, piracy, cheating. The narrative will show that in response to the uncertainty, there were two possible risk-pegging mechanisms: 1) military action or 2) mechanism for sanctioning the shirkers. Which mechanism was more cost-effective? It is argued (Greif et al 1994:751) that before the fifteenth century, the defensive technology was superior to the offensive one. Thus, compared to military action, "diplomatic" actions or even "trade sanctions" like embargoes were cost-effective measures for enforcement of mutual benefits from trade. We will argue that the merchant guild which enforced a unilateral reputation mechanism was helping to protect trade from shirkers.

A short history overview indicates that in 1189, the Hanseatics – Germans and Gotlanders – signed the oldest known treaty with the Russian Prince Jaroslav, stipulating similar privileges to Russian and German merchants. In 1205, merchants created *Peterhof* – a base for traders in Novgorod, which then created the first trade organization called *kontor* (Dollinger 1970). In 1229, free trade was re-confirmed under the "Gotland Community" (Sartorius 1830). Starting from 1280, Lübeck was called *capud et principium* of all Hansa towns (Christensen 1957:107). The first trading routes to Novgorod crossed Tallinn via lake Ladoga and rivers Neva and Volga. "Eastward expansion" created profitable trading route for the Hansa and Tallinn was a trading establishment for the east-bound trade. In 1230, two hundred German merchants accompanied by Danes and Swedes settled in Tallinn. Tallinn became a base for operations and assembling-point for German merchants travelling to Novgorod by sea.

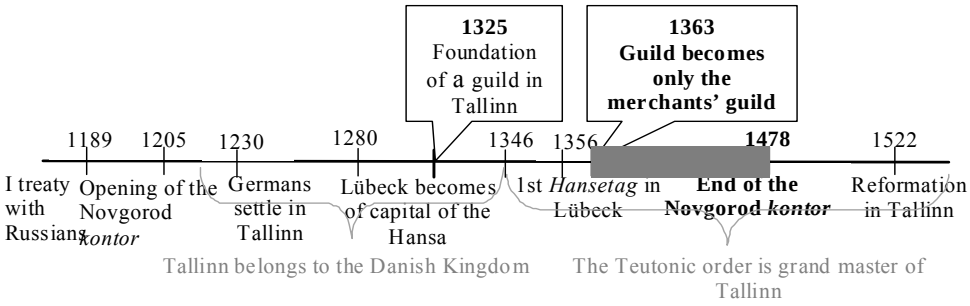

Figure 1: Overview of the Hansa history and our case (1363-1478)

In Germany, cities emerged through a political process (Greif 1995:21) that led to the establishment of relatively small cities. Hence, the community or organization of the Hansa – or as Greif (1995) states, an inter-city merchant gild – emerged to govern the relations between German merchants. Trade has started only after negotiating appropriate safety arrangements (Dollinger 1970). Organizational unit for this coordination abroad – the office or *the kontor* – was the conditional residency of Hansa merchants in one particular town. Any "common merchant" who arrived in a non-hanseatic town could join local *kontor,* which coordinated the disputes and financial obligations. Hanseatic privileges were conditional on citizenship of member town. The number of active Hansa member-towns varied between 55 to 80, but more than 180 towns were somehow related with Hansa trade (Dollinger 1970:88). Active members had to show up in annual conferences or diets (held in Lübeck), which was the only official organizational tool for central-planning since the Hansa had no official administrative, military or fiscal apparatus. From 1356 onwards the regularly held annual *Hansetag*, the general assembly of Hansa towns, was the only controlling organ of the league. Summons were mainly held in Lübeck and because of heavy cost of traveling, not all the

members participated. Delegates from the town councils voted over regulations of Hansa under a simple majority rule (Dollinger 1970:95), although Lübeck, being always present, played a vital role in Hansa affairs. Starting from 1347, in the Hansa statutes the three "thirds" of the cities were mentioned – Tallinn was one of the leading figures in Gotland-Livonia "third" (Dollinger 1970:95). Local or regional assemblies were also held several times per year, which sent their deputies to general diet and decided "more local affairs".

> It [the nature of Hansa] was neither a society, nor a college, nor a corporate body, but a permanent federation of towns owing allegiance to various princes, having no common institution – even the Hanseatic diet as not admitted as such – and consequently not responsible for the acts or undertakings of any of its members (Dollinger 1970:106-107).

Thus the question arises – how could this loose "organization" expand and create growth for many centuries? Greif (1995) believes that this could have only been accomplished through mutually beneficial cooperation. Merchant guilds emerged and supported trade expansion and market integration "[…] and their function was to ensure the coordination and internal enforcement required to make the threat of collective action credible" (Greif 1995:19). Was it really so? According to Dollinger (1970), first, in the case of conflicts, matter has to be discussed in the circle of neighboring towns (any participation by territorial ruler in this mediation has to be avoided). Second, if this was unsuccessful, matter was brought up in the Hansa diet, which made the final decision – in most severe cases, exclusion of the town from commercial privileges, never a military action. In some cases exclusion could apply to individuals, but then sentence was pronounced by the town where the merchant was a *burger* or by *kontor* – it includes confiscation of goods (in the case of smuggling), or exclusion from the rights of the "common merchant". Third, only in extreme cases more severe sanctions were used like suspension of trade by embargo or war. An embargo or a war is clearly damaging for all sides, making enforcement in loose organization even more complicated. An ultimate sanction – war – was used only against piracy, not for economic domination, and even then a great number of towns tried to evade the burden because of heavy military expenses (Dollinger 1970:112). Thus the "optimal" institution of Hansa was neither able nor willing to provide the public good of military action for protection but was providing the public good – economic growth through trade.

III. SETTING UP A PROBLEM: CREDIBLE COMMITMENT

As Bardhan (2005) points out, literature on the economic analysis of social and political institutions has focused mainly on the role of those institutions as protectors of property rights. A more neglected role of institutions is to correct the coordination failures or commitment problems that sometimes plague the most basic type of economic interactions. In our case, the merchants' welfare was dependent on efficient trade. "International prices" signalled about relative scarcity and gave information about efficient exchange, but there were huge risks

involved in trade. There was practically no formal business organization of the merchants – a merchant was an entrepreneur with full responsibility over the risks taken. Risks in inter-city trade, especially in the thirteenth century, were remarkable. At the same time increase of trade volume would have benefitted both foreign and local merchants. Therefore there was a common interest to decrease the risks of being cheated, being attacked by pirates, or being constrained by local rulers. Later credit risks were included. However, like in case of many social situations, one merchant has neither incentives nor means to make investments for the provision of this public good the security of trade. Without an external enforcer we are faced with a classical problem of an empty promise of punishing the cheated party even in the case of perfect information (see Figure 2).

In Figure 2, Merchant I has two alternatives – to cheat (C) or not (N), and Merchant II has in the second stage of the game two options: to punish (P) by ostracizing or prohibiting further trade or not (N). A simple extensive form game with perfect information indicates the payoff profiles, and it is evident that the strategy "never punish" strictly dominates over "always punish" and weakly dominates over "punish when cheated and not punish when not cheated". Thus cheating is the optimal strategy of the first player.

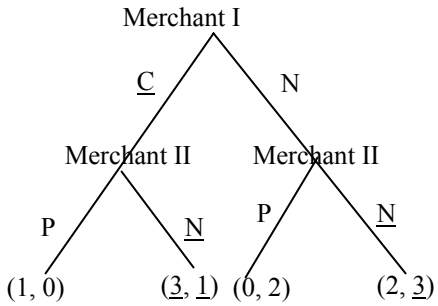

Figure 2: Punishing is not a credible threat

Although evolutionary games (Axelrod 1984) justify the emergence of reciprocity and cooperation in repetitive situations, we assume that independently operating merchants may not belong (at least initially) to the network of repetitive interactions (there were approximately 180 trading places in the Hansa, each having dozens of independent merchants). However, if it can be enforced that punishment is a social norm in the case of cheating, then Merchant I will amend his behaviour. Obviously, this commitment to punish is beneficial for the second player, and therefore it is very likely that the second player is ready to bear considerable cost (enforcement costs) of making the threat of punishment credible.

Greif et al (1994:756) state that the merchant guild's strategy is the conditioning of future trade on adequate past protection, the use of ostracism to achieve security (rather than privileges or lower prices). We will argue that there is one more important strategy – reputation building. "The war of everybody against

everybody" created the precondition of the emergence of an organizational form like a merchant guild. On the one hand, a guild was caused by individualistic organisation of the "common merchants" as there were no alternative corporations for risk backing and trade mediation. On the other hand, it was caused by the need to enforce credible commitment by "the community label". This label could make all the merchants from a certain community responsible for the damage created by any member of the community. Thus like Greif et al (1994) show the reputation building of the community was vital and inside the community there was a keen surveillance over the behavior of traders, which made the intra-community enforcement mechanisms to support inter-community exchange.

IV. THE SOLUTION: THE AGENCY MODEL

We will show that agency is an institutional structural solution to the credible commitment problem. Later, we will demonstrate how the narrative is supporting our argument. But first we have to admit that forming an organization (like a merchant cartel), which will transfer information, stand for the members in conflicts with local rulers, and most of all, commit sanctions towards its own members, is costly. The benefits from the efficient 'community label' or quality mark are related to the volume of trade accompanied with the decreased risks of being cheated. Let assume that each community-member faces a dilemma – the ability to credibly commit to the punishment will increase the trade volume $\sum x(p)$, where *p* is the number of people committed and *x* is the value of traded goods per merchant. Compared to the model in Figure 2, now we add local guild brother (who is also a merchant), thus his benefits are coming also from honest trade. The sanctions (or Axelrod (1997) metanorms) to make punishment a credible threat are used by local guild brother. To keep the game as simple as possible we assume that sanctioning is costly. Cost of sanctioning is c_s. If discount factor is δ, indicating the preferences over time, and the game is repeated infinitely, then the total benefits from sanctioning of the guildbrother are $\frac{x(p)}{1-\delta} - \left[x(p) - x(p-1) + c_s\right]$. Meaning that sanctioning will benefit future but hurt current trade, and of course it is costly. In the Figure 3 we substitute the latter three arguments by *u,* so $u = x(p) - x(p-1) + c_s$, which indicates the one time difference of trade volume because of punishing plus the costs of sanctioning. If sanctioning is not enforced, the future trade volume will be infinitely lower, so the guild brother benefits stay at $\frac{x(p-1)}{1-\delta}$.

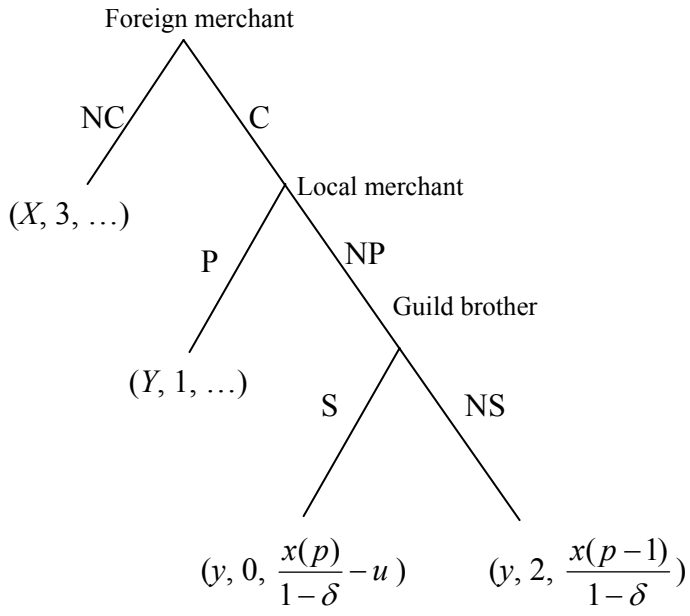

Figure 3: agency in the sanctioning and punishing game

Thus, at the final stage, the guild brother compares two possible discounted payoffs and chooses to sanction if

$$x(p) - (1-\delta)u > x(p-1).$$

The value of the left side of the equation is dependent on discount factor – more patient agents are (the bigger is discount factor), the higher is the probability of sanctioning. Although in Economics this conclusion seems trivial, due to the static nature of the medieval worldview, it could be that traders are not just after the short run profits. However, the difference in trade volume $\left[x(p) - x(p-1)\right]$ also matters a lot. In Figure 3, also the local merchant's cardinal preference ordering is given (the bigger number indicates the higher preferences). If we assume that sanctioning is beneficial to the guild brother, "punishing" (P) is also beneficial, and thus sanctioning must be credible threat to make agency self-enforcing. Assuming that foreign merchants benefits are *X, Y* and *y* accordingly and $X > Y$ (and this is independent from *y*) a foreign merchant chooses "not cheating" (NC) over "cheating" (C), and the game will end in the first stage. The honest trade is established.

The costs of sanctioning (c_s) must also be considered – the lower they are, the more probable is that "sanctioning" is a dominant strategy. Cost of sanctioning are dependent on compliance with the group and this is also dependent on the group size. Thus we may argue that restricted access to the merchant guild in early

periods is not caused by the cartelization argument, but rather by the information argument – the more optimal is the size of the group the easier it is to enforce sanctioning, and to obtain information about possible misbehavior of the members. Due to cost considerations certain rules (like membership by nationality) can be justified. To an extent, it defined communities and fostered their internal organization similarly to other norms of identification like clothing and rituals. This observation is consistent with North's (1990) claim that "groups of individuals bound by some common purpose of achieving objectives […] come into existence and […].evolve [in response to] the institutional framework".

Will the result of our model – credible threat – find any empirical evidence? Although the number of sources is limited, we can combine a narrative to show that there is considerable evidence supporting our model.

V. BACK TO THE NARRATIVE: TALLINN MERCHANT GUILD IN THE 14TH CENTURY

Up to the mid-thirteenth century, a Hansa merchant was an itinerary trader, who traveled in groups and traded by barter (Dollinger 1970:163). Later this tradition was replaced by an independent entrepreneur in charge of his own firm, who conducted business from his office at home and used representatives or clerks for travelling. Merchant was the owner in many partnerships and this was the standard form of commercial enterprise. In partnerships, there was a small number of associates, for a limited period, and for a specific project –

> […] there was no single commercial firm, permanent, centralized, having its headquarters in a special building, with subsidiary firms, its own clerk and agents and surviving through several generations – the sort of business represented for example in Italy […] or in south Germany […] (Dollinger 1970:168).

Transaction costs (costs of using inter-city markets) were therefore relatively low (which is definitely not true at the beginning of the trade) and it seems that transaction costs could be lowered by using alternative institutions to the market – a guild or a *kontor* . The risks in the first period of Hansa were more related to piracy and security of sea travelling, later credit-risk was included.

A guild is a common organizational feature of all Hansa towns, mainly dealing with organizing the overseas trade (Hammel-Kiesow 2008). Its relative importance and role varied from case to case, depending on the social power of the Princes and the particiate, on the size of the population, and on a guild's relative wealth. Our case focuses on the town of Tallinn in the 14th century (see also Figure 1) and we show that in this case, the merchant guild (g*rosse gilde*) was a cooperative agency which enforced honest trade.

From 1346-1561 Tallinn was ruled by the Teutonic Order. The ruler of the town was not the Grand Master alone but rather the Order as a corporation (Kreem 2002:20). While the relationship between the Order and the Town may not be as

unimportant as portrayed by Pullat (1976) and Margus (1939), we consider merchant to be independent players. This follow from the fact that in 1346, the Teutonic Order confirmed all the privileges of the citizens granted by the Danish kings as a part of medieval routine (Kreem 2002:39).

Tallinn's total trade in 1368 amounted to 99 294 *marks* (the price of the average stone-house in Tallinn was 60-80 *marks* at that time (Kaplinski 1980)). Fur – sable, beaver, lynx, squirrel and rabbit – all from Novgorod, were in great demand in the Hansa and the amounts imported were impressive – 300 000 pelts between 1403-1415 , 30% of which came through merchants of the Tallinn, the rest through Tartu, Pärnu and Riga (Dollinger 1970:325). The town remains small. According to the sources from the 14th century the total population of the lower-town was approximately 4000 (Mänd 2004). By adding together approximate numbers of participants from Christmas and Shrovetide festivals based on Mänd (2004: 138-139) we propose that there were altogether more than 200 merchants in the town. Only guild brothers are included (bachelors and non-citizens are not included) the number would have likely been between 70-150 merchants in 1510-1550. Also, it may be assumed that the number of guild brothers has increased considerably over time (Mänd 2005), and it was smaller during our period of interest.

By the 15th century, the social career of the merchant in the late medieval Tallinn was well formalized. First the non-citizens and bachelors were accepted to the Brotherhood of Black Heads. On average, a "blackhead" spent five years in the corporation before being accepted to the g*rosse gilde*. Only merchants could be members of that guild. Although all *schra*s (regulations) of the guild had to be accepted by the city council (*magistrate)*, the guild was rather independent in its every day "club-life". *The* g*rosse gilde* (probably founded in 1363) was the only merchant corporation in Tallinn.

Increasing institutionalization (also formalization due to increasing literacy) is characteristic to that time. In later periods (in the 15th century), as successful merchants became members of the *magistrate,* increasingly more initiative in merchant affairs is taken over by the *magistrate. The Hansetag* in Lübeck gradually became gathering of the a*ltermen* (members of the assembly) of the *magistrate,* accompanied by the guild brothers. *The Magistrate* consisted of two (Kotter 1991:8) or four (Kala 1998:31) burgomasters and fourteen life-time procured *aldermen*. *Aldermen* and burgomasters didn't receive any material reward or exemptions for their service. Only the members of *the grosse gilde* could be elected to the *magistrate*. *Aldermen* were divided to 11 different sub-courts (Kala 1998:31), which dealt with town affairs in provision of public goods like the court, military defense, diplomatic relations, minting, and various constructions. Kotter (1999:76) describes the cost structure of the *magistrate* during 1433-1705, showing that 70% of the town revenues were spent on salaries (usually non-monetary rewards like clothing and footwear) of the *magistrate*-craftsmen and on other services (like musicians), court expenses, defense, "foreign affairs" (like travel costs, gifts, official dinners, letters and translations), buildings

and renovations. Already in 1282, the Lübeck town law of Tallinn stated that each *burgher* has to contribute an annual personal tax (Kala 1998: §108). The tax consisted of two parts – the poll tax (a fixed tax of 1/12 of Riga mark)[3] and property tax approximately 4-5% from the value of the property. The largest part of the revenues came from the excise taxes on beer (levied in 1454 (Jatruševa 1986:36)) and on export of wine and stones (Kotter 1999). This shows that the town earns directly 15-20% of total revenues on export excises. The wealth of *the burgher* (the value of his property) was dependent on the efficient trade relations and the reliance on trade in town fiscal affairs is obvious.

Over time *magistrate* increasingly started to coordinate the internal and external affairs of the town, while social ties between the *magistrate* and merchant guilds were tight. Dollinger (1970:135) states, government in some towns have practically been a family business. This is not true in our case; in Tallinn it was prohibited to elect brothers, fathers, or sons to the *magistrate. The aldermen* didn't receive any salary for their duties, thus had to maintain simultaneously their merchant activities. *The Aldermen* were elected from among the *grosse gilde* brothers, mostly from among brothers who have been *the alderman* or the assessor of the guild (this indicates that they were before election the members of the merchant guild approximately twenty years (Mänd: 2005:180)). *The alderman* of *the magistrate* remained a member of the guild, he did not participate in all of the social events of the guild, although he did participate in the guild's most important festivals and feasts.

It can be assumed that in the early days of Hansa, merchants gave an oath of commitment to honest trade, including to paying all customs and tariffs (Hammel-Kiesow 2008). Eventually certain trade norms called the *schra*s[4] were agreed upon. All of the exclusive rights of "common merchant" were granted by citizenship of Hansa towns. Becoming a *burgher* (citizen) simultaneously meant becoming a member of the guild (Mänd 2005:141, and also *Lübeck town Rights 1282*). There are no earlier *schras* (if there were such) preserved, but 1395 *schra* does not indicate any direct trading principles of the guild, rather states the requirements for guild brotherhood (and sisterhood). "Everyone who belongs to

[3] To give some reference to the size of the taxes the only source is property prices at that time. The wooden house costs 10 to 15 *Riga marks*, small stone houses 50 to 60 and bigger ones 100 to 150 *Riga marks* (Kaplinski 1980). Also six marks was the price of the relatively luxurious coat or the price of 600 to 1000 liters of beer or approximately 1000 kilo oats (Põltsam 2002c). Thus 1/12 of one *Riga mark* as an annual poll tax was considerable amount of wealth. The property tax was approximately 5% of total wealth (the monetary system of Livonia stated that 1 *Riga mark* is 4 *veering* is 36 *killing*s is 48 *öres*), and approximately 75% of "official *burghers*" had some kind of property (Kaplinski 1980:77).

[4] Tallinn Town Archives has a collection of materials on the g*rosse gilde*, which consists on more than 400 different sources mainly from 15th – 19th century, only some of them date back to the period we study. S*chras* of *the grosse gilde* are also available in printed version by Nottbeck (1885).

our guild must be honest and trustworthy" (Nottbeck 1885:40); moreover it is said that till all conflicts between guild brothers or others (it can be assumed that by others also Hansa merchants are considered) are not solved out, the person will not belong to the guild. *The schra* states that those who "desecrate" contracts will be ostracized. *A* 1541 *schra* includes a paragraph stating that "if somebody violates general trading principles of the guild, he has to be expelled from it" (Nottbeck 1885:61§93). This is worth stressing, as the rights of "common merchant" were related to the town citizenship and the membership in the guild. Also *the schra* indicates that the ban is imposed on any illicit trading by non Hansa merchants And guild members cannot belong to the other guilds in the same town (Nottbeck 1885:§57). The implication is that the "guild label" was seen as the guarantee of honesty of trade. Ostracising problematic local traders and acceptance (or at least invitation to guild "club-activities" (Mänd 2005:170)) of all Hansa merchants from other cities justifies our model. The oral culture enforced institutions based on credibility and trust, and reputation building was the most important aspect in efficient enforcement. Most legal procedures relied on oral witnesses[5], on a social network based on reciprocity of credible commitment of "telling the truth".

Although only more recent (from 17th century) cashbooks of *the grosse gilde* have been preserved and *the schra* from 1395 does not indicate fees other than penalties (mainly fines) related to misbehavior, it still may be assumed that guild brothers paid an entrance fee and a quarterly lump sum membership fee (poll tax). "Project specific" payments (e.g. related to the building of the guild house 1406-1417 as well as fees for the annual feasts and festivals) were also probable. As the cost of building the guild house, organizing the feasts, social security and care, was notable, it can be assumed that the membership fee was relatively high.

The next section will overview the gradual decline of Hansa due to "political" reasons. As the benefits from Hansa declined, the guild brothers' income decreased and the intrinsic reasons for the existence of *the grosse gilde* changed. The protection of the town's interests against the interests of Hansa merchants or even against other gilds in the town become more important, and the membership become increasingly more exclusive.

VI. THE DECLINE OF THE GROWTH ENHANCING GUILD: DEVELOPMENTS FROM 1450S TO 1520S

Although Tallinn still flourished in the fifteenth century, the period was already marked by the gradual decline of the Hanseatic community. During this period, monarchical power was being consolidated in the Northern Europe, increasing the town's cost of compliance with the Hansa. Ivan III annexed the great urban

[5] The court decisions based on oral confessions, in §117 in *Lübeck town Law in Reval* states: "If somebody is accused because he has not totally paid the tax [and] he has good reputation, he can give an oath and can be released from the guilt. But if he admits that he has not fully covered the taxes, then he has to pay the reward to the town and court."

republic Novgorod in 1478, and this ended the functioning of the *kontor* because the Muscovite empire was hostile to foreigners. The private benefits that the Livonian towns, and merchants individually gained from the East-bound trade, initialized the gradual monopolization of the trade. In 1422, Tartu started to control *the kontor* and decide who can trade with Novgorod, and in 1459, Riga stopped all foreigners, including Hansa merchants, from trading directly with Polotsk (Dollinger 1970:294). These changes in the economic policy and foreign affairs created a bankruptcy wave in Tallinn before Reformation (Margus 1939:87).

Later, in the 1520s the Reformation began almost at the same moment in all the North German towns. At first, town councils were hostile to the new religion, in 1525 diet of Lübeck even passed measures against teaching Luther's doctrine, but only a few delegates approved it (Dollinger 1970:320). The second diet of the year proclaimed that in religious matters, each town had to decide for itself (Dollinger 1970:321). The Reformation made the social relations in Tallinn more intense – in the 1530s, conflicts between merchants and artisans often took place (Põltsam 2003:21). In 1526, craft-guilds of Tallinn decided that all who do not support the new religion, and in some cases, even those who visited Catholic masses, were expelled from the guild (Põltsam 2003:22). The reformation, teaching equality of humans in the eyes of God, encouraged the craftsmen to defend their rights against the *magistrate* and patriciate (Margus 1939:88). Guilds became increasingly nationally and socially segregated. This indicates that guilds gradually changed their role in the urban community and became unions to protect artisans' economic interest against merchants and *vice versa*.

Based on our model and sources (Hammel-Kieslow 2008; Pagel 1942), it can be assumed that originally, merchant guilds were not restricting access by nationality. Over time, merchant affairs became increasingly more institutionalized, merchants were no longer travelling much, and merchant guild started accepting members from lower social classes, to do travelling for them. Access to town citizenship was however restricted for the lower social classes, as one had to live in the town for at least a year and have recommendations, in order to become a citizen. In later periods, the access to the guild became increasingly more restricted and regulated. Estonians were not accepted to the g*rosse gilde*, later the restrictions applied for everyone who worked for salary, and finally it also came to apply to local shopkeepers (Mänd 2005:167). Eventually, non-Germans or workers could not even visit the guild house (Mänd 2004). In the 1528 *schra*, an additional paragraph stated that the issues discussed in the guild house cannot be shared with any outsiders (Nottbeck 1885:45).

A century after the creation of social norms embodied in the formal rules of town-culture, the role of guilds in the social life of the town had become increasingly greater, and we can assume that the compliance with guild regulations was high. Therefore the enforcement cost of sanctioning (c_s) were low. The individual enforcement costs were now primary direct costs related to a membership fee. Thus average cost (c) was constant. The members' total benefits

from optimal group size $\hat{n}$ are now smaller than the individually optimal group size n^* (see Figure 4).

Figure 4 indicates that each individual had to pay a membership fee (c) for penetrating the club, and thus we deal with a fixed average cost. The total benefit $G(n)$ is now a decreasing function due to the competitive provision of an almost private good now – the bigger the group, the less beneficial is the cartel to a single member. Thus each individual has an incentive to become a member of the guild as far as $\frac{G}{n+1} > c$, and this condition is satisfied when we reach n^*. The insiders' total benefit is maximized when $\frac{dG}{dn} = c$, meaning that the optimal size of the group is $\hat{n}$. As far as $n^* > \hat{n}$, insiders have the incentive to limit the entrance to the guild, like in all monopolistic cases. Is there any additional evidence to restrictions on entry and increasing secrecy to justify our interpretation? There is some, for example the dress-codes.

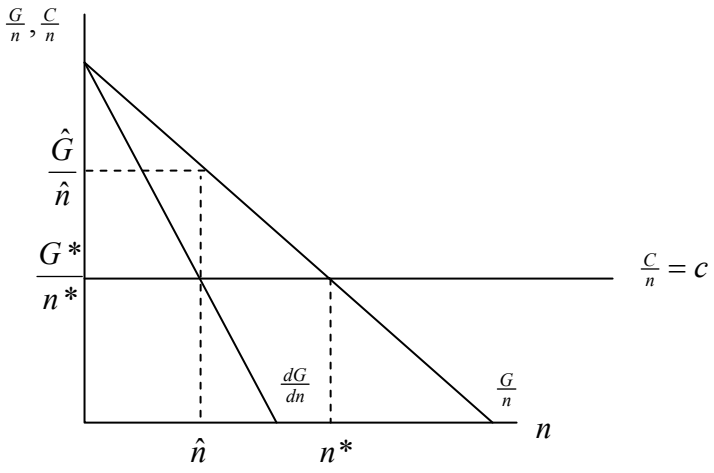

Figure 4: optimal *versus* insiders' benefits from the protecting organization

Segregation by dress is one additional measure similar to entry restrictions and this was common. However, there is no evidence that dress-norms created any tensions in Tallinn before the 15th century. The first sumptuary law regulating the costs of female jewelry was implemented in the end of the 15th century (Põltsam 2002). It is difficult to assess whether it was the relative cost of clothing that did not make sumptuary codes relevant earlier, or if it was the relative compliance with the informal dress-codes that was higher until the end of 15th century. Dress-norms enforce segregation. It is clear that in the beginning of the sixteenth century, the urban societies became increasingly formally regulated. However, after 1541 no

additional paragraphs were added to *the schra* of the merchant guild concerning honest trade.

VII. CONCLUSIONS AND DISCUSSION

More than 100 years is a long period for a case study. Regarding the limited number of original sources and our ability to perceive historical context, we assume that the guilds' social and economic role in the society changed considerably over time. Initially, it was a risk pegging agency for itinerary travelling merchants, then increasing its social role and finally becoming a rent-seeking cartel. We demonstrated that initial institutsionalisation of merchant affairs was self enforcing by supporting trade and thus also economic growth.

In our case conclusively we can say that by the middle of thirteenth century the Hanseatics already held a near-monopoly in trade in two seas, and their commerce was organized around the great axis Novgorod-Tallinn-Lübeck-Hamburg-Bruges-London, enlarging also later to southern Germany, Italy, France, Spain and Portugal. At the same time Hansa remained an anomalous institution which can puzzle contemporary political scientists and economists.

> It was not a sovereign power, for it remained within a framework of Empire and its members continued to owe some measure of allegiance to many different overlords, ecclesiastical or lay. It was an amorphous organization, lacking legal status, having at its disposal neither finances of its own nor an army or a fleet. It did not even have a common seal or officials and institutions on their own except for the Hansetic diet or *Hansetag*, and even then met rarely, at irregular intervals and never in full strength (Dollinger 1970:xvii).

In spite of the structural weaknesses and the conflicting interests inevitable in an association of towns so different and so distant from another, the Hansa lasted for nearly five hundred years. In 1630, a closer alliance was set up between Lübeck, Hamburg and Bremen as a substitute for the Hansa. In 1669, the Hanseatic diet met for the last time, and a final attempt of restoration proved unsuccessful (Dollinger 1970:xix). The secret of its longevity is not to be found in coercion, but in the realization of common interests bounding the members of the community together. The common interest was based on voluntary cooperation, and was not easy to enforce under medieval technological, informational and institutional constraints.

Our study indicated that the guild acted as a substitute of formal state or legal institutions. While the "common knowledge" among economists often views guilds as monopolistic cartels or rent-seeking organizations, Merges (2004) states that guilds were efficient information transferees solving the asymmetric information and quality assurance problems in medieval society. Greif et al (1994) describe merchant guilds were organizations vital for efficient trade. Both the rent-seeking argument and the credible commitment argument demand that organizations fulfill certain criteria: (a) segregation principle (differentiate insiders

from outsiders); and (b) shared norms by insiders (Merges 2004:4). We have seen that the role of segregation has increased in importance throughout the history of the merchant guild. Various social norms of segregation – by clothing, by profession or by nationality – eventually appeared. In order to be self-enforcing, norms have to be beneficial to follow. Merchants benefited from an inter-community exchange that included common merchants, but excluded all local shopkeepers and craftsmen, and eventually all non-Germans. Traders applied a principle of community responsibility that linked the conduct of a trader and the obligations of each and every member of the community. Through decreased trade volume, "community label" made all the merchants from certain community partly responsible for the damage created by anyone inside the circle. Greif et al (1994) also confirm that communal punishment or sanctions became a credible threat and traders were able to use intra-community enforcement mechanisms to support the inter-community exchange. The system created the need for restrictions on membership due to the cost considerations which lead to constraints like membership by nationality. The restrictions defined communities and fostered their internal organization like other norms of identification, such as clothing and rituals.

Institutional studies reveal a variety of reasons that led to institutional change, but we believe that a change in private benefits had a important role in this gradual change. In institutional literature, the most elaborated cause of change is called the "critical juncture" (Pierson 2002, Rittberger 2003), which can be an unanticipated technological change (Guinnane, 1994), political changes (Greif et al 1994), or population increase (Hoffmann et al 1994). In our case private benefits changed mainly due to changes in the political situation brought on by the closing of the Novgorod *kontor*. Whereas most institutional studies concentrate rather on the path-dependency or on the inability to change, we also note the gradual decline of Hansa, and the gradual transformation of the function of the guilds. The most elaborated causes of path-dependency are "cultural beliefs" related to some institutional settlement (Greif 1995:23), and vested interest or assets specificity (Pierson 2002:205). When the guild as an organization was firmly established and functioning, then the new role of protection of the economic rights was a logical continuum under the changed economic and political circumstances. Guild became beneficial for a narrow circle of insiders, partly at the expense of outsiders. The days of positive-sum game ended for Livonia and Tallinn.

The most severe criticism to the institutional studies is presented by Clark (2007) who states that narratives do not allow for demonstrating universal knowledge or any policy recommendations, because everything depends on the specific cultural and historical context. This has also been duly noted by one of the promoters of the method, Margaret Levi (2002), who calls the (in)ability to make generalizations the Achilles' heel of the method. Our case suffers from the same limitation, but we believe that although the specific game may not be totally portable it does yield explanations that can be tested in different settings. As Levi (2002:16) states, "The comparisons can be done by other area specialists,

historians, and others who must conquer languages, archives and other sources to acquire in-depth authority over the subject matter". That is why it can be said that the demonstration of generalisability may rest on a larger community of scholars. We encourage also comparative studies about the impact of similar contemporary institutions. Will the political change or current turmoil of the world economic climate transform our current "guilds" – national or other – into organizations hostile to new entrants? What about international "guilds" like the EU?

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Appendix 3

THE LIGHTHOUSE IN ESTONIA: THE PROVISION MECHANISM OF "PUBLIC GOODS"[1]

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Abstract

The purpose of this paper is to discuss the incentive structure or the mechanism that defines the private and public provision of public goods. Analytic narratives are used based on historical studies of the provision of lighthouse services in Estonia. The latter allows a theoretical discussion over the boundaries of private initiatives in public good provision and also allows a dialogue with Coasean principles. Findings show that there is no clear-cut division between private and public provision, rather throughout history there have been some combinations of private and public provision. Private agents are only able to provide lighthouses with the aid of supportive institutions – rewards for lighthouse owners and credible threat of punishments to the ship owners. Rewards must be at least as big as costs of exclusion, e.g. central collection of light dues; punishment of the ships that shrink in payment; provision of information about light dues and technical matters.

JEL code: C72, H41, N4

Classification: public goods, analytic narrative, history of public economics

1. Introduction

The purpose of this paper is to discuss the incentive structure or the mechanism that defines private and public provision of public goods. The hypothesis tested states – can pure public goods be privately provided under a publicly provided institutional system? This institutional system may differ, but it is a combination of property rights, legal order and financial support. Methodologically, analytic narratives are used based on historical studies of the provision of lighthouse services in Estonia. The method enables a theoretical discussion over the boundaries of private initiative in collective goods provision and also a dialogue with Coasean principles.

Starting from Coase (1974), a lighthouse is debated as being or not being a perfect example of public goods which instead of private individual or firm should be provided by the government. Looking at the historic mindset until the Coasian "revolution", we see that lighthouses are considered to be a perfect example for public provision. In Mill's *Principles* (1984), the government was mentioned as a

[1] The shorter version of the paper oriented to the international reader will be available in Põder, K. (2014). The Lighthouse: Historic analytic narrative on the provision of 'public goods' in Estonia. *Transformations in Business and Economics*, Vol 13, No 2(32), March edition.

builder and maintainer of lighthouses. Furthermore in 1883, Sigwick stated: "[…] there are some utilities which, from their nature, are practically incapable of being appropriated by those who produce them […]. It may easily happen that the benefits of a well-placed lighthouse must be largely enjoyed by ships on which no toll could be conveniently imposed" (Sidgwick 1901, p. 406). Pigou considered the lighthouse a perfect example of a service where "marginal product falls short of marginal social net product" (Pigou 1938, p. 183-184), which is an often used concept to relate the public good provision to the broader issue of externalities. The latter also defines the boundaries of private enterprise and agrees that there are "some indispensable public services without which community life would be unthinkable" (Pigou: ibid) and thus the role of the government is imminent. Classical writing of Samuelson (1964, p. 159) states clearly that "[…] a businessman could not build it [lighthouse] for a profit, since he cannot claim a price from each user. This certainly is the kind of activity that the governments would naturally undertake".

By definition the consumption of public goods is not excludible and nonrivalrous; and the provision is related to nonexistent marginal costs. These arguments are diminishing consumers' interest in revealing their interest toward such goods and thus the question – is a private enterprise able to provide certain kinds of goods – is more or less the question of ability to charge the consumer. Is charging really impossible? Coase (1974) shows that by the example of the British system all the latter statements must be reconsidered and the "Estonian system" gives similar implications.

The British lighthouse authority – Trinity House – has been, but not always[2], responsible for the provision of seamarks. However Trinity House has been an ancient institution evolved out of a medieval seamen's guild, and the patent of the right to regulate pilotage was granted to the institution in 1514. In 1566, it acquired the right to control the maintenance of privately held seamarks, and in 1594 to also place marks. Although Trinity House built some new lighthouses, from 1610-1675 ten were built by private individuals, and none by Trinity House. Also, at this time the King gave patents to private bodies granting the right to levy tolls. Tolls were collected at the ports by private individuals or by custom officials. Tolls varied between the ships, dependent on the size of vessels. In the late 17th century, Trinity House adopted a policy of cooperation with private individuals – giving grants for a lease to build and maintain a lighthouse and share profits with Trinity House. In 1820 there were forty six lighthouses: twenty four operated by Trinity House and twenty two by private individuals. Only eleven of them were actually built by Trinity House. Trinity House, because of strong support by Parliament to purchase them, left only fourteen lighthouses to be run by private individuals by 1834. In 1836 an Act of Parliament vested all lighthouses in

[2] The review of the British system is based on Coase (1974, p. 362-372).

England to Trinity House, and this was more or less accomplished by 1842. Centralization was justified by the too high light dues.

Leaving the discussion of light dues' rates open, we note that even a centralized lighthouse service provision has been based on the collection of dues from ship owners. Thus the orthodox argument is overruled – ships were made responsible for their own "consumption" of lighthouses. And the lighthouse services were not financed from general state revenue. For a comparison, let us have a few insights into the Estonian experience of providing such services.

Compared to the British sources, no systematic study of the financing of the building and maintaining of Estonian Lighthouses exists. The memoirs about the history of lighthouses provides us some insights. Luige (1982) states that Estonian lighthouse history started at the second half of the 15th century, when the Hansa league was initiating the building of the Kõpu lighthouse. The Swedes initiated building two more lighthouses in 1646. From this time on, private individuals were maintaining and building lighthouses even after the Uusikaupunki Peace Treaty by which Estonia became part of the Russian Empire. The Swedishi-German nobility retained the privileges of owning and charging tolls. Although all new seamarks were initiated by the state primarily for military purposes, the toll or light dues were still collected from ships. Almost all lighthouses and other main seamarks were finally owned by the state in the end of the 18th century. At least seven new lighthouses were built by the central authority and one by a private initiative during the second half of the 19th century, increasing the total amount of lighthouses and marks to approximately fifty. During the first Estonian Republic (1920-1940) a new agency – *Mereasjanduse Peavalitus* – was created, which outsourced building to private firms until 1934 and was still financed from light dues. Starting from 1934, thirteen new lighthouses were built by the state brigade, all financed by the state budget. This system came to an end in 1940 after Soviet occupation.

The preceding review of the Estonian system is far from complete, and a more detailed the description of the Estonian system is one of the objectives of the current study. Collected data (mainly archive documents) are used to construct an analytic narrative. This narrative is a combination of a rational choice game, theoretic deductive logic and historical study. Narratives are not used, like historians or anthropologists usually do, for describing ethnical and cultural ideologies building up people's identities, rather *vice versa.* The analytical part of a narrative is coming from the analysis of choice rules and payoffs of the individuals using non-cooperative games. Bates et al (1998, p. 10) proposes that "…it [analytic narrative] combines analytic tools that are commonly employed in economics and political science with the narrative form, which is more commonly employed in history". What is meant to be a narrative and analytic is explained – "Our approach is narrative; it pays close attention to stories, accounts, and context. It is analytic in that it extracts explicit and formal lines of reasoning, which

facilitate both exposition and explanation" (Bates et al 1998, p. 10). Games are used to make the framework comprehensive, while archive, anthropological and ethnographical sources are mixed to provide information for reliable narrative building.

The paper proceeds as follows. Section II gives an overview of the theoretical discussion over the public-private dilemma. Section III reports on the relevant history. Presenting the history is not a subject on its own. It encompasses the narrative, which is used for building the game theoretic analyses. Section VI presents the "rules of games". These institutional rules may permit or promote private provision. Section V discusses the narrative in the light of a game theoretic model and alternative academic findings. The conclusion is the elaboration of ideas that give historical insights into the current mindset over the boundaries of private-public dilemma, if there is a dilemma at all.

2. Private *versus* public – discussion of theory

The terminology of public goods was developed in economics by Samuelson (1954) and has been expanded later on by many. Head (1974) enumerates ten different characteristics of public goods: decreasing costs of production; externalities; joint supply; nonexclusion; nonrejectability; benefit spillovers; unenforceability of compensation; indivisibility; nonappropriability and nonrivalness. We can add the free rider possibility (Buchanan 1975, p.207) and lumpiness (Head 1974, p. 168). Many of these characteristics are evidently related to each other and thus reduction to a few crucial ones is possible. According to Ver Eecke (1999), the ideal concept of public goods has only two factors that distinguish those from private goods: (1) they are "joint in supply", so that consumption by one person does not diminish the amount available to others (also called nonrivalness). (2) They are "nonexclusive" so that if the good is available to one person, it is automatically available to all others. This narrow economic interpretation of public goods helps to define two main problems of the public goods provision. The first problem is that if one person purchases public goods, others will also be able to consume the goods and thus take a "free ride". That arises the question of the "fair distribution" of costs – who must pay for public goods? The second problem is the optimal or at least suboptimal provision of the good. The possibility to free ride gives consumers an incentive not to reveal their preferences for the goods and hope that others will meet the costs of their provision. This result lowers the level of production less to than optimal from a societal standpoint. Pigou (1932) states that this constitutes an externality problem – marginal revenue and social marginal benefit is much higher than the marginal cost of production.

If our aim is to assess the possibility of private agents to provide public goods, then both factors need clarification. First, "jointness of supply" technically means that each of the next customers will not create any additional costs to the provider, thus

marginal costs of extention (MC_e) are zero. This doesn't mean that the second type of costs – marginal costs of production (MC_p) – are zero as well. But public goods are not free goods, and MC_p can be positive and decreasing. In the case of lighthouses, we have high fixed costs but also nonexistent MC_p. Thus a lighthouse is a perfect example of good that satisfies the first necessary condition from the definition of public goods.

Second, it is important to understand that "nonexclusivness" is not the same as the producers' inability to control exclusion (Snidal 1979, p. 541). If producers cannot control exclusion, the marginal cost of exclusion (MC_{ex}) is infinitely big. The level of MC_{ex} will depend on many aspects, but most of all the physical properties of the good and the social context of the consumption. The latter is a combination of social structure, government power and property rights. It is clear that the physical conditions of the lighthouse do not make exclusion a low cost activity. However, the social context – protection of the property rights facilitated by a strong powerful central force and enforcement of laws can lower the MC_{ex}. Thus even in such goods where physical properties will not make exclusion easy, it may be possible to exclude "free riders".

Conclusively the ideal type of public goods is defined by $MC_e=0$, $MC_p=0$ and $MC_{ex}=\infty$. Snidal (1979) states that if

$$MC_{ex} > MC_p, \qquad (2.1)$$

then no private attempt will be made to exert exclusion over the goods, since control over exclusion is more costly than the provision of the units themselves. Therefore all production in this range will be in terms of public provision. Theoretically, in the case of lighthouses, private provision is possible only when social context will totally take over the control of consumption, meaning that for a private producers $MC_{ex} = 0$. Thus the notion of control over the exclusion is the fundamental question and the existence of an authority system to enforce price exclusion is a vital question.

However the question remains – is the public control over price also enough to ensure economic efficiency in private provision of public goods? It is clear that any restriction on the distribution of the goods having jointness in supply that serves to restrict the extent of distribution of already produced units of those goods is suboptimal. Whenever $MC_{ex} = 0$, then, if there exists any potential consumer who has positive marginal benefit from the good, optimality requires that the good be extended to them. Thus the ideal price system from the efficiency perspective would be a system of perfectly discriminating monopolist who has perfect knowledge of the preference functions of all shippers. This system will grant Pareto efficiency and private provision of the lighthouses at the same time. How difficult is it to collect information about these preference functions? Generally

speaking not too easy, but we may use proxies because in ports there it is quite easy to acquire information on particular vessels, such as length, draft, gross tonnage, cargo, owner, etc. It should therefore be straightforward in terms of levying a charge on any such a ship entering a port (Baird 2004, p. 378). Those who refuse to pay such charges would be subject to legal proceedings brought against them.

Of course we may state that the Snidal condition ($MC_{ex} > MC_p$) does not pay any role to a public benefits created by the seamarks, ports and lighthouses in general. Public benefits such as the development of marital trade as a part of the creation of economic welfare, or public military interest related to territorial claims or mercantilist public benefits from greater territory, have not been included in the analyses. The "standard efficiency condition" related to large-number case is set by Samuelson (1954) that $\sum_{i=1}^{n} MRS_i = MRT$, where MRS_i is *i*'s individual marginal rate of substitution between the public goods and arbitrarily chosen private goods and MRT is marginal rate of transformation between the same goods. MRS can be interpreted as the disposable income the economy is ready to sacrifice for an additional unit of public goods (Bergstrom et al 1988). In large *n* situations "welfare calculus", like "Samuelson efficiency condition" demands, has a marginal analytic value, because of the subjective and dynamic nature of vital information. *Ex ante* predictions are hard or impossible to make.

However in some circumstances lighthouses could provide this additional utility to only certain restricted groups, such as local seamen or local village in general. Thus in some circumstances lighthouses can rather be club goods, which are excludable with congestion (Buchanan 1965). Buchanan (1975) suggests that in small groups organization and enforcement of efficient institutional arrangements for provision of such goods is possible, but rarely successful under a large *n*. Wicksell's unanimity rule (Buchanan 1975) also supports the argument that the free-rider motivation can be eliminated only when an individual is made aware that their own choice among alternatives does affect, and in some positive and measurable sense, the outcomes of others in the group, even if the membership is large. This of course leads us to the game theoretic definition of the public good dilemma.

To illustrate the need for institutions, Taylor (1976) established public-goods problems as prisoner's dilemma (PD) game where agents can state true preferences or lie about their rates of marginal substitution between public goods and an all purpose private goods. Taylor (1976) showed that if no binding contracts can be enforced between the agents, a nonoptimal equilibrium will results in which the public good would be underprovided. If there is no planner who has information about the preferences of the agents, then it is difficult to imagine that planner can organize the economy efficiently. Although, as is the case for Shubik (1973) and Hurwicz (1973), social institutions can have various rules of conduct that are

defined by the planner and whose definition determines different *n*-person games. This kind of institutional scholarship suggests that planners devising optimal allocating mechanisms will make agents reach towards an optimal equilibrium (Schotter 1981). This will lead us again to the idea, that for the private provision at least some kind of institutional mechanism is needed; either for (1) lowering or ceasing the costs of exclusion; or for (2) changing the game structure so that private agents have incentives to reach to the optimal allocation in PD framework.

3. Narrative: The Estonian system

Chronologically we can divide the Estonian lighthouse system into four periods: (1) The Swedish and Hansa period of foundation (from the first half of the 16th century till the end of the 17th century); (2) Private property under the Russian Empire (18th century); (3) Nationalization (19th century till the Estonian Republic in 1920); (4) State and private partnership (1920-1940). The division is initiated from an institutional ownership framework and has only analytic purposes. In all periods we are interested in special features of the system – ownership; who is the provider of service; financing (also administration of it); and initiation of the construction. The change in the general state structure can also initiate the quick alteration of the ownership structure, however the change may also be gradual; vested interest of agents and institutional setup can make quick changes impossible, thus presented chronology will not perfectly reflect change of political regimes.

3.1. Foundation

The earliest evidence of the first light-marks reaches us from the first part of 16th century. The ownership form of those is not that easily definable – most probably it was some kind of mixture of private and public.

In 1697 *Placat* announces Swedish rules defining punishments to local communities who damage drifted ships and sailors, showing that social evolutionary institutions – consuetude was not self-enforcing. However according to Spafarjev (1820, p. 10) there existed the so-called ancient *Stranda*, that was an informal institutional rule; according to which "rescue teams" (who where either owners of the private light-marks or local community members) received a part of the rescued cargo. The first indicates the public interest in marital affairs and the second the existence of the "global" informal rules. The economic development as an indicator of naval activity is probably vital here, because initiators of the building of the Kõpu lighthouse in 1531 was Hansa or more concretely the Revals Magistrate, and this encounters a flourishing era for the Hansa League. Kreem (2008) assures that in the case of Kõpu most of the finances came directly from Revals Magistrate, but if they were part of the taxes from the general city revenue is not known, although it is known that buoys mounted near Reval were financed by a separately levied tax. After the building of Kõpu the economic slowdown, that endured approximately a hundred years, started (Küng 2004, p. 19). This is

probably why there is no information about the operation of the lighthouse, and it may even be doubted if the light-mark was operational until 17 century (Luige 1982, p. 15).

Later the Swedish state became the initiator of building other sea-marks. Relying on Küng (2004, p. 21) we may argue that Hansa and other private merchandise became a state interest – competing with the threat of the Netherlands sea-monopoly; interest in increasing tariff revenues; and interest in creating a fleet and navy. Offering tariff abatements for Swedish ships was reactivating navigation and in 1646 building of the wooden lighthouses in Sõrve and Ruhnu was initiated. Permission to build lighthouses was given to local land owners and this regulation was in force till the 19th century and in the interest of local navigation probably also later. However, (as far as we know) in this period the initiators were Hansa, the City Magistrate or Swedish state; and local nobility only built-maintained and also received financing for their effort. As a matter of fact the cost of building and maintaining was high and was assigned to local peasants-bondservants for "optimization" purposes. Costs were financed by collecting light dues from local ports. Luige (1984) assures that all cargoes landing in Riga, Pärnu or Kuressaare were taxed, light dues were four state thalers[3] per ship.

A new economic boost in the Baltic Sea took place at the end of the 17th century, with the number of vessels under the "Estonian towns" flags increased almost tenfold (Küng 2004, p. 25). During the same era the cargo fleet of Estonian and Livland towns was founded (Küng 2004, p. 27). However, May (1936, p. 87) confines that in the year 1750, Estonia had only six lighthouses: Kõpu, Keri, Suurupi, Pakri, Sõrve and Ruhnu. The building of three of them – Keri, Suurpi and Pakri – can be enrolled to the "good old Swedish times". Keri or Kokskäri was ready in 1721, Suurupi was not fully ready until 1760, and the exact foundation date of Pakri is not known, but it was ready before Peter the Great died in 1725.

3.2. Private property under the Russian Empire

The 18th century is a new period in ownership-relations. All seamarks under the Russian Empire were officially subordinated to the Tsar State Admiralty, who became a new initiator of building new lighthouses. According to the 1721 Uusikaupungi Peace Treaty Kõpu, Ruhnu, Kolka (Domesnäsi situates in current territory of Latvia) and Vaindloo (Stenskäri or Seiskari was built by 1718) went under Russian supervision. At the same time, all of the aforementioned lighthouses, excluding Vaindloo, still remained under the well known Swedish-Baltic nobility, Osmussaare (built in 1765) was finally given to the state only at the beginning of the 19th century (Luige 1984, p. 28) and Kõpu even later. The institutional structure probably remained unchanged as a part of concessions the state made to the local nobility for their support (Laur 2000, p. 31). Till the 18th

[3] According to Vanamölder (2007) this was approximately the price of 25 kg of wheat.

century there was no major change in this so called Baltic special-order and only laws, which were not antagonistic to the local confirmed privileges, were applicable in the Baltic territory (Laur 2000, p. 203). According to privileges, half of the light dues collected from cargos were distributed to the owners (Luige 1984). Light dues were probably collected in custom offices which according to Laur (2000, p. 60) were located in Pärnu, Kuressaare, Tallinn, Haapsalu and Toolse.

The customs-officials were not subordinates of the provincial government; and whereas the importance of tolls among state revenues was substantial, the size of the bureaucracy of customs was remarkable. Although in all other state-institutions the working language was still German, in customs it was Russian (Laur 2000, p. 62). At least some orders were taken directly from the "central government", for example in 1723, the decree of Peter the Great ordered that in dark nights the lights must be ignited only when their "own" ships were on the sea (Luige 1967, p. 27). Economic policy preferred Petersburg's port to Riga and Tallinn, also custom tariffs and bans on grain export diminished the amount of cargo remarkably (Laur 2000, p. 173-176). Probably existing lighthouses still operated. And privately run lighthouses were still operated – equipped with wood and lights maintained – as a natural burden by local serfs (Aitsam 1937, p. 26). For meeting operation costs, owners received direct allowances from the state and/or according to the contracts still half of the light dues were distributed to owners. Aitsam (1937, p. 27) states that in the case of Kõpu, there was a contract, according to which 3000 roubles were paid annually for the maintenance of the lighthouse. Predictably the contract was due even until 1910. In addition all kinds of renovation expenditures were met separately (Ibid).

During the second part of the 18th century only one more lighthouse was privately built – Osmussaare (May 1936, p. 87). The first twenty years of the 19th century gave a boost to public lighthouse building

3.3. Nationalization in the 19th Century

The reign of Catherine II also brought changes to the so called Baltic special-order, which had been tolerated for a half of a century. Attitudinal change resulting from the legal change in Baltic affairs also gave ground to alterations in lighthouse legislation. "Global" ideological change probably also played a role: in Britain, an ideological change against private profit earning was emerging (Taylor 2001, p. 750). There were also some bureaucratic changes as Leonti Spafarjev was appointed as the Head of Lighthouse Supervision and stayed in the position for 35 years (Luige 1984, p. 38). Spafarjev called for many changes and reorganizations. All publicly owned sea-marks located in Estonian territory were divided into two expeditions of Kronstad and Tallinn. The rest of the lighthouses (e.g. Kõpu, Ruhnu and Osmussaare) were probably privately run. Spafarjev stated that lighthouses in private hands were unsafe, had obsolete technology and hindered safe navigation (Spafarjev 1820, p. 10). In addition, he condemned the ancient *Stranda*, which

delegated part of the cargo to the saviours: “This rule can be efficient only accompanied by affection to fellow man and sense of righteousness, which must dominate over greed” (Spafarjev 1820, p. 9). The military aims must also not be underrated, as there were accusations that the light-ship crews are not sufficiently state-minded (Dampf 1935). In 1805, Spafarjev was ordered to compile data for budgeting the building of new lighthouses. According to Luige (1967, p.28) Admiralty-department decided among other things also transfer Kõpu from private hands to public ownership. The grand plan of Spafarjev’s was almost completely implemented. During the first twenty years of 19th century, 13 public lighthouses were built, the majority of Finnish and Riga Gulf lighthouses were renovated, and also two light-ships were manned.

In 1807, the majority of lighthouses went to public hands (Mey 1936, p. 86), but private lighthouse ownership did not disappear completely. Mey (ibid) states that two Kolka lighthouses, which according to the old Swedish privileges from 1608 belonged to Duke Osten-Saksen, remained the owner’s. Aitsam states (1937, p. 27) that Kõpu also stayed in private hands and its owner Duke Unger-Sternberg possessed also two additional lighthouses - Paralepa and Hobulaiu (Tallinna Kinnistusamet 1939). There were probably some other local sea-marks or lighthouses, that have been noted in Duke Nolcken’s correspondence (Nolcken 1923, Nolcken 1926) about the Postrova lighthouse in the Alatskivi manor (at the shore of lake Peipsi).

At the end of the 19th century, there were about fifty lighthouses and sea-marks. By then, new technology of metal construction prevailed. The first concrete lighthouse was constructed at Viirelaid (Paternoster) in 1857, followed by new lighthouses of Keri (1858), Vormsi (1864), Kihnu (1865), Virtsu (1866), Vaindloo (1871) and Tahkuna (1875). All aforementioned were public premises. There is data about building at least two private lighthouses during this period – in 1840, Ungern-Sternberg built a lighthouse and a keepers-house (later a pub as well) in Harilaid. One wooden lighthouse in Käsmu (1891) was initiated by the local community, financed from fines collected from drunk captains (Luige 1982, p. 49).

3.4. State ownership during the Estonian Republic

The Estonian Republic placed the Department of Waterways (under Transport Ministry) in charge of the maintenance of lighthouses. All private lighthouses belonging to the local Baltic nobility were nationalized together with accompanying manor lands. After nationalization and reallocation of the manor lands, some sea-marks remained on the privatized lands. These lighthouses (Paralepa and Hobulaiu) were separated from the farms and compensated by the state (Tallinna Kinnistusamet 1939). Renationalization of land under sea-marks lasted until 1939 (Riigikantselei toimik 1939, 1940).

According to payrolls from 1920, the Lighthouse Department had thirty four lighthouses in addition to pilot and rescue-ports. The Lighthouse Department became a contractor to private firms, technical supervision remained the responsibility of the Department of Waterways. In 1934, instead of continuing a private-public partnership, a state brigade started to build and renovate lighthouses. During the following eight years, this brigade built twenty five reinforced concrete lighthouses (Luige 1982, p. 72).

The revenues of the Department of Waterways came from port dues. According to *Riigiteataja* (1924), differentiated port dues were collected from foreign and domestic vessels, as well as from sailing, steam or motor ships. Port dues consisted of pilotage, lighthouse and cargo fees; also dues for lifesaving, for sailors' retirement homes, for social security, for ice-breaking, for fresh water, and for winterization. Light dues were only paid in the first port in the territory of Estonia and were not dependent on the number of visits to other ports. Light dues were dependent on pilotage, and domestic vessels paid annually for eight voyages, foreign-going vessels for four voyages. Depending on the aforementioned criteria, light dues stayed in between 0.24 to 0.3 golden francs[4] for each net registered ton of cargo. In 1924 port tariffs changed only marginally the arrangements that had been set in 1921 (Riigiteataja 1921).

Although all lighthouses belonged to the state, some private ports remained: Kunda, Tallinn-Beckeri, Tallinn-Balti Shipyard and Kärdla port. State covered costs related to sea-marks also in private ports (Kõpu 1930). All lighthouse servants were on the state payroll, and had long term contracts. In 1930, there was a political initiative to transfer fourteen "strategic" lighthouses under the supervision of the Defence Ministry and substitute life-time servants with soldiers, but this proposal didn't find support in the Senate (Riigikogu kantselei 1930). In state ports, pilots were also on the state payroll, but private pilots in Harilaid and Kärdla were probably also self-employed, because they can not be found on the state payrolls (Kõpu 1930).

On 15th May 1940, the Soviet Military Commendatory announced to the Estonian Government that according to the Molotov-Ribbentrop pact they would take over the following lighthouses: Pakri, Osmussaare, Tahkuna, Ristna, Kõpu and Sõrve (Sõjaministeeriumi toimik 1940). In addition, a few months later, a telegram was sent letting the Government know that the Soviets have the intention to also take over the lighthouses in Suurupi, Naisaare, Keri and Juminda. Later many other lighthouses were also handed over.

The Department of Waterways was liquidated on the 1st January 1941, and all its responsibilities, excluding military holdings in the above-mentioned lighthouses, went to the newly created agency of *Merelaevandus* (Luige 1967 p. 35). At that

[4] This was approximately the price of ½ kg of butter.

time, there were 140 different sea-marks for navigation purposes in Estonian waters: 117 lighthouses, 20 light-buoys and 3 light-ships (Luige 1967, p. 36).

4. The Lighthouse Game

Non-cooperative game theory is typically used to explain the prisoner's dilemma characteristics in the public goods' dilemma (Schotter 1981). The illustration of a free-rider problem in a 2×2 matrices indicates that the players' optimal strategy is to hinder information about their true preferences in public goods. Non-cooperative games are also used in experiments, where different aspects of the dilemma are studied. Dawes (1980) showed the role of small groups; Maxwell and Ames (1980) and Axelrod (1984) indicated the vital role of repeated action; Schwartz-Shea and Simmons (1993) presented the importance of framing; and Turner (1981), Kramer and Brewer (1984) introduced the role of group identities. In experimental games the PD is typically presented via return function – choices of the individuals are contributions to the cost and payoff functions depends on the total contributions of the players (Goetze 1944:66). Experiments also indicate that the credible threat of punishing will solve the under-contribution problem in the public goods games (Noussair and Tucker 2005, Bochet et al 2006). However there are not many empirical papers, besides experimental ones, which rely on non-cooperative games. Bates et al (1998) starts almost a methodological innovation in this area. One of the proposals of this methodological "new wave" is to use structural solutions in explaining empirical phenomena. Structural solutions change the rules of the game through modifying the social dilemma (Swedberg, 2001). Altering payoff profiles, affecting available strategies or including players – all these belong to the toolbox of structural solutions. The current model follows the "new wave".

Our lighthouse game, as a public-good provision game, is a PD where two players, "private owner of the lighthouse" (*lighthouse*) and "ship owner" (*ship*), both have two options. The *Lighthouse* can provide either credible or non-credible service, and the *ship* may pay light dues in the nearest port or evade the due. The credibility of the lighthouse has been an empirical problem mentioned in all eras of our narrative and is considered one of the main reasons for public interference by Spafarjev (1820). Also commonly told stories about shore-robberies and false lighthouses were common even continuing up to the present, supported by Otzen-Hansen (1884) and Aitsam (1937). The *Ship* has the classical choices of a free-rider – to pay or not to pay. Payoff profiles indicate possible interdependent mutual payoffs related to the benefits from service and related costs of providing goods or paying for it. In figure 1: b_1 are the *lighthouse* benefits paid by the *ship*; $c(t)$ indicates the costs of providing credible service, where t stands for technology; C is the fixed costs of providing "false lights" and b_2 are benefits to the *ship.*

In such a game both players have a dominant "action" and the game has a Nash equilibrium in payoff profile $(-C; 0)$, indicating that the *Lighthouse* will provide non-credible service and the *Ship* will not pay. Of course this classical Prisoner's dilemma result is not Pareto efficient. Both parties are kind of trapped into bad outcomes, instead of credible service and payment they both optimize and lose. A normal form game assumes that players act simultaneously, but even if we add a time element to the game, and assume that payment is made after the credibility is checked, we end up with the same result. Technically speaking – the prisoner's dilemma will not allow an easy solution by making games extensive. A time element can allow a ship to assess the credibility of a *lighthouse* service in the first stage and hence the *ship* can make the payment decision in the next port. Unfortunately the time element will not get us out of bad outcomes. However the normal form or extended form setup of the game demands that players have one-time interactions only. In repetitive setup, where interactions are frequent, all kinds of strategic outcomes are possible. Axelrod's (1984) optimistic standpoint about the human ability to cooperate in repetitive games is well known. However, in our case a close face to face interaction is not taking place and the credibility of such reputational or strategic solutions is questionable.

		Ship	
		Pay	Not pay
Lighthouse	Credible	$b_1 - c(t); b_2 - b_1$	$-c(t); b_2$
	Not credible	$b_1 - C; -b_1$	$-C; 0$

Figure 1: The lighthouse game

Structural solutions involve, for example, a change of rules of the game by changing rewards or punishments related to the game which allow players to change their behaviour toward more cooperation or by changing the structure of the game directly by adding or subtracting the players (Rittberger 2003). This "third party" can be either some social norm, which will affect payoff profiles of the players, or more formalised institutional body, e.g. government or some other body that can protect property rights and enforce contracts (Van Vugt 1998). This "third body", which will simply be called the *institution*, can implicitly affect the structure of the game directly or through payoffs, in both cases *ex post* payoffs will be affected. Also we assume first that the institution itself has no preference order, although the latter in the case of an institution widely defined – institution as an organisation – we make the institution explicit. In the first step we add a narrowly defined institution according to North (1990) – institutions are the rules of the

games – which have no preference order of their own. Thus we can still use the 2×2 normal form game structure (see Figure 2).

		Ship	
		Pay	Not pay
Lighthouse	Credible	$b_1 - c(t) + r; b_2 - b_1$	$-c(t) + r; b_2 -$
	Not credible	$b_1 - C; -b_1$	$-C; -p$

Figure 2: The lighthouse game with rewards and punishments

In Figure 2 we add punishment and rewards to the *lighthouse game*. Let us assume that a credible provision of the lighthouse service will be rewarded by some fixed amount r and not paying by threat of legal punishments (or community punishments) is indicated by p. If $r > c(t) - C$, where r is some type of reward for a provision of the good, then a non-credible provision will be the dominated action, but it makes "not pay" a rational temptation. Thus we need another instrument to make payment credible. If $p > b_1$, where p is some sort of punishment for not paying, then such a game has a self-enforcing property – players will reach to the Pareto efficient outcome and the properties of the prisoner's dilemma are lost. From the *state* perspective, the game has a weakly dominated Pareto efficient equilibrium when:

$$\begin{matrix} r \geq c(t) - C \\ p \geq b_1 \end{matrix}, \qquad (4.1)$$

indicating that *the state* has to provide the private body a reward, which is at least as big as the difference in the costs of operating a credible service. Assuming that C indicates fixed costs of building and $c(t)$ indicates the total costs, then the reward must be at least equal to the variable costs of providing the lighthouse service (although these variable costs are not affected by quantity of ships consuming the service and still MC=0), plus the costs of extension. In the late medieval and early modern age, where technology (t) gives local landlords comparative advantage in running the operation of the lighthouse compared to some central (merchant or city) institution, it is imminent that expected rewards could have been relatively lower. Technological change affects the optimal combination of capital and labour, so that more technology specific capital and labour was needed for building a lighthouse – first in the late 19th century with the Gordon system and later in the early 20th century when reinforced-concrete was used. This gave a comparative advantage to specialised units for constructing a

lighthouse. So the private costs for building a lighthouse went up despite $dC(t)/dt < 0$.

If the conditions (4.1) are satisfied, then the punishment (*p*) is just a credible threat and that is why we are not able to indicate any narratives related to punishing the ships that didn't pay light dues. Although payment $b_1 \leq b_2$, indicate that if ships have "subjective" preferences and benefits from the service, then payment must also be discriminating among them.

Now we take one step further and make the preferences of the state explicit. We assume that *the state* has certain military or trade growth related preferences to control the provision of the lighthouse service – assuming that the state has clear preferences that a certain efficient amount of lighthouse services have to be provided. This can be accomplished through private or public provision. In the first stage of the game *the state* just observes the choices of *the lighthouse,* who can either provide an efficient (E) or not efficient (NE) amount of service. In the second stage of the game *the state* can, in the case of NE, provide goods on its own or create institutional support for efficient private provision. In the third stage *the lighthouse* makes again its choice over efficiency of provision and then the game is over (Figure 3).

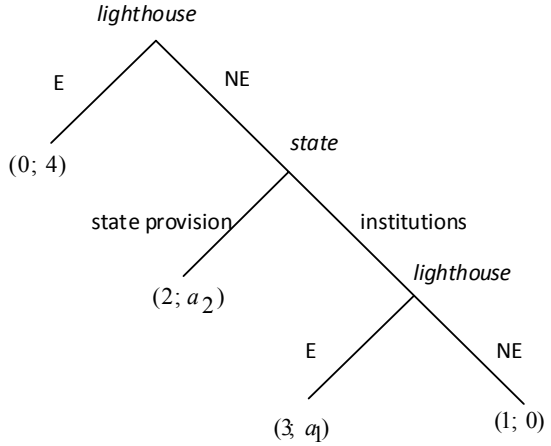

Figure 3: *The state* and lighthouse game

Payoff profiles in the state and lighthouse game indicate cardinal utility coefficients. In the first stage *the lighthouse* has a certain incentive to choose NE and in the last stage *the lighthouse* will choose E. Thus the subgame perfect Nash equilibrium will depend on the relationship between a_1 and a_2. If $a_1 > a_2$, then *the state* will provide the institutional framework described in the "lighthouse game" in Figure 2, and the game will end up in the third stage by $(3, a_1)$. But if

$a_2 > a_1$, then *the state* prefers to provide public lighthouse services and the game ends in the second stage. The ideological change – the alternation of the importance of military power, trade dominance or other chauvinistic attitudes of the state – will also affect the preference ordering over a_1 and a_2, and thus affect *the state* strategies. Although it is worth mentioning that *the state* has no dominant strategy in this game and *the lighthouse* has a weakly dominant strategy NEE, which makes NE the optimal choice in the first stage and E in the last stage, independently from other player choices.

5. Back to the narrative – Discussion

Summing up the results of the previous section, we may say that the private provision of lighthouse services is possible only when there is some institutional frame to support private activity. This institutional support must have two components – a credible threat to punish shirking ships and a reward system for private providers to lower the costs of provision. The latter is consistent to the Snidal condition (2.1). The extended form game in figure 3 also indicated that if the state has their own preferences over possible outcomes it may not provide institutions for efficient operation of private sector, but rather provide lighthouse services publicly. Now we turn back to the narrative to confirm that theoretical founding can be verified.

Our four-period description of the Estonian lighthouse system shows that lighthouses were never purely publicly provided nor purely privately provided. In Figure 4 we are using the structure of Van Zandt (1991) poles, where the public-private dilemma is not a dichotomy, but divided into certain poles: (1) private provision with no government enforcement; (2) private provision with government enforcement of property and contract rights only; (3) private provision with government fixing rights, granting monopolies and enforcing collection of specified user levies; (4) government provision from collection of specified user levies; and (5) government provision from general revenues.

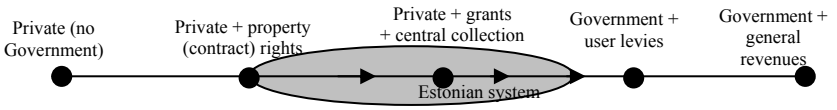

Figure 4: Estonian system and Van Zandt (1991) poles.

We see that historically the Estonian system has moved step-by-step from a private provision with a central collection of grants and some state initiative over allocation of public goods to a public provision. At the same time the system never reached the extreme – lighthouses were not financed from general revenues. At the same time the government played a substantially greater role in the provision of

lighthouse services than Coase's term "private" suggests, the same is shown by Van Zandt (1992, p. 48). Of course we may argue that almost every market needs some kind of institutional support and in this regard enforcement of property rights may not be a substantial government involvement, and this is not worth mentioning in the lights of Nozik's (1974) minimal state definition. Of course Nozik (1974) and others (Ellikson 1991, Umbeck1981 and Van Zandt 1991) show that the private provision of property rights is possible and is a historical fact, but in our case we see that the government has played a certain kind of regulatory or initiative taking role in every period – declaration and collection of lighthouse dues.

The theoretical model gives the explanations why the system moved towards a more public provision – this was due to technological change and "public" interests. "Public" interests were military and naval ambitions of the Russian Empire which emerged during Peter the Great and also had some element of distrust to the Baltic nobility. These features weakened after Peter's death and re-emerged during Catherine the Great's reign. During the Estonian Republic the cost argument due to technological change to the Gordon system and later to the reinforced concrete constructions, justifies the change. The public ownership during this period was mainly the result of historical consequences – nationalisation of all land holdings of Baltic nobility.

Comparing the stake and structure of public institutions in lighthouse affairs (figure 5) we see that periods have differed. We subtract five characteristics of the provision process – (1) who made the decision over building the lighthouse (initiative); (2) who was the legal owner of the asset (ownership); (3) who collected and declared levies (collection of levies); was the production financed by actual consumers or from general revenues (user levies); and who operated the lighthouse (operation). In the figure the origin of axes (zero) stands for private provision and the end of axes (one) for public provision.

Period I is a foundation period (described in Section 3.1); period II is a period of private property under Russian Empire (described in Section 3.2): period III is a nationalisation period in the 19th century (described in Section 3.3); and IV period is a state ownership period during the Estonian Republic (described in Section 3.4). In period I there are two characteristics provided by the state – initiative and collection of lighthouse dues levied from the ship. In period II there is already some state ownership and only private initiative taking. In period II most of the initiative, approximately half of the operation and ownership, was public. In the last period only user levies were still paid by private consumers. So periods differed by the institutional framework provided by the state. Only the collection of lighthouse dues by custom officials in the ports was common to all periods. So the cost of exclusion for private providers was zero in all periods, which is also consistent to the Snidal (2.1) condition. In period I the foundation of an impersonal "lighthouse market" was mediated by the Hansa league or the city council of Reval, the city which mainly benefitted from eastern Hansa trade. Also the

initiative over questions, such as where to build and how to operate, were in central hands.

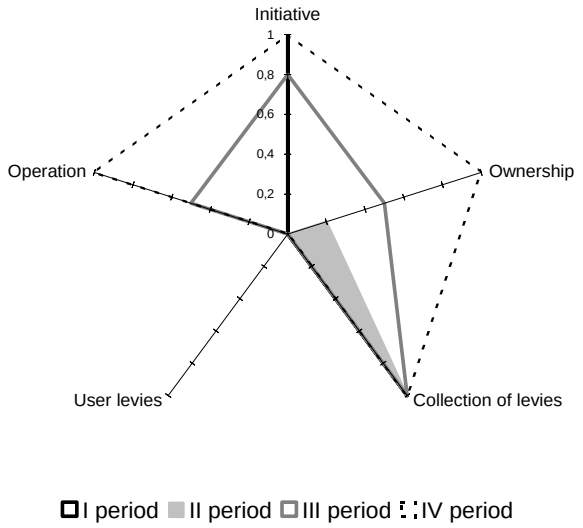

Figure 5: five characteristics of the institution (0-private; 1-public).

Basically the central body only contracted out building and operation by offering light dues or a proportion of it. During the early "Russian days" in Estonian territory the persistence of the previous system lasted, although Peter the Great recognised the military importance of lighthouses, but he died in 1725 being able to govern the territory for only 4 years after the peace treaty. Instability of the state erased private and state initiatives of building new lighthouses. Only at the beginning of the 19th century did the state take the initiative of organising lighthouse affairs, this also brought along many new lighthouses and an attempt to take over some private ones. However the legal system protected the property rights of the local nobility and despite of the preferences the state was not able to take control of all the lighthouses. Still some private lighthouses were built on private land. The Estonian Republic nationalised the lighthouses and the state also provided the service, although there was some private contracting in building lighthouses in the early days of the republic. Also it is interesting to draw attention to the system of lighthouse levies – price discrimination between domestic and local vessels, by tonnage and by type and power of engine. Assumable this kind of pricing has historical roots and this indicates that a private system might have been efficient.

6. Conclusions

Until recently many policy-makers argued that "public goods" must be provided by the government if they are to be provided at all. A revisionist Coase (1974) article showed that lighthouse services were, in fact, provided by private enterprise for an extensive period of human history. This public-private dilemma is our main interest and we seek for the analytical narrative to present a mechanism which will allow public goods to be provided privately.

The typical features of public goods that make them market failures are: "jointness of supply" or nonrivalry and non-excludability. The first feature creates a problem of free-riding and the second that private owners have technical or legal difficulties of controlling exclusion. The first problem is related to pricing – make "consumers" responsible, or simply – how to make ships pay, because any free-riding will make the quantity provided suboptimal. This also raises the question of technological improvement and innovations, which are considered to be an imminent side-effect of the competitive market. The second problem – control over exclusion – is not supported by natural characteristics of the lighthouse. But this does not mean that control can not be executed. For the private agent it can be related to high cost, but for the powerful agent like government the execution of property rights and management of pricing system can be much lower in cost, if it already has a supporting institutional structure – custom officials in ports, legal and other power structures for protection of property rights.

However the definition of "public goods" does not require *a priori* government involvement. And this is shown in the British examples by some authors (Coase 1974, Taylor 2001) and in the current Estonia's historic case as well. Until 1836 many of England's lighthouses were privately owned (Taylor, 2001, p. 749) and the same applies to Estonia until the 20th century. At the same time we may say the government played a substantially greater role in the provision of lighthouse services than Coase's term "private" may-be suggests. Our Estonian system shows that some government institutional involvement was present in all the different historical periods, the same has also been shown by Van Zandt (1992).

Our lighthouse game showed that the private provision of the credible lighthouse service is problematic. Probably the same *rationell* also inspired fiction by the telling of false lighthouses stories of Hiiumaa (Otzen-Hansen 1884), which as stories told attracted ships to the reefs. The prisoner's dilemma type of game has devastating results – no credible service can be provided. Game theoretic analysis suggests that private provision is possible only when there is a certain institutional framework – rewards to private agents and credible threats of punishments to the ships. Thus there may-be some agreement with Snidal (1979, p. 550), that even when there is no control over the exclusion of the good itself a central agency capable of charging consumers for provision of the good, can lead to a more optimal provision of public goods. Is the government ready to provide this

institutional framework for private agents is a different question. It can be shown that government preferences can make them provide lighthouses publicly.

The narrative shows that according to Van Zandt (1992) we may say that the Estonian case shows, that instead of private and public dichotomy, there is a continuum between poles of pure private provision to full government provision. The latter, in extreme, can be financed from general revenues, which has not been the case in Estonia, at least not till the occupation by the Soviets. Our historic case, from period to period, slipped from private provision with government enforcement of property and contract rights, only during Hansa times, to government provision, accompanied with collection of specified user levies, during the Estonian Republic. In between there was some kind of mixing that allowed private and public provision simultaneously.

The question what kind of "pole" society, where government has no ideological preferences, chooses dependent on two factors – technological conditions and institutional path-dependent framework. First, let us concentrate on technology. Technology defines the efficient combination of manpower and capital needed for construction and operation of the lighthouse. It is clear that the local nobility had cheaper management and labour costs back in history. Of course this advantage was diminishing in time because new technology needed more information and asset-specific labour skills. Also Luige (1982, p. 73) assures that the specialized state brigade was 40% more cost effective than private sub-contractors in building reinforced concrete lighthouses. Private provision is thus possible only when costs of providing lighthouse services are relatively low and, as the model shows, state "reward" finances, at least exclusion costs of provision, the service.

The second important factor is the historic path-dependent institutional arrangement that can either support or restrict the private provision. This institution can be either formal or informal. Informal arrangements that help organize navigation have a long evolutionary path and can be summarized nowadays in "seaman ethics" and marital law. But even more important is that governments have provided certain services of the lighthouse owners, for instance burning regulations; setting and enforcing a fixed schedule of light dues and assisting in collecting these dues. This kind of "rewards" decreased the cost of private provision and made it possible after all. Thus we may also say that private operators have provided a cheaper technology in provision of the service and government in provision of tax collection and other institutional setting. In the previously discussed model this kind of reward can take different forms – help in collecting light dues; punishment of the ships that shrink in payment; provision of information about light dues and other important matters as what kind of light is burning and at what time, but also more direct help like financing of the building.

It is also important to state that besides a reward system some kind of punishing mechanism for ship owners is also needed. Our historic case was not able to

indicate any punishing instruments and as a model proposes a punishment institution as a credible threat, that makes ship-owners to pay light dues.

The Estonian lighthouse system ensures that the debate private *versus* public provision is not a black and white institutional choice; rather there is a kind of mixed system in which the government provides specific services that can help or restrict the private provision of lighthouses. Thus any type of narratives from history or any others are complementing the theoretical principles for explaining institutional choices needed for the private supply of public or semi-public goods. We hope that the current paper will encourage interdisciplinary research and make analytical narratives a tempting methodology in social sciences.

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Kokkuvõte

TULETORNID EESTIS: "AVALIKE KAUPADE" PAKKUMISE MEHHANISM

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Käesolev artikkel kuulub avaliku sektori ökonoomika valdkonda, kitsamalt käsitletakse mehhanisme, mis võimaldaksid erapakkujal toota avalikke kaupu. Hüpotees, mida kontrollitakse, on järgmine – kas erainitsiatiiv suudab luua efektiivsel määral avalikke kaupu? Ning kui hüpotees ei leia kinnitust, siis milline peaks olema mehhanism või institutsionaalne maatriks, mis seda tagaks? Mehhanismi või institutsionaalse maatriksi all peetakse silmas riigipoolset „abi" turgudele ehk kombinatsiooni omandiõiguse kaitsest, seadusandliku korra tagamisest ja finantstoetusest.

Artikli teoreetiline raamistik kasvab välja debatist, mis saab alguse Coase (1974) artiklist, kus pannakse peavoolu ökonoomika seisukoht kahtluse alla. Peavoolu ökonoomika (õpik) kasutab tuletorni näitena puhtast avalikust kaubast ja eeldab, et selliseid kaupu tuleks riiklikult pakkuda, või vähemasti nende tootmismahtu riiklikult reguleerida ja „tellida" need kaubad riigieelarve tulude arvel. Coase (1974) näitab Briti tuletornisüsteemi ajaloolise kirjelduse abil, et tegelikult on tuletorne aastasadade jooksul ehitatud ja käigus hoitud erainitsiatiivil. Siit jõuamegi teoreetilis-empiirilise konfliktini. Arutelu olemasoleva kirjanduse üle nõuaks kõigepealt avaliku kauba selget definitsiooni. Kombineerides erinevaid olemasolevaid lähenemisi (näiteks Head 1974, Samuelson 1954, Buchanan 1975), jõuame optimaalse definitsioonini: (a) avalike kaupade tarbimine on mitterivaalitsev (ühe tarbimine ei vähenda teiste võimalusi tarbida); ja (b) välistamise võimatus (kui kaup on kättesaadav ühele, on ta kohe kättesaadav ka teistele). Siit koorub ka põhiline probleem: nn „tasuta sõitmine" ehk tarbijatel puudub ajend selliste kaupade eest maksta. Lisaks toob tasuta sõitmine kaasa nn informatsiooni varjamise probleemi – tarbijal ei teki ajendit oma eelistusi avalike kaupade osas välja näidata, lootes, et seda teeb (ja ka kaupade eest tasub) keegi teine. Seega jääb teoreetiliselt turumehhanismi abil pakutavate avalike kaupade hulk väiksemaks, kui see oleks sotsiaalselt efektiivne (kui selliseid kaupu üldse pakutakse).

Artikli metoodikast: kasutatud on mittekonventsionaalset lähenemist majandusteoorias – analüütilist narratiivi. Selle mõiste toovad metoodilisse debatti Bates, Greif, Levi, Rosenthal ja Weingast (1998) oma samanimelises raamatus. Meetod on loodud ühendamaks neid sotsiaalteadlasi, kes kasutavad kvalitatiivseid empiirilisi andmeid, kuid neid kasutatakse leidmaks üldisemaid seaduspärasusi läbi mänguteooria mudelite. Põhiliselt kasutatakse analüütilise vahendina laiendatud

vormi mänge. Meetodi raskuspunkte on kaks: (a) allikate ekspertiisil põhineva loo (narratiivi) koostamine; (b) mudeli loomine, mis kajastaks tekkinud mängu-situatsiooni. Meie artiklis on narratiivi aluseks peamiselt arhiivimaterjalid, kuid ka teisesed allikad (mälestused, intervjuud, nopped kirjandusest). Artikli analüütiline osa defineerib kõigepealt probleemi läbi mänguteooria vahendite – normaalvormi mängu – ja näitab, et probleem ei ole lahendatav (erainitsiatiivil pakkumist ei saa olla) ilma mängu struktuuri muutmata. Mängu struktuuri on võimeline muutma vaid mingi „ülimuslik" võim või institutsioon, meie juhtumi korral nimetame seda kokkuleppeliselt „riigiks".

Narratiivist: kui Coase näitas, et Briti ajaloos on märkimisväärne arv juhtumeid, kus „tuletorninduses" on domineerinud erainitsiatiiv, siis meie näide on veidi erinev. Võib ka väita, et tõlgendame erinevalt seda, mida me ajaloost teada saame, ehk küsimus ei ole tihti vaid omandisuhtes, vaid ka laiemas institutsionaalses raamistikus. Meid huvitab: (a) kelle initsiatiivil hakati tuletorni/e ehitama; (b) kes (era/avalik) ehitas; (c) kelle omandusse jäi tuletorn; (d) kes maksis teenuse eest; (c) kes määras hinna ja kuidas maksmist administreeriti. Nendele küsimustele erinevaid vastuseid saades jaotasime ajaloolise narratiivi neljaks osaks: 1) Süsteemi rajamine; 2) Eraomandus Vene impeeriumi ajal; 3) Natsionaliseerimine 19. sajandil; ja 4) Riigiomandus Eesti Vabariigi ajal.

Süsteemi rajamine sai oletatavasti alguse 16. sajandi esimesel poolel. Tulemärgid ei olnud küll päris tuletornid, ka võib eeldada, et omandi mõttes oli seal nii ühte kui teist (eraomanikke, munitsipaalomandust, seltsiomandust). Kõpu tuletorni hakati ehitama 1531. a. Tallinna Rae ja Hansa initsiatiivil. Torni ehitamine jäi majanduslanguse (Hansa venesuunalise kaubanduse lõppemise) tõttu pooleli, torni omanikuks jäi ehituse organiseerinud mõisnik. Hilisemal ajal sai ehitamise initsiaatoriks Rootsi riik, kelle kaubanduslikud (ja ka sõjalised) huvid põrkusid Madalmaade huvidega. 1646. a. ehitati Sõrve ja Ruhnu puittornid. Ehitasid kohalikud mõisnikud, kes said selleks raha tellijalt. Riik finantseeris ehitust omakorda tuletornimaksudest, mida koguti kohalikest sadamatest. Kaubalaevad, mis randusid Riias, Pärnus või Kuressaares, maksustati kindlasummalise maksuga. Uus majanduskasvu periood oli 17. sajandi lõpus. Siiski võib allikatest leida, et 1750. a. oli Eesti territooriumil vaid kuus tuletorni: Kõpu, Keri, Suurupi, Pakri, Sõrve ja Ruhnu. Arvatavasti olid need kõik eraomanduses.

Teine periood – eraomandus Vene Impeeriumi ajal – algas 18. sajandil. Kõik meremärgid, sh tuletornid, läksid formaalselt tsaaririigi admiraliteedi alluvusse. Samas läksid Uusikaupungi rahulepingu kohaselt ka Kõpu, Ruhnu, Kolka (tuntud ka kui Domesnäsi) ja Vaindloo (tuntud ka kui Stenskäri või Seiskari) riigi käsutusse. Tegelikkuses jäid omandisuhted muutmata (va Vaindloo puhul) ja omanikeks jäid endised rootsi-balti parunid. Ilmselt jäi see nii, kuna Vene Tsaaririik otsis kohaliku aadelkonna toetust, säilitades nende rootsiaegsed privileegid. Kuni 18. sajandini säilis nn balti erikord endisel kujul. Endiste privileegide kohaselt läks pool riigi poolt kaubalaevadelt kogutud tuletorni-

maksudest omanikele. Ilmselt korjati tuletornimaksu tollimaksude ühe osana Pärnu, Kuressaare, Tallinna, Haapsalu ja Toolse sadamates. Tuletornide käigushoidmine jäi endiselt eraomanike hooleks. Ilmselt maksti neile eraldi ka hooldustasusid ja remonditasusid (vähemasti Kõpu tuletorni puhul). 18. sajandi teisel poolel ehitati erainitsiatiivil vaid üks tuletorn (Osmussaare). Oluliselt muutus olukord 19. sajandil.

19. sajandi natsionaliseerimise periood saab alguse muutustega balti erikorras, mida initsieerib Katariina II. Võib oletada, et erakasumivastane meeleolu võttis maad ka laiemalt, näiteks kattub natsionaliseerimine ajaliselt Inglismaal toimuvaga (Taylor 2001:750). Olulised on ka bürokraatlikud muutused. Tuletornide Järelevalveameti etteotsa määratakse Leonti Spafarjev, kes jääb sellele positsioonile 35 aastaks. Spafarjev moodustab kaks jaoskonda: Kroonlinna alluvusse lähevad Kotlini, Vaindloo, Suursaare tuletornid ja Revali alluvusse Keri, Suurupi, Pakri ja Sõrve. Võib eeldada, et ülejäänud tuletornid (näiteks Kõpu, Ruhnu, Osmussaare jne) on eraomanduses. Spafarjev kurdab, et eraomanduses olevad tuletornide tehnoloogia on vananenud ja nad takistavad ohutut meresõitu (Spafarjev 1820:9). 1805. a. otsustabki admiraliteet, et tuleb ehitada rida uusi tuletorne, rekonstrueerida olemasolevaid ja ühtlasi ka natsionaliseerida Kõpu tuletorn (Luige 1967:28). Spafarjevi plaan viiakse peaaegu muutusteta ellu. Ehitatakse 13 uut tuletorni ja Mey (1936:86) väidab, et enamik tuletorne Eesti territooriumil on riigistatud. Samas ei ole see eraomandi lõpp. Eraomandisse jäävad kaks Kolka tuletorni ja ka Kõpu. Lisaks Kõpule kuulub krahv Unger-Sternbergile tuletorne ka Paralepas ja Hobulaiul. Arhiiviallikate põhjal võib väita, et eraomandusse jäi ka Postrova tuletorn Peipsi rannikul. Kokku on 19. sajandi lõpuks Eesti territooriumil ligemale poolsada tuletorni või tulemärki. Samal ajal toimub tuletorniehituses tehnoloogiline muutus – kasutusele võetakse raudbetoon. Sajandi lõpul ehitatakse riigi poolt uue tehnoloogia järgi mitmeid tuletorne (tuntumad on Kihnu, Vormsi ja Tahkuna). Samal perioodil ehitatakse erainitsiatiivil ja finantseerimisel vähemasti kaks tuletorni – Harilaiule ja Käsmu. Põnev on see, et viimane kuulub kohalikule kogukonnale ja ehitamist rahastatakse purjutanud kaptenitele tehtud trahvidest.

Viimane periood Eesti Vabariigi ajal lõpetab eraomanduse. Tuletornindus liigub Transpordiministeeriumi alluvusse. Koos mõisamaadega riigistatakse ka Balti aadelkonnale kuulunud tuletornid. Palgalehtede järgi võib öelda, et Tuletornide osakonnale kuulub algselt 34 tuletorni. Osakond tellib nende hooldamise ja parandamise erafirmadelt, tuletornivahid on aga riigiteenistujad. Alates 1934. a. luuakse Veeteedeameti alluvusse eraldi brigaad, mis asub tuletorne hooldama ja ehitama. Eesti Vabariigi viimase kaheksa aasta jooksul ehitab see brigaad 25 raudbetoonist tuletorni (Luige 1982:72). Veeteedeameti tulud saadakse endiselt tuletornimaksudest. 1924. aasta Riigiteatajas on toodud diferentseeritud maksumäärad välis- ja kodumaistele alustele. Maksumäärasid diferentseeritakse ka purje-, auru- ja mootorlaevade lõikes, ning maksu suurus määratakse tonnaaži alusel. Tuletornimaksu tuli maksta vaid esimeses sadamas Eesti vetesse sisenedes

ja see ei sõltunud edasistest sadamakülastustest. Kuigi tuletornid on riigistatud, leidub sellel perioodil erasadamaid: Kunda, Tallinna Beckeri, Tallinna Balti laevaehituse ja Kärdla. Ka nendes olevate meremärkide hoolduskulud tasub riik. Samas töötavad nendes sadamates eralootsid. 1930. aastatel tõstatunud poliitiline huvi viia tuletornid Kaitseministeeriumi alluvusse ja asendada tuletornivahid sõduritega, jääb Riigikogu toetuseta. 15. mail 1940. a. saadetud telegrammis annab Nõukogude Liidu Sõjakomandantuur teada, et vastavalt „lepingule" võetakse üle Pakri, Osmussaare, Tahkuna, Ristna, Kõpu ja Sõrve tuletornid. Paari kuu pärast saadetud uues telegrammis antakse teada, et võetakse üle ka Suurupi kaks tuletorni, Naissaare, Keri ja Juminda. Ülevõtmiste nimekirjast selgub, et Nõukogude Liidu kätte läksid ka Hiiesaare, Kübarsaare, Viimsi, Roomassaare ja Papisaare tuletorn. Veeteedeamet likvideeriti 1. jaanuaril 1941. a., kõik tuletornid (kaasa arvatud juba varem mainitud) läksid loodud Merelaevanduse alluvusse. Luige (1967:35) väidab, et selleks ajaks oli Eesti territooriumil 140 erinevat meremärki: 117 tuletorni, 20 valguspoid ja 3 tulelaeva.

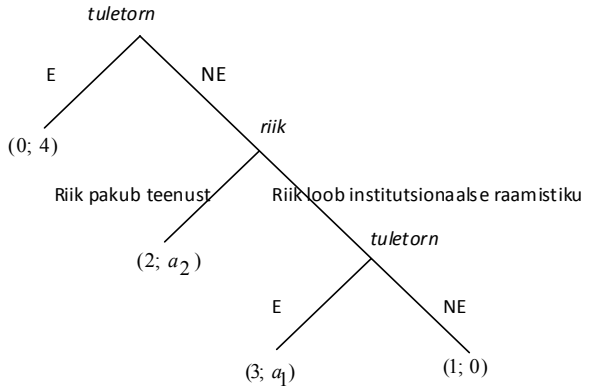
Mudeli koostamisel tuleb kõigepealt probleem identifitseerida. Tuletornimäng on toodud joonisel 1. Kahel mängijal: *laeval* ja *tuletornil* on kaks valikut. Tuletorn saab pakkuda kvaliteetset teenust või mitte; *laev* saab maksta tuletornile või mitte. Vastavalt on b_1 *tuletorni* tulu ja $c(t)$ kvaliteetse toote pakkumise kulu, kus t on tehnoloogia näitajaks (mida spetsiifilisem tehnoloogia, seda kulukam on kvaliteeti pakkuda). C on valetulede (mittekvaliteetse teenuse) pakkumise püsikulu ning b_2 kvaliteetsest teenusest saadav tulu *laevale*. Selles mängus on vaid üks Nashi tasakaaluline tulemusprofiil ($-C$, 0), ehk *tuletorn* ei paku usaldusväärset teenust ja *laev* ei maksa. Mõlemad osapooled on lõksus (muidugi võib öelda, et valetulede omanikul ongi eesmärgiks laeva röövimine, see aga ei lahenda meie avalike kaupade pakkumise probleemi). Nagu ikka vangide dilemma tüüpi mängudes, ei saa lahenduseks pakkuda informatsiooni sissetoomist mängu (näiteks *laev* esimesel etapil jälgib teenuse kvaliteeti ja maksab hiljem), sest see ei muuda *laeva* optimeerivat käitumist. Tüüplahenduseks tuuakse sellisel juhul strateegilisi lahendusi, mis eeldavad korduvat äritehingut ja nn reputatsiooniehitamist. Antud juhul on seda raske rakendada, kuna näost-näkku äritehingut ei toimu.

		Laev	
		Maksta	Mitte maksta
Lighthouse	Usaldusväärne	$b_1 - c(t); b_2 - b_1$	$-c(t); b_2$
	Mitte usaldusväärne	$b_1 - C; -b_1$	$-C; 0$

Joonis 1: Tuletornimäng

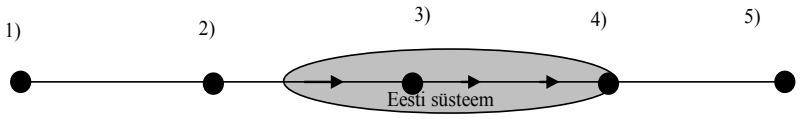
Kuna mängu struktuuri saab muuta vaid piisava mõjuvõimuga „mängija", siis meie poolt pakutud lahenduses nimetame, seda *riigiks*. Riigi sissetoomine mängu muudab mängu struktuuri järgmiselt – esimesel etapil valib *tuletorn* kas efektiivse

(E) või mitteefektiivse teenuse koguse/kvaliteedi (NE); teisel etapil järgib *riik tuletorni* valikuid ja otsustab juhul, kui teenuse kogus või kvaliteet ei ole piisav, kas pakkuda ise või aidata kaasa institutsionaalse raamistiku loomisega. Viimases ehk kolmandas etapis saab jällegi *tuletorn* vastavalt riigi institutsionaalse raamistiku loomisele valida E või NE. Selles laiendatud vormi mängus (joonis 2) sõltub alammängu täiuslik Nashi tasakaal seosest a_1 ja a_2 vahel. Kui $a_1 > a_2$, tuleb *riik* erapakkujale nn appi ja mäng lõppeb tulemusprofiiliga (3; a_1).



Joonis 2: *Riik* ja laiendatud tuletornimäng

Narratiivi juurde tagasi tulles näeme, et ajalooliselt ongi *riik* sarnaselt mänguga jooniselt 2 talitanud. Kokkuvõtlikult võib erinevate ajalooetappide kohta öelda, et tuletornide teenuseid ei pakkunud avalik või erasektor kunagi puhtalt. Joonisel 3 on Van Zandt'i (1991) „poolused": 1) erapakkumine ilma igasuguse riikliku sekkumiseta; 2) erapakkumine koos riigipoolse omandi- ja lepinguõiguse jõustamisega; 3) erapakkumine koos valitsusepoolse tuletornimaksude kogumise administreerimisega; 4) riigipoolne pakkumine koos laevade tasutud tuletornimaksudega ja 5) riigipoolne pakkumine koos riikliku finantseerimisega.



Joonis 3: Eesti süsteem ja Van Zandti poolused

Ajalooliselt on Eesti „tuletornindus" nihkunud enama riikliku sekkumise suunas. Kindel on see, et riik on igal perioodil pakkunud eraturgudele enam kui lihtsalt omandiõiguse kaitset – on määranud tuletornimaksu ja selle kogumist administreeritud. Miks on aga sellest „minimaalsest" institutsionaalsest raamis-

tikust kaugemale mindud? Mudel ja ajalooline narratiiv näitavad, et põhjusi on kaks: tehnoloogia muutus ja avalik huvi. Tehnoloogia areng tõi kaasa spetsiifilise oskuse ja teabe vajaduse, mis võis muuta avaliku spetsialiseerunud brigaadi kasutamise tuletorni ehitamisel suhteliselt odavamaks. Avalik huvi (olgu see siis Vene tsaaririigi sõjaline ambitsioon või Hansa ja Eesti Riigi kaubandushuvid) nõudis, et tuletornide pakkumise mehhanism võimaldaks enam tuletorne, kui „miinimummehhanismiga" toetatud eraturud oleksid pakkunud.

Lõpetuseks võib öelda, et debatt selle üle, kas avalikke kaupu peaks pakkuma riik või eraturg, ei ole valik musta ja valge vahel. Peame arvestama, et avalike kaupade puhul on selge see, et vaid „minimaalriigi" (Nozick 1974) abiga eraturud sellistes valdkondades hakkama ei saa. Lisaks on vaja ka mingit „abipaketti". Tuletornide puhul olid miinimumpaketis sees riigipoolne abi tuletornimaksude määramisel, nende kogumisel ja maksude administreerimisel. Kui aga avalik huvi nõuab enamat kui miinimum, siis peab ka pakett kasvama. Tuletame meelde, et sarnaseid avalikke kaupu ei olegi nii vähe: haridus, linnaruum, mitmed loodusvarad ja palju muud.

Appendix 4

THE EVOLUTION OF NON-COOPERATIVE BEHAVIOUR: THE CASE OF POST-TRANSITIONAL ESTONIA[1]

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Abstract

Purpose – The purpose of this paper is to explain the emergence of non-cooperative behaviour after the economic transition in Estonia.

Design/methodology/approach – The paper uses a combined research design, in that evolutionary game theory and network segregation models are enriched with semi-structured interviews. Simulations are used to deal with analytical complexity; in this case a prisoners' dilemma situation is used and randomness is created through the exogenous shock of opening the network to "aliens".

Findings – Consequently, it is found that individuals in large and small communities differ in their behavioural strategies: in an open community, players are more self-interested and reciprocate only benevolent behaviour; in a regular community, people rely on cooperative social norms. Case specific information leads to the suggestion that in open networks people behave cooperatively only in teams of up to four members. Increasing the random connections in a network makes people use group segregation – that is, they behave cooperatively in regular connections and in a self-regarding manner towards others.

Research limitations/implications – The method brings certain limitations to the implications of the results – simulations are sensitive to the initial conditions set up using qualitative data.

Practical implications – In managerial areas the results can provide at least two insights. First, it is obvious that only small teams (with personal connections) can be fully cooperative. In this case, the ideal number of co-operators is four. In larger teams, individuals find it more profitable to segregate an inner circle and others. Second, if players are interpreted as firms, then competition between firms will prevail even in small communities (where new players can penetrate the market) and thus any cartel or other cooperative action will fail.

Originality/value – The main value of the research is twofold: it allows to introduce the combined research methodology and explain the mental change after transition in the 1990s. The first enables to reduce the methodological impediments researchers find in the qualitative-quantitative dichotomy. The second explains the emergence of, and changes to, the behavioural or moral codes as a result of rational social learning.

Keywords Behaviour, Social norms, Estonia

Paper type Research paper

1. Introduction

The current analytical research paper investigates the potential of evolutionary game theory to explain behavioural differences based on the belief in common

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behavioural norms or strategies. It proposes that different structures of social networks – the probability of meeting "alien species", intensity of social interactions and time preferences – make individuals choose different optimal behavioural strategies. The research question – how can the evolution of non-cooperative behaviour or a self-regarding morality be explained in Estonia after the economic transition of the 1990s – is answered using a combination research design. We put forward the hypothesis that in random networks, cooperation is overruled by an alternative strategy according to which individuals will treat a small group of individuals in a cooperative manner and others in a self-serving manner.

The motive behind writing the paper is to:

- demonstrate the potential of using a combination research design to explain cultural or moral change, and;
- explain cultural change at a micro level.

Socio-cultural discussions from sociology or other neighbouring disciplines are not included in the paper; rather we concentrate on the construction of a model that permits generalisations to be elicited from a narrow range of observations over a large spectrum of events. For this microeconomics, or more specifically game theory, is used.

Game theory allows us to construct models where macro behaviour is explained at the micro level. To do this, game theory uses simple choice situations. The *prisoners' dilemma* (PD) is one of the most often used situations and involves two players choosing alternative strategies – cooperation or defection. It is shown that defection is individually rational and thus the ultimate result of the game is derived from non-cooperation, which will actually hurt both parties. The PD structure can be used in characterising many real life situations like the provision of public goods or the exploitation of the commons. In managerial areas PD can also be used in many situations starting with cooperation problems between employees working in teams and ending with cooperation between firms, oligopolistic behaviour or cartel enforcement. That is why the explanation of the emergence of cooperative or non-cooperative behaviour is important and the results can be applied across a wide range of events.

Of course in many situations the simple matrix form of the game theory is not adequate to explain changes in behaviour. We may be faced by multiple actions or a wide range of players with different degrees of knowledge about possible strategic choices. This is why we need a network structure to enrich the game. Microeconomic models follow one specific criterion – simplicity of explanation – although it sometimes loses the case specific features. Thus readers should bear in mind culturally specific issues, even though they are almost excluded from this paper.

To address the research question the paper uses a combined research design. This means that a theoretical deductive model is enriched with empirical insights. Methodological impediments researchers find in the qualitative-quantitative dichotomy are mitigated by current methodology. We call this combined research

methodology an analytic narrative (inspired by Bates *et al*., 1998). An analytic narrative is a combination of qualitative and quantitative study. It unites qualitative data collection techniques with formal logic in analysing the data. The rigour of the formal model is enriched by empirics. Also it is important to stress that in studying macro processes micro data are used. We believe that customs and norms can be thought of as equilibria in games, but is it true that they arise through the accretion of many uncoordinated decisions, not from the actions of a few key people. Obviously it would be absurd to claim that they arise only in the former manner. We do, however, suspect that influential actors (including managers) often get credit for things that were about to happen anyway. Even if major players do sometimes matter, they may be minor relative to the scale of the social institutions under consideration (socially acceptable behaviour, informal rules etc). Change is driven in part by small individual variations that tip expectations into a new equilibrium, and in part by the concerted actions of influential individuals and groups. We emphasize the role of the small players of the so-called plain man, while not denying the importance of the larger ones (e.g. managers). The qualitative part of the research collects empirics by interviewing high school graduates from the island of Hiiumaa. A case specific feature is the relatively closed community (an island population) and the homogeneous cultural setting (similar preferences). Semi-structured interviews with people who completed secondary school in the transition period, 1989–1992, are coded by studying attitudes and preferences. The sample can be divided into two groups – those who left the community after graduation and those who remained on (or returned to) the island. The narratives obtained give us insight into three main areas:

- how social networks and random connections between players affect individual strategies;
- how behavioural norms differ within a large group (an open community) and a small group (a local community);
- how much their strategic behaviour is a rational choice by individuals or how much they are aware of their strategic choices or whether they perceive their choices just as socially accepted behaviour related to coercion or as group related punishments rather than a voluntary individual choice.

The interviews have been recorded, transcribed and maintained in the author's home archive.

Transition does not only involve a change of formal institutions, but also of informal ones. The latter is complicated to depict, let alone to measure. Legal changes, economic policy changes, re-establishment of democratic procedures and institutions are considered a vital part of the economic and political transition of the eastern bloc. In many cases informal institutions are hindered or not considered important to such a procedure. The economic freedom indicators or "Doing business database" and "Economic freedom data"[2] signify the relative success of

[2] World Bank survey of legal and other formal constraints of doing business from web-page: http://www.doingbusiness.org; and Freedom House's indicators about economic freedom from web-page: http://www.cato.org/pubs/efw/efw2005/efw2005-app2.pdf .

the Estonian transition. At the same time, we do not have many surveys describing transformation at the informal level. Sokolova and Põder (2004) attempt to map the trust indicators by surveying masters and bachelor students, and Human Development Reports also give some idea about the lack of trust and cooperation in post-soviet Estonia. Our aim is to provide a rational explanation and show that closed groups that have evolved into cooperative units via social norms went through a transition in the early nineties. Individuals, who "escaped" from community morals, adopted an individualistic strategic morality. This "new" morality was less cooperative and more individualistic. Those young people, who didn't make this transformation, remained on the island or returned later. They hadn't any need to maintain beneficial relationships and their motives driving their behaviour were less individualistic and more determined by social norms.

The article is structured as follows. Section 1 discusses the theoretical framework, drawing on evolutionary models by Axelrod, Schelling and Smith explaining cultural and behavioural changes. To assist non-economists abbreviations are collated and explained in appendix 3. Then, section 2 describes and interprets the empirical narratives related to behavioural norms. Section 3 builds up the theoretical argument – the simulation – relying on the initial conditions set by the narratives. The specification of the model gives us the ability to explain the strategic and territorial segregation of the players. Finally we sum up and present our conclusions in section 4.

2. Discussion of Theoretical Foundations

Evolutionary game theory has developed two tracks for investigating the evolution of informal institutions like social behavioural norms. First, the evolution of cooperation (Axelrod, 1984) created a new wave of optimism – social cooperative problems have a rational evolutionary response *via* the strategy called tit-for-tat (TFT). Mutual cooperation will be achieved because TFT "beats" all other possible strategies. Axelrod shows that "it paid to be nice [and] being the first to defect is costly" (1990:43). Thus the desirable properties of the strategic profile are: nice, forgiving and retaliatory. Mutual cooperation can emerge in a world of egoists "without central control by starting with some cluster of individuals who rely on reciprocity" (ibid, 69). The second way to construct an analytical landscape for analysing evolutionary changes in individual behaviour is developed by Smith (1982). The key concept of evolutionary game theory is evolutionary stable strategy (ESS), which describes the robust and "fixed" behavioural norm, which is not endangered by other alternative norms, and which could create greater utility for the followers as far as the proportion of alternative norm users stays under a certain proportion of the community. Smith's (1982) ideas originate from the biological evolution of species, but can also be transplanted to the cultural context of an individual society – showing the preconditions of change or *vice versa,* the stability of cultural norms. How the proportion of certain norm users can change falls within our sphere of interest, and for this the ideas of Schelling (1971, 1978)

are used for simulations where instead of the change of position in the network the change of strategy is considered.

We are interested in the social dilemmas – the situations where individual rationality will not lead us to the social first best solution. One example of a social dilemma is a PD type of game (see Figure 1).

According to Axelrod (1984, 1997) and the experimental findings (Pruitt and Kimbell, 1977), the average actor in the PD soon realises the absurdity of the situation and is willing to cooperate if others are willing to do so. The problem is how trust between players will be established. This is related to the information players are getting (or believe they have) about other players and how risk averse these individuals are. In Axelrod's iterated PD, individuals can create information only through past experience of the game. Each player is imbued with a "strategy", which is a mapping from past experience (i.e. a history of cooperation and defection) of the probability of cooperation on the next play of the game. "Players may represent corporations or nations or individuals or biological species (Barthold III *et al.*, 1986:130). If according to Barthold et al. (1986) we assume that all this information is summarised in discount factor *w*, a fundamental parameter would be $0 \le w < 1$, and may be thought of as the probability of two players meeting again for another interaction, then one of the main conclusions of Axelrod is that the viability of a strategy depends on how heavily the future is discounted. In Figure 1, mutual cooperation (C) will lead to the cooperative reward (R), and mutual defection (D) will lead to uncooperative punishment (P). Also $F > R > P > L$ and $R > (L + F)/2$, indicating that mutual cooperation is more rewarding than the average of the world of unilateral defection.

Figure 1. The Structure of One Stage of Axelrod's Iterated Prisoners' Dilemma

	C	D
C	R, R	L, F
D	F, L	P, P

For a given strategy S, let us define its *region of stability* to be the set of *w* for which S is collectively stable. For example, in Axelrod (1981, 1984) and Axelrod and Hamilton (1981) it can be shown that the region of stability of *AllD* (players play D in each stage) is $0 \le w < 1$ and the region of stability of TFT is:

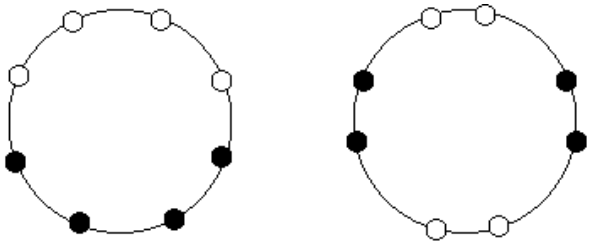
$$\max\{(F-R)/(F-P),(F-R)/(R-L)\} \le w < 1.$$

So, non-cooperative behaviour is much more probable than cooperative behaviour, and with a low chance that the game will be iterated, the non-cooperative behaviour is thought to be the best way to prevail. According to the game, we can define the r*egion of despair*: $0 \le w \le w_D$, within which *AllD* is

the unique best strategy; and the *region of hope*: $w_D < w < 1$, within which there is no strategy that is best independent of the other strategic alternatives. According to the values obtained by a specific game, there is a unique w_D, which defines the possible *regions of hope and despair*; in other words, it defines the possibility of cooperation. As we can see, the possibility of cooperation depends on the relative size of the cooperative reward compared to the punishment for defection, but also on the benefits of unilateral defection. If we are not able to specify game related payoff profiles precisely, then we have instead to try to characterise other variables. These are the probability of meeting the other players again and how sure we can be that the other players' behaviour or strategy is understandable to us. In addition, the size and the structure of the social network are important because these affect the rationality of sustaining certain behaviour in the changing environment.

To illustrate the role of social space, we use Schelling's neighbourhood segregation model (Schelling, 1971, 1978). Let's assume that there are two types of individuals: types can be defined by many criteria like, for example preferences, colour, sex, and nationality amongst others. In a cultural context, types can be defined by the different strategies the players use. In Schelling's self-forming neighbourhood model (1978:147-153) individuals cannot change their types, but they can change their location in the network. Instead of defining the neighbourhood by the 8 surrounding members of the 2×2 space, for simplicity the circular neighbourhood model (Young 1998, 8) can be used, where each individual transacts with only the two members directly surrounding them and there are only 8 members in the network (see Figure 2). Each type has strict preferences to transact with the player in their type, being surrounded by "alien" types, which make the player move.

Figure 2. Two Equilibrium Configurations: Segregated and Integrated (Young 1998)



If there are eight players, then the initial allocation of types and how location in the network is changed (the rules of the games are changed) define the different

final equilibrium configurations. So there are many dynamic paths to the equilibrium and furthermore, there are many possible equilibrium configurations (see Figure 2). Of course, the number of equilibrium configurations alters if we increase the dimensions of the model by modifying the amount of social ties, opportunities to change location by jumping or the total size of the network. Thus there isn't one specific model, which can predict the cultural evolutionary equilibrium of whatever society. Rather the results are dependent on the specific inputs – the initial conditions (Toomere, 2005). Thus the model can predict either segregation or integration, also different evolutionary paths are possible, depending on initial conditions or different institutional "rules of the game" (formal or informal) can emerge. In our model (see subsequent section) we are interested in the situation where individuals can adjust their strategies. Changing the strategy is basically equivalent to a territorial jump. This two-fold change is dependent on the initial conditions of the network and exogenous shock – opening the network to "aliens".

The later attempts (Kim, 1994; Bendor and Swistak, 1997; Vilone *et al*., 2002) to integrate and instil a mathematical rigor into the evolutionary models formalise the ideas, confirm and develop the insights. Consequently, evolutionary game theory provides a wide range of theoretical principles for formal modelling: initial conditions are vital for the model setup, rules of the game are vital for defining equilibrium configurations, the share of co-operators must be relatively large and there should be a high probability of iteration to make a cooperative strategy sustainable. Thus for the explanatory model, we need empirical information about all these parameters. Empirical information, which we code and interpret in the next section, gives this information for the construction of the model, and allows us to make generalizations on specific characteristics such as size of network or average number of random connections.

3. Strategic Choices of Different "Networkers" – Empirical Evidence

Individual utility maximising behaviour is socially efficient – this is the classical Smithian principle of the invisible hand. However, the principle will not be applicable in the situations called social dilemmas, where individual rationality will not lead to collective rationality. Strategic solutions applied to the dilemmas show that people are able to learn to curb their own individualistic aims and behave in a cooperative manner. The opposite must be true as well. We assume that the soviet period created stable "strategic" patterns where cooperative behaviour was vital in the close neighbourhoods or regular and small communities. The break-up of the system in the 1990s constitutes an exogenous shock. Transition in the 1990s shook the informal institutional framework as well as the formal one. We have collected information about the behavioural rules individuals obtain. The group under observation consists of young people who were just about to make their voluntary decisions after high school graduation in the early nineties. All the individuals

studied were members of a small community on the island. However, a number of the individuals remained on the island and others left. Numerically, 20 graduates of 160 from the Secondary School[3] during the period 1989–1991 were interviewed (for sample characteristics see Appendix 2); almost half of the interviewees remained on or returned to the island. A similar cultural and social background is considered an important initial condition. Interviews were semi-structured and needed coding — the interview questions are provided in Appendix 1. For our model specification the following information was collected and coded:

- community belonging and motivation for staying or leaving (dominating values);
- behavioural regularities and norms people follow – including the importance of individual materialistic causes over social norms of the community;
- the size of the "inner-circle" where social norms are followed.

In general, we term those who stayed on the island "small networkers" and those who left the community "large networkers". At the beginning we have to admit that almost all those who left the community had a reason – further studies. Almost everyone had an intention to come back after that. Almost all who stayed on the island were not willing to change the choice once made. Consequently individuals didn't have any initial motivational or certain type-based characteristics, which might have determined their behavioural strategies. Thus we state that behavioural strategies are the result of strategic social learning. At the same time, "networkers" have also learned to appreciate different frameworks; a close network provides security, stability, close social ties; and a large network – a salary, job, and a competitive and open cultural environment.

3.1. Strategic Behaviour

Do people perceive themselves as strategic actors? In our case most of the respondents admitted that they don't consider themselves as players of different roles in society. Only *large networkers* admitted that they consciously behave differently in some situations − the more public recognition they had (e.g. top managers, public officials, experts), the more they considered themselves as followers of some certain social roles. Although *large networkers* admitted that they have small "inner circles" where they are more altruistic and reciprocal. *Small networkers* make a difference neither in the roles nor in the group based behaviour. So, we assume that in a small network people have one particular behavioural "strategy", expanded to include everyone. What kind of strategy is followed? Generalizations made for large and small networks are summarised in Table 1. *Large networkers* follow behavioural criteria: self-regarding behaviour and expectations of reciprocity. *Small network*ers admit that norms dominate over self-interest and they are altruistic.

[3] This was the only secondary educational establishment on the island of Hiiumaa which covers an area of over 1000 km^2.

Table 1. Summary of Behavioural "Strategy"

	Self-regarding behaviour	Altruistic behaviour	Expectations of reciprocity	Vengeful	Norms dominate over self-regarding behaviour
Large networkers	×	-	×	-	-
Small networkers	×	×	-	-	×

Large networkers admitted that communal norms must and can be overruled by self-interest. At the same time, some of them admitted that there are moral codes, which must be followed. None of the respondents admitted that they follow some well-recognised moral codes like religious ethics or others. Nor did anyone admit to being vengeful, but many argued that they could reciprocate benefaction.

Small networkers state that they don't apply behavioural differences when interacting with their "inner circle" and the larger community. However, *large networkers* admit that such an "inner circle" does exist for them, citing relationship groups varying in size from three to ten people.

It is also worth mentioning that *small networkers* do not stress their group belonging as islanders, whereas *large networkers*, in this study, designate themselves as islanders without exception. The latter may be interpreted as the "quality signal" which is efficient only in communication with "outsiders". This signal must give information about the pleasant and cooperative nature of the player and thus increases the possibility of the game itself being of cooperative in nature. Inside a small group, information is public and such a signal loses its power of segregation.

In conclusion, we can generalise that *large networkers* use a *group segregation strategy* (GSS) – pleasant and cooperative reciprocal behaviour is pursued in the "inner circle" and self-regarding behaviour in random connections. *Small networkers* follow altruistic or *cooperative social norms* (CSN), which dominate self-regarding rationality in areas where such norms exist. They don't make any behavioural distinctions between groups. Why do groups have these kinds of different behavioural traits? Modelling can provide an answer.

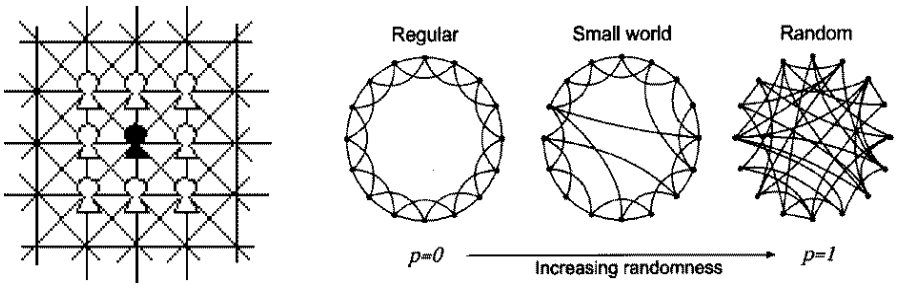
4. Model and Simulations

Our aim is to show how strategic "cultural" segregation or different social norms emerge as an evolution of informal institutions, and we are convinced that the phenomenon can be described on a micro or an agents level. In agents based modelling the complexity must be handled by clearly explaining assumptions to make the results replicable. Our simulations are based, like those of Axelrod (1986), on a simple game structure – PD, which is a simplistic preference setup, but addresses the individualistic-cooperative dilemma. The players are adaptively rational by choosing strategies which are dependent on the social space. The change of individual behaviour is motivated by the exogenous shock. These shocks play the same role as mutations in biology. In our model this external shock is denoted as the increase of randomness and also the probability of meeting rational utility maximisers, who in PD situations are self-regarding

4.1. Network Structure

The size of the network or the structure of connections between players is an important characteristic of any model. In Figure 4, the possible structures are given: 2-lattice and 1-lattice structures, where *p* represents the probability of random relationships. The small world hypothesis has already been provided by Milgram (1967) in his experimental work, and states that complete strangers in the US are connected by a chain with a median number of six acquaintances on average. Here instead of a small world we use a *small community* metaphor, because the explanatory meaning differs – a small community is characterised by few random connections and these are simple face-to-face interactions or interactions via mail, thus impersonality here is smaller than in virtual networks denoted by the *small world* (see Figure 4).

Figure 4. 2-lattice Local Network, 1-lattice Local Network, Small-world Network and Random Network (Watts 1999)



To specify the structure of the network we use a 1-lattice network where the increase of *p* transforms the networks from regular to random. With the increase of

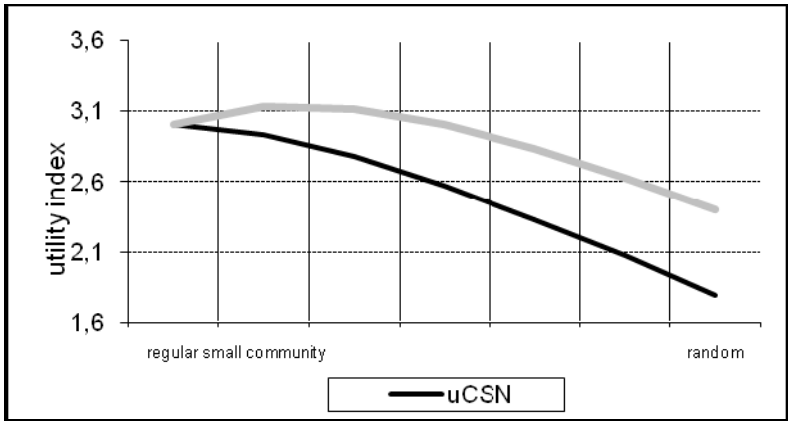
p the number of connections (t) also increases and in our simulations a *small community* is characterised by $4 < t < 10$.

The network consists of the undetermined amount of players who are placed on the ring-shaped networks (periodic 1-lattice network). Every player has two neighbours in both directions, who they are certain to play with (p=1). Thus four connections are certain and there is no "rewiring", but randomness increases the probability of meeting other unknown strategic actors, some of whom can also be co-operators. The probability of meeting co-operators is determined by $t - pt - 4p$, where 4 is determined by certain connections. According to the interviews, t takes values from 4 to 10, and p from 0 to 1.

4.2. Simulations

The simple form of the PD framework is followed, where from Figure 1 the payoff profiles are as follows: (R; R) = (3; 3); (P; P) = (2; 2) and (F; L) = (4; 1) and (L; F) = (1; 4). To make the framework strategic, discount factors are used, so utility from the game $G = u_i /(1 - w)$, where w is probability of meeting again and u_i indicates the average utility per connection. Figure 5 summarises the result from the simulation where only two strategies are compared – cooperative social norms (CSN) and group segregation strategy (GSS). Accordingly in figure 5 u_{CSN} measures the utility from cooperative behaviour and u_{GSS} from segregated group strategy.

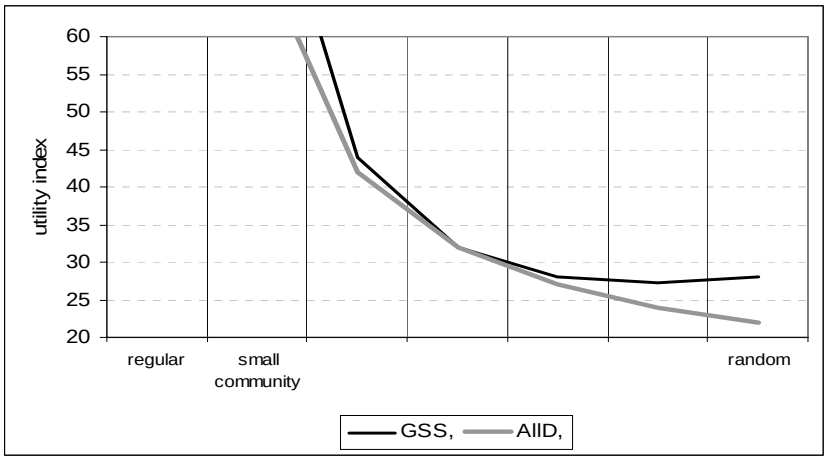
Figure 5. Simulation Results: Utility from Cooperative Social Norms or Group Segregation Strategy in Regular, Random Networks and a Small Community without Discounting



If p = 0 and t = 4, or in the case of regular networks without discounting, there is no difference between the utility from using CSN or GSS, because only close

relationships exist and there are no random connections. In the case of a small community it is always more profitable to use GSS. Thus it is also clear that the increase of randomness makes GSS more "profitable" and only in a regular network does CSN prevail. In GSS, players reserve reciprocal cooperation for four connections and demonstrate self-regarding behaviour toward others, although some of the random relationships may be with co-operators. Furthermore, if the number of connections is larger than 9, norms fail to satisfy the folk theorem and utility maximisers abandon the strategy. Accordingly, the increase of random connections makes "individual rationality" (*AllD*) a dominant strategy, which will lead to Nash equilibrium at each stage. From biology it can be found that cooperation is easy to break, but hard to establish or re-establish (Le and Boyd 2006). Also Galan and Izquierdo (2005) have provided evidence showing that the results reported by Axelrod (1986) are not as reliable as one would like. They (Galan and Izquierdo 2005) ran the model for longer, using other mutation rates, modifying the payoffs slightly or using an alternative selection mechanism, then cooperation was not the imminent result, rather *vice versa*. At the same time we may show that GSS is still an efficient strategy. We add an individual rational strategy (*AllD*) to the framework and also use discounting. Of course, in the regular world discounting mathematically makes the utility from the entire game equal to infinity, because the probability of meeting again in the future equals 1. Also we have to recall that cardinal measures of utility don't have any interpretive meaning other than for comparison.

Figure 6. Comparison of Group Segregation Strategy (GSS) and Individually Rational Strategy (AllD), by Total Utility with Discounting



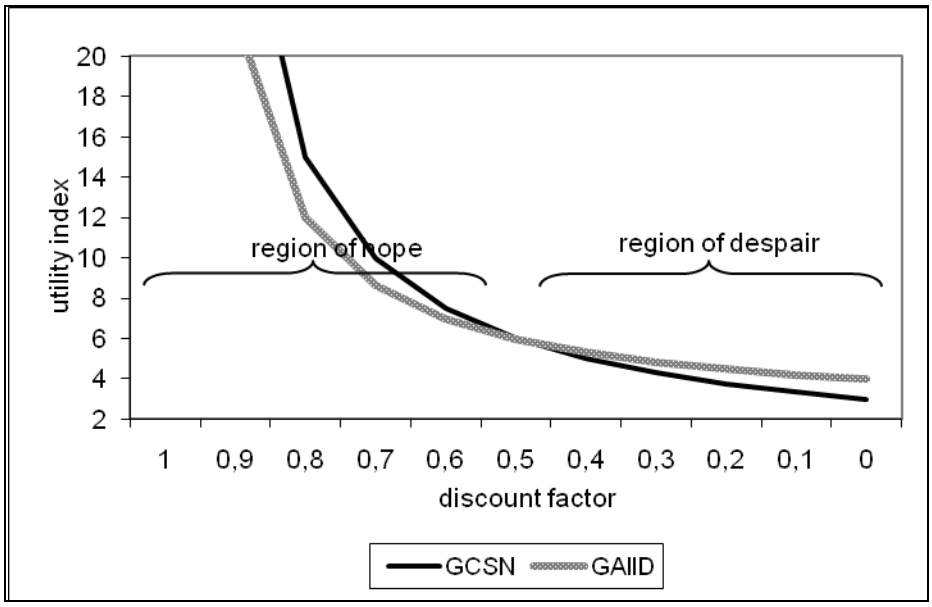
In Figure 6 we see that GSS weakly dominates over *AllD*. Thus we may speculate that the increase of randomness will make GSS even more efficient; the more open

and random the networks are, the more players divide themselves into "inner circle" and "aliens" groups. Whether they will also widen their "inner circle" is the question we are not able to answer. Also we are not able to answer whether players will learn (and how fast they will learn) that in iterated games some "aliens" cooperate and thus can be considered members of the "inner circle". However we can study other adaptations. It is clear that such models are very sensitive to parameters (Galan and Izquierdo 2005) and thus allow only the partial study of the phenomena (Edmonds and Hales 2003). However, it gives a simple opportunity to test some hypotheses on social change through adaptation.

4.3. Adaptation and preferences for the future

If a *small networker* meets an individually rational player who is not confronting norms, then as indicated in Table 1, in the future if the players meet, the *small networker* also learns to choose an individually rational action (D). The question is how fast the strategic adaptation or learning takes place? Of course, we see that following the norms in a small community or random world is always less beneficial than individual rationality, despite any discount factor. Utility from playing CSN is measured $G_{CSN} = \frac{2}{1-w} + 1$ and utility from *AllD* is $G_{AllD} = \frac{2}{1-w} + 2$. Here the discount factor plays no role. However, we can also interpret *w* as the subjective time preference. If players are impatient and evaluate the current stage utility relatively higher, then learning and adaptation are also rapid. We may speculate that transition is an external shock, which created rapid reallocation of wealth and also made people less patient, opening the world and increasing randomness at the same time. Thus the learning and adaptation break the norm based behavioural rules over time. In Figure 7, using the same PD-structure as before, the illustrative result shows that following norms is more utility-creative only when people are relatively patient. If the discount factor is more than 0.5, then the first stage maximum results overweigh uncooperative results in the future. If we break the norms in the PD framework it harms all patient sides, and increases the probability of strategic transfer to *AllD*. In the current setup we can define $w_D = 0.5$, thus the region of hope is defined where $1 < w > 0.5$ and the region of despair in discounts rates $0.5 > w > 0$.

Figure 7. The impact of Impatience on Strategic Learning in Infinitely Iterated PD



The utility index is just a comparative measure and has no cardinal interpretation. The discount factor 0.5 is dependent on cardinal payoff profiles. Thus this number has only an explanatory meaning – if individuals assign low values to the future utility, then cooperation fails. The coefficient 0.5 shows that the future period must be at least half as important as the current utility to make cooperation sustainable.

5. Conclusions

Our aim was to use semi-structured interviews to create the initial conditions in evolutionary games, which allow us to explain why individuals are cooperative only in the regular world where there are no random connections. The strategic behaviour of individuals was simulated to show possible efficient strategies in iterated games. Although theoretically there are numerous strategies that satisfy the folk theorem, we know from the literature that Axelrod's TFT is infamous for advocating cooperative behaviour. However, we link strategic behaviour in repetitive situations with randomness in the network and the number of possible "alien" connections, showing that there is one specific efficient behavioural pattern called group segregation strategy.

Coding the interviews gave us the initial conditions for simulations. Despite their similar social backgrounds, individuals (according to their behavioural principles) can be separated into two groups: *large networkers* and *small networkers*. Individuals in the first category clearly segregate two groups: the "inner circle", where cooperative reciprocal norms are followed and the larger

group, where self-regarding principles dominate. *Small networkers* are altruistic and consider social norms more important than individual utility. The empirical findings give us grounds for separating networks into regular, small community and random networks. The latter is characterised by a total randomness of connections. The regular network is characterised by the lack of randomness and small amount of connections (i.e. from four to ten connections). The small community is something in between the two extremes.

Although it is accepted that simulations lack the modelling rigor of deductive reasoning, exploiting them is justified by the theoretical complexity in the evolutionary games where agent-based modelling is used. Simulations show that a strategy of following cooperative social norms (CSN) is efficient only in a regular network. A group segregation strategy (GSS) is clearly more efficient than maintaining norms in a small community, which is equivalent to always choosing a cooperative strategy in the PD game or, as Binmore (1998) states, basically the same as choosing equal shares in an ultimatum game.

Here the opening up event is interpreted as being the economic, social and cultural transition that occurred in the 1990s. From the simulations it is evident that such a transition changes rational strategy, because individualistic choices (avoiding social cooperative norms) can bring huge utility gains. Individualistic, self-regarding behaviour is justified as a rational response to increasing randomness. Segregating four to ten close members and treating others in a self-serving manner is justified, even if some of the random players could be co-operators. At the same time, if the number of random connections is increasing, then following cooperative norms will not satisfy the folk theorem. Thus we may speculate that the opening up will ultimately cause GSS to dominate; how fast the norms are broken, is determined by the speed of social learning.

How much we value the future is a question of patience or time preferences. It is clear that the less patient we are, the less we value the future relative to our current welfare. If the future matters, then adhering to norms is more probable. After transition, not only the network structure changed, but the players' attitudes did too (towards a time preference). Current utility became more important compared to long-run stability or slow change. This gives us grounds to interpret the result as: opening the network also increases impatience and helps the self-regarding form of morality to prevail. This explains why the changes to the moral codes we use for everyday decision-making have been implemented so quickly during the last fifteen years.

As in Axelrod's (1986) study, TFT didn't perform better individually and also our GSS was not always the best, but rather weakly dominated group norms (CSN) and completely selfish choices (*AllD*). In a way GSS is a more complex strategy than TFT, because according to that, players differentiate between an "inner circle" and "aliens". Complexity is of course not a theoretical aim; rather, it is justified because it allows a better explanation of chance and adoption in the open network. In the iterated PD we see that cooperation (playing CSN) can be ESS, only when there is no randomness. Like Smith (1982), this shows that cooperation is not ESS

in more complex settings. From biology it can be found that cooperation is easy to break, but hard to establish or re-establish (Le and Boyd 2006). We also demonstrate the same – breaking cooperation is an imminent result of opening up, adding randomness or making the future less important. Also, Galan and Izquierdo (2005) have provided evidence showing that the results reported by Axelrod (1986) are not as reliable as one would like, and this paper does the same.

In the interpretation of the results we have to be mindful of the fact that simulations are dependent on initial conditions such as payoff profiles, defined strategies and game structure. Despite the validity problems we are able to provide an explanation for strategic changes in behavioural rules after the break-up of the Soviet system. The opening up of a society and the increase of economic incentives will cause the sacrifice of social cooperative norms, socially adopted during the Soviet era and will make us more self-regarding. Such change is efficiency enhancing, on the one hand, and creates social traps, on the other. In situations which can be defined by PD – where competing will not lead to Pareto-efficient outcomes and thus market signal based behaviour will not give the best outcomes – we are trapped in bad outcomes. These bad outcomes can be over-utilisation of common resources, misuse of public goods, wasteful competition in some specific areas of social life. Examples from everyday life are numerous – the appearance of "private property" signs on seashores or other valuable areas; new buildings of questionable architectural value; pre-school competition or over-utilisation of advertising. In managerial areas the results can provide at least two insights. First, it is obvious that only small teams (with personal connections) can be fully cooperative. In the current case, the ideal number of co-operators is four. In larger teams individuals find it more profitable to segregate an inner circle (with whom they behave cooperatively) and others (with whom they behave in a self-regarding and competitive manner). Second, if we interpret players as firms, then competition between firms will prevail even in small communities (where new players can penetrate the market) and thus any cartel or other cooperative action will fail. Or more precisely, cooperation can be sustained in repetitive games between members of a small group. However the latter demands a stable economic environment, which has not been the case in all transitional countries over the last 15 years.

If an exogenous shock makes us reconsider our behavioural or moral codes, then finding ourselves in the trap will probably do the same. Adaptation to new network conditions is the process of (slow) learning, because unilateral deviation is individually harmful and has no effect on general behavioural patterns. How fast we learn that we are trapped, if at all, is the question that can explain social change and thus is a common interest of all social sciences. Of course explaining the past is interesting, but investigating the future has much more flavour. Thus studying the opportunities arising from the emergence of cooperative behaviour is a challenge to all social scientists. The current paper reveals a starting point for using combined research strategy in cultural change studies. How well our results reflect outcomes derived from neighbouring social sciences like cultural anthropology or sociology will be a challenge for further studies as well.

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Appendix 1: Semi-structured Interview Questions

Community belonging:

1. After graduation what motivated you to stay in / leave the community?

2. How do you assess your staying/leaving choice today (would you like to change your choice made then or are you more or less satisfied)?

3. What are the most important factors (friends/ work/ environment/ opportunities/ wage/ family/ etc) that keep you in a small/large community?

4. What are the most important values to you (name two): (friends/ family/ nature/ wage/ job/ cultural environment/ living standards/ security/ etc)

Behavioral strategies:

5. Do you in essence agree with the statements …
   a) you treat others the way they treat you (reciprocity)
      turn the other cheek (forgiving and not retaliatory)
   b) I can only be betrayed once, betrayal will never be forgiven (not forgiving)
   c) self-interest is the most important factor when making choices (selfish behavior)
   d) there are group-specific social norms that cannot be questioned (name them)… (social norms)
   e) taking care of or being responsible for others is the most important behavioral criterion…" (altruism)

6. Material arguments prevail over social habits (religion, habits from childhood, some moral codes etc). Do you agree?

7. Are you a religious person or do you follow some behavioral norms that can be classified as similar to those of a sect or religion.

Which strategies prevail over others?

8. Are you ready to amend or change your own behavior (customary consumption/life style/access to certain resources (natural or others) to prevent the loss of a certain group specific morality (lifestyle/ natural resources/ traditional production methods/ etc)?

9. Are you ready to behave altruistically toward some member of the group (who might that be?) even if it is not in your own best interests (how could

that hurt you)? Do you expect those people to do same to you? (reciprocity)

10. Do you follow different behavioral rules (less egoistic, more reciprocal, altruistic) with some particular small group of people (your inner circle) than with foreigners (in general).

Network size:

11. What is the size (number of people) of this inner circle of yours?

12. Do you consider yourself as a member of certain group (I am from this community/ I am vegetarian/ I am ….). How big is this group? Do you have multiple groups you consider yourself to be a member of? If yes, do you differentiate between the groups? (by applying different behavioral rules?)

Appendix 2: sample characteristics

	large	small	female	male	sample	total
1989	4	4	4	4	8	50
1990	2	1	2	1	3	58
1991	5	4	6	3	9	52
Total	**11**	**9**	**12**	**8**	**20**	**160**
%	55%	45%	60%	40%	13%	

Appendix 3:
Abbreviations Used

Abbreviation	Full version	Short explanation
PD	Prisoners' dilemma	Game type where individual rationality will not lead to the collective best outcome
iterated PD	Iterated Prisoners' dilemma	Game where PD game is played repeatedly
G	Utility from game	Total utility from iterated game
u_i	one stage utility	Utility from one stage of the game or average utility from the whole game
ESS	Evolutionary stable strategy	Strategy that can not be invaded by better-performing strategy
TFT	Tit-for-tat	Reciprocal strategy - if opponent was previously cooperative, the agent is cooperative
w	Discount factor	Shows the importance of the future and can be interpreted as probability of meeting opponent again
w_D	Unique discount factor	Value which defines the border between theoretical possibility of cooperation and non-cooperation
C	Cooperation	Cooperative action in the game
D	Defection	Defection from cooperative action in the game
R	Cooperative return	Utility obtained then action profile (C, C) in chosen
P	Uncooperative punishment	Utility obtained then action profile (D. D) is chosen
F	Unilateral win	Utility from unilateral defection in PD game
L	Unilateral loss	Utility from unilateral cooperation in PD game
S	Strategy	Complete description of the behavioral principles in game
allD	Play always D	Selfish strategy -- play always defection independently of opponents action
GSS	Group segregation strategy	Strategy - play cooperatively in "inner circle" and selfishly with others
CSN	Collective social norms strategy	Strategy - follow cooperative social norms where they exist, if not play selfishly
u_{CSN}	Average utility (per stage) from playing CSN	Utility obtained from playing CSN strategy (on average per stage)
u_{GSS}	Average utility (per stage) from playing GSS	Utility obtained from playing GSS strategy (on average per stage)
p	Probability of random connections	Value stays between 0 and 1 and shows how open the network is to random connections
G_{CSN}	Utility from CSN	Total utility from playing CSN
G_{AllD}	Utility from *AllD*	Total utility from playing always D
t	Number of connections	How many connections players have in the network (in the game)

Appendix 5

ELULOOKIRJELDUS

1. Isikuandmed
   Ees- ja perekonnanimi: Kaire Põder
   Sünniaeg ja -koht: 2.10.1972, Tallinn
   Kodakondsus: Eesti

2. Kontaktandmed
   Aadress: Suureniidu tee 11, Püünsi, Viimsi vald
   Telefon: (+372)56621662
   E-posti aadress: kaire.poder@tseba.ttu.ee

3. Hariduskäik

Õppeasutus (nimetus lõpetamise ajal)	Lõpetamise aeg	Haridus (eriala/kraad)
Tallinna Tehnikaülikool Majandusteaduskond		Doktoriõpe majandusteoorias
Kesk-Euroopa Ülikool Politoloogia teaduskond	2005	Magistriõpe politoloogias
Tallinna Tehnikaülikool Majandusteaduskond	2002	Magistriõpe majandusteoorias
Estonian Business School	1995	BBA (Rahvusvaheline ärikorraldus)
Kärdla Keskkool	1991	Keskharidus

4. Keelteoskus (alg-, kesk- või kõrgtase)

Keel	Tase
Eesti	Emakeel
Inglise	Kõrgtasemel
Vene	Kesktasemel
Saksa	Algtasemel
Ungari	Algtasemel

5. Täiendusõpe

Õppimise aeg	Täiendusõppe läbiviija nimetus
16.–19. juuni 2006	PEGC, Turu Ülikool, Soome
15.–20. mai 2006	ESNIE 2006, Corsica, Prantsusmaa
27. september–2. oktoober 2005	Ronald Coase Institute, Tucson Arizona, USA
18.–25. juuni 2005	Institute of Humane Studies, University of Virginia, USA

6. Teenistuskäik

Töötamise aeg	Tööandja nimetus	Ametikoht
2008–tänaseni	Tallinna Tehnikaülikool	Erakorraline teadur
2006–2008	Lapsehoolduspuhkusel	
2005–2006	Estonian Business School	Majandusteooria lektor
2004–2005	CEU Department of Political Science	Magistrant
2001–2004	Estonian Business School (EBS)	Majandusteooria lektor
1999–2000	Lapsehoolduspuhkusel	
1997–1999	Eesti Pank	Juhtiv spetsialist
1999–1995	Estonian Business School (EBS)	Majandusteooria assistent

7. Teadustegevus

Artiklid:

1) Põder, K. 2014. The Lighthouse: Historic Analytic Narrative on the Provision of 'Public Goods' in Estonia. *Transformations in Business and Economics*, Vol 13, 2(32), xx-xx, (ilmumas).

2) Põder, K. 2010. Credible Commitment and Cartel: The Case of Hansa Merchant in the Guild of the Late Medieval Tallinn. *Baltic Journal of Economics*, Spring, xx-xx, (ilmumas).

3) Põder, K. 2010. The Lighthouse in Estonia: The Provision Mechanism of „Public Goods“. M. Raudjärv (toim.). *Eesti Majanduspoliitilised Väitlused*, xx-xx.

4) Põder, K. 2009. The Evolution of Non-cooperative Behavior: The Case of Post Transitional Estonia. *Baltic Journal of Management*, 4(3), 301-317.

5) Kerem, K., Põder, K. 2009. Possible Dilemma - Nordic Welfare State versus Anglo-American Liberal Regime: "Estonian Social Model" in a Comparative Context. J. Sepp, D. Frear, W. Taylor (Eds.), *The Key-factors of Business and Socio-Economic Development During the Global Crisis*, 89-105. USA, Wilkes-Barre: Congress of Political economists International (COPE).

6) Põder, K. 2008. Cooperative Norms and Defection in Prisoner's Dilemma Game: Analytic Narratives on Evolution of Strategic Non-cooperative Behaviour in the Networks. *Working papers in economics* (TUTWPE), 23(162), 55-67.

7) Põder, K. 2006. How to Catch a Seal? The Study of Rational Norms of 19th Century Island Communities in Western Coast of Estonia. *CEU Political Science Journal,* 1(2), 2-14.

8) Põder, K. 2006. What We Research In Social Sciences: Is Homo Oeconomicus Dead? *Working Papers in Economics (TUTWPE),* 18(137), 1-17.

9) Põder, K. 2003. Our Fatal Conceit. *EBS Review*, Summer 2003, 25-29.

10) Põder, K. 2002. A Rent Seeking Society, a Rent Providing Government and Social Goals. *EBS Review*, Summer 2002, 49-53.

Toimetamine ja tõlkimine:

1) Põder, K (ed.). 2006. *Mis see on, mida nimetatakse majandusteooriaks? Valik tõlkeesseid majandusteooria ajaloost ja distsiplinaarsetest dilemmadest*. Tallinn: EBS Print.

Konverentsid:

1) Ettekanne: Management and Rent-Seeking: Measuring Social Cost of Imperfect Competition and Rent Seeking in Estonia. *ATINER conference in Athens*. Ilmunud *Proceedings of ATINER,* Summer 2003.

2) Ettekanne: How Costly the Markets Are?"(in Estonian); *Ronald Coase Seminar, EBS*. Tallinn, 15. mai 2003.

3) Ettekanne: How to measure the transaction costs? *Ronald Coase Institute Workshop for Graduate Students, University of Arizona*. Tucson, USA, 1. oktoober 2004.

4) Ettekanne: Why Good Management Can Be Socially Ineficient? *BMDA Annual Conference*. Riia, Läti, 6. - 7. mai 2004. Ettekanne avaldatud Konverentsi kogumikus *Enhancing Baltic Managerial Competiveness*, 2004, 51-54.

5) Ettekanne: Kuidas püüda hüljest: analüütiliste narratiivide kasutamine majandusteoorias. *I Eesti Majandusteaduse Seltsi aastakonverents*. Pärnu, 20.–22. jaanuar 2006, Artikkel avaldatud: (www) http://www.emselts.ee/konverentsid/EMS2006/1_Economics/Kaire_Poder.pdf.

6) Ettekanne: Is homo Economicus Dead? Methodological considerations in Social Sceineces. *Second CEU Graduate Conference in Social Sciences*. Budapest, Ungari, 5.–7. mai 2006.

7) Ettekanne: How to Catch a Seal? Analytical Narratives of 19th Century Aiboland. *ESNIE Cargese*. Korsika, Prantsusmaa, 15.–20. mai 2006.

8) Ettekanne: Institutional Solutions to Coordination Traps: Social Structure – Guilds, Unions, and Social Norms in Medieval Hansatown Tallinn. *PEGC, Turu Ülikool*. Soome (http://vanha.soc.utu.fi/valtio-oppi/mopi/pegc.shtml), 16.–19. juuni 2006.

9) Ettekanne: Keskaegne hansalinn Tallinn: koordinatsiooniprobleemi lahendamine ühiskondlike riskide tingimustes. *Konverents: Inimteadvus ja käitumine riski tingimustes*. (www). http://www.euroscience.ee/human_awareness_est.html. Tallinn, 27.–28. oktoober 2006.

10) Ettekanne: Strategic Non-cooperation in Post-Soviet Estonia. *Doktorikool*. Kääriku, 30. juuli–2. august 2007.

11) Ettekanne: Kas me suudame käituda kooperatiivselt? Baseerub artiklil: „Cooperative norms and Defection in Prisoner's dilemma game: Analytic Narratives on Evolution of Strategic Non-cooperative Behavior in the Network". *Eesti Sotsiaateaduste Aastakonverents*. Tartu, 23.-24. novem-

ber, 2007. Konverentsiettekanne avaldatud *ESSO*; nr IV. (www) http://www.sotsioloogia.ee/esso4/show_article.php?id=30101&lang=eng.

12) Ettekanne: The Lighthouse in Estonia. 15th Nordic Conference on Small Business Research: *Challenges for Enterpreneurship and Small Business Development in the Context of European Enlargement.* Tallinn, 21. – 23. mai 2008. Avaldatud *Conference proceedings in* CD ROM.

13) Ettekanne: The Lighthouse in Economics: The Estonian Case. *Doktorikool*. Väimela, 28. – 31. juuli 2008.

14) Ettekanne: Credible Commitment and Cartel: The Case of Hansa Merchant in the Medieval Tallinn. *Doktorikool (Economics and Innovation)*. Otepää, 27.-30. juuli 2009.

15) Ettekanne: Avalike kaupade pakkumise probleemid: ajalooline tuletornide näide Eestis. *Eesti Majandusteaduse Seltsi aastakonverents*. Viljandi, 29.– 30. jaanuar 2010.

16) Ettekanne: The Lighthouse: The Case of Hansa Merchant in the Medieval Guild of Tallinn. *The 42th annual conference of Finish political science association: Democracy at Various Levels*. Tallinn 12. märts 2010.

8. Kaitstud lõputööd

Magistritöö: *How to Catch a Seal: Social Norms in 19th Century Aiboland.* Juuni 2005. CEU, Department of Politcal Science.

Magistritöö: *Sotsiaalne kulu ja Renditaotlus*: Eesti ettevõtluskeskkonna näidetel. Juuni 2002. Tallinna Tehnikaülikool, Majandusteooria õppetool.

Bakalaureusetöö: *Marshall Lerner Conditions in Estonia 1992-1995*. EBS 1995, Majandusteooria õppetool.

9. Teadustöö põhisuunad

Institutsionaalne ökonoomika (Uusinstitutsionaalne ökonoomika), Mikroökonoomika, Interdistsiplinaarsed (politoloogia, majandusteooria, sotsioloogia) uurimused ja metoodika.

10. Teised uurimisprojektid

Eesti Sotsiaalse mudeli analüüs Euroopa ja Balti riikide kontekstis. Plaanitav publikatsioon sügis 2010.

Appendix 6

CURRICULUM VITAE

1. Personal data

   Name: Kaire Põder.
   Date and place of birth: 2nd of October, 1972; Tallinn; Estonia.

2. Contact information

   Address: Suureniidu tee 11, Püünsi, Viimsi county, Harjumaa
   Phone: (372)56621662
   E-mail: kaire.poder@tseba.ttu.ee

3. Education

Educational institution	Graduation year	Education (field of study/degree)
Tallinna University of Technology		PhD in Economics
Central European University (CEU)	2005	MA in Political Science
Tallinna University of Technology	2002	MA in Economics
Estonian Business School (EBS)	1995	Bachelor of Business Adminisration (BBA)

4. Language competence/skills (fluent; average, basic skills)

Language	Level
Estonian	Mother tongue
English	Fluent
Russian	Average
German	Basic skills
Hungarian	Basic skills

5. Special Courses

Period	Educational or other organization
16-19 June 2006	PEGC, Turku University
15 - 20 May 2006	ESNIE 2006, Corsica, France
27 September – 2 October 2005	Ronald Coase Institute, Tucson Arizona, USA
18 - 25 June 2005	Institute of Humane Studies, University of Virginia, USA

6. Professional Employment

Period	Organization	Position
2008–…	Tallinn University of Technology	Researcher
2006–2008	Parental leave	
2005–2006	Estonian Business School (EBS)	Lecturer (Economics)
2004–2005	CEU Department of Political Science	Master and doctoral courses
2001–2004	EBS	Lecturer (Economics)
1999–2000	Parental leave	
1997–1999	Bank of Estonia	Leading specialist
1999–1995	EBS	Assistant (Economics)

7. Scientific work

Published articles:

1) Põder, K. 2014. The Lighthouse: Historic Analytic Narrative on the Provision of 'Public Goods' in Estonia. *Transformations in Business and Economics*, Vol 13, 2(32), xx-xx. (forthcoming)

2) Põder, K. 2010. Credible Commitment and Cartel: The Case of Hansa Merchant in the Guild of the Late Medieval Tallinn. *Baltic Journal of Economics*, Spring, xx-xx.

3) Põder, K. 2010. The Lighthouse in Estonia: The Provision Mechanism of „Public Goods“. In: M. Raudjärv (ed.), *Discussions of Estonian Economic Policy,* xx-xx.

4) Põder, K. 2009. The Evolution of Non-cooperative Behavior: The Case of Post Transitional Estonia. *Baltic Journal of Management*, 4(3), 301-317.

5) Kerem, K., Põder, K. 2009. Possible Dilemma - Nordic Welfare State versus Anglo-American Liberal Regime: "Estonian Social Model" in a Comparative Context. In: J. Sepp, D. Frear, W. Taylor (eds.). *The Key-factors of Business and Socio-Economic Development During the Global Crisis*, 89-105. USA, Wilkes-Barre: Congress of Political Economists International (COPE).

6) Põder, K. 2008. Cooperative Norms and Defection in Prisoner's Dilemma Game: Analytic Narratives on Evolution of Strategic Non-cooperative Behaviour in the Networks. *Working Papers in Economics (TUTWPE),* 23(162), 55-67.

7) Põder, K. 2006. How to Catch a Seal? The Study of Rational Norms of 19th Century Island Communities in Western Coast of Estonia. *CEU Political Science Journal,* 1(2), 2-14.

8) Põder, K. 2006. What We Research In Social Sciences: Is Homo Oeconomicus Dead? *Working Papers in Economics (TUTWPE),* 18(137, 1-17.

9) Põder, K. 2003. Our Fatal Conceit. *EBS Review*, Summer 2003, 25-29.

10) Põder, K. 2002. A Rent Seeking Society, a Rent Providing Government and Social Goals. *EBS Review*, Summer 2002, 49-53.

Editing:

1) Põder, K (ed.). 2006. *Mis see on, mida nimetatakse majandusteooriaks? Valik tõlkeesseid majandusteooria ajaloost ja distsiplinaarsetest dilemmadest* (in Estonian). Tallinn: EBS Print.

Conferences:

1) Presentation: Management and Rent-Seeking: Measuring Social Cost of Imperfect Competition and Rent Seeking in Estonia. *ATINER conference in Athens*. Printed version in *Proceedings of ATINER,* Summer 2003.

2) Presentation: How Costly the Markets Are?"(in Estonian); *Ronald Coase Seminar in EBS.* Tallinn, 15 May 2003.

3) Presentation: How to measure the transaction costs? *Ronald Coase Institute Workshop for Graduate Students in University of Arizona.* Tucson, 1 October 2004.

4) Presentation: Why Good Management can be Socially Ineficient? *BMDA Annual Conference.* Riia, Läti, 6 - 7 May 2004. Publication in Conference Proceedings: *Enhancing Baltic Managerial Competiveness*, 2004, 51-54.

5) Presentation: Kuidas püüda hüljest: analüütiliste narratiivide kasutamine majandusteoorias (in Estonian).*Majandusteaduse Seltsi aastakonverents.*, Pärnu, 20-22 January 2006, Publication in (www) (http://www.emselts.ee/konverentsid/EMS2006/)

6) Presentation: Is homo Economicus Dead? Methodological considerations in Social Sciences. *Second CEU Graduate Conference in Social Sciences*. Budapest, Hungary, 5-7 May 2006.

7) Presentation: How to Catch a Seal? Analytical Narratives of 19th Century Aiboland. *ESNIE in Cargese*. Corsica, France, 15–20 May 2006.

8) Presentation: Institutional Solutions to Coordination Traps: Social Structure – Guilds, Unions, and Social Norms in Medieval Hansatown Tallinn. *PEGC in Turku University*. Finland (http://vanha.soc.utu.fi/valtio-oppi/mopi/pegc.shtml), 16–19 June 2006.

9) Presentation: Keskaegne hansalinn Tallinn: koordinatsiooniprobleemi lahendamine ühiskondlike riskide tingimustes (in Estonian). *Conference: Human awareness and behavior under the risky environment* (http://www.euroscience.ee/human_awareness_est.html). Tallinn, Estonia, 27-28 October 2006.

10) Presentation: Strategic Non-cooperation in Post-Soviet Estonia, based on article „Transition of Informal Institutions: Analytic Narratives on Evolution of Strategic Non-cooperative Behaviour in Post-Soviet Estonia". *Doctoral Summer School*. Kääriku, 30 July–2 August 2007.

11) Presentation: Kas me suudame käituda kooperatiivselt? (in estonian) Based on article: „Cooperative norms and Defection in Prisoner's dilemma game: Analytic Narratives on Evolution of Strategic Non-cooperative Behavior in the Network". *Eesti Sotsiaateaduste Aastakonverents*. Tartu, Estonia 23–24

November 2007. Publication in ESSO; no IV, (www) http://www.sotsioloogia.ee/esso4/show_article.php?id=30101&lang=eng.

12) Presentation: The Lighthouse in Estonia. 15th Nordic Conference on Small Business Research: *Challenges for Entrepreneurship and Small Business Development in the Context of European Enlargement.* Tallinn, Estonia, 21–23 May 2008.

13) Presentation: The Lighthouse in Economics: Estonian case. *Doctoral Summer School*. Väimela, Estonia, 28–31 July 2008.

14) Presentation: Credible Commitment and Cartel: The Case of the Hansa Merchant in the Medieval Tallinn. D*octoral Summer School in Economics and Innovation*. Otepää, Estonia, 27–30 July 2009.

15) Presentation: Avalike kaupade pakkumise probleemid: ajalooline tuletornide näide Eestis (in Estonian). *EMS annual conference*. Viljandi, Estonia, 29–30 January 2010.

16) Presentation: The Lighthouse: The Case of Hansa Merchant in the Medieval Guild of Tallinn. *The 42th annual conference of Finish political science association: Democracy at Various Levels*. Tallinn, 12 March 2010.

8. Defended theses

MA thesis: *How to Catch a Seal: Social Norms in 19th Century Aiboland.* June 2005. CEU, Department of Politcal Science.

MA thesis: *Sotsiaalne kulu ja Renditaotlus: Eesti majanduskeskkonna näidetel* (Social Cost and Rent seeking: the Case of Estonia). June 2002. Tallinn University of Technology, Institute of Economics.

Bachelor thesis: *Marshall Lerner Conditions in Estonia 1992-1995*. EBS 1995, Chair of Economics.

9. Main areas of scientific work/Current research topics

Institutional Economics, Microeconomis (game theory), interdiciplinary (political science, economics, sociology) research and methodology.

10. Other research projects

Comparative study of 'Estonian Social model'. Publication agenda Fall 2010.

KOKKUVÕTE

Strukturaalsed lahendid sotsiaalsete lõksude vältimiseks: formaalsed ja mitteformaalsed institutsioonid

Käesolev väitekiri uurib institutsioone. Kuna (uus) institutsionaalse ökonoomika tööriistad ja valdkonna spetsiifika ei ole selgelt väljakujunenud, siis täpsustavalt on antud uurimuses analüüsi all individuaalsed valikusituatsioonid, kus enesekeskne käitumine ei vii parima võimaliku tulemuseni. Olukordi, kus individuaalne valik ei taga Pareto efektiivset jaotust, nimetatakse sotsiaalseteks lõksudeks. Antud uurimuse neli erinevat artiklit on pühendatud erinevate sotsiaalsete lõksude analüüsile. Esimeses artiklis (Põder 2006) on vaatluse all ühiskasutuses olevate ressursside ülekurnamise probleem. Teises artiklis (Põder 2010a) on tegemist koordinatsiooniprobleemiga ja usaldusväärsuse küsimusega. Kolmandas artiklis (Põder 2010) vaagitakse Coase (1974) jälgedes tuletorni kui avaliku kauba pakkumise võimalikkust eraomanduse kaudu. Viimases artiklis (Põder 2009) vaadatakse koostöö katkemise võimalikkust suhete-võrgustiku väliste omaduste (suhete arv ja teadmatus teise osapoole strateegilise käitumise kohta) muutumise korral.

Metoodilises plaanis on kõik artiklid sarnased – kasutatakse analüütilisi narratiive. Analüütilise narratiivi puhul peab empiirika (narratiiv) toetama analüütilist mudelit. Mudeliks on mänguteoreetiline konstruktsioon, üldjuhul laiendatud vorm mäng. Mäng määratleb valikusituatsiooni struktuuri – mängijad, valikute ja strateegiate väljad, tulemusprofiilid, mängu ajaloo. Mängu struktuur paneb paika ka võimalikud lahendusmeetodid, oluline on ka eeldus mängu korduvuse kohta ja korduvate mängude korral ka ajaliste eelistuste kohta. Narratiiv ehk empiirika kombineeritakse erinevate allikate alusel. Antud uurimuse erinevad artiklid kasutavad ka erinevaid algallikate tüüpe: intervjuud, teisesed andmed, mälestused ja arhiividokumendid. Narratiivi kokkupanek on meetodi oluline osa, sest sellest hakkavad lähtuma mudeli algtingimused.

Antud doktoriväitekirjas toodud artiklite puhul on institutsioonid struktuuraalseteks lahenditeks teatud mängu läbi defineeritud probleemile (näiteks vangide dilemma probleemile). Strukturaalsete lahendite puhul eeldatakse, et mängijal (või kolmandal osapoolel) on võimalik mängu struktuuri muuta. Mängu struktuuri muutmine võib tähendada nii valikute (strateegiate) välja muutmist, mängijate lisamist kui ka tulemusprofiilide muutmist. Pea kõik artiklid kirjeldavad isejõustuvaid institutsioone ehk struktuurimuutus tagab mängijatele parema tulemuse, kui seda võimaldaks „institutsioonivaba“ mäng. Sellised institutsioonid võivad olla formaalsed – riik, seadusandlus, organisatsioon; aga ka mitteformaalsed, näiteks sotsiaalsed normid, tavad, traditsioonid.

Antud doktoriväitekirjas esitatud artiklid kinnitavad järgmisi teoreetilisi väiteid:

(1) Väikesed seotud kogukonnad suudavad vältida sotsiaalseid lõkse (ühiskaupade ülekurnamine ja kohalike avalike kaupade pakkumine) omavahel täiendavate informaalsete institutsioonide (sotsiaalsed normid) abil.
(2) Keskaegne kaupmeeste gild (Suurgild) oli reputatsioonimehhanism, mis jõustas pettustevaba kaubavahetuse ja seega aitas luua majanduskasvu läbi kaubavahetuse suurenemise.
(3) Puhtaid avalikke kaupu saab eraomandil põhinevalt pakkuda vaid siis, kui eraomanikku toetab (riigi poolt pakutav) institutsionaalne süsteem. See institutsionaalne süsteem võib erineda, kuid peab koosnema omandiõiguse tagamisest, juriidilisest ja rahalisest või administratiivsest toetusest.
(4) Juhuslikes võrgustikes on koostööstrateegiast kasulikum järgida alternatiivset strateegiat, mille korral käitutakse kooperatiivselt vaid väikese hulga kindlate mängijatega ja teiste puhul jälgitakse Nashi tasakaaluni viivat valikut.

Kokkuvõtvalt võib öelda, et kõik artiklid demonstreerivad indiviidide võimet koostööd teha, õigemini oskust luua institutsioone, mis jõustavad kooperatiivset käitumist. Üldistavalt võib välja tuua, et artiklite puhul on ühendavateks väideteks (a) väikeste gruppide puhul saab sotsiaalseid lõkse vältida luues erinevaid üksteist täiendavaid mitteformaalseid institutsioone; (b) suuremates gruppides või juhuslikes suhetes vajavad mängijad selliste institutsioonide loomiseks välist jõustamist; (c) selline väline jõud ei pea tingimata olema riik, vaid selleks võib olla ka organisatsioon. Lisaks väärib tulemuste poolt väljatoomist arusaam, et mitmed kultuurilis-antopoloogilised nähtused võivad olla grupispetsiifilise ratsionaalse valiku tulemus. Mudelite abil on võimalik näidata, miks isegi sellised ebameeldivad kultuurilised nähtused, nagu grupist väljatõukamine, salatsemine, informatsiooni varjamine jne, võivad olla grupiliikme seisukohast ratsionaalsed. Kuigi toodud mudelid ei ole dünaamilised, võimaldab simulatsioon siiski näidata, kuidas väliste tingimuste muutudes võib käitumine hüpata ühest tasakaalustrateegiast teise.

Muidugi ei sea toodud tulemused kahtluse alla väidet, et institutsionaalsed muutused on aeglased ja nendel on enamasti mingid välised mõjutajad (majandiskliima, tehnoloogia või poliitika muutus). Samuti ei eita me, et institutsionaalne areng võib viia heaolu vähendavate või isegi ohtlike institutsioonide tekkimiseni. Samuti leiab toetust väide, et institutsioonid võivad tekkida või muutuda vaid kitsa grupi heaolu tagamiseks ja seda teiste arvelt (nagu näiteks juhtus gildide puhul). Samuti võib traditsioonidesse ja teistesse mitteformaalsetesse institutsioonidesse takerdumine tuua kaasa muutuste aeglustumise.

Antud doktoriväitekirja panust võib jaotada kolmeks: (a) interdistsiplinaarsus, mis võimaldab uurida sotsioloogia, antropoloogia ja majandusteooria piirialadele jäävaid küsimusi; (b) institutsioonide analüüs, mis valgustab turge toetavaid ja asendavaid institutsioone; (c) metoodika – analüütilised narratiivid – rakendused.

ABSTRACT

Structural solutions to social traps: formal and informal institutions

Current thesis studies institutions. We research institutional solutions to conflict situations, where individual interactions will not reach to the Pareto efficiency. The four articles that constitute the doctoral dissertations are using a similar methodology for studying the social phenomena called cooperation. The fist article (Põder 2006) is describing how various institutionalized social norms solved social traps in the 19th century communities in Estonia's small islands. The second article (Põder 2010a) is explaining the role of the Tallinn merchant guild in the flourishing late medieval Hansa trade. And the third article (Põder 2010b) is confronting Coase's (1974) ideas by studying the Estonian lighthouse system throughout four centuries up until World War II. The final paper (Põder 2009) is analyzing a change in individual behavioral patterns after transition in the early 1990ies. In all cases the research method used is called analytic narratives, which can be considered one specific type of combined research design where qualitative research is enriched with deductive modeling.

All articles present different possibilities in using analytic narratives in research design. The analytic portion pre-requires the problem to be "translated" into the language of economics – for this, typical set-ups of the prisoners' dilemma (also other normal form games) or extensive form games are used. In the first article (Põder 2006) households are playing the tragedy of commons game and have different social norms to change the game structure. In the second article (Põder 2010a) merchants are unable to solve coordination problems without organizational (guild) enforcement. In the third paper (Põder 2010b) lighthouses and ships are trapped in a detrimental equilibrium – only state provided help in administration of light dues and other state provided rewards help them out of the trap. And finally (Põder 2009), we show the change of optimal strategy due to alternation of network rules, which was the economic transition in the early 1990ies. Solution design in each case is dependent on model set-up. Qualitative data are used for indicating players, payoff profiles and the structure of the game. Despite the criticism that the study of small *n* (or unique case) has not enough degrees of freedom for falsification, the hypotheses that historical studies using analytic narratives has not only contributed in studying historical institutional frames, it also allows the making of generalizations (and even some

policy recommendations). The articles test and find verification to following statements:

(5) Small close communities are able to solve social traps (like under-provision of public goods and tragedy of commons) by complementary informal institutions (Põder 2006);
(6) Merchant guilds enforced reputation mechanism that made sanctions through punishment of shirked merchants a credible threat and thus guilds were helping promoting growth by increasing trade volumes in medieval Hansa (Põder 2010a);
(7) Pure public goods can be privately provided under a publicly provided institutional system. This institutional system may differ, but it is a combination of property rights, legal order and financial support (Põder 2010b);
(8) In random networks, cooperation is overruled by an alternative strategy according to which individuals will treat a small group of individuals in a cooperative manner and others in a self-regarding manner (Põder 2009).

All the articles show that individuals are able to cooperate or to establish institutions for enforcing mutually beneficial cooperation. In general it can be said that all the articles agree upon certain statements that (a) social traps can be overcome by small closed communities by creating different complementary informal institutions; (b) in larger networks or in case of random connections players need some sort of external assistance for solving social traps; (c) this external assistance can also be an organization (that will internalise external costs). Also evident is that many anthropological-cultural phenomena can be considered as a rational response to certain community specific social trap (Põder 2006). These models will help us understand some even nasty cultural phenomena (like ostracism, secrecy, hiding information) and also will cast some light into the dynamics – how the change in the structure of the game will tip expectations into new equilibrium (Põder 2009).

Of course we agree that change of institutions is not a rapid procedure and thus under circumstances (after change of economic climate, technology or political transition) these can also be unbeneficial or even hazardous. Also it may happen that for the players there is intrinsic logic (vested interests) that keep institutions that may be beneficial only to a narrow range of people in existence, such as guilds turning into rent seeking institutions after the end of the flourishing era of the Hansa (Põder 2010a). Also as it is in the case of informal institutions, being embedded into tradition can slow down the change (Põder 2006). The

more informal and embedded into traditions players are, the more difficult the alteration is.

The current thesis contributes to further research in three areas: (a) interdisciplinary comparative studies; (b) institutional studies concentrating on substitutes and complements to the market mechanism; and (c) methodological discussion over the analytical narratives. Overall, the undeniable role of the market mechanism in solving coordination problems is not being questioned, rather the institutional substitutes and complements to the market are studied. Cases studied are not well-known; however, their local origin will not diminish their relevance.

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3. **Tatyana Põlajeva**. The comparative analysis of market's attractiveness. 2001.
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