LAWS, MORALITY AND EFFICIENCY OF INSTITUTIONAL EQUILIBRIA

By
Martin Schmidt

Submitted to
Central European University
Department of Economics

In partial fulfillment of the requirements for the degree of Master of Arts

Supervisor: Professor Peter Grajzl

Budapest, Hungary
2007

Abstract

This paper develops a model that embodies an interaction mechanism between law and social norms derived from empirical findings. The analysis allows studying the impact of morality, in the form of social norm abidance, on economic equilibria and efficiency while agents with largely contrasting interests try to influence the institutional framework of the economy. My results show that the presence of social norms in economic activity has a considerable impact on economic outcomes, i.e. economic equilibria, and economic efficiency. Standard approaches of economic and sociological analyses appear in the analysis as extreme cases of an initial fraction of norm abiders. Finally, an application of this model to the problem of legal transplants is presented.

Table of Contents

Table of Figures

I. Introduction

Social norms have been a central concept in sociology and anthropology since the founding of these disciplines, but have only been discussed in economics recently. Social norms entered the economics discipline through three channels. First, they have become central in legal studies as an alternative means, apart from law and self-interest, to guide behavior (e.g. Ellickson 1998). From there, through the sub-discipline of law and economics that uses economic tools to analyze incentives for behavior (often trying to achieve efficiency and/or fairness) norms found their way into economics (for a recent overview of literature and relevance see McAdams & Rasmussen 2006).

The second channel through which social norms have entered economics is the quest for an experimental validation of game theoretic predictions concerning the standard assumption of self-regarding behavior (the landmark paper that invented the ultimatum game experiment is by Güth et al. 1982). Experiments have shown that self-regarding behavior is generally not observed when contracts are incomplete and individuals can punish or reward other individuals with whom they strategically interact. One often finds altruistic cooperation and/or punishment as well as the presence of character virtues like honesty or promise keeping (see Gintis 2007, chapter 3 for an overview of relevant experiments). Occurrence of non self-regarding behavior is seen as a strategy that is long-term fitness enhancing.

Finally, social norms have surfaced in economics within the sub-discipline of institutional economics that is concerned with the mechanisms that underlie the vast disparities in economic performances of different economies. Institutions are regarded as the main reason for allowing large-scale economic cooperation that is said to be essential for economic prosperity. For example, social norms, next to formal institutional constraints like the law, play an important role as informal institutional constraints in the work of Douglas North (e.g. North 1990) and are seen as a source of cooperation, but also of economic inefficiency.

In spite of the fact that the interaction between social norms and the law is widely regarded as important and worthwhile to study, explicit mathematical models that incorporate an interaction mechanism and study its consequences on economic activities are scarce. In the existing law and economics literature, for example, Posner (1997) starts from an analysis of the incentives for obeying social norms to delineate possibilities for legal measures to overcome inefficient norms. Shavell (2002), in a paper that extensively evaluates the comparative effectiveness of social norms and law within different contexts, also mentions a mutual interaction. Eisenberg (1999) applies a framework for the analysis of social norms to the special case of corporate law. He argues that a classical law and economics perspective that is exclusively based on the expected cost of legal punishment cannot explain a large part of the behavior of corporate executives if it does not include the complementary role of social norms. On the other hand, he claims, social norms are affected by the expressive function of law. All these papers, however, abstain from an explicit mathematical analysis. The same seems to be true for the large body of institutional economics literature.

In *this paper*, I will start from the assumption that the population of agents in my model economy can be classified either as purely self-regarding or conditionally cooperative. Conditional cooperators cooperate under the condition that other agents also cooperate; if other agents do not cooperate, the conditional cooperators will also end their cooperation. Conditional cooperators have internalized cooperative social values because not only their self-interest shapes their behavior, but conditional cooperation motives as well. Cooperation can be seen as an altruistic act when, in the long run, it benefits another party at a cost to the cooperating party. In real life experiments conditional cooperators would even incur costs to punish non-cooperators without receiving any benefits[1]. In this paper, the punishment motive of conditional cooperators plays only a secondary role, as conditional cooperators, due to a lack of information and direct contact, can punish norm violators only by ending their cooperation. The role of a sanctioning mechanism that can sustain conditional cooperative behavior has to be taken by a third party institution. Here the role of the third party institution is played by a legal institution that punishes norm violators. The punishment mechanism is modeled, along the lines of the law & economics tradition, as a cost incurred by violators[2]. The dynamics of the sub-population of conditional cooperators is then modeled by a replicator dynamics, well known from evolutionary game theory (e.g. Gintis 2007).

In my economy two types of economic actors - purely self-regarding agents and entrepreneurs - are given the possibility to influence the legal institutional framework. The purely self-regarding agents, often also named Homo oeconomicus, can illegally expropriate entrepreneurs and therefore have an interest to reduce expected punishment. Entrepreneurs try to exploit business opportunities and to do so have to commit to a long-term investment; they have an interest to protect their investments from expropriation and consequently are interested in an increase of expected punishment. Both parties try to advance their interests, are well organized and possess all available information so that their behavior can be analyzed with the techniques of optimal control theory.

[1] For recent evidence concerning the plausibility of this kind of population classification and the behavior of conditional cooperators, see e.g. Fischbacher and Gächter (2006).
[2] The analysis of punishment within the terms of microeconomic price theory is subject to common reservations and criticisms (see e.g. Nussbaum 1997, Bernstein 2005), but seems plausible in the context of my model.

Using this stylized economy I investigate how the interaction between a formal institution and abidance to social norms produces different equilibrium outcomes. These outcomes are entirely determined by the initial values of norm abiders and institutional quality. I solve the mathematical problem for two special scenarios: in the first scenario only entrepreneurs can influence institutional quality, whereas in the second scenario only purely self-regarding agents can influence institutional quality. In these scenarios the phase space, spawned by the levels of norm abidance and institutional quality, splits into three separate regions: one where no entrepreneurial activity takes place and the economy remains unchanged, one where entrepreneurial activity leads to changes in the levels of norm abidance and institutional quality, and one where entrepreneurial activity takes place but the levels of norm abidance and institutional quality stay constant. I am able to rank these regions by efficiency criteria and to describe the steady states of the different regions.

Interpreting the level of norm abidance as the level of acceptance of the legal institution[3], I find that a legal transplant that improves institutional quality and is widely accepted (or receptive in terms of Berkowitz et al. 2001) has a better chance of resulting in a business-friendly environment if only entrepreneurs can influence institutional quality, but can have a worse chance if only purely self-regarding agents can influence institutional quality. Moreover, I show that the standard approaches of economists that tend to disregard altruistic motives (i.e. conditional cooperators never cooperate) and sociologists that tend to disregard egoistic motives (i.e. conditional cooperators always cooperate) can be seen as special cases of my analysis.

[3] The possibility to interpret obedience to law as a social norm is mentioned by Galligan 2001 and also by Fehr and Fischbacher 2004

In the existing literature I could only find a few papers that try to model mathematically the often proclaimed connection between law and social norms. A rudimentary model is given by Parisi and Wangenheim (2005) where they show that law changes incoherent with existing social norms can have unintended countervailing effects. In another interesting paper (Bohnet et al. 2001) a possible crowding out effect of agents that follow norms of honesty due to higher legal sanctions is formulated mathematically. Two very similar papers (Funk 2005; Weibull & Villa 2005) produce equilibrium models that extend the classical Becker type models of crime and punishment to include social norms. Leukert (2005) builds on the new institutional economics framework of formal institutions, informal institutions and their enforcement characteristics; he shows mathematically that informal institutions' adaptation costs to a changing formal institutional framework can lead to an inefficient outcome of non-adapted informal institutions. Finally, Francois' paper (2007), which is closest to my paper and served as a starting point, presents a dynamic model of the interaction between norms and a sanctioning mechanism that is subject to institutional change. He shows that his setup leads to two possible end states: a well-functioning economy with high levels of honest behavior and a failing economy with low levels of honest behavior. The end states depend only on the initial values of honest behavior and institutional enforcement characteristics. One thing all these papers have in common is that social norms are subject to change and depend on incentive structures. This is a specific feature of the economic approach to social norms and is far less prevalent in related disciplines like sociology or anthropology.

The rest of the paper is organized as follows. Chapter II is split in four different sections. In section II.A I outline the setup of the general economic model and give some justifications for the plausibility of assumptions. In sections II.B and II.C I summarize and discuss the features of the solutions for the two special scenarios already mentioned. For each scenario, I first summarize and discuss the solution features of the two extreme cases often encountered in the literature: egoists and altruists that are insensitive to incentives. In section I discuss the influences of the remaining exogenous parameters on the phase diagram. In section II.D I list some comparative statics results and use the interpretation of norm abidance as acceptance of the rule of law to apply my model to the problem of legal transplants. Chapter III concludes and outlines the direction for further research. The appendix presents extensive mathematical derivations.

II. The Model

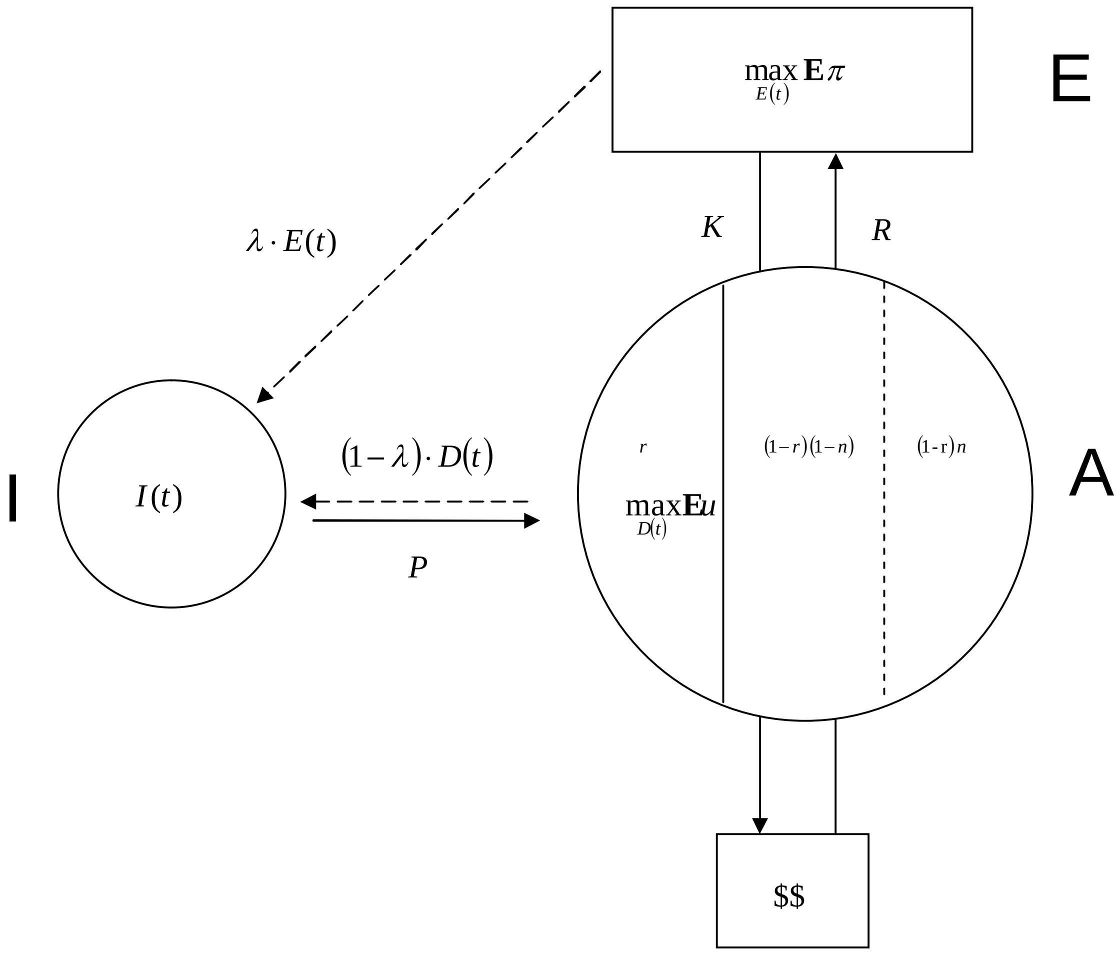
In this stylized economy, an environment that consists of interacting formal and informal institutions is subjected to the influence of entrepreneurs and purely self-regarding agents. The formal institution corresponds to a legal institution and the informal institution corresponds to a social norm. Entrepreneurs try to exploit profitable businesses and to do this depend on the collaboration of agents who are indispensable for the completion of investments. These agents belong to a population of agents that consists partly of purely self-regarding agents and partly of conditional cooperators. Entrepreneurs cannot distinguish between these two types of agents beforehand and just know the overall distribution. Purely self-regarding agents will deceive the entrepreneurs and expropriate their investments whenever the difference between gains from expropriation and costs from expected punishment is positive. Conditional cooperators will not deceive the entrepreneurs as long as they adhere to a cooperative social norm. The number of social norm adherents among the conditional cooperators can shrink though when behavior in harmony with social norms repeatedly leads to economic disadvantages. Entrepreneurs have an interest to stop purely self-regarding agents from expropriating their investments and can improve the legal institution to achieve this goal. Purely self-regarding agents have an interest not to deter entrepreneurs from investment and, at the same time, can worsen the legal institution as to diminish their punishment costs.

This model is inspired by a conference paper of Francois (2007), but deviates from it in major aspects, overcomes some of its limitations and reinterprets it in terms of the recent literature on experimental game theory and institutional economics. I maintain his insight of how to model an interaction between a sanctioning mechanism and norm abiding agents, namely in terms of a replicator dynamic. I also preserve his split of the population of collaborators into two types whose distribution is static and the split of one these types into two subtypes whose distribution is dynamic. I deviate from his characterization of the two subtypes in terms of unconditionally honest agents that can turn into unconditionally cheating agents (cheating even if expected punishment is higher than the gains from expropriation) and interpret the population in terms of the far more realistic distinction between purely self-regarding agents and conditional cooperators. I completely abandon his way of modelling entrepreneurial activity in terms of producers who can freely enter the market, are always in a long run equilibrium state and react to price movements of a competitive market commodity. My entrepreneurs commit to long term investment, they do not change their number, they do optimize over the whole life cycle of their investment and they know the fixed returns to their investment beforehand. Moreover, I overcome his limitation of an exclusively positive influence on the sanctioning institution that does not allow for institutional deterioration and his limitation of myopic collaborators who focus only on momentary gains and costs. In my model economy institutions can erode and purely self-regarding collaborators who profit from expropriation act as rationally as the entrepreneurs.

A. Description

I will now portray the stylized economy more extensively. I first describe the entrepreneurs and the legal institution, before I then turn to the population of collaborators and its dynamics. Hereafter I present the optimization problems of the entrepreneurs and the purely self-regarding agents. Finally, I introduce the phase space that completely describes the optimization problems. The stylized economy is schematically depicted in Figure 1. All features of this figure are mentioned in the subsequent descriptions.

Figure 1: Scheme of Stylized Economy



Entrepreneurs (E)

The economy is populated by identical, profit maximizing entrepreneurs E who try to exploit business opportunities by making use of a constant returns to scale technology with per period return R and per period investment K. These investments are bound to a long-term commitment that is decided before the per period investments take place. The numbers of entrepreneurs in the economy does not change over the whole investment cycle. To carry out their investments and receive the corresponding returns, they depend, as is common in modern economies, on other agents A (i.e. collaborators like government officials or business partners) who also populate the economy and whom they randomly encounter. These agents are in a position to expropriate the investments of the entrepreneurs during their collaboration and the only two things that stop them from expropriating investments are deterrence through a legal institution I or adherence to a social norm of honesty. Entrepreneurs, in general, have information on the overall distribution of willing expropriators, but do not know before entering collaboration if a particular agent intends expropriation or not.

Legal Institution (I)

The legal institution works by punishing expropriation through a fine P[4]; the time-dependent probability I(t) that an expropriator will be actually fined depends on the healthiness of the legal institution (e.g. the uniform application of the law, the enforcement of the law, the qualification and motivation of law enforcers, etc.). Misdetections do not occur and the whole legal process of detecting, convicting and punishing expropriators is left out of consideration. The healthiness of the legal institution can be fostered by organized efforts E(t) of the entrepreneurs who want safety of investments and can be obstructed by organized efforts D(t) of the other agents who want to avoid punishment when expropriating the entrepreneurs. All efforts come with a cost C(E(t)) to the entrepreneurs and a cost B(D(t)) to the other agents. Other actors, e.g. consumers, are assumed to be unable to organize in a way that can effectively influence the legal institution and therefore are not present in the economy.

[4] The fine P is just a shorthand form for a punishment cost P to the expropriating agents when detected and convicted. Making use of the law and economics approach the punishment can be more general and, for example, be a mixture of fine and imprisonment.

The relative effectiveness of entrepreneurs' constructive efforts vs. the other agents' destructive efforts is measured by a structural parameter $\lambda \in (0;1)$. A value of $\lambda = 1$ signifies futility of destructive efforts (i.e. idealized societies where the legal institutions are very strong and keenly defended, and where business interests and the security of property rights play a fundamental role and where even the greatest biggest obstructive efforts have no effect at all). A value of $\lambda = 0$ signifies futility of constructive efforts (e.g. an idealized society with a stable dictatorship and all powerful bureaucracy that does not depend on entrepreneurial activity due to high natural resource endowments; there even the greatest constructive effort has no effect at all). A value of $\lambda = 1/2$ means that both kinds of efforts have the same effectiveness.

Agents (A): Purely Self-regarding Agents

The agents consist of a large and constant population of two types; agents that belong to the same type are always indistinguishable. The first type occurs with a constant fraction r and corresponds to the purely self-regarding agents or standard Homo oeconomicus type of behavior: agents of this type maximize their private expected utility without regard to others and use any opportunity available that increases their expected utility. They would appropriate investments if their expected utility given by $K - P \cdot I(t)$ is positive and would abstain from appropriation if it is negative. Moreover, they organize obstruction of the legal institution if this allows them to create conditions for a profitable expropriation of investments. Homo oeconomicus type behavior has been shown to be nearly universal in anonymous market experiments with well specified contracts (e.g. Davis and Holt 1993) and to be present in the form of free riding in various forms of experimental cooperation games (e.g. Fehr & Fischbacher 2003).

Agents (A): Conditional Cooperators

The remaining fraction of agents 1 - r corresponds to the conditional cooperators type of agents that have an internalized propensity for moral behavior. These agents stick to their cooperative and forego self-enrichment through expropriation, thereby encouraging investment activities of the entrepreneurs, if other agents behave accordingly. If the Homo oeconomicus type agents can expropriate entrepreneurs without proper punishment, the conditional operators begin to abandon their cooperative and pro-social behavior. The number of agents who are ready to restrain themselves decreases. On the other hand, if expropriators are punished effectively the number of cooperative agents does not decrease. For experimental evidence concerning the existence of conditional cooperators and a description of this kind of social dynamic, see e.g. Fehr and Gintis 2007.

Consequently, conditional cooperators can be display two different kinds of behavior that correspond to two subtypes and the relative proportion of these two subtypes can change. One subtype, at time t, abides by a cooperative social norm (the norm can be enforced by private feelings of guilt or social feelings of shame) and does not expropriate investments, even if a classical expected utility analysis would demand it. The social norm abiders are present with a fraction $(1 - r) \cdot n(t)$. The other subtype, at time t, has stopped cooperation, disregards social norms, mimics the behavior of the purely self-regarding type of agents, expropriates if expected utility is positive and does not expropriate if it is negative. Though mimicking the purely self-regarding agents, they do not take part in intentional organized obstruction of the legal institution. The social norms violators are present with a fraction (1 – r) · (1 - n(t)). Norm violators at time t, contrary to the purely self-regarding agents, can become norm abiders later and vice versa. The time development at time t of the average fraction of norm abiders among the conditional cooperators n(t) is governed by a replicator dynamic:

$$\dot{n}(t) = \left(\mathbf{E}u(t) - \mathbf{E}\bar{u}(t)\right) \cdot n(t)$$

$$\mathbf{E}\bar{u}(t) = n(t) \cdot \mathbf{E}u_n(t) + (1 - n(t)) \cdot \mathbf{E}u_{1-n}(t) = \begin{cases} n(t) \cdot 0 + (1 - n(t)) \cdot (K - P \cdot I(t)) = (K - P \cdot I(t)) \cdot (1 - n(t)) & if\ K - P \cdot I(t) > 0 \\ n(t) \cdot 0 + (1 - n(t)) \cdot 0 = 0 & if\ K - P \cdot I(t) \leq 0 \end{cases}$$

$$\mathbf{E}u_n(t) = 0$$

$$\Rightarrow \dot{n}(t) = \begin{cases} (K - P \cdot I(t)) \cdot (1 - n(t)) & if\ K - P \cdot I(t) > 0 \\ 0 & if\ K - P \cdot I(t) \leq 0 \end{cases}$$

The first equation characterizes a replicator dynamic and states that the time development of n(t) equals the difference between the expected payoff **E**u(t)[5] to the norm abiding conditional cooperators and the average payoff **E**ū(t) to the subpopulation of conditional cooperators. The average payoff **E**ū(t) can be easily calculated and the payoff to norm abiders **E**u_n(t) always equals zero. The number of norm abiding conditional cooperators decreases whenever it pays to expropriate entrepreneurs and stays constant whenever it does not[6].

A replicator dynamic can just be assumed, but can also be derived from a cultural evolution approach first introduced by Luca Cavalli-Sforza and coworkers (see, for example, Luca Cavalli-Sforza and Feldman 1981). The cultural evolution model used here was developed in a paper by Bisin and Verdier (Bisin and Verdier

[5] Please note the similarity between the expectation operator **E**(·) and the effort level for institutional improvement E(t). These two entities should not be confused. Different from the effort level for institutional improvement E(t) expectation operators **E**(·) use bold letters and never depend on time only.
[6] This statement is subject to a minor reservation, namely that n(t)≠0 and n(t)≠1, and will be extensively discussed in this chapter.

2001) and presented in a short version in the paper of Francois (2007) so I will not rederive it in this paper. As usual with a replicator dynamic, a fraction of agents (here the fraction of the subtype displaying norm-abiding behavior) decreases if the payoff that results from its behavior is lower than the average payoff of the whole population of agents (here the subpopulation of conditional cooperators). It would increase if the payoff that results from its behavior is higher than the average payoff of the whole population.

Entrepreneurs' Optimization Problem

The behavior of all actors in the economy can be described by a set of equations. Entrepreneurs maximize their expected time-discounted lifetime profits. They lose profits if the legal institutional framework makes it worthwhile for agents to cheat, as some of the agents that the entrepreneurs randomly encounter during their investment activities will expropriate them and only norm abiding conditional cooperators allow a return to investment. Moreover, successful expropriation activity encourages norm abiders to forego their principles of cooperation and participate in future expropriation activities. This is reflected in the replicator dynamic of n(t). If the expected overall return to investment is below zero, the entrepreneurs will not invest at all. Consequently, entrepreneurs will have an interest in improving the institutional framework to a level where expropriation becomes unattractive. Costs incurred from institution building activities are assumed as strictly convex. This and the above outline of the economy lead to the following maximization problem for the organized entrepreneurs:

$$\max_{E(t)}\int_0^\infty e^{-\delta\cdot t}\mathbf{E}\pi(t)dt, \quad \pi(t)=\begin{cases} R-K-C(E(t)) & if \quad \mathrm{K}-P\cdot I(t)\le 0 \\ (1-r)\cdot n(t)\cdot R-K-C(E(t)) & if \quad \mathrm{K}-P\cdot I(t)>0 \end{cases}$$

$$\dot{n}(t)=\begin{cases} (P\cdot I(t)-K)\cdot(1-n(t))\cdot n(t) & if \quad \mathrm{K}-P\cdot I(t)\le 0 \\ 0 & if \quad \mathrm{K}-P\cdot I(t)>0 \end{cases}$$

$$\dot{I}(t)=\lambda\cdot E(t)-(1-\lambda)\cdot D(t)$$

$$\int_0^\infty e^{-\delta\cdot t}\mathbf{E}\pi(t)dt\ge 0$$

$$0\le n(t)\le 1$$

$$0\le I(t)\le 1$$

$$D(t)\ge 0$$

$$E(t)\ge 0$$

$$I(0)=I_0,\ \lim_{t\to\infty} I(t)\, free$$

$$n(0)=n_0,\ \lim_{t\to\infty} n(t)\, free$$

$$0\le\lambda\le 1$$

$$C(E(t))\ge 0,\ C(0)=0,\ C'(E(t))\ge 0,\ C'(0)=0,\ C''(E(t))>0$$

It is apparent that n(t) as a relative proportion and I(t) as a detection probability are confined to the interval [0;1]; the effort level of institutional improvement is confined to the interval [0;∞). The terminal states of n(t) and I(t) are entirely to the discretion of the entrepreneurs while the initial values of n(t) and I(t) are determined exogenously. Also the parameters λ, R, K, P and the cost function C(E(t)) are exogenously determined.

Purely Self-regarding Agents' Optimization Problem

The purely self-regarding agents maximize their discounted lifetime expected utility. They can favorably expropriate if the legal institution is sufficiently weak. As long as their expected lifetime utility does not fall below zero, the agents will try to obstruct the legal institutional framework. Purely self-regarding, they care about social norms of others only insofar as they influence the investment behavior of entrepreneurs. Non-investment from entrepreneurs destroys their opportunity to expropriate investments. This and the above description of the economy lead to the following maximization problem for the organized purely self-regarding agents:

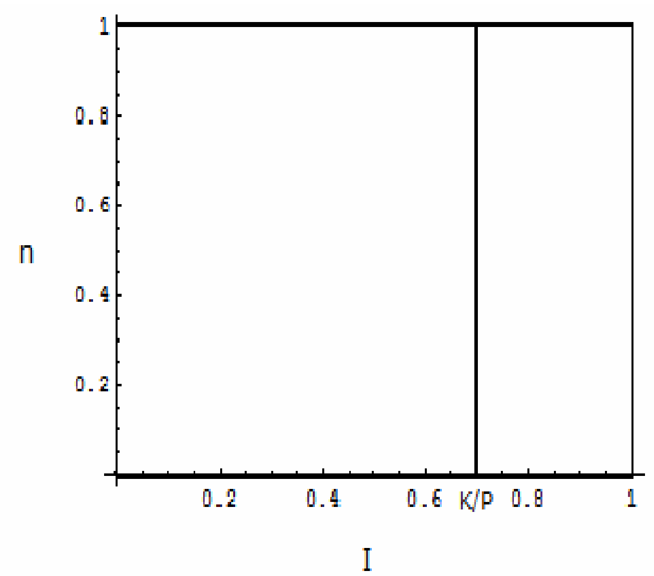
$$\max_{D(t)} \int_0^\infty e^{-\delta\cdot t}\mathbf{E}u(t)dt, \quad u(t) = \begin{cases} 0 & if \quad \mathrm{K} - P\cdot I(t) \le 0 \\ K - \mathrm{P}\cdot\mathrm{I}(\mathrm{t}) - \mathrm{B}(\mathrm{D}(\mathrm{t})) & if \quad \mathrm{K} - P\cdot I(t) > 0 \end{cases}$$
$$\dot{n}(t) = \begin{cases} (P\cdot I(t) - K)\cdot(1-n(t))\cdot n(t) & if \quad \mathrm{K} - P\cdot I(t) \le 0 \\ 0 & if \quad \mathrm{K} - P\cdot I(t) > 0 \end{cases}$$
$$\dot{I}(t) = \lambda\cdot E(t) - (1-\lambda)\cdot D(t)$$
$$\int_0^\infty e^{-\delta\cdot t}\mathbf{E}u(t)dt \ge 0$$
$$\int_0^\infty \mathbf{E}\pi(t)dt \ge 0$$
$$0 \le n(t) \le 1$$
$$0 \le I(t) \le 1$$
$$D(t) \ge 0$$
$$E(t) \ge 0$$
$$I(0) = I_0, \ \lim_{t\to\infty} I(t)\, free$$
$$n(0) = n_0, \ \lim_{t\to\infty} n(t)\, free$$
$$0 \le \lambda \le 1$$
$$B(D(t)) \ge 0, \ B(0) = 0, \ B'(D(t)) \ge 0, \ B'(0) = 0, \ B''(D(t)) > 0$$

Analogously to the optimization problem of the entrepreneurs the permissible values of n(t) and I(t) are constrained to the interval [0;1], while the permissible values of D(t) are constrained to the interval [0;∞). Again the terminal states of n(t) and I(t) are can be freely chosen and n_0, I_0 λ, R, K, P and the cost function B(D(t)) are exogenously determined.

Phase Space for n(t) and I(t)

The state variables I(t) and n(t) can be depicted in a phase diagram. Nearly all of the results of interest can be represented within this phase diagram and it will lie at the heart of the subsequent analysis. To start with, a usual steady state analysis can be carried out. While the steady states of the equation of motion for I(t) depend on E(t) and D(t) and need further investigation, it is clear that the equation of motion for n(t) has three distinct steady state sets. These sets in the phase diagram take the form of two horizontal lines parallel to the I axis (n = 0 and n =1) and one vertical line parallel to the n axis (I = K / P). The n = 0 and n = 1 sets are characteristic for replicator equations in general, but the vertical line set is specific to the replicator equation used here. The steady state sets for n are illustrated in Figure 2 where they appear thicker than the other lines in the quadratic phase space.

Figure 2: Phase Space of State Variables and $\dot{n} = 0$ Loci



In the subsequent sections II.B and 0 I will analyze two extreme case scenarios with λ = 1 and λ = 0, respectively. Each section will start with an investigation of the special cases where $n_0 = 0$ and $n_0 = 1$ before I address the more general case with

n_0 Є (0;1). This approach is meaningful for two reasons. First, it turns out that the special cases can be seen as limiting cases yielding minimum and maximum values that adumbrate the general case behavior of magnitudes like expected lifetime profits **E**π or expected lifetime utility **E**u.

Second, the special cases can be given an interpretation in terms of academic disciplines and so shed some light on the different disciplinary approaches. The case where $n_0 = 0$ is analytically indistinguishable from the standard economic approach where only Homo oeconomicus like creatures, i.e. blatant undersocialized egoists, are assumed to be present (i.e. r = 1) and so corresponds to a standard economic analysis where social behavior is left out of consideration. The case $n_0 = 1$ is very close to standard sociological or anthropological approaches that assume complete determination of an individuals' behavior through internalized static norms and society's insuperable sanctioning behavior (i.e. r = 0 and n = 1 supposed that altruistic norms have been internalized). The oversocialized individuals, sometimes called Homo sociologicus, are immune to anti-social behavior and egoistic motives do not play a significant role. I will often discuss the more interesting case where r ≠ 0, n = 1. The purely self-regarding agents can then be seen as sociopaths.

B. Futility of Obstruction (λ = 1)

If the purely self-regarding agents A have no chance of influencing the legal institution then it is clear that they will avoid costs for futile obstructive efforts D(t) and so D(t)=0 for all times t. Consequently, the analysis of the economy is much simplified. First, I focus on the extreme cases where only egoists or only altruists are present and then I turn to the more general case.

1. Either Egoists Only or Altruists Only

I will treat the special case where either egoists only or altruists only exist among the conditional cooperators in two sections. I address first the case where all agents initially cooperate and then I address the case where only agents that abide to pro-social norms initially cooperate.

a) $I_0 \geq K / P$, either $n_0 = 0$ or $n_0 = 1$

When $n_0 = 0$ or $n_0 = 1$ the replicator dynamic necessitates constancy of n(t). Moreover, if $I_0 \geq K / P$ the entrepreneurs will not exert effort to improve the institutional framework as the economy is already in a state as favorable as possible for them. Any further effort would be a waste of their resources and, as a consequence, E(t) = 0. Therefore, expected lifetime profit **E**π, expected lifetime utility **E**u, n(t) and I(t) can be completely specified (see appendix for the relevant equations):

$$\mathbf{E}\pi = \frac{R-K}{\delta}$$
$$\mathbf{E}u = 0$$
$$n(t) = n_0$$
$$I(t) = I_0$$

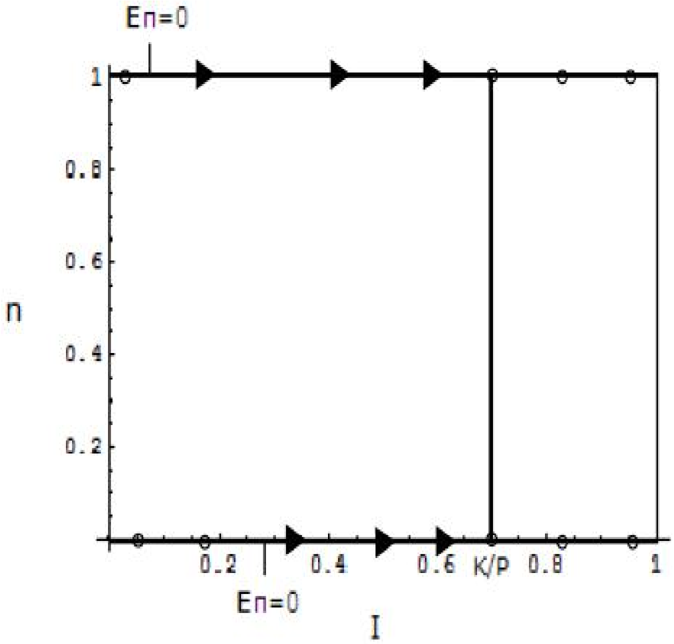
The economy is in a business-friendly equilibrium and remains there. Entrepreneurs will invest whenever R ≥ K and collect maximum profits. The economy has reached a socially efficient state where investments of K / δ pour into the economy and entrepreneurs create the maximum possible value (R - K) / δ. The total value of economic activity equals R / δ. Homo oeconomicus will never expropriate and it is irrelevant to the outcome if the population of conditional cooperators consists of only egoists or only altruists. This case is one of the few where a standard economic approach produces the same predictions like a standard sociological approach.

b) $I_0 < K/P$, either $n_0 = 0$ or $n_0 = 1$

If the legal institution initially makes it worthwhile to expropriate investments, n(t) still remains constant whenever either $n_0 = 0$ or $n_0 = 1$, but the entrepreneurs have now to decide about the optimal use of E(t). This can be achieved by a two-step optimization procedure. First optimizing E(t) in the region where $I_0 < K / P$ so that for a fixed time T the quality of the legal institution I(T) = K / P and then optimizing total profit with respect to T taking into account the profits that accumulate in the business-friendly environment after time T determines the optimal time T*. If maximal profits are not below zero the entrepreneurs will commit themselves to invest, otherwise they will step back. Solving the relevant equations shows that the entrepreneurs use more and more resources E(t) to improve the quality of the legal institution the more time passes and the more I(t) approaches the terminal value K / P (see appendix). The shadow price associated with the corresponding costate variable is constant over time. As soon as I(t) = K / P the entrepreneurs will not further improve institutional quality, but reap the maximal benefits that accumulate in an environment that is free from potential expropriators by setting E(t) = 0 like in II.B.1.a). The economy then has reached equilibrium.

The optimal time T* spent in the predatory environment where I(t) < K / P results from a tradeoff between rising costs if higher effort for institution improvement is exerted and, on the positive side less expropriation in the predatory environment and less foregone profits in the business-friendly environment. If $n_0 = 0$ entrepreneurs, starting from the initial value I_0, try to end the predatory environment faster than if $n_0 = 1$. In spite of the shorter transition time T* an initial value of $n_0 = 0$ will lead to lower expected lifetime profits Eπ if compared with the case where $n_0 = 1$ (see appendix for a derivation of these results). Consequently, to make investment profitable in the presence of only egoists the initial value I_0 has to be closer to K / P than in the presence of only altruists (see appendix). Moreover, entrepreneurs' profits are lower than in the efficient case where $I_0 \geq K / P$, n(t) stays constant and agents seize a share of the lifetime investment K / δ. A phase diagram incorporating the special n_0 cases described in this section has the following form (see Figure 3):

Figure 3: Typical Phase Diagram for λ = 1, either $n_0 = 0$ or $n_0 = 1$



Cutoff points below which lifetime profits become negative are indicated by **E**π = 0. Arrows point to the direction of movement in the phase diagram and the number of arrows of along a path in the phase diagram is roughly correlated with the transition speed. A higher number of arrows per unit length indicates a higher transition speed. Possible equilibria are represented by little circles. Overall, three intervals can be distinguished for each n_0 value. The first interval lies between 1 and $I_0 = K / P$. As already mentioned all initial values I_0 within this interval are efficient equilibria and there is no difference between $n_0 = 0$ and $n_0 = 1$. The second interval lies between $I_0 = K / P$ and a cutoff value I_0 where lifetime profits **E**π = 0. Here entrepreneurs invest and make efforts to improve the legal institution until it reaches the equilibrium value $I = K / P$ that deters expropriation. Efficiency is nearer to the efficient outcome the closer I_0 is to K / P. Moreover, efficiency is higher if $n_0 = 1$ and actually is highest if one makes an extreme sociological assumption where $r = 0$ and $n = 1$ (entrepreneurs never fear expropriation and never waste effort to improve the legal institution). The third interval lies between zero and a cutoff value I_0 with zero lifetime profits. In this interval no investment takes place and the economy remains in its pre-entrepreneurial, most inefficient equilibrium.

2. Egoists and Altruists Mixed

A dynamic population of conditional cooperators will change the behavior of entrepreneurs as the shadow price of the costate variable associated with I(t) is no longer constant. Entrepreneurs will take the social dynamics of norm abiders and norm violators into account when they make their investment decisions and try to delay the decline of norm abiders whenever it pays off to do so.

a) $I_0 \geq K/P$, $n_0 \in (0;1)$

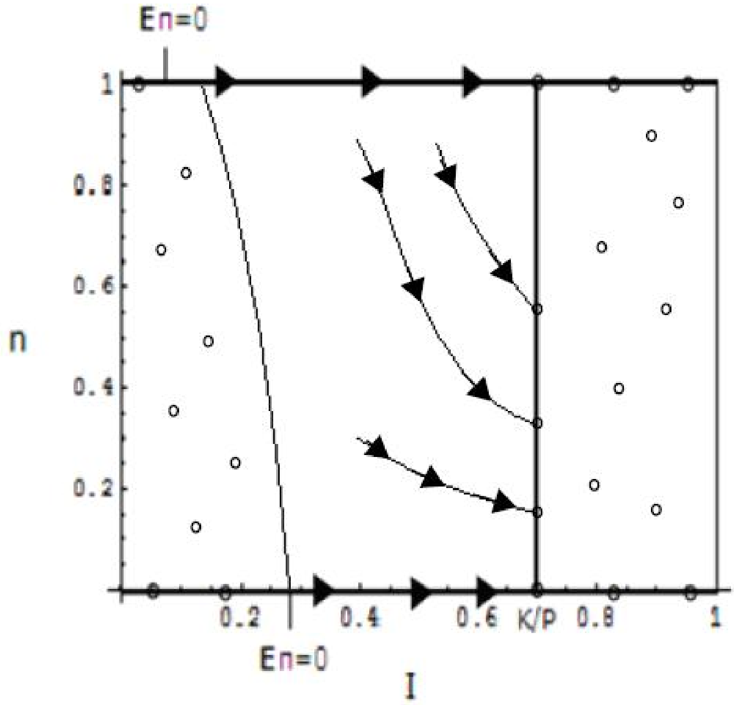
If the legal institutional framework is sufficiently efficient to deter expropriation, the optimization problem is identical to the case where conditional cooperators are present as altruists only or egoists only and the results remain unchanged. Entrepreneurs receive maximal profits, other agents have no opportunity to expropriate, and every initial state with $I_0 \geq K / P$ and n_0 arbitrary is an efficient equilibrium.

***b)* $I_0 < K/P$, n_0 Є (0;1)**

Again, the purely self-regarding agents will consider expropriation worthwhile. Moreover, the distribution of norm abiders and norm violators is now subject to change in the population of conditional cooperators. The entrepreneurs will take the impact of I(t) on n(t) into account and adapt the use of E(t) accordingly. Optimal control theory can be used for the first term of this two-step optimization problem (see appendix). Time optimization then leads to the optimal transition time T*. As usual, if **E**π = 0 the entrepreneurs will invest, if not the fraction of norm abiders and the institutional framework remain in the inefficient pre-entrepreneurial equilibrium. Analyzing the corresponding equations one can see that the shadow price of the costate variable related to I(t) is not constant like in the scenario with a static population of conditional cooperators. It starts at its maximum value and then decays quite rapidly to a constant value below the maximum. The value of its maximum depends on I_0 and the transition time T. Entrepreneurs invest more resources to retard the rapid decay n(t) at the beginning of their investments when their return to investments in the predatory environment is highest. As in the case where the population of conditional cooperators is static, entrepreneurs will refrain from institutional improvement when I(t) equals K / P.

As in the special cases with either $n_0 = 0$ or $n_0 = 1$ the optimal transition time T* is the consequence of a tradeoff between rising costs for institutional improvement and less expropriation and foregone profits. For any fixed initial value I_0, the optimal transition time T* for a non-static population of conditional cooperators lies below the optimal value for a static population of altruists and above the optimal value for a static population of egoists. The same is true for lifetime profits **E**π. The fewer the fraction of conditional cooperators adhering to social norms of honesty the faster entrepreneurs try to leave the predatory environment behind them. This leads to rising costs that diminish entrepreneurs' profits. Optimal transition time and lifetime profits change continuously with initial values n_0 and I_0 except in the neighborhood of $n_0=1$. A typical phase diagram for the general case then has the following features (see Figure 4):

Figure 4: Typical Phase Diagram for the General Case, λ = 1



In the general case, cutoff points where **E**π = 0 become cutoff lines. The cutoff lines are continuous except in the neighborhood of $n_0 = 1$.Here the cutoff line makes a sudden jump. This is because per period profits, when starting from $n_0 = 1$, do not diminish contrary to the case where n_0 is slightly smaller than one[7]. Once more, arrows indicate the direction of movement in the phase space and equilibria are represented by circles. In the general phase space the three intervals discussed

[7] The difference decreases the closer I_0 is to K / P.

before and corresponding to a different behavior of the economy expand into regions[8] that show very similar behavior.

The first region is delimited by the intervals n_0 Є [0;1] and I_0 [K/P;1]. All initial values n_0 and I_0 within this region are efficient. The second region is defined by the initial values of n_0 Є [0;1) and the initial values I_0 lying between K / P and cutoff values I_0 that depends on n_0; higher values of n_0 allow a lower cutoff value I_0. Entrepreneurs invest and incur costs to end the predatory environment until the quality of the legal institution reaches the equilibrium value I = K / P. Profits and efficiency increase with higher n_0 and higher I_0. Generally, the fraction of norm abiders decreases while the quality of the legal institution improves and remains constant as soon as a business-friendly environment has been established. Steady states in this region always lead to the I = K / P line. A higher initial value of institutional quality I_0 leads to a higher final level of norm abiders if the initial value of norms abiders n_0 is kept unchanged. On the other hand, a higher initial level of norm abiders n_0 guarantees a higher final level of norm abiders if the initial value of institutional quality I_0 is left unaltered. The third region lies between zero and cutoff values I_0 that varies with n_0. Entrepreneurs do not invest and the state of the economy stays in its pre-entrepreneurial equilibrium of maximum inefficiency.

The effect of an occurrence of norm abiding agents is evident. If compared to the standard Homo oeconomicus, it allows an institutional environment that would otherwise remain void of entrepreneurial activity to achieve a business-friendly equilibrium state. Whenever entrepreneurs invest outside a business-friendly environment efficiency is increased. If compared to the standard Homo sociologicus, the fact that the number of norm abiders can erode leads to a drastic revision of the

[8] Form now on I will not pay special attention to the anomaly in the neighborhood of n0 = 1.

attainable profits and of the range of predatory environments open to sustainable institutional improvement.

C. Futility of Constructive Efforts (λ = 0)

If the entrepreneurs E have no possibility to change the legal institutional environment they will not incur costs for futile efforts, i.e. E(t) = 0 for all time t. Once more, the analysis of the economy is simplified. As in the scenario where λ = 1, I will investigate the extreme case of egoists only or altruists only separately and then treat the more general case. Different from the scenario where λ = 1, I will first treat the predatory environment and then turn to the business-friendly environment

1. Either Egoists Only or Altruists Only

Homo oeconomicus type agents pay attention to the value of n(t) only insofar as it makes investment of entrepreneurs profitable. As n(t) is necessarily constant when $n_0 = 0$ or $n_0 = 1$, they do not have to take the effect of their obstructive activities on n(t) into account. It is sufficient to guarantee entrepreneurs enough time so that they will make non-negative profits. Hence, they will obstruct legal institutions as effectively as possible while making sure that investment takes place.

a) I_0 < K / P and either n_0 = 0 or n_0 = 1

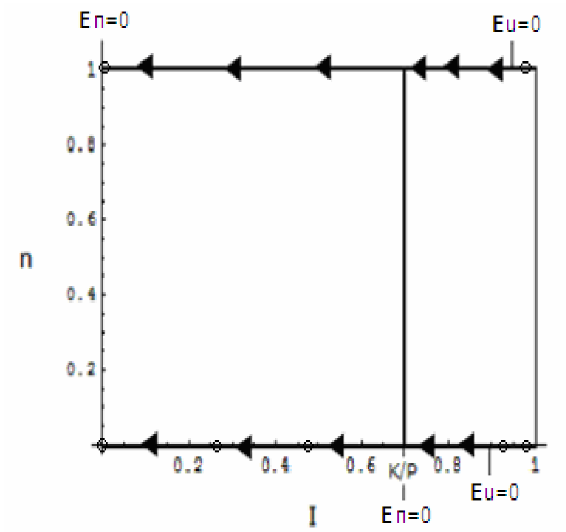
It is clear that for $n_0 = 0$ entrepreneurs' lifetime profits are always negative and so investment will never take place if $I_0 < K / P$. Purely self-regarding agents will not waste effort to obstruct legal institutions (i.e. D(t) = 0), entrepreneurs will not invest and payoffs to both parties will equal zero. The number of norm abiding conditional cooperators n(t) will equal zero for all times t and I(t) will equal I_0 for all times t. The same is true if $n_0 = 1$ and $(1 - r) \cdot R < K$, except that n(t) equals one in this case. If on the other hand $n_0=1$ and $(1-r)\cdot R \geq K$ then Homo oeconomicus type agents will obstruct the legal institutions in any case and spend an equal amount of effort per time until the quality of the legal institution I(t) has linearly decreased to zero. The shadow price associated with the costate variable μ(t) that corresponds to the punishment probability I(t) is exponentially decreasing.

b) $I_0 \geq K / P$ and either $n_0 = 0$ or $n_0 = 1$

In both cases (either $n_0 = 0$ or $n_0 = 1$) and independent from I_0 entrepreneurs can achieve non-negative lifetime profits whenever $R \geq K$. Purely self-regarding agents will try to create a predatory environment as rapidly as possible, but are bound by increasing obstruction costs and by the participation constraint. If the participation constraint is non-binding the transition time T* follows from a two-step optimization procedure. Profits of the entrepreneurs then are positive. If the participation constraint is binding the transition time T* equals the minimal transition time T_{min} that is needed to guarantee non-negative profits to the entrepreneurs. In general, the lower bound for the transition time T_{min} is higher for $n_0 = 0$ than for $n_0 = 1$ (for this and all mathematical demonstrations see appendix). A binding participation constraint means that the purely self-regarding agents will delay the creation of a predatory environment just as long as necessary to give the entrepreneurs an incentive to invest. The delay is accomplished by reduced obstruction efforts in the business-friendly environment. The delay lowers the gains for the purely self-regarding agents and increases the expected lifetime profits of the entrepreneurs until they equal zero. The effort level D(t) never equals zero before the quality of the legal institution is entirely destroyed, i.e. I(t) = 0.

Obstruction can become unprofitable if I_0 is too high and the necessary obstruction effort leads to costs higher than the gains from expropriation, i.e. **E**u(T*) < 0 if the participation constraint is non-binding or **E**u(T_{min}) < 0 if the participation constraint is binding. T_{min} for n_0 = 0 is higher than T_{min} for n_0 = 1 and accordingly **E**u(T_{min}) will fall below zero for n_0 = 0 before it falls below zero for n_0 = 1. Interestingly then it can happen that expropriation becomes unattractive to the purely self-regarding agents if only egoists are present while it is still attractive if only altruists are present. If the participation constraint is non-binding over the whole range I_0 Є [K/P;1] the cut-off point for worthwhile obstructive activities for n_0 = 0 and n_0 = 1 are equal. Assuming that (1 – r) · R > K and that the participation constraint is binding a typical phase diagram looks like (see Figure 5):

Figure 5: Typical Phase Diagram for either n_0 = 0 or n_0 = 1, λ = 0, (1 - r) · R > K



The participation constraint (i.e. **E**π = 0) and the non-negative lifetime utility requirement (i.e. **E**u = 0) partition the phase space into three different intervals. Arrows and circles have the usual meaning. The first interval runs from 1 to the cutoff value where **E**u = 0. For initial values I_0 lying in this area purely self-regarding agents will consider obstruction not worthwhile and the efficient business-friendly environment remains untouched, i.e. the economy remains in an efficient equilibrium. The second interval extends from the cutoff value where **E**u = 0 to the cutoff value where **E**π = 0 and below which entrepreneurs' lifetime profits become negative. Here purely self-regarding agents obstruct the legal institution is quickly as they can until the economy reaches an equilibrium where the quality of the legal institution equals zero. In the phase diagram depicted above the participation constraint binds for n_0 = 0 and does not bind for n_0 = 1. This implies that entrepreneurs' lifetime profits always equal zero if n_0 = 0 and are always positive if n_0 = 1. Consequently, not only is n_0 = 1 case less inefficient than the n_0 = 0 case, but entrepreneurs will always invest if n_0 = 1. The third interval comprises all values lying between 0 and the cutoff value below which lifetime profits become negative. Here entrepreneurs do not invest and the economy maintains the most inefficient pre-entrepreneurial equilibria. The third interval does not exist for the n_0 = 1 case as lifetime profits are always positive.

2. Egoists and Altruists Mixed

As before in the λ = 1 scenario, a dynamic population of conditional cooperators changes the shadow price of the costate variable associated with I(t). The purely self-regarding agents consider this when pondering obstruction. It is helpful for an understanding of the general scenario to understand the situation when entrepreneurs and self-regarding agents can influence the legal institution, i.e. E(t) = 0 and D(t) = 0 for all times t. Then entrepreneurs will invest in a predatory environment only if the initial level of social norm abiders and institutional enforcement are high enough to allow for sufficient returns in spite of the rapid deterioration of norm abidance. Only if investment in the predatory environment takes place the population distribution of conditional cooperators will change, otherwise n(t) and I(t) will remain constant. It is obvious that the set of initial values for which investment is profitable if E(t) and D(t) equal zero is a subset of the scenario where $\lambda = 1$. This subset is the empty set whenever $(1 - r) \cdot R < K$.

a) $I_0 < K / P$, $n_0 \in (0;1)$

The purely self-regarding agents are interested in the level of n(t) only insofar as they intend not to violate the participation constraint of the entrepreneurs. As Homo oeconomicus type of agents cannot build up the institutional framework, it is apparent that the set of initial values for n(t) and I(t) for which investment takes place is identical for the case where D(t) = 0 and E(t) = 0. Purely self-regarding agents will make no efforts to obstruct the institutional framework if their obstruction makes investments of the entrepreneurs unprofitable. If their obstructive activities do not decrease entrepreneurs' profits below zero they will obstruct the institutional framework without paying any attention to the level of n(t) or the entrepreneurs profits. As in the case where $I_0 < K / P$ and $n_0 = 1$, the optimal effort level then leads to time linear obstruction of institutional quality until I(t) equals zero. The shadow price corresponding to the associated costate variable decreases exponentially (for a mathematical demonstration of this and the other statements see appendix).

If their obstructive activities would push entrepreneurs' profits below the zero profit line, they adapt their behavior as not to deter entrepreneurs from investing. They do this by initially reducing obstructive activities, possibly - for a certain period - not carrying out obstructive activities at all, before they reach the final optimal level P/δ like in the unconstrained case. The participation constraint thus reduces the shadow price at the beginning before it returns to normal, exponentially decreasing behavior of the unconstrained case. The difference between this and the situation where $E(t) = 0$ and $D(t) = 0$ is that the profits of the entrepreneurs are reduced, the gains of the purely self-regarding agents are increased, n(t) decreases faster over time and also I(t) decreases and does not remain constant. In comparison with the scenario where $\lambda = 1$, identical initial values of n_0 and I_0 result in lower efficiency if obstruction is actively practiced.

Generally, entrepreneurial activity can take place only if returns to investments are unusually high, i.e. $(1 - r) \cdot R \geq K$. Entrepreneurs are aware that they will never be able to conduct business in a business-friendly environment, but high returns to their investments at the beginning of their activities can set off not only the later losses due to natural deterioration of conditional cooperation, but also the deliberate obstructive efforts of purely self-regarding agents who are known not to repel entrepreneurs. The standard economic analysis ($n = 0$) would predict no entrepreneurial activity at all, while the standard sociological analysis ($n = 1$) predicts unchanging returns to investment whenever $(1 - r) \cdot R \geq K$. In my model returns to investment plummet if the initial value of n_0 is only slightly below $n_0 = 1$; only environments with an initially high adherence to social norms of honesty can support entrepreneurial activity. Only the highest initial fractions of social norm abiders allow entrepreneurs to make positive profits; otherwise purely self-regarding agents drive their profits down to zero while further obstructing the institutional environment. Obstructive efforts are well timed and set in as soon as entrepreneurs are guaranteed to reach the expected zero level of lifetime profits.

b) $I_0 \geq K / P$, $n_0 \in (0;1)$

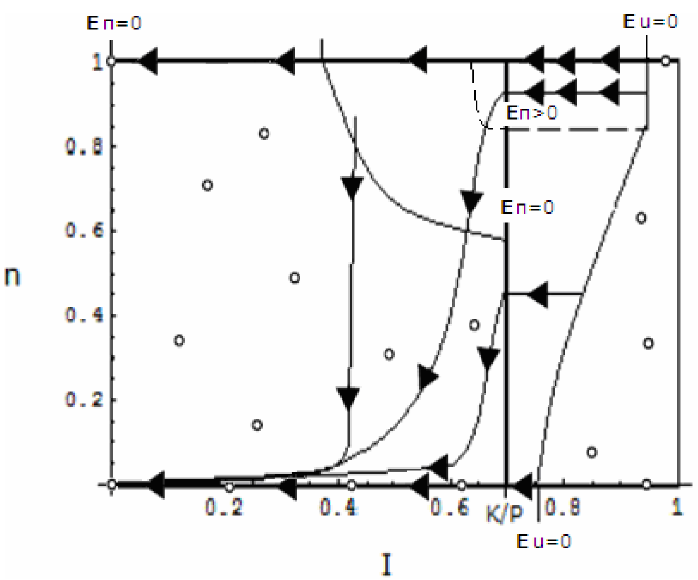
If I_0 lies in the business-friendly environment the participation constraint for entrepreneurs can always be fulfilled as profits of the entrepreneurs in the business-friendly environment (supposed $R > K$) are necessarily positive. The question for the purely self-regarding agents is then how to extract maximal gains while not violating the participation constraint. Their full optimization problem can be split up into two steps: the first step is very similar to the optimal control problem where $I_0 \geq K / P$ and either $n_0 = 0$ or $n_0 = 1$; the second step can be transformed so that it is nearly identical to the case where $I_0 < K / P$ and $n_0 \in (0;1)$. The only difference is that the participation constraint does not embody zero profits but the amount of profits earned in the business-friendly environment. Optimization of the transition time then leads to the final payoffs for Homo oeconomicus type agents, entrepreneurs and time behavior of n(t) and I(t).

If $(1 - r) \cdot R \geq K$ there is an interval for initial values of $n_0 \in [n_{min}(I_0);1]$ such that the purely self-regarding agents can obstruct institutions optimally as in the absence of a participation constraint. Within the interval of initial values $n_0 \in [0;n_{min}(I_0))$ they have to adapt their obstructive activities as not to violate the participation constraint. They can do this by decreasing their obstructive activities in the business-friendly environment or in the predatory environment. The higher the value of I_0 the lower the value of n_{min} as, due to rising obstruction costs, it is not worthwhile for purely self-regarding agents to obstruct institutions with higher speed than the optimal level. It should be clear that D(t) will not equal zero until I(t) equal zero. This is because any time at which D(t) equals zero can be used to increase the gains of the purely self-regarding agents by decreasing the obstructive activities in the business-friendly environment. The same gains from expropriation could then be reached with lower obstruction costs. If $(1 - r) R < K$ purely self-regarding agents are always constrained by the participation constraint.

If purely self-regarding agents are constrained by the participation constraint they slow down their obstructive activities in a way that entrepreneurs receive exactly zero profits. If they can obstruct without being constrained by the participation constraint entrepreneurs will receive positive profits. Obstructive activities can become unattractive when the necessary slowdown of obstructive activities results in a shortfall of expropriation opportunities to an extent that expected lifetime utility becomes negative. This will be the case whenever the optimal transition time associated with a binding participation constraint is higher than the optimal transition time that allows only for zero profits if the participation constraint is non-binding.

A non-binding participation constraint does not imply that obstruction is desirable for the purely self-regarding agents. It might still be not worthwhile pursuing it because even optimal obstruction activities can incur higher costs than the expected gains from expropriation. The complete optimization and determination of the optimal transition time T* then is a tradeoff between rising costs for institution obstruction, foregone gains from expropriation and higher possible speed of institution obstruction in the predatory environment while not violating the participation constraint of the entrepreneurs. A possible phase diagram then has the form shown in Figure 6.

Figure 6: Typical Phase Diagram for the General Case, $\lambda = 0$, $(1 - r) \cdot R > K$



The participation constraint (i.e. **E**π = 0) and the non-negative lifetime utility requirement (i.e. **E**u = 0) partition the phase space into three different regions. The meaning of arrows and circles is as before. The first region forms the efficient and business-friendly environment where purely self-regarding agents will not bother to obstruct. The region begins at I_0 values of 1 and is then delimited by a straight line if values of n_0 are high and by a curve for lower values of n_0. The straight line stems from the requirement of non-negative lifetime utility and the curve derives from a binding participation constraint. The second region defines the predatory environment. It lies to the left and to the right of the I = K / P line. On the right hand side of this region begins the business-friendly environment, on the left hand side of this region begins the pre-entrepreneurial environment. The border with the pre-entrepreneurial environment is identical with the border when E(t) = 0 and D(t) = 0. Furthermore, the second region consists of two subregions; in the first subregion the participation constraint is always binding and lifetime profits **E**π equal zero; the level of inefficiency in this subregion is the same everywhere. In the second subregion entrepreneurs profits are still positive and the participation constraint is not binding, purely self-regarding agents choose the optimal level of obstructive effort and efficiency is higher than in the first subregion. The only equilibrium outcome of this region consists of the point where n(t) and I(t) both equal zero The third region lies on the left hand side of the predatory environment and every point in this region corresponds to a pre-entrepreneurial equilibrium. Again, if compared with the scenario where λ = 1, identical initial values of n_0 and I_0 result in lower efficiency if obstruction is actively practiced. An important counter-intuitive result that derives from the constraints imposed by the participation constraint is that a stable business-friendly environment can erode if levels of norms abidance increase.

D. Further Results and Discussion

So far I haven taken the exogenous parameters of λ, R, K, P, r, C(E(t)) and B(D(t)) as given and just have paid attention to the consequences of changes in n_0 and I_0. In this section I will add some remarks on the influence and meaning of these parameters. Moreover, I apply the model developed above to the problem of legal transplants.

1. Discussion of Remaining Structural Parameters

I have already discussed the meaning of different values of λ and will not add further comments here. Let it just be noticed that an understanding of the general case where λ Є (0;1) would be highly desirable and I will remark on this in the last chapter when I conclude. Changes in R, K and P mainly shift the form of the distinct regions in the phase diagram or the location of the I = K / P line. If K and P remain unchanged and just R increases it is clear that the region open to profitable investment expands while the region without entrepreneurial activity shrinks. An increase of P leads to a leftward movement of the I = K / P line and pushes the existing distinct regions to the left. This implies a reduction of the region without entrepreneurial activity, while the business-friendly environment is enlarged. An increase in K can have both effects, i.e. a change of regions and a shift of the I = K / P line. An increase of r, on the other hand, aligns the regions with the $n_0 = 0$ intervals.

A faster increase of the cost function C(E) has two effects. First, the translation rule of the current value Lagrange multiplier corresponding to I(t) into the effort level E(t) means that effort level will be distributed more equally over time.

Second, an increase in the cost function obviously influences the distinct regions in the phase diagram. The region susceptible to entrepreneurial activity shrinks while the pre-entrepreneurial region grows. A faster increase of the cost function B(D(t)) also distributes the effort level more uniformly over time. Additionally it reduces the area where the participation constraints binds and reduces the region in the business-friendly environment that is susceptible to institutional obstruction.

Two more, slightly speculative, interpretive observations can be added. Whenever legal punishment P is lower than the expropriable investments K a business-friendly environment will never arise. If entrepreneurs see business opportunities with very high returns, i.e. $(1 - r) \cdot R > K$, investment might take place and entrepreneurs might even exert some effort to slow down the deterioration of social norms, but the fraction of agents abiding to norms of honesty will inevitably approach zero. If $(1 - r) \cdot R > K$ the economy will remain in its former state of economic activity that does not depend on an advanced form of collaboration and so does not allow for expropriation. One can imagine this economy as an economy where economic activity is limited to immediate exchanges of goods and payments. Opportunities for expropriation therefore do not arise.

If $P \gg K$, then K / P is close to zero and nearly the whole phase space consists then of a business-friendly environment. Expected utility of expropriative activities will never be high and entrepreneurs do not have to exert large efforts to transform a predatory environment into a business-friendly one. Institutional quality does not have to be high to deter purely self-regarding agents from expropriation. Extremely high punishments and low institutional quality are features of authoritarian regimes that do not adhere to the legal principle of proportionality. In these regimes the cost of regime change to entrepreneurs (C(E(t)), but also to Homo oeconomicus type of agents B(D(t)) will rapidly become very high and therefore the regime will be quite static and not see significant institutional changes. In general, low rising costs (C(E(t)) and B(D(t)) can be said to correspond to a lower adaptability of the institutional framework. To determine which real-life society has higher or lower adaptability is admittedly a difficult task and I will not enter into this discussion.

2. Application to Legal Transplants

The problem of legal transplants, i.e. the question when it is appropriate, as a means of institutional reform, to import an already existing body of law from another jurisdiction, is an open research question in economics and legal studies. A well-know study of Berkowitz et al. (2003) concludes that a transplant that is receptive, i.e. that is meaningful in the context of a country receiving the legal transplant, has a far better chance of resulting in legal effectiveness and economic development than a transplant that is unreceptive. A reinterpretation of the magnitudes in my model allows me compare the hypothesis of Berkowitz et al. with predictions from my model.

The reinterpretation regards the level of norm abidance as the level of acceptance of the legal institution or as acceptance of the rule of law (for a justification see, for example, Galligan 2001; Fehr and Fischbacher 2004). A transplant in my model then can be seen as a means to move the economy from an inefficient pre-entrepreneurial environment to a business-friendly environment. A transplant would increase the initial level of institutional quality I_0 and could try to increase the initial level of the acceptance of the legal institution n_0. If only entrepreneurs are able to influence the legal institution (i.e. $\lambda = 1$) a higher value of n_0, in accordance with the receptivity view, would indeed imply a higher probability to end up in the business-friendly environment (assuming that the exact cutoff values where **E**π = 0 are not known to the legal reformer).

If, alternatively, only the purely self-regarding agents (i.e. $\lambda = 0$) can influence the legal institution a higher initial value of acceptance of the transplanted does not necessarily have a positive effect. It is clear that far higher levels of institutional improvement I_0 are needed to have a chance to establish a sustainable business-friendly environment. Furthermore, it is possible that an unreceptive transplant (i.e. low levels n_0 of acceptance of law) succeeds in an environment where purely self-regarding agents have control over the legal institution while a receptive transplant (i.e. high levels n_0 of acceptance of law) fails and purely self-regarding agents drive the economy back to a pre-entrepreneurial stage. A solution to the general scenario $\lambda \in (0;1)$ is desirable here as it might further clarify the situation.

III. Conclusion & Outlook

In this paper I start from a model developed by Francois (2007) and subject it to major modifications that overcome some of its limitations, result in a higher degree of reality and lead to a reinterpretation in terms of the recent literature on experimental game theory and institutional economics. My model embodies an interaction mechanism between law and social norms that is well founded on empirical findings. A two-dimensional phase diagram analysis allows studying the impact of morality, in the form of social norm abidance, on economic equilibria and efficiency while agents with largely contrasting interests try to influence the institutional framework of the economy. My results show that the presence of social norms in economic activity has a considerable impact on economic outcomes, i.e. economic equilibria, and economic efficiency. Standard approaches of economic and sociological analyses appear in my analysis as extreme cases of the initial fraction of norm abiders n_0. Sociologists tend to be too optimistic, i.e. they predict efficient economic activity and profitable business far too often, whereas economists tend to be too pessimistic, i.e. they predict economic activity and profitable business in too few cases. One surprising and counter-intuitive finding is that a higher degree of social norm abidance can weaken an efficient economy if only purely self-regarding agents can influence the institutional framework.

A minor reinterpretation of social norm abidance in terms of the willingness to accept the rule of law allows application of my model to the problem of legal transplants. A legal transplant is meant to improve the business environment through a change of the legal institution that supports economic activity. Berkowitz et al. (2003) claim that higher acceptance of or receptivity to the transplanted legal institution, i.e. a higher acceptance of the rule of law, has a unanimously positive effect on outcomes of legal transplants. My model supports this view for the scenario where the institutional framework is susceptible only to entrepreneurs' efforts, but predicts the possibility of an opposite effect if the institutional framework can be influenced only by purely self-regarding agents. Higher initial acceptance of the law can remove a self-restraint from the purely self-regarding agents that would make obstructive behavior unattractive in case of a lower initial acceptance of the law.

My model allows extension in various directions. First, a more sophisticated modeling of institutional quality I(t), e.g. a connection between institutional quality and norm abidance that results in punishment of the form K*I(t)*n(t), could further increase resemblance to reality. Also allowing Homo economic type of agents to play not only a destructive, but also constructive role in their influence on institutions could produce interesting results (i.e. D(t) can take negative values). I expect the Homo oeconomicus type of agents to be instrumental in building up institutions so that they can attract entrepreneurs' investments that then can be expropriated. Both these extensions lead to a considerable increase in complexity of the analysis. This is not true for another extension that allows for a better fit with real world observations. Advanced economic activity was found to go hand in hand with higher levels of trust and social norm abidance (e.g. Henrich et al. 2004). Moreover, neuroeconomic studies seem to indicate that human beings derive satisfaction from complying with internalized social norms (e.g. Rilling et al. 2002). These findings can be incorporated into my model with a slightly modified replicator dynamic[9]. The phase diagram analysis remains very tractable, but the fraction of social norm

9 $\dot{n}(t) = \left(\mathbf{E}\,u_n(t) - \mathbf{E}\,\overline{u}(t)\right)\cdot n(t)$,

$$\mathbf{E}\,u(t) = n(t)\cdot \mathbf{E}\,u_n(t) - (1-n(t))\cdot Eu_{1-n}(t) = \begin{cases} n(t)\cdot a - (1-n(t))\cdot(K - P\cdot I(t)) & if \quad K - P\cdot I(t) > 0 \\ n(t)\cdot a - (1-n(t))\cdot 0 = \mathrm{a}\cdot n(t) & if \quad K - P\cdot I(t) \le 0 \end{cases}$$

$$\mathbf{E}\,u_n(t) = a$$

$$\dot{n}(t) = \begin{cases} (P\cdot I(t) - K + a)(1-n(t))n(t) & if \quad K - P\cdot I(t) > 0 \\ a\cdot(1-n(t))n(t) & if \quad K - P\cdot I(t) \le 0 \end{cases}$$

,

abiders increases in the business-friendly environment and even in the predatory environment if near to the business-friendly one.

Finally, future study along the lines of this model should focus on the general case where λ Є (0;1). Entrepreneurs and purely self-regarding agents enter into a dynamic game and Nash equilibria where no one of these agents has an incentive to deviate should arise. I was not yet able to solve the general case problem and the only certain finding is that, in the general case, the institutional framework not change if either entrepreneurs refrain from investment in the case where λ = 1 or purely self-regarding agents refrain from obstruction in the case where λ = 0. A large amount of research that might open up further unexpected vistas remains to be done.

IV. Appendix

1. Equations for λ = 1, either $n_0 = 0$ or $n_0 = 1$

$I_0 \geq K / P$

The general equation system reduces to the following far simpler one as λ=1 and therefore, D(t)=0. Moreover, n(t) is fixed and shows no dynamic behavior. In addition, no agent has an incentive to expropriate entrepreneurs and therefore:

$$\max_{E(t)} \int_0^\infty e^{-\delta \cdot t} \left[R - K - C(E(t)) \right] dt$$
$$\dot{n}(t) = 0$$
$$\dot{I}(t) = E(t)$$
$$\int_0^\infty e^{-\delta \cdot t} \left[R - K - C(E(t)) \right] dt \geq 0$$
$$0 \leq n(t) \leq 1$$
$$0 \leq I(t) \leq 1$$
$$E(t) \geq 0$$
$$I(0) = I_0,\ \lim_{t \to \infty} I(t)\, free$$
$$n(0) = n_0,\ \lim_{t \to \infty} n(t)\, free$$
$$C(E(t)) \geq 0,\ C(0) = 0,\ C'(E(t)) \geq 0,\ C'(0) = 0,\ C''(E(t)) > 0$$

The fact that E(t)=0 and integration of the integral lead to the results stated in II.B.1.a).

I_0 < K/P

The two-step optimization procedure described in section II.B.1.b) leads to the following optimization problem[10]:

$$\max_{E(t),T}\int_0^T e^{-\delta\cdot t}\pi(t)dt+\int_T^\infty e^{-\delta\cdot t}\left[R-K-C(E(t))\right]\ ,\quad \pi(t)=\begin{cases}(1-r)\cdot R-K-C(E(t)) & if\ \ t<T\ \wedge\ n=1\\ -K-C(E(t)) & if\ \ t\geq T\ \wedge\ n=0\end{cases}$$
$$\dot{n}(t)=0$$
$$\dot{I}(t)=E(t)$$
$$\int_0^\infty e^{-\delta\cdot t}\mathbf{E}\pi(t)dt\geq 0$$
$$0\leq n(t)\leq 1$$
$$0\leq I(t)\leq 1$$
$$E(t)\geq 0$$
$$I(0)=I_0,\ I(T)=\frac{K}{P},\ \lim_{t\to\infty}I(t)\,free$$
$$n(0)=n_0,\ n(T)\,free,\ \lim_{t\to\infty}n(t)\,free$$
$$C(E(t))\geq 0,\ C(0)=0,\ C'(E(t))\geq 0,\ C'(0)=0,\ C''(E(t))>0$$

If n_0 = 0 application of standard optimal control theory to the first part produces a system of Hamiltonian equations that is shown below[11]:

$$H(t)=\left[-K-C(E(t))\right]e^{-\delta t}+\mu(t)E(t)$$
$$m(t)=\mu(t)e^{\delta t}\Rightarrow H_C(t)=-K-C(E(t))+m(t)E(t)$$

$$\frac{\partial H_C(t)}{\partial E(t)}=-C'(E(t))+m(t)=0\Leftrightarrow \max_{E(t)}H_C(t)\ \ as\ \ H_C(t)\ \ concave\ \ in\ \ E(t)$$
$$\dot{m}(t)=-\frac{\partial H_C(t)}{\partial I(t)}+\delta m(t)\Rightarrow m(t)=C_0e^{\delta t}$$
$$\dot{I}(t)=E(t),\ I(0)=I_0,\ I(T)=\frac{K}{P}\Rightarrow C_0(T)$$

[10] Here as in the whole paper I assume that intervention ending with a legal framework that deters expropriation is always more profitable than intervention that stops before K = I / P is reached. This excludes a possibility that is not relevant for the overall analysis.
[11] If n_0 = 1 the system is identical except for an additional positive term (1 - r) · R · $e^{-\delta\cdot t}$ in the Hamiltonian and does affect only the overall profitability, but not the dynamic behavior.

These equations are not solvable in closed form without specifying a special functional form of C(E(t)). It is clear though that E(t) increases monotonously while m(t) increases exponentially. As a result I(t) increases not only monotonously, but also the faster the closer I(t) approaches K / P. To determine the optimal time T* one has to use the solutions obtained for E(t,T) and maximize lifetime profits with regard to T. Leibniz's rule for the differentiation of integrals implies:

$$n = 0 \Rightarrow \frac{\partial \mathbf{E}\pi(T)}{\partial T} = -\int_0^T \frac{\partial C(E(t,T))e^{-\delta t}}{\partial T} dt - C(E(t,T))e^{-\delta T} - (R-K)e^{-\delta T}$$

$$n = 1 \Rightarrow \frac{\partial \mathbf{E}\pi(T)}{\partial T} = -\int_0^T \frac{\partial C(E(t,T))e^{-\delta t}}{\partial T} dt - C(E(t,T))e^{-\delta T} - (R-K)e^{-\delta T} + (1-r)\mathrm{Re}^{-\delta T}$$

As ∂π / ∂T > 0 if n = 1 whenever ∂π / ∂T = 0 and n = 0 it is evident hat the optimal time T* for n = 1 is higher than the optimal time T* if n=0. Additionally, because of the additional term (1 - r) · R in the profit function if n = 1 it is clear that for n = 1 **E**π(T*) is higher for all T than **E**π(T*) for n = 0. Accordingly, entrepreneurs, if n_0 = 1, will have their zero profit cut-off point, below which no investment takes place, at a lower initial value of I_0 than if n_0 = 0.

2. Equations for λ=1, n_0 Є (0;1)

$I_0 \geq K / P$

This case identical to the case where either $n_0 = 0$ or $n_0 = 1$ (see section IV.1).

$I_0 < K / P$

The optimization problem for the entrepreneurs now looks as follows:

$$\max_{E(t),T} \int_0^T e^{-\delta \cdot t} \left[(1-r)\cdot n(t)\cdot R - K - C(E(t))\right] dt + \int_T^\infty e^{-\delta \cdot t} \left[R - K - C(E(t))\right] dt$$

$$\dot{n}(t) = \begin{cases} (P \cdot I(t) - K)\cdot(1-n(t))\cdot n(t) & \text{if} \quad \mathrm{K} - P \cdot I(t) \leq 0 \\ 0 & \text{if} \quad \mathrm{K} - P \cdot I(t) > 0 \end{cases}$$

$$\dot{I}(t) = E(t)$$

$$\int_0^\infty e^{-\delta \cdot t} \mathbf{E}\pi(t) dt \geq 0$$

$$0 \leq n(t) \leq 1$$

$$0 \leq I(t) \leq 1$$

$$E(t) \geq 0$$

$$I(0) = I_0, \ I(T) = \frac{K}{P}, \ \lim_{t \to \infty} I(t) \ \textit{free}$$

$$n(0) = n_{0,} \ \ n(T) = \mathrm{n_T} \ \textit{free}, \ \lim_{t \to \infty} n(t) \ \textit{free}$$

$$C(E(t)) \geq 0, \ C(0) = 0, \ C'(E(t)) \geq 0, \ C'(0) = 0, \ C''(E(t)) > 0$$

Application of standard optimal control theory leads to the following current value Hamiltonian and system of four simultaneous first-order differential equations:

$$
\begin{aligned}
&H(t) = [(1-r)Rn(t) - K - C(E(t))]e^{-\delta \cdot t} + \lambda(t)(PI(t)-K)(1-n(t))n(t) + \mu(t)E(t) \\
&l(t) = \lambda(t)e^{\delta \cdot t}, \; m(t) = \mu(t)e^{-\delta \cdot t} \\
&H_C(t) = (1-r)Rn(t) - K - C(E(t)) + l(t)(PI(t)-K)(1-n(t))n(t) + m(t)E(t) \\
&\frac{\partial H_C(t)}{\partial E(t)} = -C'(E(t)) + m(t) = 0 \Leftrightarrow \max_{E(t)} H_C(t) \; as \; H_C(t) \; concave \; in \; E(t) \\
&\dot{l}(t) = -\frac{\partial H_C(t)}{\partial n(t)} + \delta l(t) = \left(2(PI(t)-K)\left(n(t)-\frac{1}{2}\right) + \delta\right)l(t) - (1-r)R, \quad l(T) = 0 \\
&\dot{m}(t) = -\frac{\partial H_C(t)}{\partial I(t)} + \delta m(t) = -P(1-n(t))n(t)l(t) + \delta m(t) \\
&\dot{n}(t) = (PI(t)-K)(1-n(t))n(t), \quad n(0) = n_0, \quad n(T) \, free \\
&\dot{I}(t) = E(t), \quad I(0) = I_0, \quad I(T) = \frac{K}{P}
\end{aligned}
$$

In principle, it is possible to solve this system of differential equations by first using the technique of a multiplying factor together with the boundary condition l(T)=0 to find the solution for l(t) in terms of n(t) and I(t). With the help of l(t) and application of the same technique the solution of m(t) in terms of n(t) and I(t) can be found:

$$
\begin{aligned}
&l(t) = e^{\int_0^t 2(PI(t)-K)\left(n(t)-\frac{1}{2}\right)dt} e^{\delta t}\left(C_1 - (1-r)R\int_0^t e^{-\int_0^t 2(PI(t)-K)\left(n(t)-\frac{1}{2}\right)dt} e^{-\delta t}dt\right) \\
&n(T) \, free \Rightarrow l(T) = 0 \Rightarrow C_1 = (1-r)R\int_0^T e^{-\int_0^T 2(PI(t)-K)\left(n(t)-\frac{1}{2}\right)+\delta dt} dt \\
&m(t) = e^{\delta t}\left(C_2 - \int_0^t P(1-n(t))n(t)l(t)e^{-\delta t}dt\right)
\end{aligned}
$$

The relationship between m(t) and C'(E(t)) and m(t) can then be employed to find a relationship between E(t), n(t) and I(t). E(t) then determines the dynamics of I(t) in terms of n(t) and I(t). Separation of variables allows establishment of a relationship between n(t) and I(t):

$$n(t) = \frac{1}{1 - \left(1 - \frac{1}{n_0}\right) e^{\int_0^t (K - PI(t))dt}}$$

This relation can be used to completely determine the dynamics of I(t) in terms of I(t) only. The initial condition I(0) = I_0 and the boundary condition I(T) = K / P then fix the exact time development of I(t). I(t) then determines n(t) and the multipliers.

Unfortunately, it is impossible to find closed form solutions for this system. But making use of the fact that n(t) has to decrease in the area I(t) < K / P, that I(t), in general, has to increase or stay constant and that n(t) and I(t) are constrained to the interval [0;1], one can roughly determine the form l(t) and then, with this knowledge the possible forms of m(t). As m(t) = C'(E(t)) the time development of E(t) is approximately determined and this implies the time development of I(t). Finally, I(t) determines the time development of n(t).

As the integral $-(1-r)R\int_0^t e^{-\int_0^t 2(PI(t)-K)\left(n(t)-\frac{1}{2}\right)dt} e^{-\delta t} dt$ is monotonously decreasing and both the integral $e^{\int_0^t 2(PI(t)-K)\left(n(t)-\frac{1}{2}\right)dt} e^{\delta t}$ and the constant C_1 are positive it is clear that l(t) will start at C_1, stay positive and then approach 0. This behavior of l(t) together with the knowledge that higher values of n(t) come together with a longer optimal time T* allows to infer the behavior of m(t). The current value Lagrange multiplier m(t) consists of an exponential factor and the difference between a constant and a monotonously increasing integral function. The behavior of m(t) is determined by the constant C_2 and whenever it is profitable to reach the area of the phase space where $I(t) \geq K/P$, then:

$$C_2 > \int_0^T P(1-n(t))n(t)I(t)e^{-\delta t}dt \;\; \Rightarrow \;\; m(T) > 0$$

As a consequence, m(t) has an exponentially increasing component which is modulated by a term that depends on n(t) and I(t). Given I_0, C_2 will be the higher and the increase of m(t) the faster, the lower the initial value n_0; m(t) then implies the behavior of E(t) and I(t).

Optimization of the second term is not necessary as E(t)=0 for all t and therefore a simple integration yields:

$$\int_T^{\infty} e^{-\delta \cdot t}\left[\mathrm{R} - K\right]dt = e^{-\delta \cdot T}\,\frac{R-K}{\delta}$$

The complete optimization and determination of the optimal transition time T* then is a tradeoff between rising costs for institution formation and higher foregone profits in the business-friendly environment. It is clear that total profits in the predatory environment will be lower than in the case where $n_0 = 1$ and higher than in the case where $n_0 = 0$. Accordingly, for same I_0, the optimal transition time will lie below the optimal transition when $n_0 = 1$ and above the optimal transition time when $n_0 = 0$. This is because the tradeoff depends on the accumulated return in the predatory environment. The mean value theorem for integrals guarantees the existence of a value n^* such that:

$$\int_0^T e^{-\delta \cdot t}(1-r)R \cdot n(t) = \left(1-e^{-\delta \cdot T}\right)(1-r)R \cdot n^* \;\; \wedge \;\; n^* \in (0;1)$$

3. Equations for λ = 0, either n_0 = 0 or n_0 = 1

I_0 < K / P

The general equation system reduces to the following far simpler one as λ = 0 and therefore, D(t) = 0. Because n(t) is fixed the problem is further simplifies to:

$$
\begin{aligned}
&\max_{D(t)} \int_0^\infty e^{-\delta \cdot t}\left[K - \mathrm{P} \cdot \mathrm{I}(\mathrm{t}) - \mathrm{B}(\mathrm{D}(\mathrm{t}))\right]dt,\\
&\dot{n}(t) = 0\\
&\dot{I}(t) = -D(t)\\
&\int_0^\infty e^{-\delta \cdot t}\mathbf{E}u(t)dt \geq 0\\
&\int_0^\infty e^{-\delta \cdot t}\left[(1-r)R \cdot n_0 - K\right]dt \geq 0\\
&0 \leq n(t) \leq 1\\
&0 \leq I(t) \leq 1\\
&D(t) \geq 0\\
&I(0) = I_0,\ \lim_{t\to\infty} I(t)\, free\\
&n(0) = n_0,\ \lim_{t\to\infty} n(t)\, free\\
&B(D(t)) \geq 0,\ B(0) = 0,\ B'(E(t)) \geq 0,\ B(0) = 0,\ B''(D(t)) > 0
\end{aligned}
$$

If n_0 = 0 the participation constraint can never be fulfilled and entrepreneurs will not invest. Therefore, Homo oeconomicus type agents will not enter into obstructive activities (D(t) = 0). Consequently n(t) = 0 and I(t) = I_0 for all times t. If n_0 = 1 there are two possibilities: First, (1 - r) · R < K, then entrepreneurs will not invest and the situation is identical to the n_0 = 0 case, expect that n(t) = 1 for all times t. Second, (1 - r) · R ≥ K, then entrepreneurs will invest no matter what and Homo oeconomicus type agents will obstruct institutions without paying further attention to the participation constraint. This leads to the following system of two first order differential equations:

$$H(t)=[K-PI(t)-B(D(t))]e^{-\delta \cdot t}-\mu(t)D(t)$$
$$\mathrm{m}(\mathrm{t})=\mu(t)e^{\delta \cdot t}$$
$$H_C(t)=[K-PI(t)-B(D(t))]-m(t)D(t)$$
$$\frac{\partial H_C(t)}{\partial D(t)}=-B(D(t))-m(t)=0 \Leftrightarrow \max_{D(t)} H_C(t) \ \ as \ \ H_C(t) \ \ concave \ \ in \ \ D(t)$$
$$\dot{m}(t)=-\frac{\partial H_C(t)}{\partial I(t)}+\delta \cdot m(t)=P-\delta m(t)$$
$$\dot{I}(t)=-D(t), \ I(0)=\mathrm{I}_0, \ \lim_{\mathrm{t}\to\infty} I(t) \, free$$
$$0 \le I(t) \le 1$$

Solving these equations by the method of a multiplying factor gives:

$$m(t)=\left(C_4+\frac{P}{\delta}\right)e^{\delta \cdot t}-\frac{P}{\delta}$$
$$\lim_{\mathrm{t}\to\infty} H(t)=0 \Rightarrow \lim_{t\to\infty} m(t)e^{-\delta \cdot t}=0 \Rightarrow C_4=-\frac{P}{\delta}$$
$$\Rightarrow m(t)=-\frac{P}{\delta}$$
$$I(t)=\begin{cases} I_0-B'^{-1}\left(\frac{P}{\delta}\right)t & if \quad t<\dfrac{I_0}{B'^{-1}\left(\frac{P}{\delta}\right)} \\ 0 & if \quad t \ge \dfrac{I_0}{B'^{-1}\left(\frac{P}{\delta}\right)} \end{cases}$$

The constant value of m(t) translates into a constant value for E(t). Consequently, I(t) decreases monotonously until it reaches zero and then remains there.

$I_0 \geq K / P$

Two step optimization in this special case leads to this set of equations:

$$
\begin{aligned}
&\max_{E(t),T} \int_0^T e^{-\delta\cdot t}\left[-\mathrm{B}(\mathrm{D}(\mathrm{t}))\right]dt + \int_T^\infty e^{-\delta\cdot t}\left[K - \mathrm{P}\cdot \mathrm{I}(\mathrm{t}) - \mathrm{B}(\mathrm{D}(\mathrm{t}))\right]dt \\
&\dot{n}(t) = 0 \\
&\dot{I}(t) = -D(t) \\
&\int_0^\infty e^{-\delta\cdot t}\mathbf{E}u(t)dt \geq 0 \\
&\int_0^T e^{-\delta\cdot t}\left[R-K\right]dt + \int_T^\infty e^{-\delta\cdot t}\left[(1-r)Rn_0 - K\right]dt \geq 0 \\
&\Leftrightarrow \frac{R-K}{\delta} + \left[(1-r)n_0 - 1\right]\frac{R}{\delta}e^{-\delta\cdot T} \geq 0 \Leftrightarrow T \geq T_{\min} \frac{\ln \frac{R(1-(1-r)n_0)}{R-K}}{\delta} \\
&0 \leq n(t) \leq 1 \\
&0 \leq I(t) \leq 1 \\
&D(t) \geq 0 \\
&I(0) = I_0,\ I(T) = K/P,\ \lim_{\mathrm{t}\to\infty} I(t)\, free \\
&n(0) = n_0,\ n(T) = n_0,\ \lim_{\mathrm{t}\to\infty} n(t)\, free \\
&B(D(t)) \geq 0,\ B(0) = 0,\ B'(D(t)) \geq 0,\ B'(0) = 0,\ B''(D(t)) > 0
\end{aligned}
$$

Initially neglecting the constraints and optimizing the first term leads to the following Hamiltonian system:

$$
\begin{aligned}
&H(t) = \left[-B(D(t))\right]e^{-\delta\cdot t} - \mu(t)D(t) \\
&m(t) = \mu(t)e^{-\delta\cdot t} \\
&H_C(t) = -B(D(t)) - m(t)D(t) \\
&\frac{\partial H_C(t)}{\partial E(t)} = -C'(E(t)) - m(t) = 0 \Leftrightarrow \max_{E(t)} H_C(t)\ as\ H_C(t)\ concave\ in\ D(t) \\
&\dot{m}(t) = -\frac{\partial H_C(t)}{\partial I(t)} + \delta m(t) = \delta m(t) \\
&\dot{I}(t) = -D(t),\ \ I(0) = I_0,\ \ I(T) = \frac{K}{P}
\end{aligned}
$$

This can be solved for m(t) and I(t):

$$m(t) = C_5 e^{\delta \cdot t} \Rightarrow C_5 \leq 0 \;\; as \;\; \mathrm{B}(D(t)) = -m(t) \geq 0$$

$$I(t) = I_0 - \int_0^T \mathrm{B}'^{-1}\left(-C_5 e^{\delta \cdot t}\right) dt$$

$$I(T) = \frac{K}{P} \Rightarrow C_5$$

The optimization problem of the second term can be transformed via a variable transformation into the already optimization problem. The solution of the time optimization problem can be carried out with standard methods though it has no closed form solution. It clear though that the optimal transition time T* will correspond to the maximum expected utility **E**u(T*) attainable as long as **E**u(T*) is positive and as long as the optimal transition time T* is higher than the lower bound T_{min}. If T_{min} is higher than T* the Homo oeconomicus type agents will adjust their transition speed so that the transition time than equals T_{min}. This will lead to reduced gains from expropriation and might even turn the whole obstructive activities undesirable as **E**u(T_{min}) becomes negative. Because T_{min} for n_0=0 is higher than T_{min} for n_0=1 it is evident that **E**u(T_{min}) will become negative if n_0=0 before it becomes negative if n_0=1. I restate the explicit expressions for T_{min}:

$$n_0 = 0 \rightarrow T^* \geq T^*_{\min} : \int_0^{T^*_{\min}} e^{-\delta \cdot t}\left[R - K\right] dt + e^{-\delta \cdot T^*_{\min}} \int_0^{\infty} e^{-\delta \cdot t}\left[-K\right] dt = 0 \;\; \Rightarrow \; T^*_{\min} = \frac{\ln\left(\frac{R}{R-K}\right)}{\delta}$$

$$n_0 = 1 \rightarrow T^* \geq T^*_{\min} : \int_0^{T^*_{\min}} e^{-\delta \cdot t}\left[R - K\right] dt + e^{-\delta \cdot T^*_{\min}} \int_0^{\infty} e^{-\delta \cdot t}\left[(1-r)R - K\right] dt = 0 \;\; \Rightarrow \; T^*_{\min} = \frac{\ln\left(\frac{rR}{R-K}\right)}{\delta}$$

4. Equations for λ = 0, n_0 Є (0;1)

I_0 < K / P

The general equation system reduces to the following far simpler one as λ=0 and therefore, D(t) = 0. The behavior of n(t) is important to the Homo oeconomicus type agents only as a participation constraint for the entrepreneurs and appears in the form of an integral constraint:

$$\max_{E(t)} \int_0^\infty e^{-\delta\cdot t}\mathbf{E}u(t)dt, \quad u(t)=\begin{cases}-\mathrm{B}(\mathrm{D}(\mathrm{t})) & \text{if} \quad \mathrm{K}-P\cdot I(t)\le 0\\ K-\mathrm{P}\cdot\mathrm{I}(\mathrm{t})-\mathrm{B}(\mathrm{D}(\mathrm{t})) & \text{if} \quad \mathrm{K}-P\cdot I(t)>0\end{cases}$$

$$\dot{n}(t)=\begin{cases}(P\cdot I(t)-K)\cdot(1-n(t))\cdot n(t) & \text{if} \quad \mathrm{K}-P\cdot I(t)\le 0\\ 0 & \text{if} \quad \mathrm{K}-P\cdot I(t)>0\end{cases}$$

$$\dot{I}(t)=-D(t)$$

$$\int_0^\infty e^{-\delta\cdot t}\mathbf{E}u(t)dt\ge 0$$

$$\int_0^\infty \mathbf{E}\pi(t)dt\ge 0$$

$$0\le n(t)\le 1$$

$$0\le I(t)\le 1$$

$$D(t)\ge 0$$

$$I(0)=I_0,\ \lim_{t\to\infty} I(t)\, free$$

$$n(0)=n_0,\ \lim_{t\to\infty} n(t)\, free$$

$$\mathrm{B}(D(t))\ge 0,\ B(0)=0,\ B'(D(t))\ge 0,\ B'(0),\ B''(D(t))>0$$

The integral participation constraint can be transformed into an equation of motion of a state variable Γ(t) with:

$$\Gamma(t):=\int_0^t e^{-\delta\cdot t}\left[(1-r)Rn(t)-K\right]dt$$

$$\dot{\Gamma}(t)=e^{-\delta\cdot t}E\pi(t)=e^{-\delta\cdot t}\left[(1-r)Rn(t)-K\right],$$

$$\Gamma(0)=0,\ \lim_{t\to\infty}\Gamma(t)=\int_0^\infty e^{-\delta\cdot t}\left[(1-r)Rn(t)-K\right]dt\ge 0$$

Application of optimal control theory then leads to the following current value Hamiltonian and system of six simultaneous first-order differential equations:

$$H(t)=[K-PI(t)-B(D(t))]e^{-\delta\cdot t}+\kappa(t)[(1-r)Rn(t)-K]e^{-\delta\cdot t}+\lambda(t)(PI(t)-K)(1-n(t))n(t)-\mu(t)D(t)$$
$$k(t)=\kappa(t)e^{\delta\cdot t},\ l(t)=\lambda(t)e^{\delta\cdot t},\ \mathrm{m(t)}=\mu(t)e^{\delta\cdot t}$$
$$H_C(t)=[K-PI(t)-B(D(t))]+k(t)[(1-r)Rn(t)-K]e^{-\delta\cdot t}+l(t)(PI(t)-K)(1-n(t))n(t)-m(t)D(t)$$
$$\frac{\partial H_C(t)}{\partial D(t)}=-B(D(t))-m(t)=0\Leftrightarrow \max_{D(t)} H_C(t)\ as\ H_C(t)\ concave\ in\ D(t)$$
$$\dot{k}(t)=-\frac{\partial H_C(t)}{\partial \Gamma(t)}+\delta\cdot k(t)=\delta\cdot k(t)\Rightarrow k(t)=k\cdot e^{\delta\cdot t}\wedge\ \mathrm{k}\geq 0\ \text{ as }\ \lim_{t\to\infty}\Gamma(t)\geq 0\Rightarrow \lim_{t\to\infty}k(t)\geq 0$$
$$\dot{l}(t)=-\frac{\partial H_C(t)}{\partial n(t)}+\delta\cdot l(t)=\left[2(PI(t)-K)\left(n(t)-\frac{1}{2}\right)+\delta\right]l(t)-k(1-r)R$$
$$\dot{m}(t)=-\frac{\partial H_C(t)}{\partial I(t)}+\delta\cdot m(t)=P-Pl(t)n(t)(1-n(t))+\delta m(t)$$
$$\dot{\Gamma}(t)=e^{-\delta\cdot t}\langle\pi(t)\rangle=e^{-\delta\cdot t}[(1-r)Rn(t)-K],\ \Gamma(0)=0,\ \lim_{t\to\infty}\Gamma(t)=\int_0^\infty e^{-\delta\cdot t}[(1-r)Rn(t)-K]dt\geq 0$$
$$\dot{n}(t)=(PI(t)-K)(1-n(t))n(t),\ n(0)=n_0,\ \lim_{t\to\infty}n(t)\,free$$
$$\dot{I}(t)=-D(t),\ I(0)=\mathrm{I}_0,\ \lim_{t\to\infty}I(t)\,free$$

If k=0 the participation constraint for the entrepreneurs is not binding and consequently the differential system becomes simpler. The solutions for l(t) and m(t) in terms of n(t) and I(t) are then:

$$l(t)=C_3e^{\int_t^t 2(PI(t)-K)\left(n(t)-\frac{1}{2}\right)+\delta\,dt}$$
$$\lim_{t\to\infty}l(t)e^{-\delta t}=0\Rightarrow C_3=0$$
$$m(t)=e^{\delta\cdot t}\left[C_4+P\int_0^t e^{-\delta\cdot t}\right]=e^{\delta\cdot t}\left(C_4+\frac{P}{\delta}\right)-\frac{P}{\delta}$$
$$\lim_{t\to\infty}m(t)e^{-\delta t}=0\Rightarrow C_4=-\frac{P}{\delta}$$

The last transversality condition for μ(t) is permissible even if, as it turns out, I(t) leaves its constraint region [0;1]. The linearity of m(t) though guarantees that the constrained path of I(t) does not change until it reaches the lower boundary of the constraint set where it then remains. Utilization of the relationship between m(t) and D(t) allows determination of the effort level D(t), the level of the legal institution and the level of the fraction of norm abiding agents:

$$B'(D(t)) = -m(t) = \frac{P}{\delta} \Rightarrow D(t) := D^* = C'^{-1}\left(\frac{P}{\delta}\right)$$

$$\dot{I}(t) = -D(t) \Rightarrow I(t) = \begin{cases} I_0 - D^* t & if \quad t < \dfrac{I_0}{D^*} \\ 0 & if \quad t < \dfrac{I_0}{D^*} \end{cases}$$

$$\dot{n}(t) = (PI(t) - K)(1 - n(t))n(t) \Rightarrow n(t) = \begin{cases} \dfrac{1}{1 - \left(1 - \dfrac{1}{n_0}\right) e^{-(PI(t)-K)t + PD^* \frac{t^2}{2}}} & if \quad t < \dfrac{I_0}{D^*} \\ \dfrac{1}{1 - \left(1 - \dfrac{1}{n\left(t = \dfrac{I_0}{D^*}\right)}\right) e^{Kt}} & if \quad t < \dfrac{I_0}{D^*} \end{cases}$$

If k≠0 the participation constraint is binding and the Homo oeconomicus type agents will reduce the obstruction of institutions to guarantee investment from entrepreneurs. The differential equation for l(t) is identical, except for the constant k, to the scenario where λ=1. The differential equation for m(t) remains unchanged:

$$l(t) = e^{\int_0^t 2(PI(t)-K)\left(n(t)-\frac{1}{2}\right)+\delta\, dt} \left(C_3 - k(1-r)R \int_0^t e^{-\int_0^t 2(PI(t)-K)\left(n(t)-\frac{1}{2}\right)+\delta dt} dt \right)$$

$$\lim_{t \to \infty} l(t) e^{-\delta t} = 0 \Rightarrow C_3 = k(1-r)R \int_0^\infty e^{-\int_0^\infty 2(PI(t)-K)\left(n(t)-\frac{1}{2}\right)+\delta dt} dt$$

$$m(t) = e^{\delta t}\left[C_4 + \frac{P}{\delta} - P\int_0^t (1-n(t))n(t)l(t)e^{-\delta t} dt \right] - \frac{P}{\delta}$$

$$\lim_{t \to \infty} m(t) e^{-\delta t} = 0 \Rightarrow C_4 = -\frac{P}{\delta} + P\int_0^\infty (1-n(t))n(t)l(t)e^{-\delta t} dt$$

The effect of k is to change l(t) to a positive, non-zero function that starts at C_3 and approaches zero when t goes to infinity. l(t) then has an impact on m(t) through the two integral terms, whose difference is always positive and monotonously decreasing. The effect is that the value of m(t) is always higher than in the unconstrained case, so that it does not violate the participation constraint. The increase of m(t), and thereby the reduction of efforts D(t), is highest initially and then approaches the unconstrained value. The higher the value of $C_{3,}$ the higher is also the value of C_4 and consequently the higher the value m(t). C_3 is finally determined through its effect on n(t) and the binding participation constraint. As m(t) is constrained to non-positive values it is clear that m(t) cannot become greater than zero. A possible violation of this constraint is accounted for by setting m(t)=0 until a time τ, defined by $\int_0^{\tau} m(t)dt = 0 \quad if \quad m(0) > 0$

It is clear that τ can become infinite and therefore m(t)=0 for all times t, i.e. the Homo oeconomicus type agents will not obstruct the legal institution. If the participation constrained is still violated the entrepreneurs will not invest.

$I_0 \geq K / P$

Two step optimization starts from the following setup:

$$\max_{E(t),T} \int_0^T e^{-\delta \cdot t}\left[-\mathrm{B}(\mathrm{D}(\mathrm{t}))\right]dt, + \int_T^\infty e^{-\delta \cdot t}\left[K - \mathrm{P} \cdot \mathrm{I}(\mathrm{t}) - \mathrm{B}(\mathrm{D}(\mathrm{t}))\right]dt$$

$$\dot{n}(t) = \begin{cases} (P \cdot I(t) - K) \cdot (1 - n(t)) \cdot n(t) & if \quad \mathrm{K} - P \cdot I(t) \leq 0 \\ 0 & if \quad \mathrm{K} - P \cdot I(t) > 0 \end{cases}$$

$$\dot{I}(t) = -D(t)$$

$$\int_0^\infty e^{-\delta \cdot t}\mathbf{E}u(t)dt \geq 0$$

$$\int_0^\infty \mathbf{E}\pi(t)dt \geq 0$$

$$0 \leq n(t) \leq 1$$

$$0 \leq I(t) \leq 1$$

$$D(t) \geq 0$$

$$I(0) = I_0,\ I(T) = K / P,\ \lim_{t \to \infty} I(t)\, free$$

$$n(0) = n_0,\ n(T) = n_0,\ \lim_{t \to \infty} n(t)\, free$$

$$B(D(t)) \geq 0,\ B(0) = 0,\ B'(D(t)) \geq 0,\ B'(0) = 0,\ B''(D(t)) > 0$$

As n(t) necessarily stays constant in the business-friendly environment its behavior can be completely neglected during the optimization of the first term. As in the case where $n_0 = 0$ or $n_0 = 1$ the resulting current Hamiltonian and implied system of two first-order differential equations are:

$$H(t) = \left[-B(D(t))\right]e^{-\delta \cdot t} - \mu(t)D(t)$$

$$m(t) = \mu(t)e^{-\delta \cdot t}$$

$$H_C(t) = -B(D(t)) - m(t)D(t)$$

$$\frac{\partial H_C(t)}{\partial E(t)} = -B'(D(t)) - m(t) = 0 \Leftrightarrow \max_{E(t)} H_C(t)\ as\ H_C(t)\ concave\ in\ D(t)$$

$$\dot{m}(t) = -\frac{\partial H_C(t)}{\partial I(t)} + \delta m(t) = \delta m(t)$$

$$\dot{I}(t) = -D(t),\quad I(0) = I_0,\quad I(T) = \frac{K}{P}$$

The solution is identical to the case where $n_0 = 0$ or $n_0 = 1$:

$$m(t) = C_5 e^{\delta \cdot t} \Rightarrow C_5 \leq 0 \;\; as \;\; \mathrm{B}(D(t)) = -m(t) \geq 0$$
$$I(t) = I_0 - \int_0^T \mathrm{B}'^{-1}\left(-C_5 e^{\delta \cdot t}\right) dt$$
$$\wedge \;\; I(T) = \frac{K}{P} \Rightarrow C_5$$

It is clear that I(t) will decrease monotonously and its decrease accelerates over time. The shorter the transition time T the higher the constant C_5. The accumulated profit to the entrepreneur during the transition period T is given by $(1 - e^{-\delta \cdot T}) \cdot (R - K)/\delta$. A variable transformation (t := t' + T) and an adaptation of the integral constraint allows reduction of the optimization of the second term to the case where $\lambda=0$, $I_0<K/P$:

$$\int_T^\infty e^{-\delta \cdot t}\left[K - \mathrm{P} \cdot \mathrm{I}(\mathrm{t}) - \mathrm{B}(\mathrm{D}(\mathrm{t}))\right] dt = e^{-\delta \cdot T} \int_0^\infty e^{-\delta \cdot t}\left[K - \mathrm{P} \cdot \mathrm{I}(\mathrm{t}) - \mathrm{B}(\mathrm{D}(\mathrm{t}))\right] dt$$
$$\int_0^\infty e^{-\delta \cdot t} \langle \pi(t) \rangle dt \geq 0 \;\; \rightarrow \;\; \mathrm{e}^{-\delta \cdot \mathrm{T}} \int_0^\infty e^{-\delta \cdot t}\left[(1-r)R \cdot n(t) - K\right] dt + \left(1 - e^{-\delta \cdot T}\right)\frac{R-K}{\delta} \geq 0$$
$$\Leftrightarrow \;\; \int_0^\infty e^{-\delta \cdot t}\left[(1-r)R \cdot n(t) - K\right] dt \geq \left(1 - e^{\delta \cdot T}\right)\frac{R-K}{\delta}$$
$$n(0) = n_0, \;\; \lim_{t \to \infty} n(t) \, free$$
$$I(0) = \frac{K}{P}, \;\; \lim_{t \to \infty} I(t) \, free$$

With these manipulations, the full time optimization problem becomes:

$$\max_T \int_0^T e^{-\delta \cdot t}\left[-\mathrm{B}(\mathrm{D}*(\mathrm{t},\mathrm{T}))\right] dt + e^{-\delta \cdot T} \int_0^\infty e^{-\delta \cdot t}\left[K - \mathrm{P} \cdot \mathrm{I}*(\mathrm{t},\mathrm{T}) - \mathrm{B}(\mathrm{D}*(\mathrm{t},\mathrm{T}))\right] dt$$
$$\int_0^{T*} e^{-\delta \cdot t}\left[-\mathrm{B}(\mathrm{D}*(\mathrm{t},\mathrm{T}*))\right] dt + e^{-\delta \cdot T*} \int_0^\infty e^{-\delta \cdot t}\left[K - \mathrm{P} \cdot \mathrm{I}*(\mathrm{t},\mathrm{T}*) - \mathrm{B}(\mathrm{D}*(\mathrm{t},\mathrm{T}*))\right] dt \geq 0$$
$$\int_0^\infty e^{-\delta \cdot t}\left[(1-r)R \cdot n(t) - K\right] dt \geq \left(1 - e^{\delta \cdot T*}\right)\frac{R-K}{\delta}$$

The same results as before then hold: The Homo oeconomicus type agents initially would slow down their obstructive activities if the participation constraint were violated. As profits of the entrepreneurs in the business-friendly environment (supposed R > K) are necessarily positive, it is clear that the time before obstruction begins would be finite. As Homo oeconomicus type agent can decrease their obstruction costs in the business-friendly environment by slowing down obstruction, it is evident that the transition from obstruction in the business-friendly environment to obstruction in the predatory environment will be seamless. Any waiting time in the isolated problem of maximizing expected utility in the predatory environment would be incorporated into a slower transition from the starting value of I(t) of the complete optimization problem to I(T) = K / P. The complete optimization and determination of the optimal transition time T* then is a tradeoff between rising costs for institution obstruction, foregone gains from expropriation in the predatory environment and a obstruction speed in the predatory environment that is closer to the optimal constant value of P/δ that applies in the absence of participation constraint.

Accordingly, for a given I_0 entrepreneurs profits will be higher the higher the initial value of n_0 and the transition time T* to the predatory environment will be the lower the higher the initial value of n_0. The lower bound for the transition times if $n_0 = 0$ or $n_0 = 1$ was already given above. The lower bounds for the general case will lie between the bounds for $n_0 = 0$ and $n_0 = 1$. This is guaranteed by the mean value theorem for integrals (for a more extensive statement see II.C.1.b). Transition times will equal the lower bounds if the optimal time needed for obstruction in the business-friendly environment is below these bounds.

V. References

Berkowitz, Daniel, Katharina Pistor and Jean-Francois Richard. 2003. Economic Development, Legality, and the Transplant Effect. *European Economic Review, 47:1, 165-195*

Bernstein, Anita. 2005. Whatever Happened to Law and Economics?. *Maryland Law Review, 64, 101*

Bisin, Alberto and Thierry Verdier. 2001. The Economics of Cultural Transmission and the Dynamics of Preferences. J*ournal of Economics Theory, 97, 298-319*

Bohnet, Iris, Bruno Frey and Steffen Huck. 2001. More Order with Less Law: On Contract Enforcement, Trust and Crowding. *American Political Science Review 95:), 131-144*

Davis, Douglas D. and Charles A.Holt. 1993. Experimental Economics. *Princeton University Press*

Eisenberg, Melvin. 1999. Corporate Law and Social Norms. *Columbia Law Review, 99:5, 1253-1292*

Ellickson, Robert. 1998. Law and Economics Discovers Social Norms", *Journal of Legal Studies, 27, pp. 537-552*

Fehr, Ernst and Urs Fischbacher. 2003. The nature of human altruism. *Nature, 425, 785-791*

Fehr, Ernst and Urs Fischbacher. 2004. Social Norms and Human Cooperation. *TRENDS in Cognitive Sciences, 8:4, 185-190*

Fehr, Ernst and Herbert Gintis. 2007. Human Motivation and Social Cooperation: Experimental and Analytical Foundations. to appear in *Annual Review of Sociology*

Fischbacher, Urs and Simon Gächter. 2006. Heterogeneous social preferences and the dynamics of free riding in public goods. *IEW Working Paper No. 261, University of Zurich*

Francois, Patrick. 2007. Norms and the Dynamics of Institution Formation. *Conference Paper presented on January 5 at the AEA Conference 2007*

Funk, Patricia. 2005. Governmental Action, Social Norms, and Criminal Behavior. *Journal of Institutional and Theoretical Economics JITE, 161:3, 522-535*

Galligan, Denis J. 2003. Legal Failure: Law and Social Norms in Post-Communist Europe. *Law and Informal Practices The Post-Communist Experience Galligan, D.-J, Marina Kurkchiyan (eds.)*

Gintis, Herbert. 2007. Game Theory Evolving, Second Edition. *http://www-unix.oit.umass.edu/~gintis/*

Güth, Werner, Rolf Schmittberger and Bernd Schwarze. 1982. An Experimental Analysis of Ultimatum Bargaining. *Journal of Economic Behavior and Organization, 3:4, 367-388*

Henrich, Joseph, Robert Boyd, Sam Bowles, Colin Camerer, Ernst Fehr and Herbert Gintis. 2004. Foundations of Human Sociality: Economic Experiments and Ethnographic Evidence from Fifteen Small-scale Societies. *Oxford University Press*

Leukert, Andreas .2005. The Dynamics of Institutional Change: Formal and Informal Institutions and Economic Performance", *http://www.lrz-muenchen.de/~leukert/LeukertInst.Change27.1.2005.pdf*

Luca Cavalli-Sforza, Luca and Martin Feldman. 1981. Cultural Transmission and Evolution. *Princeton University Press*

McAdams, Richard and Eric B. Rasmussen. 2005. Norms in Law and Economics. .Handbook of Law and Economics. Polinsky, A.M., Shavell, S. (eds.)

North, Douglas. 1990. Institutions, Institutional Change and Economic Performance. *Cambridge University Press*

Nussbaum, Martha. 1997. Flawed Foundations: The Philosophical Critique of (a Particular Type of) *Economics. University of Chicago Law Review, 64:4, p. 1197*

Parisi, Francesco and Georg von Wangenheim. 2005. Legislation and Countervailing Effects from Social Norms. *http://www.isnie.org/ISNIE05/Papers05/Parisi-Wangenheim.pdf*

Posner, Richard. 1997. Social Norms and the Law: An Economic Approach. *American Economic Review, 87:2, 365-369*

Rilling, James K., David A. Gutman, Thorsten R. Zeh, T.R., Giuseppe Pagnoni, Gregory S. Berns, Charles D. Kilts. 2002. A Neural Basis for Social Cooperation. *Neuron, 35:2, 395-405*

Shavell, Steven. 2002. Law versus Morality as Regulators of Conduct. *American Law and Economics Review, 4:2, 227-257*

Weibull, Jörgen and Edgar Villa. 2005. Crime, Punishment and Social Norms. *SSE,EFI Working Paper Series in Economics and Finance No. 610, http://swopec.hhs.se/hastef/papers/hastef0610.pdf*