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Briberyscape: an Artificial Society-Based Simulation Model of Corruption's Emergence and Growth

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Briberyscape:
An Artificial Society-Based Simulation Model of Corruption's Emergence and Growth[1]

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Abstract

This paper introduces the Corruption Emergence Model (CE Model), an artificial society-based simulation model of the corruption emergence. The model considers the attitude change as a generative mechanism. The attitude changes are described and simulated with a set of self-organizing processes which feed on each other in a cross-recurrent setup. The simulation model investigates the connection between the dynamics of the processes describing the social trust, the cognitive dissonance of the agents, their honesty, fairness and responsibility degrees and the emergence of corruption in the artificial society.

Keywords: artificial society, corruption emergence, attitude change, self-organizing processes

1. Introduction

Our approach is focused on a fundamental issue concerning corruption: its sources and favouring conditions. How does corruption actually emerge in society ? What are the essential social and political mechanisms that generate and maintain corruption?

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The present approach is mainly concerned with the sources and the favouring conditions which allow for corruption emergence and its dynamical evolution. The paper presents an artificial society as the experimental framework meant to reproduce the real conditions in which corruption emerges in real human societies.

The general aim of the paper is to identify the social, psycho-social and political mechanisms which allow for the corruption processes to emerge and to further evolve in society. The theoretical and experimental background of this approach includes several models of artificial societies (Axelrod, 1995; Epstein and Axtell, 1996; Situngkir, 2003a,b).

The present approach identifies several questions which address the issue of research briefly described above. In order to find an answer to these questions, it introduces a set of hypotheses:

The first question that arises when we talk about corruption is: *"What is it corruption?"* – The classical answer so far is that corruption is a "behaviour", more precisely, a "rational behaviour" which does not abide by the social normative system of the society (Weber, 1969). Other answering alternatives are that, besides rationality and economical necessity, this behaviour should include cultural, anthropological, or political attributes.

The first hypothesis is concerned with the various definitions of corruption: we introduce the hypothesis that corruption is better defined as an *institution* and not as a *behaviour* or a *behaviour's attribute* (the "*corruption as institution"* hypothesis). This would explain why corruption evolves to a considerable level of social concern as it does now in the Eastern European post-communist countries, for example. The issue is not new and the institutional approach is mentioned by several authors: North develops a theory of institutional change (North, 1990), Teorell introduces a set of analytical arguments concerning the institutional nature of corruption, being inspired in his own approach by the characteristics of the corruption phenomena and their high intensity in the Eastern European countries which undergo transition processes to democratic regimes (Teorell, 2007). Mungiu-Pippidi argues on the institutional nature of corruption in advancing the hypothesis of competing social normative systems (Mungiu-Pippidi, 2010). While both Mungiu-Pippidi's and Teorell's approach are of a conceptual modeling type, ours is more an experimental setup aimed at providing practical demonstration of the above-mentioned conceptual models.

The second hypothesis is that corruption is better explained by attitude change mechanisms rather than by the classical rational, goal-oriented choice mechanisms as they are defined in the rational choice theory and in the game theory (the "*self-organizing nature"* hypothesis). This hypothesis allows for a complexity approach on corruption, aimed at explaning why and how is its dynamics dependent on the initial conditions, why is it path-dependent and what are the corruption emergence mechanisms in a sociey. The idea of corruption's dependence on the initial conditions is typical for those approaches on corruption which involve dynamical models (Rinaldi et al., 1998; Bardhan, 2001). These approaches, both analytical and experimental, are concerned with the dynamics of corruption and its characteristics.

The third hypothesis, the "*possible-world"* hypothesis, is concerned with the potential outcomes of the social normative systems competition. The idea is that, on the long run, social normative systems evolve and compete in a society, making thus possible the emergence of institutions. This would explain corruption not as a behaviour or as a deviance from a traditional normative system, but rather as an institution which emerges as multiple social normative systems compete with each other. This idea is suggested by the studies of corruption in long-term social

changes like the transition processes from one political regime to another, a phenomenon which is characteristic to several post-communist countries in the Eastern Europe. This type of scenario would make corruption not a criminal behaviour, as it is considered now, but a "possible world", which can evolve from the current social normative system compettition under certain initial or favouring conditions and on certain dynamically evolving trajectories. In her work, Mungiu-Pippidi stresses the parsonians idea of "ethical universalism" and its impact on the relationship between the concepts of "governance mode" and "corruption" as it has been developed by Weber with reference to the concept of "classic patrimonialism" or by O'Donnell (O'Donnell, 1996) with reference to the concept of "post-modern particularism" (Mungiu-Pippidi, 2010). This kind of approach, though keeps corruption in the behavioural framework, succeeds to change the research paradigm confined by the rational choice theory and game theory towards a research paradigm of structuralism and complexity. The idea of competing social normative systems and, therefore, of evolving institutions appears in this framework as an open alternative in comparison to the closed-world assumptions of the analytical approaches based on the game theory. In this particular context, corruption exceeds its classical status of illegal behaviour and becomes an issue of institutional complexity.

Each of these three hypotheses are used in a complexity-based experimental setting, described in the separate sections and subsections of the present paper. Starting from these hypotheses, the paper aims at analyzing the social and political scenarios of coorruption emergence and also at suggesting further research and theoretical developments.

The paper is structured as follows:

Section 1 and *Section 2* briefly present a history of the definitions and modeling approaches on corruption. It provides the historical perspective over the research on corruption from the late 70's to the present days and provide the criteria used for classifying the corruption models. Both the individualistic and the structuralistic approaches are briefly presented and analysed. This perspective is meant to provide the specific arguments this approach is based on in studying corruption, namely: (1) the limitations of the classical corruption models which involve game theoretical analysis; (2) the need for enlarging the theoretical framework by introducing the dynamical models and the models based on artificial life techniques: agent-based simulation systems and artificial societies. The rationales of the present approach are presented and explained.

Section 3 presents the conceptual work on corruption developed mainly with concern to the Eastern European countries involved in transition processes towards democratic regimes. Several such researches on corruption reinforce one of the classical approaches on corruption: the institutional approach. They often provide the means to investigate the sources of corruption outside the very restrictive framework of game theory. Also, some of their authors have constantly promoted a mechanism-based explanation of the social processes (Headström, 2005; Headström and Svedberg, 1998) which, for corrrruption studies in particular, proves extremely useful.

Section 4 introduces the conceptual framework of the *Corruption Emergence Model,* which represents the theoretical and experimental contribution of this paper. The theoretical assumptions of the paper allow for the approach of corruption emergence mechanism as a set of several self-organizing processes enacting social structures and perceptions. These self-organizing processes are modeled as dynamical processes of (i) trust, (ii) honesty, (iii) fairness, (iv) cognitive dissonance and (v) responsibility. The agents are assumed to be able to learn norms, to adapt to normative

changes and to distinguish among several types of normative patterns of access rights to public (shared) resources and institutions.

Section 5 describes the artificial society-based model of corruption emergence. An artificial society is described as a framework of agents and relationships essentially based on the "sugarscape" idea (Epstein and Axtell, 1996). In this paper the artificial society is called "briberyscape". In the briberyscape basic scenario, the agents are classified into several classes: bureaucrats, politicians, magistrats and ordinary citizens. Some of the agents are trying to offer bribe in exchange of privilleges or in exchange of access rights to public resources. Some agents accept bribe and become corrupt agents. Such agents are oftenly connected in networks of corruption. The whole artificial society mimics the well-known situations of corruption emergence which are described by a rich literature of special reports elaborated by several international organizations and institutions during the years after 1989 especially in the Eastern European post-communist countries.

Section 6 introduces the experimental setting and the experimental results. The experimental setting is a NetLogo based framework of intelligent autonomously moving agents and a fix artificial environment which contains public resources. In this virtual environment, the agents communicate with each other and develop networks of corruption.

Section 7 introduces the case studies and the experimental results. There are three main case studies: (i) a case study of petty corruption, namely the Briberyscape, (ii) a case study of great corruption, in which a "privillege market" is described and analysed, namely Privillegescape, and (iii) a case study of corruption networks emergence, namely Baronscape. Each case study starts from the assumption that the attitude and attitude change of individual agents can be modelled by means of a set of self-organizing processes which model some basic social behavior characteristics: *honesty, fairness, responsibility, trust* and *cognitive dissonance*. These processes are used to describe how the attitude change emerges such that individual agents become corrupt agents. The typical scenario is inspired by sociological and psycho-social researches in the Eastern European post-communist countries, with a special focus on Romania, which has experienced the most destructive communist regime. Such researches report that the citizens in such countries inherited from the communist regime a low trust in the state, a minimal set of survival values and the culture of privillege in the social and political life. In this context, corruption emergence may be modelled as an attitude change. The attitude which characterizes the corrupt agents is operationalized as a resignation from the moral values of honesty, social fairness and responsibility and a submission to the newly appeared normative system of corruption. The attitude change is operationalized by evaluating the cognitive dissonance and the social trust of the individual agent: while the cognitive dissonance increases, the individual agent experiences a lower trust in state and government. This ever decresing trust in the state impairs the agent's relationship with the society. As a consequence, the agent's value system is reduced to a minimal set of survival values. As the cognitive dissonance increases, the agent experiences a higher pressure to make an attitude change (Festinger, 1957). In such a society, while struggling to survive, an individual agent would easily accept corruption as a new normative system. The idea of this attitude change has inspired an artificial society-based model called the *Corruption Emergence Model*.

Section 8 describes the main conclusions which are drawn from this experimental work. The experimental results provide support to the ideas that: (i) the sources for corruption are better described by an institutional-based approach, than by a behavioral one; (ii) the corrupt society is

better modelled as an artificial society than a theoretical game, and (iii) the artificial society-based simulation of corruption provides a better description of the society as a whole in terms of the macro-micro link than a game theoretical simulation.

2. Brief History of Corruption Studies
2.1. Early Researches on Corruption

During the past decade, the issue of corruption has became a subject for agent-based modelling and simulation due to the difficulties faced by the classic analytic approaches in assessing the complexity of this phenomena and in measuring its characteristics using the statistical and game theoretical analysis only. The complexity of this issue lies not only in its definition, but also in its measurement and evaluation.

During the early 70's, the weberian concept of bureaucracy and of its rational-legal character has been applied to the broad analysis of the corruption phenomena. First analyses on corruption in the weberian paradigm of the separation between public and private sectors as a guarantee for non-corrupt political and administrative democratic institutions[2] have been elaborated by Krueger (Krueger, 1974) and Susan Rose-Ackermann (Rose-Ackermann, 1975). Susan Rose-Ackerman became famous starting with the 70's and mainly during the 90's for her studies of corruption on four main dimensions: (a) the relationship between state and society, (b) the cultural factor impact on the nature and expression of corruption in different countries and in different social paradigms, (c) the impact factor of the relationship between public and private sector onto the growth or decay of corruption phenomena, and (d) the conditions to achieve reform in the presence of corruption and in spite of its increasing/decreasing aspects. The aim of her several high-level researches is to find a set of characteristics of the individual corrupted behavior and also a relevant set of its incentives and deterrents in order to recommend anti-corruption prevention and currative measures. Klitgaard identifies a formula which is now famous and also studied the complex conections between corruption and culture (Klitgaard, 1988).

In the following years, the sharp peak of occurences and the wide spread of corruption phenomena experienced by many countries, especially after 1989 by the former communist Eastern European countries in their transition processes to democratic regimes, determined an increased attention and a special focus on this research issue. Country and cross-country case studies offered the means for acquiring a deeper understanding of the sources and causes of corruption. These case studies have determined a shift in the research interest on corruption from the classic individualistic paradigm towards the structuralist one and, recently, towards the institutional emergence paradigm. Though several authors have approached the issue of corruption modelling on different theoretical and experimental backgrounds – game theory, agency theory, dynamic systems, agent-based systems or artifical society – no one has suceeded so far in identifying and providing a full picture of the sources which generate and maintain the various and complex corruption phenomena.

2.2. Definitions and Theoretical Paradigms

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[2] Médard J.-F. 1995. "La corruption politique et administrative et les différenciations du public et du privé : une perspective comparative", in M. Borgi et P. Meyer-Bisch(eds.), *La corruption ou l'envers des droits de l'homme*, Editions universitaires, Fribourg, Suisse, pp.37-46.

Corruption has been defined in different ways, depending on both the goal of research and of its theoretical and empirical background. Some of these definitions have succeeded to get the wide acceptance of the scholars from social, economical, and political sciences. These definitions should be however explicitly associated with the research paradigm underlying the different approaches. The undeniable fact that corruption research is nowadays very much differentiated itself is a clear consequence of the variation these definitions allow for in both conceptual and in the empirical and experimental working paradigms.

There are two main areas of theoretical descriptive definition which are concerned with corruption phenomena: (i) the research focused on the individual corrupt behaviour and (ii) the research focused on the social and political processes which actually produce, involve or just favor the emergence of corruption phenomena (Jain, 2001). Each of these domains is characterized by a particular research paradigm, by specific types of models and by associated types of measurements and/or empirical or experimental methodologies of result validation.

We will briefly present the approaches, the paradigms and the impact each of them had or is actually exerting onto the historical development of the corruption research as a whole. We will therefore identify schools of thought, schools of modeling and trends in the area of experimental simulations of the corruption phenomena.

2.2.1. Definition and research on the issue and types of of corrupt behaviour

A major motivation for the interest in this issue of research was that of understanding, promoting and improving the good-governance in democratic societies. Therefore, we can identify definitions of corruption as an individual behaviour which goes against democratic rules and whose economical and political consequences are particularly harmfull for the good-governance in a democratic system. Under these assumptions concerning the democratic society, such a definition for corruption entails the development of appropriate description of its economical effects and of the anti-corruption means. The definition which has been widely accepted is that which considers individual corrupt behaviour as the use of public office and/or public resources for personal interest and gain (Klitgaard, 1988; Rose-Ackerman, 1996; 1997; 1998). The research approaches developed on the basis of this definition aim at describing corruption as a process characterized by: (i) a set of qualitative attributes which can be conceptually defined and explained using rational concepts and terminology like "rational agent", "rational behaviour", "maximizing utility", "risk aversion", "payoff", "gain", etc.; the classical type of approaches are fundamentally based on the game theoretical analysis; (ii) a set of quantitative attributes which can be observed and measured in empirical studies using either *experience-based* or *perception-based* methods of measurement (Jain, 2001; Johnston, 1996). There are, however, some other types of measurement, for instance, those based on public opinion and on social attitude measurement, which are very interesting, but which oftenly lack, according to some authors, accuracy and objectivity (see Jain, 2001). A widely used perspective over corruption is the economical perspective, which mainly involves the rational agency theory and game theoretical analysis. Oftenly, it is directly connected or it is directly addressing a legal perspective, mainly involving the concept of "criminal behaviour" (Rose-Ackerman, 2010) and dichotomies like "legal/illegal", "legitimate/illegitimate", which are discussed and analysed with respect to the concept of "law enforcement" as one of the pivotal concepts in the theories concerning the issue of the anticorruption fight.

The classical approaches are concerned with two level of granularity in dealing with the actors of corruption phenomena. One is the macro level or, put in other words, the level of the fundamental institutions in a democracy, like the Government, the Parliament, etc. The other is the micro level or the individual level. Approaches on the macro level are mainly concerned with the state and society, the government and the social-economical system as a whole. This kind of approaches investigate the good-governance in democratic societies and the impact of corruption on the macro structures of its fundamental institutions. This type of corruption is usually called "grand corruption" (Jain, 2001), because the main actors in such scenarios are the politicians and/or the magistrats. The main themes are concerned with the legislative, political and administrative corruption. The legislative corruption is concerned with law enforcement, while the political corruption is mainly concerned with the vote behaviour (Rose-Ackerman, 1998; 1999)[3]. The main research themes in this area of research have been the relationship between (i)corruption and the size of the wage (Rijckeghem and Weder, 1997; Gupta, Davoodi and Rosa, 1998), (ii)between corruption, economical growth and the level and type of investments (Mauro, 1995; Tanzi and Davoodi, 1998; Barreto, 2000), (iii) the productive vs. rent-seeking behaviour (Buchanan, Tollison and Tullock, 1980; Pasour, 1983; Tullock G. 1980), (iv) the relationship between corruption and governance (Klitgaard, 1998; Rose-Ackerman,1999: Ch.8), (v) the impact of corruption on economical growth (Mauro, 1995; Tanzi and Davoodi, 1997; Gupta et al., 1998), (vi) public vs. private sector corruption (Thompson, 2000), (vii) corruption and political power (Rose-Ackerman, 1989), (viii) the structure of the governmental institutions and the way it favors corruption, thus inducing distortions in the functioning of the governmental institutions themselves (Shleifer and Vishny, 1993).

Approaches on the micro-level are concerned with the individual actor's actions, decision makings and goals. This kind of approaches investigate the behaviour of individual agents and the efffect of their actions with respect to other individuals. This type of corruption is usually called "petty corruption", because the main actors are the bureaucrats and the individual citizens.

Both macro- and micro-level research approaches are generally based on the investigation of the corrupt behaviour and the ways in which it can be sanctioned and/or corrected, ultimately eliminated, by specific law enforcements and economic regulations.

2.2.2. *Scales of investigation on the causes and sources of corruption*

One of the criteria used for classifying the type of definitions and approaches on corruption is the scale of investigations. Usually, research approaches on corruption are concerned with either the macro-level or with the micro-level of theoretical description and very often the macro-micro link provide the researchers with the opportunity to understand the causes of the phenomena under investigation. Approaches on the macro-level are mainly concerned with the state and/or society as a whole. Approaches on the micro-level are concerned with the individual actor and the actions, decision makings and goals this actor might have. The research approaches which investigate corruption at the level of macro-micro relationship are usually oriented towards the investigation of the sources, causes or favouring conditions which allow for corruption phenomena to occur. The

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[3] See Jain (Jain, 2001), and Tanzi (Tanzi, 1998) for an extended and comprehensive description and interpretation of these approaches.

scale of research approach and also the philosophy behind the interpretation of the findings at each level and of their inter-relationship with respect to the causes and sources of corruption may provide for different kinds of classification, namely into *individualistic* and *structuralistic* types of approaches. The *individualist* type, has been mostly preferred by the experts in economical science and political economy, and, in general, by the researchers interested in behaviour-oriented research. The *structuralist* type, is usually preferred by the sociologists and experts in political science due to its micro-macro social perspective.

3. Modelling Approaches on Corruption

The history of corruption researches includes several modeling approaches. The main trend in the area of corruption modeling is that of considering corruption as a socio-economical phenomenon, deeply involving both economical and political aspects. The economical perspective has provided support for the advance of game theoretical analysis of the corruption phenomena, among which *bribery* is the most investigated. Early and classic approaches on corruption are mainly elaborated with a background in (i)game theoretical models, and (ii) dynamical models.

Early models of corruption describe it as a game (Cadot, 1987; Becker & Stigler, 1974). The game theoretical models start from the assumption that the society is represented as a system of rational agents, whose behaviours try to maximize the utility of their individual actions with respect to a particular goal. The dynamical evolution of the interdependence relationship in such a system could be described as a stochastic process able to reach single or multiple equilibrium states.

Other authors introduced dynamical models of corruption (Rinaldi et al.,) which are mainly dynamical descriptions of decision-making scenarios based on economic concepts and theory.

There have been developed two main classical analytical models: the *principal-agent model* and the *resource-allocation* model. Both types of models are providing an economical and rational perspective over corruption issues. Rose-Ackerman builds-up two kind of models: (i) a *top-down* model, concerning "grand" corruption and good-governace, and (ii) a *bottom-up* model, concerning the causes of "petty" corruption in the every-day life of citizens. The latter approach is mainly inspired by extensive studies on corruption in the Eastern European countries with a post-communist regime. Gambetta elaborates one of the most interesting game theoretical model based on *trust* (Gambetta, 2000, 2001). Gambetta introduced an analytical model of corruption as a game with three players: T (truster), F (fiduciary) and C (corrupter) in which the corruption standard case is an exchange in which each agent has incentives/deterrents to act. His model and, in general, the issue of *trust*[4] have been the incentives for relevant developments of corruption research in the area of social order and social cohesion.

Lately, the research on corruption has been approached in agent-based models (Hammond, 2000) and in artificial society-based models (Chakrabarti, 2001; Situngkir, 2003). In his approach, Hammond achieves a stable equilibria description of an agent system which has to deal with internal corruption in a closed-form solution. Hammond's idealistic description of the agents focuses exclusively on the endogeneous factors in rejecting corruption.

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[4] The issue of social trust and its connection to social order, soccial cohesion, and, lately, to corruption are approached by several authors. See: Ernest Gellner (2000), Fukuyama, (1995), and Hardin (2001).

Bottom-up simulation models of corruption have been inspired by the early 90s' research works in the area of political analysis by means of artificial society simulation models, namely the *tribute model* (Axelrod, 1995), and the *sugar scape* model, (Epstein and Axtell, 1996). Chakrabarti develops an agent-based model of corruption inspired by the Epstein and Axtell's model. This model is used to study the dynamics of a multi-generational population of agents with adaptive expectations (Chakrabarti, 2001, pp.6-7). Latest agent-based and artificial society-based approaches on corruption like those of Situngkir (Situngkir 2003a, 2003b) are designed for the study of the influence of both endogeneous and exogeneous factors in facing corruption. The *money scape* model is inspired by the seminal work of Epstein and Axtell on bottom-up approaches of social processes (Epstein and Axtell, 1996). In spite of this important characteristic, Situngkir's approach keeps close to the classical view of corruption as a rational choice scenario in which the corrupt agents has and manages economical attributes, operational principles and resources in the artificial society.

One of the most important contributions of Situngkir's approaches is that he introduces the recurrent descriptions of the corruption processes, developing a family of self-organizing processes underlying the evolution of a corruption phenomenon like bribery. Moreover, Situngkir makes evident that the experimental study of corruption lacks both a theoretical and an experimental view of the mechanisms which can and should be used in order to describe the causes or the conditions of corruption emergence. The social mechanism problem is not new in the area of social processes description: it has been approached from different perspectives and on different backgrounds[5]. The literature of this domain covers both the conceptual and analytical issues (Hedström and Svedberg, 1998; Tilly, 1995, 2001, 2002). Situngkir's "*money scape*" is, nevertheless, the first artificial society-based simulation model which makes explicit the need to clarify the issue of mechanism as a conceptual and technical requirement in the description, simulation and prediction of corruption phenomena.

4. Corruption and the Eastern European Post-Communist Regimes

The structuralist approaches on corruption are characterized by the focus on the social micro-macro link. The definition of corruption change considerably under this assumptions: different authors (Teorell, 2007; Karklins, 2005; Precupeţu, 2008; Rousseau, 2008; Mungiu-Pippidi, 2010) introduce and support the idea that the view on corruption should involve a global structural view on the society itself. Such a view on the society would be able to provide advanced perspectives over the sources of corruption.

Teorell advances the idea that corruption should be approached rather as an institution and not as an illegal behaviour (Teorell, 2007). He argues that an institutional approach would allow the corruption models and analyses to include a certain aspect which in the classical principal-agent models and in the game theoretical analysis is not considered at the degree of relevance it really deserves. This aspect concerns the horizontal dimension of corruption. According to this view, corruption studies could be extended to the phenomena of social conflict rooted in the "*inequalities and injustice*", "*disparities and polarization*", "*frustration*" and "*decrease of*

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[5] See Mayntz (Mayntz, 2003) for a complete overview of the issue from both theoretical and application perspectives.

trust" in the state (Precupeţu, 2008) which characterizes the societies which undergo long-term transition processes from one political regime to another. It is the case of the post-communist societies in the Eastern and South-Eastern Europe which are currently undergoing transition processes to democratic regimes. For such societies, corruption induces a distribution of the social conflicts within the social structure itself (Precupeţu, 2007; Karklins, 2002). In such societies, corruption is not only an illegal individual behaviour, it is an ubiquous phenomena, accepted or tollerated by the citizens either from fear or from frustration (Miller et al., 2001). Its existence, persistance and pervasivness prove essential weaknesses of the state and society.

The approaches based on economical models of interaction between the state and society are mainly focused on the principal-agent models. Klitgaard (1988) characterizes the corruption as being a phenomenon directly generated by the relationship between individual and society: if this relationship presumes higher degrees of responsibility of the individual to a limited group or to his/her familiy than the degrees of responsibility to social duties and bondings, then this type of relationship evolves to a lack of trust of the individual in society. Klitgaard focuses on the relation public-private in the day-to-day life of citizens: he emphasizes that corruption is fundamentally associated with a change in the relevance and priority of private ties as compared with the public ties: *"personal loyalties are held to be more important than formal rules and public duties"* (IRIS Report, p.50).

 The issue of *trust* is studied by Precupeţu in relation to the moral values of the society and with the social cohesion: in her research on corruption phenomena in Romania, she shows that a main characteristic of the societies penetrated by corruption is the decrese of the trust of their citizens in the social values, in the state protection and in the individual chances in such societies: "*trust in the moral ways of social success decreases and frustration at individual level increases*" (Precupeţu, 2008). This and several other arguments in the Precupeţu's research introduce the main idea about corruption in the post-communist countries, namely that corruption produces an "*impaired relationship between individual and the state*":

> "Socialisation during communist times is considered as a major cause of today's corruption by experts from NGOs, media and economy groups. In those times, people have learned to develop life strategies within their private sphere of life and, with few exceptions, in conflict with the outside world which was not worthy of trust. Moreover, a specific rupture between citizens and the state contributed to an impaired relationship that people developed with their society. Morality was not assimilated in relation with the state but rather conveyed to the groups like family and friends within which people developed strong bonding relations." (Precupeţu, 2008, p.29)

From the perspective of the Romanian justice system (Danileţ, 2009), what really makes corruption emerge in a society is in one way or another linked to poor education, lack of information and access to information, low ethics and, especially, the lack of control and accountability:

> "[…] lack of judicial democracy, non-involvement of civil society in monitoring the system, poor professional competence, excessive bureaucracy and disorganisation, fear of retaliation, flawed accountability mechanisms, regulations that allow for discretionary decisions" (Danileţ, 2009, p.42).

Danileţ provides a global anaysis of the causes of corruption in the justice system and among the high magistrats (Danileţ, 2009): among these causes, he also stresses the idea of

public tollerance of corrupt acts (i.e., bribery) as an implicit norm which emerges in post-communist societies:

> "In many areas, people regard the payment of additional amounts of money in exchange for services as "normal". Usually, patients find it normal to pay extra money to their doctors; similarly, court users are more interested in how they may win the favour of the judicial body than in a fair presentation of their case. […] The distrust is deepened by the idea—fuelled by mass media reports—that magistrates are subject to political influence; […] The ethics in the judicial system reflects the ethics of the Romanian society, which is rather low. This is because there is no ethics assessment upon the recruitment of applicants, and, throughout their career, assessments are rather perfunctory and sometimes a means of pressure in the hands of decision-makers." (Danileț, 2009, pp.47-48).

Similar ideas are introduced in the works of Ramsa Karklins (Karklins 2002, 2005), which are mainly concerned with the public opinion, political attitude formation and corruption. His experience in the analysis of the corruption phenomena in post-communist societies is of high relevance: many of his ideas are in agreement with the survey findings and scholar studies of corruption in several post-communist societies. His emphasis on the attitude, political culture and evolving institutions is deriving from a neo-institutionalist view on the corruption phenomena. Karklins stresses the importance of studying the day-to-day attitude patterns of common people towards corruption in societies with a strong communist legacy: the attitudes of these people is typically characterized by their low expectations, by their decreasing trust in social values, by their preference to survival values in spite of moral values of the society (Karklins, 2005, p.58). Corruption is thus viewed as a change in the attitude and mentality of people which allows for the emergence of new social normative rules, the emergence of new political structures and culture. Corruption is but one of these emerging phenomena:

> "[…] the post-communist region shows certain attitudinal patterns […] the formerly communist-ruled societies stand out with an overemphasis on survival values, at the expense of self-expression values, including those linked to the community. As shown below, arguments about the necessities of daily life and survival are also prominent in public discourse […] But political attitudes are not static; they shift over time, especially when major changes occur in regimes, policies, or social conditions. […] the analytical conclusion is that political culture is dynamic and can change, for better or worse. That is so if one accepts a definition of political culture that links a people's political cognition, emotions, evaluations, and values to concrete political structures, experiences, and opportunities. This is also in accord with the theoretical assumptions of neo-institutionalism underlying this study, […] institutions can shape new attitudes and behaviors. People's attitudes toward corruption can change, and with this the overall level of corruption in specific societies can change. Yet, besides constituting a scholarly argument, this proposition refers to a crucial public attitude, and one has to ask how many people in specific post-communist states believe that such change is possible." (Karklins, 2005, p.60)

The neo-institutionalist theories have penetrated the research on corruption and today different authors stress the need to approach corruption not only from the governance perspective or the legal behavior perspective, but mainly from the perspective of attitude change in a social framework as a side-effect of the appearance of new norms, culture and institutions. These ideas are implicitly associated with the emergent and competing social normative regimes introduced by Mungiu-Pippidi (Mungiu-Pippidi, 2010). The conceptual assessment of corruption in her approach provide the theoretical means for the analysis of institutional emergence in the context of transitional processes some societies undergo in social changes from one political regime to

another: The example which is again particularly relevant is the case of post-communist regimes in the Eastern and South-Eastern Europe, namely Romania.

> "We know that in societies undergoing transition there are competing normative regimes which strive to become dominant. Democratic transition can therefore de described also as an effort to reach a governance mode based on ethical universalism. The battle that post communist countries wage is not the legal one against individual corruption from developed Europe, where the norm of government impartiality and integrity is already set, but a struggle to enshrine such norms and unseat the norm of particularism" (Mungiu-Pippidi, 2010, p.4).

Mungiu-Pippidi's definition is particularly relevant to our approach since it sheds light on the emergent, competing normative systems. This view assumes a global perspective (namely, the generation of a social normative system) over the process of corruption emergence. It also assumes corruption as an institution which actually characterizes the post-communist societies which undergo transition processes to democratic regimes.The institutional perspective over corruption emergence resides in the emergence of the social normative system itself. They are tied together in a fundamental relationship: corruption might emerge in societies where such social normative systems are competing amongst themselves such that one of them only could finally become dominant. In such a framework, corruption is not a battle against defectuous behavior under strict norms and legislations which characterizes good-overnance, but an institution like any other which could become dominant if the proper context is favorable.

As these aspects connect to each other, activate and support each other and work convergently, the type of the relationship between the state and society in the countries of the post-communist Eastern European region prove to be almost completely changed in comparison with the relationship between state and society in the Western European countries with a traditional democratic regime. The difference is not only at the structural and social values level, but first and foremost at the level of the collective attitude and social mentality. As mentality is the most resistant to change characteristic of social behaviour, it becomes obvious that the influence of corruption should be considerable since it succeeded to induce change in mentality itself. This phenomena is identified in the several country and cross-country studies elaborated by international and European institutions and organizations, like IRIS-USAID ("*An Anticorruption Reader: Supplemental Sources On Transparency, Accountability, Prevention, Enforcement & Education*", 2005), World Bank Reports ("*Bosnia and Herzegovina: Diagnostic Surveys of Corruption*"- 2000; "*Corruption in Poland*" - 1999, "*Corruption in Slovakia*" - 2001), ICG ("*Macedonia's Public Secret How Corruption Drags the Country Down*", 2002), UNDP ("*Fighting Corruption in Post-Communist States - Lessons from Practice*", 2002), Transparency International (2007, 2008), European Commission (*Attitudes of Europeans towards Corruption",* Special Eurobarometer, 2009).

5.   The Corruption Emergence Model

The *Corruption Emergence Model* (called in this paper the *CE Model*) starts from the assumption that the corruption processes are dynamical, recurrent processes, feeding on each other in cycles which entail the approach on the complexity of their relationship.

5.1. The Conceptual Framework

Our modeling approach on corruption is based on the concept of "*impaired relationship between the state and society*" as described by Precupeţu in (Precupeţu, 2008). This concept belongs to a class of concepts derived from the study of the corruption emergence in post-communist societies of Eastern Europe. This class of concepts includes: (a) the concept of institution emergence as defined by North (North, 1990), (b) the concept of survival-based values of an agent in a post-communist society as defined by Klitgaard (Klitgaard, 1988), (c) the concept of connectivity of corrupt agents in networks of corruption (Precupeţu, 2008; Danileţ, 2009), (d) the concept of corruption as emergent from political attitude and mentality change, and from political culture as defined by Karklins (Karklins, 2005), (e) the concept of corruption as institution as defined by Teorell (Teorell, 2007), (f) the concept of competing social normative systems as defined by Mungiu-Pippidi (Mungiu-Pippidi, 2010).

In this paper we introduce an emergent model of corruption based on political attitude change. In order to described corruption emergence in this paradigm, we develop a simulation model of an artificial society in which agents undergo transformations of their political attitude induced by changes in their conceptual social framework. This social framework is defined by the concepts of *trust*, *cognitive dissonance, responsability*, *honesty* and *fairness*.

Trust, Responsibility, Honesty and *Fairness* are considered attitude structural components.

The concept of *trust* has been approached and modelled by different authors. Gellner approaches *trust* in the context of social cohesion and social order research from the perspective of the philosophy of governance (Gellner, 2000). Barbalet defines *trust* from different perspectives, going from rationality to emotion, and from social order to social capital, from social theory to political theory (Barbalet, 2005). The best known approach on *trust* modeling is that of Gambetta (Gambetta, 2000). It is an analytical model based on the concepts of cooperation and rationality which approaches trust as a structural aspect of corruption. In this model, the T (truster), the F (fiduciary) and the C (Corrupter) agents are meant to describe in game theoretical terms the way in which trust changes in the economy of a corrupt behaviour. Several computational modeling approaches on trust are in the area of *Social Simulation*. They are elaborated on different backgrounds: cooperation strategies, reputation, beliefs and emotions, psychology of friendship. Agent-based models approach *trust* either as the output of cooperation and decision-making strategies or as the output of psychological and emotion-based multiagent social systems or social networks. In these models, *trust* is an emergent feature of a relationship between social agents either as a side-effect of decision-making strategies or as a direct effect of the psychology of the social relationships (see (Sutcliffe and Wang, 2012) for an excellent presentation of researches on trust modeling approaches in the area of Social Simulation).

In this paper, we understand *trust* as social order, in the sense defined by Gambetta (Gambetta, 2000). There is an reversed proportionality relationship between cognitive dissonance values and the values of *honesty, fairness, responsibility* and *trust*. The cognitive dissonance varies as the set of recurrent processes of *honesty, fairness, responsibility* and *trust* vary themselves within certain limits.

The conceptual framework of the CE Model is based on the following concepts: *Responsibility, Fairness* and *Honesty* are described with reference to the agent's relationships with (1) the other agents, (2) with the (public or private) resources and (3) with herself. The variations of these relationships are produced by each agent's decision making. By *responsability* we

understand the capacity of an individual agent to make decisions in which the social values are compared with survival values. By *honesty* we understand the capacity of an individual agent to make decisions in which the private resources are compared with the public resources. By *fairness* we understand the capacity of an individual agent to make decisions in which social ties are compared with personal ties. By *trust* we understand the capacity of an individual agent to make decisions in which society as a whole is compared with the agent herself.

The CE Simulation Model is based on a complex set of relations and processes which model the concepts of *attitude, attitude change, honesty, fairness, responsibility, trust* and *cognitive dissonance*. The recurrent *responsibility* process models the relationship evolving between an agent and the public resources, the recurrent *fairness* process models the relationship evolving between one agent and its individual ties (related agents), the recurrent process of *honesty* models the relationship between the agent and its own values, and the recurrent process of *trust* models the relationship between an individual agent and the society as a whole. The recurrent process of *cognitive dissonance* models the relationship between the current attitudinal state and the variations of the state described by the complex set of processes of trust, responsibility, fairness and honesty. The cognitive dissonance varies as the set of recurrent processes of *honesty, fairness, responsibility* and *trust* vary themselves within certain limits. There is an reversed proportionality relationship between cognitive dissonance values and the values of *honesty, fairness, responsibility* and *trust*.

The emergence of a political attitude change is defined as a side-effect of a variation in the complex relationship between the five recurrent processes. The CE Model simulates the transformation of an agent from a "honest" type to a "corrupted" type. This transformation process actually describes the emergence of corruption as an attitude change. The agent' stable attitude is a state in which processes of *trust, responsibility, fairness* and *honesty* evolve over a certain threshold and the cognitive dissonance is very low (under a certain threshold). As soon as one or more of the processes of *honesty, fairness, responsibility* and *trust* have variations which exceed a certain range of values, the stability of attitude is lost: the decreasing outcome of these processes allow for an increase of the cognitive dissonance. As soon as the cognitive dissonance exceed a certain threshold, an attitude change occurs. The attitude change describes the change from a "honest" type to a "corrupted" type of agent.

Our approach models corruption as an emergent feature of the self-organizing processes of *honesty, fairness, responsibility, trust* and *cognitive dissonance*. The model starts from an arbitrary stable attitudinal state. The decrease of *private resources* and the increasing *responsibility* for personal ties generate a variation in the processes of *fairness, trust* and *cognitive dissonance* such that an attitude change emerges. The emergence of attitude change is described as "corruption" if *honesty, fairness* and *trust* have low values, while *responsibility* and *cognitive dissonance* have higher values.

5.2. The Model

Our apprroach is a bottom-up approach on corruption. It is concerned with the emergence of corruption in an artificial society.

Corruption emergence is described as a micro-macro relationship. At the micro level, we describe and simulate the self-organizing processes of *honesty, fairness, responsibility, trust* and *cognitive dissonance.* At the macro level we describe and simulate the corruption emergence.

Our view on corruption description and simulation is elaborated from a twofold perspective: it combines, on the one hand, the self-organizing complexity of recurrent processes feeding on each other, with norm and behavioral learning, on the other hand. The conceptual framework accounts for the way in which agents encounter corrupt practices and other (eventually, corrupt) agents. As the agents witness a rise of the frequency of corruption phenomena (namely, bribery), they might comply with a normative system of the corrupt agents, and, ultimately, they might become corrupt themselves.

The *artificial society* is the emergent feature of a system of *artificial collective agents* placed in a virtual environment or space which will be called from now on the "landscape". The landscape represents the interaction space of the agents. In this space, the agents might encounter corrupt practices, they might experience requests for bribe from other agents as they will try to access public (common) resources which have associated, hidden access privilleges imposed by the corrupt agents. The landscape will be therefore called: (1) "bribery-scape" for petty corruption case studies, (2) "privillege-scape" for grand corruption case studies, and (3) "barron-scape" for administrative and bureaucratic corruption case studies.

The *landscape* has a random configuration of *common resources*, representing the public resources of the society. Chakrabarti in (Chakrabarti, 2001) assumes that, at the aggregate level, a society output results from two kinds of inputs: he distinguishes the individual type of input and the social type. Similar to (Chakrabarti, 2001), we will asume in our approach that the total resources in the artificial society are of social type (i.e.: this including both financial and institutional setup of the artificial society), and of individual type (i.e.: this including private resources from money to personal competence). Since this issue is actually increasing the degree of complexity of the artificial society's description, we will assume that a resource, be it private or publlic, can be either accessed or consumed. In the case studies we will extend this subject and make special considerations in this respect.

The agents and the resources are initially randomly distributed in the landscape. While the agents are mobile, the resources are fixed in the landscape. As the agents move and interact with each other, they either access and/or consume both their private resources and the common resources, thus modifying in a fundamental way the structural characteristics of the artificial society (Epstein and Axtell, 1996).

5.3. Corruption Emergence

In our approach, the corruption model starts from the assumption that: the agents undergo internal processes of adaptation to a varying normative context. The values of their individual attributes are updated iteratively by a set of self-organizing processes:

The self-organizing processes of social order at the individual level:

Trust: the recurrent process of trust receives a stimulus from the cognitive dissonance process such that the degree of cognitive dissonance operates as a excitation of the trust process:

$$tr_{new} \leftarrow tr_{old} + cd_{old} \cdot (1 - tr_{old}) \qquad (1)$$

where: the current value of trust, tr_{new}, is updated by the cumulative value of two factors: the old value of trust and the product of the degree of the cognitive dissonance and the degree of trust decrease.

Cognitive dissonance: it expresses the pressure for attitude change as the relationship between what the agent's expectation and the real situation shows an increase of the difference between expectation and reality (Rajecki, 1988); the cognitive dissonance process receive an excitation input from the responsibility process:

$$cd_{new} \leftarrow cd_{old} + r_{old} \cdot (1 - cd_{old}) \qquad (2)$$

where: the cognitive dissonance new value, cd_{new}, is recursively updated by the cumulative value of two factors: the old value of the cognitive dissonance and the product of the degree of responsibility and the degree of cognitive dissonance increase.

Responsibility: the process that supports the social order; it expresses the individual agent's capacity of decision making. We consider that lower degrees of responsibility indicate an increase in the agent's preference for the survival values and an orientation towards the preservation of kin ties in spite of the social ones:

$$r_{new} \leftarrow r_{old} + f_{old} \cdot (1 - r_{old}) \qquad (3)$$

where: the responsibility new value, r_{new}, is recursively updated by the cumulative value of two factors: the old value of responsibility and the product of the degree of fairness and the decrease of responsibility.

Fairness: is a dynamic attribute which expresses the degree of normative correctitude in the interaction with other agents concerning the access to common resources.

$$f_{new} \leftarrow f_{old} + h_{old} \cdot (1 - f_{old}) \qquad (4)$$

where: the fairness new value, f_{new}, is recursively updated by the cumulative value of two factors: the old value of fairness and the product of the degree of honesty and the decrease of fairness.

Honesty: is an individual attribute which expresses the degree of honesty as a reference to moral values; it is considered to be the behaviour counterpart of fairness. Agents with low honesty values are likely to become corrupt. The degree of honesty is recursively influenced by the dynamics of trust.

$$h_{new} \leftarrow h_{old} + tr_{old} \cdot (1 - h_{old}) \qquad (5)$$

where: the fairness new value, h_{new}, is recursively updated by the cumulative value of two factors: the old value of honesty and the product of the degree of trust and the decrease of honesty. Honesty receives a special approach in our experiments: we consider that honesty level undergoes variations as the agent faces the necessity to access common resources in order to

survive. This makes of the honesty value a relevant initial condition and it also makes of the honesty evolving process a signal for the self-organizing processes of fairness, responsibility, cognitive-dissonance and trust in social values.

At each iteration, the processes activate and feed on each other in a cross-referential relationship. The global connectivity of these processes depends on the initial values of honesty and trust. It is a path-dependent global process as we will show in the analysis of the experimental results. An attitude-change is considered to depend on the simultaneuous levels of honesty, fairness, responsibility, cognitive-dissonance and social trust: if their dynamics reaches simultaneously low level of honesty ($h<0.3$), fairness ($f<0.1$), responsibility ($r<0.5$), cognitive dissonance ($cs>0.75$) and social trust ($tr<0.3$), then an attitude change is considered to become operational: it is made visible by the emergence of corruption.

Knowledge: the cognitive or knowledge component of the attitude structure is described by means of a learning process.

Learning and Adaptivity: Agents could reject corruption as a dishonest alternative of social relationship or they could become corrupt themselves. The temptation of corrupt acts and behaviors is acquired as the agents undergo processes of iterative transformation in their social environment. Their transformation concerns the dynamics of the basic process of trust in social values: trust decreases as the agents encounter difficulties in accessing the common resources. Variations of trust which are bellow a trust threshold enable the attitude change. Corruption is therefore an emergent feature of the agents which experience an attitude change with respect to their need to access common resources (i.e., basic survival means). Learning process of new competences are usually described as reaching maximum values in an asymptotic manner (Nembhard, 2000; Zoerthout et al., 2004; 2006). Learning develops as an iterative procees: at each iteration the agents acquire new knowledge concerning the access rights to the common resources. As the access rights to the common resources turn into privilleges of access, the knowledge about old access rights reach a maximum level; this processes signal a decrease of the agent capacity to cope with the new normative rules concerning the access to common resources; at this point the agents start acquiring a new normative rule of acccess and, therefore, starts becoming a corrupt agent.

$$k_{t+1} = k_t + \lambda \cdot \frac{k_{\max} - k_t}{k_{\max}}$$

(6)

where: k_{t+1} is the current knowledge, t is the current moment of time, λ is the learning speed (λ = 0.2 in our experiments) and $k_{\max}$ is the maximum level of knowledge with regard to the access rights to a common resource.

The case studies are concerned with several corruption scenarios in which the agents learn new patterns of social normative rules:

- new patterns of protection-safety (privillege scape),
- new patterns of wealth transfer and re-distribution (bribery-scape),
- new patterns of social organization (hierachical/egalitarian) see (barron-scape)

6. The Simulation Model
6.1. The Agents' Types and Properties

The individual agents have a set of common attributes, like *responsability* and *honesty, memory* and *private resources*; they move in social space, interacting with each other, thus consuming both private and common resourcess, and consequently updating the values of their individual attributes as the context varies. The goal which this description serves is that of denoting the dynamics of two kinds of processes: the agent internal and inter-relational processes. Any agent is involved in special relationships with the other agents in the society. Each individual agent develops a specific degree of *cognitive dissonance*. The processes describing these relationships are self-organizing processes, feeding on each other in a simple but efficient connectivity pattern.

6.2. The Simulation Experiments and SetUp

The simulation model uses NetLogo 5.0.1. software[6]: it provides the means to create and evolve an artificial society with agents that move in a landscape with fix common resources.

The artificial society represents the means to construct a typical human society in which the agents are characterized by dynamic processes at two levels: micro and macro. The micro level processes are internal to each individual agent. The macro level processes concern the interconnectivity of the agents and the interdependence of the inter-agent processes. The micro—macro processes emerge from the global development of the processes described above. Corruption emergence and growth are studied at the micro-macro level.

The system allows the description of global variables either internally (by code programming in NetLogo) or by active forms and buttons, like, for instance, the sliders used to describe variable private resources or the amount of information a certain agent can either hide or reveal. The system is initialized with random values either at the NetLogo active forms level (manually) or directly in the programming code of the active procedures (auto-initialization). The system can loop for ever in the main loop or it can be stopped, re-initialized with different random values and run again. One run is called a "trial": at each trial a number of global variables are plotted in separate windows, like, for example: *number of privilleges* on the privillege-market (corrupt transactions), the global (social) level of *networking*, or the level of *common resources*, personal *wealth*, level of *discretion* (hidden information).

The micro level self-organizing processes *honesty, fairness, responsability, cognitive dissonance* and *trust*. They are recursively feeding each other at each iteration:

Honesty (Ho) is manipulated as a special variable: it is initialized with random values in the closed interval [0,1], where "0" value describes dishonesty and "1" value describe highest level of individual honesty. Honesty is not a fixed valued-variable: it is updated by a self-organizing process of *honesty* variation ($h(t)$, where t is time). Its dynamics is described recursively: if the current values are going bellow a certain "honesty-threshold", then the process of honesty undergoes a bifurcation and starts feeding negatively on the processes of *fairness, f(t),* and *responsibility, r(t).*

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[6] Wilensky, U.1999. netLogo. http://ccl.northwestern.edu/netlogo/. Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, Il.

Intuitively, we try to describe the variations of honesty in conditions of low personal-resources, when individual agents ask the access to common resources and they have to bribe in order to get it. Increasing necessity of bribing means a higher pressure for the individual agent to either reject bribery or to lower his initial level of honesty and fairness and to accept the perspective of becoming corrupt himself.

The macro level processes:

access-request--to-resource,

ask-for-bribe; offer-bribe; accept-bribe; denny-bribe;

ask-for-privillege; offer-privillege; accept-privillege; denny-privillege;

 fear-of-retaliation; retaliation;

hide-information; show-information.

There are several types of agents: *citizens, bureaucrats, magistrats* and *politicians*. There are initialy randomly distributed *common resources* and *private-resources*. The artificial society and the generic experiment is fully described in **Figure 1**.
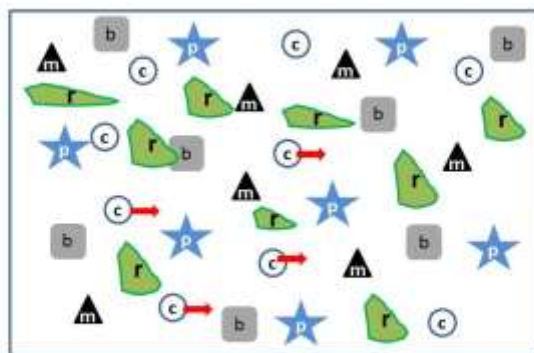

Figure 1.

The types of agents in the Bribery-Scape.

The white circles are the Citizens (c), the grey squares are the Bureaucrats (b),the black triangles are the Magistrats (m), the blue stars are the Politicians (p), the red medows are the Public Resources (r), and the red arrows are the *bribes* offered, usually, by Citizen agents (c-agents) to the privilleged agents (b-, m- and p-agents).

Each type of agent has certain characteristics, described with a set of attributes like: trust in social value, cognitive dissonance, (degree of) responsibility, (degree of) fairness, (degree of) honesty, personal-resource, and knowledge with regard to normative rules of access to common resources.The generic experiment is fully described in **Figure 2**.
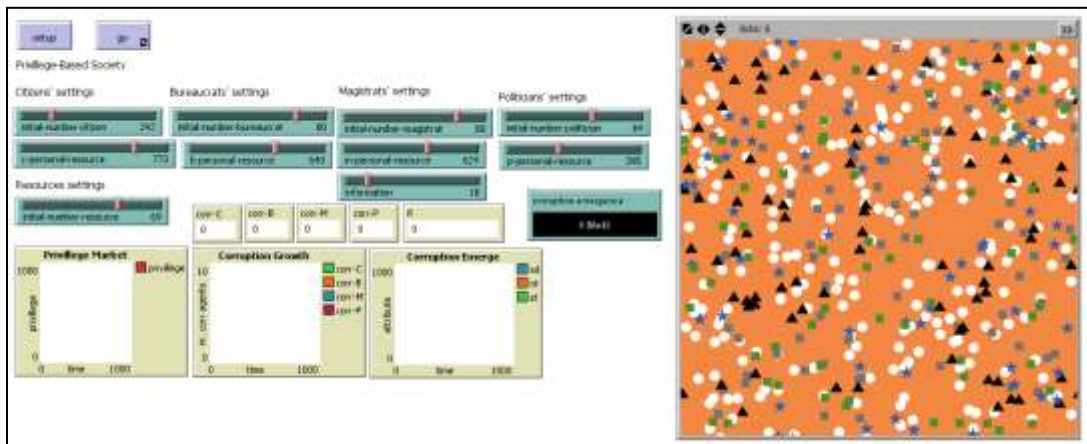
Figure 2.
The NetLogo Interface for the Corruption Emergence Model.

The artificial society is depicted in the right view. At the initial setup, all active forms are cleared, and the agents are randomly distributed in the landscape. All types of agents have their initial colours: no corruption. The moving principle is similar to the basic "sugarscape" scenario (Epstein and Axtell, 1996): the C-agents are moving freely in the landscape using their own (private) resources. As these private resources are decreasing, they reach a certain threshold. At this point, the C-agent will try to find a public (common) resource and access it. If the public resource has access privilleges and if these access privilleges are provided by B-agent(s) or M-agent(s), then the C-agent will try to bribe them. When the private resources are bellow a certain threshold (i.e., they are insufficient for surviving in the landscape), then the C-agent will not be able to offer bribe anymore, so it will try to buy access privilleges with its own freedom, so that it will be included in a corruption network.

Citizens (C-agents) are pictured as white circles. Their common task is to access the common resources (green squares); if the resources are managed by Bureaucrat, B-agents, with discretionary power, the C-agents will be asked to offer bribe; the C-agents have two alternatives: to bribe or to refuse bribing. The C-agent uses his private resources to bribe. If the C-agent accepts to bribe, but the demand exceeds his private resources then the C-agent becomes a member in the corruption network of the corrupter agent (*corruption networking* phenomenon).

Bureaucrats (B-agents), pictured as grey squares, *Magistrats* (M-agents), pictured as black triangles, and *Politicians* (P-agents), pictured as blue stars, are considered agents with discretionary powers with regard to the type of common resources they are responsible for. If their honesty levels are over a certain threshold, they will never ask or accept bribe. If, however, their individual values of honesty are bellow a certain threshold, they will ask for bribe in exchange for offering access privilleges to the common resources. In particular, the M-agents and P-agents might accept to become corrupt themselves if they fear too much of retaliation in their class of agents: they thus become members of corruption networks. The level of connectivity of agents in bribery-networks inside their class show the level of corruption of the entire artificial society.

As corruption emerges, the agents are changing their colour as follows: the c-agents and the p-agent become red, the b-agents become black, the m-agents become brown. A working interface is depicted in **Figure 3**.
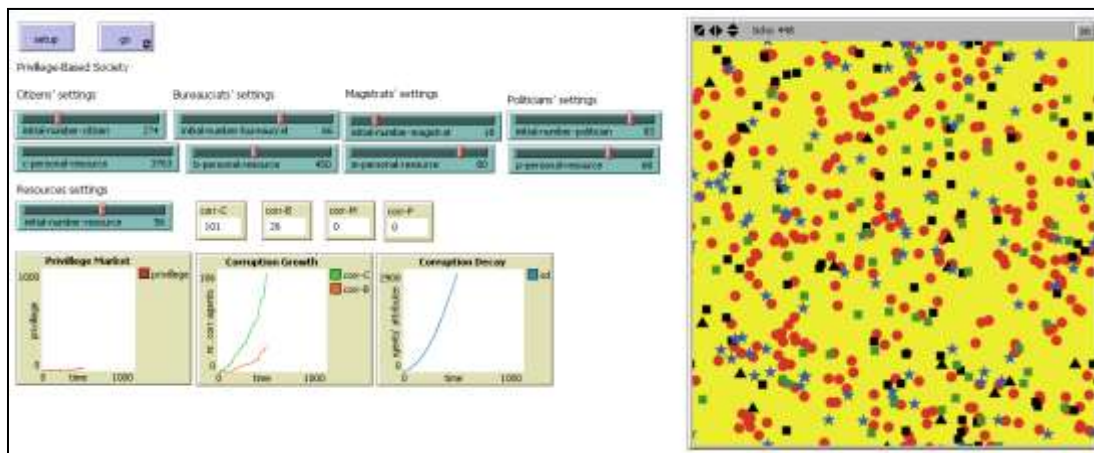

Figure 3.
The view of the bribery-scape shows that, for the current trial,
there are corrupt C-agents (red circles), corrupt B-agents (black squares) and corrupt M-agents (brown triangles).

7. Case Studies and Experimental Results

The attitude change is considered the source of corruption: it provides for the favouring conditions in the emergence of corruption. The favouring conditions are represented by the current levels of honesty (h), responsibility (r), cognitive-dissonance (cs) and trust (tr) which exceed normal values (i.e.: the normal values are in the interval [0,1] for all these variables, with low levels for normal cognitive dissonance and high levels of honesty, fairness, responsibility and trust). The case studies show how corruption emerges in different scenarios.

7.1. Case Study no.1: The "Briberyscape"

This case study is concerned with the emergence of petty corruption. In this scenario, the C-agents require access to common resources. If the common resources are in the direct responsibility of corrupt B-agents, the C-agents will offer bribe and, eventually, will get privilleged access to the resources. Usually, this kind of scenario shows that, initially, C-agents use their private resources as a means for surviving. At lower levels of personal resources, they will expect to have access to the common resources. If they ask for access and the access is conditioned by offering bribe, they will offer bribe using their private resources. As the private resources are diminishing and the access to common ressources is constantly denied by the more powerful agents, the cognitive dissonance of the C-agents starts to increase and the responsibility as well, their fairness will decrease, even if they had initially high levels of honesty. As a general consequence, their trust in the social values will start decreasing and therefore allow for an attitude change: in order to get the access to survival resources and satisfy the minimum level of

responsibility (with respect to the kin ties), they will try to bribe. This is the point where corruption emerges.The red circles are corrupt C-agents and the black squares are corrupt B-agents (*see* **Figure 4**).
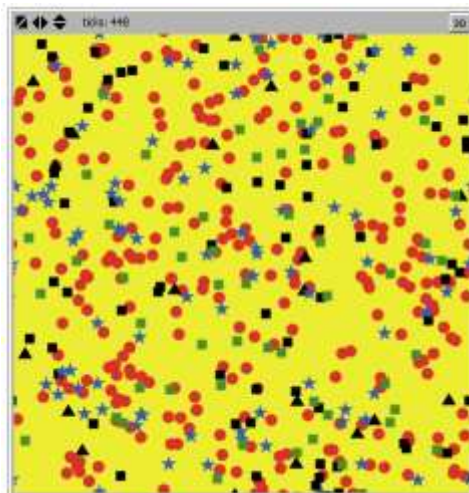

Figure 4.
The emergence of petty corruption: red circles and black squares are corrupt agents.

7.2. Case Study no.2: The "Privillegescape"

This case study is concerned with the emergence of grand corruption and it has been suggested by the work of Danileţ (Danileţ, 2009). In this scenario, the M-agents have discretionary power with regard to common resources of the legal type. These type of common resources represent *justice resources* (i.e.: *legal liberty* or *legal punsihment*). They could accept to offer privilleges (*legal liberty*) in exchange of bribe or they can reject bribe and apply *legal punishments* to eventual bribers. They could also accept to hide information with regard to common resources and therefore become corrupt either because their cogntive dissonance increases or because they fear of retaliation from the part of their mates. In either cases, as they accept bribe or accept to hide information, the M-agents become corrupt.

In this scenario, the M-agents are studied with reference to themselves in the situations in which either the C-agents or the M-agents themselves might require to be absolved of legal punishment in exchange of bribe. We have studied the emergence of *networking* between corrupt M-agents. In such networks of corruption, C-agents might be included if they ask for any of the privilleges available in the *magistrats* class.

We have also studied the opposition between democratic accountability vs. corrupt accountability. In this case, the "retaliation-scape" case study shows the distribution of M-agents which become corrupt from fear of retaliation from the part of their mates.
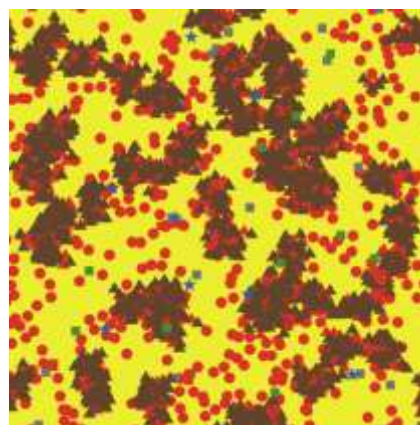
Figure 5.
The emergence of grand corruption.

The "grand" corrupt agents, like the magistrats, become members of corrupt networks. The networks start growing as new M-agents are becoming corrupt. The areas of brown color in **Figure 5** represent networks of corrupt magistrats.
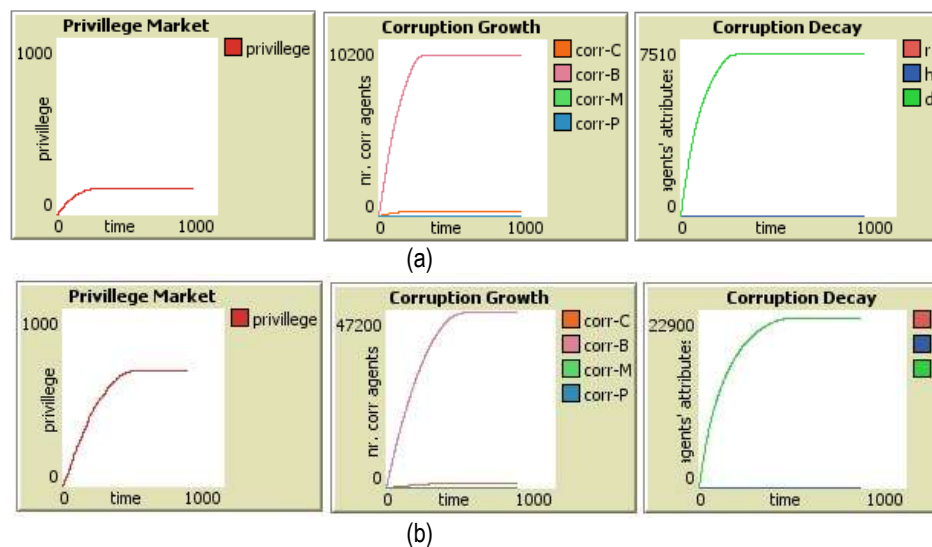

Figure 6.
The emergence of corruption (a) is dependent on the initial conditions, (b) it is path dependent.

Figure 6 includes a number of plots for the global variables of the artificial society. In the upper plots (a) the privillege market (red trace) shows that the number of acquired privilleges is increasing while the number of corrupt agents is also increasing (in particular, in this plot, the number of corrupt citizens, corr-C, and corrupt bureaucrats, corr-B, are increasing proportionally with their population size in the landscape). In the same time, the cognitive dissonance increases dramatically (green trace) while the honesty level is at lowest level. As the dynamics of honesty, responsibility and trust are dependent on the initial conditions, the plots in the (b) graphical

windows actually show how corruption emerges and evolve on different levels. For a comparison, the privillege market is higher in the (b) row of plots with respect to the (a) row of plots. This is associated with higher levels of cognitive dissonance in the (b) plots with respect to the (a) plots.

In both rows of plots, there is evidence that the processes at the macro level reach a kind of equilibrium state, in which the privillege market, for example, does not grow any more. This kind of phenomenon, for the privillege market in particular, is associated with the emergence and growth of the networking phenomenon: intuitively, when C-agents do not have anymore private resources to bribe for privilleges, they will start becoming members of the corrupt networks, and thus conceeding to serve as corrupt members in exchange for the requested privilleges.

7.3. Case Study no.3: The "Baronscape"

This case study is concerned with the emergence of the corrupt elites and their distribution in the landscape. The case has been suggested by the research analysis of the local corrupt elites in Romania, which are called "barons" in their local communities (Precupeţu, 2008).

In Romania, the corruption phenomena regarding the emergence of corrupt elites in some communities is called "baroniade", meaning a process of concentrating the discretionary powers, the resources and the networks' decision making nodes in the hands of the agents which accumulate high levels of personal wealth.
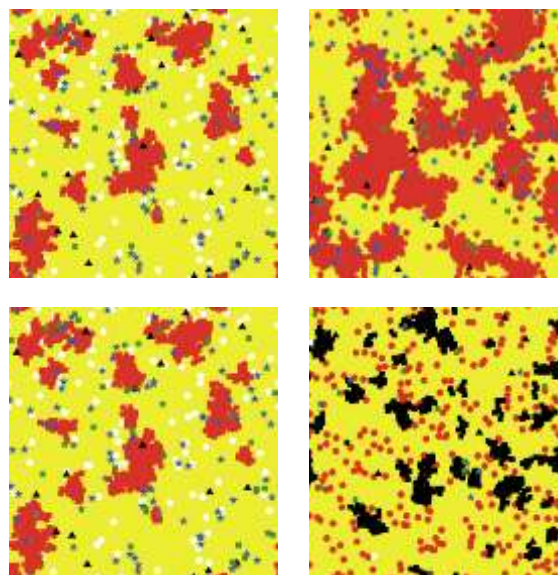

Figure 6.
The emergence of corrupt elites in local communities.

The pictures in **Figure 6** describe groups of corrupt agents which accumulate wealth and power, thus becoming powerful in their small communities. They aggregate as groups or networks of corrupt agents: red for corrupt citizens and black for corrupt bureaucrats.

8. Conclusions and Future Research

8.1. Relevance of current approach

Current research has achieved a global view over an artificial society in which corruption emerges in certain initial conditions (a certain number of agents, of common resources, of private resources and of certain values of the variables: trust, responsibility, honesty, fairness, and cognitive dissonance). The corruption level and its dynamics in the society proves to be path-dependent. Under certain assumptions, like those mentioned above, the artificial society used by the Corruption Emergence Model proves that the origins of corruption and its generating mechanism lies in the attitude change. The attitude change has been for the first time simulated as an emergent feature of a set of self-organizing processes characterizing the agents.

8.2. Limits of the present approach and issues of further research and development

The approach faces the problem of a two type complexity. First, there are a number of social normative systems which eventually emerge in the artificial society as an effect of a long-run social change (like, for instance, a transition process from a political regime to another). Second, there is a level of cognitive dissonance which cumulates the individual values to a certain threshold, over which an attitude change starts to become effective in the society, making therefore possible the competition between the different normative systems with which the individual agents comply. Both the first and the second type of complexity (norm emergence and attitude change) represent initial conditions for corruption to emerge and evolve, either by growing or by decaying. However, they both should be kept in a reasonable scale and effective simulation framework in order to make possible the descriptive and the predictive power of the artificial society.

Norms emergence is a huge simulation issue in the literature on agent-based systems (see Axelrod, 1986; Shoham and Tennenholtz, 1992; Savarimuthu et al., 2009). However, there is no approach so far on the norm emergence with concern to corruption sources and effects. Attitude change is another difficult issue: in our approach it is mainly concerned with learning and adaptivity of the artificial society, but it has to be approached at the level of social norm learning. Current researches have been developed during the past three years. The software support has been currently changed to the SWARM software and future work will be developed on this platform.

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