

Money-Scape: A Generic Agent-Based Model of Corruption

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Abstract

There has been a lot of works on corruption cases. We must think that corruption is a cultural aspect in a social life. We cannot separate the corruption with the cultural system where the corruption raised. Indonesia has been recorded to be one of the countries of the worst economic and political system on corruption case. The paper is introducing the usage of agent based simulation for analyzing the corruption specifically in Indonesia as the biggest corruption level. The model showed is named money-scape, inspiring by the way of corrupt bureaucracy in Indonesia. The paper showed how the situation taken by the revolutionary strategies combating corruption and some peaceful and smart strategies generically.

Keywords: corruption, money-scape, agent-based, revolution, strategy

*...corruption ...undermines good government,
fundamentally distorts public policy,
leads to the misallocation of resources,
harms the private sector and private sector development,
and particularly hurts the poor...*

-Mission Statement of Transparency International-

...for the love of money is the root of all evil...
-St. Paul-

1. Introduction

Indonesia has been recorded to be one of the countries of the worst economic and political system on corruption case (in the rank 97th with 1.7 point on the scale of CPI score (Transparency International, 1999). There has been a lot papers about the corruption as the bad mark of the macro-economical system. Nonetheless, the paper will discuss somehow on the cases of corruption met in Indonesia most. The different cultural system will somehow regarding to the specific cases, consequently the corruption cases in Indonesia will be somehow different. The paper will discuss about the corruption cases most occurs in Indonesia regarding the characteristics and specific cultural system where they grew.

The paper will begin with some literatures and researches about the paper on the contemporary cases on corruption around the world. The next section will discuss about some unique cultural situation output the corruption in Indonesia social system and the need for the social analysis on the cases, how to make some changes for the better social system and bureaucracies. The next section is the model built as the primary part of the paper, and how the results of the simulations. Some further works for the better accomplishment and better implemental ideas will be noted in the last section within some concluding remarks.

2. Review on Literatures about Corruption

There has been a lot of works on case corruption. Norris (2000) examines the interactions between self-interested agents in a two-tier government hierarchy, consisting of a central authority and bureaucrats in a two-stage game, where the actions of agents affect private sector allocations. In advance, Norris show in the language of game theory how the corruption regarding the utility function of bureaucrats regarding the monitoring process and the dictatorship happens in a governmental state.

Gupta, Mello, and Sharan (2000) examine the association between the higher military spending with the corruption. The work discovered the evidence indicating that defense spending can be considered for constructing governance indicators. Another relevant work is authored by Abed and Davoodi (2000) showed the adverse impact of corruption on economic performance. It was found that the corruption is largely the symptom of deeper insights into economic performance.

Nonetheless, we can find many cases of corruption (or bribery) across the countries. It is apparent that the corruption becomes an inherent factor regarding the bureaucracies even though in the modern countries with modern governmental infrastructure. But eventually, we must acknowledge that the cases on corruption are mostly occurred becoming the social disease in the social system of the developing and under-developing countries. As well as in Indonesia, lots of people said that the primary cause of the corruption is the low wages of the civil servants. However, it can be showed apparently about the negative relationship between corruption and wages, especially in the developing countries (Rijckeghem & Weder, 1997). The work of Leite and Weidmann (1999) shows another more plausible ideas on the level of corruption across the countries. Corruption is mostly happens on the natural resources abundance creating the opportunities for rent-seeking behavior, by which becoming the important factor determining the corruption level of a country.

However, the literature described above offers general approaches on cases of corruption. However, it is hard analyze the cases of corruption realizing the cultural values and the social living of a country. Some works on the top-down approach shall be completed by the bottom-up analysis, and however, the works on the artificial society shall give some important perspectives for the improvement of our understanding on corruption spatially and temporally (Axtell, 2000, Situngkir, 2003b).

Some works on corruption in bottom-up analysis are somehow existing on the approaching into the cognitive system on how someone can be corrupt. The work of Hammond (2000) introduced the agent-based studies on corruption and gave some important notes on the corruption generally; especially in the transition of endogenous factors of the corrupt agents. This was done by combining the game-theoretic decision rules of agents and the spatial and discrete modeling on micro-view of corruption and bribery. Furthermore, the analysis constructing the dynamical behavior of corruption is also available, introduced by Chakrabarti (2001). In this work, it is apparent the connection of macro-economical analysis on corruption and the micro-state factors in agent-based simulations.

Nevertheless, we must think that corruption is a cultural aspect in a social life. We cannot separate the corruption with the cultural system where the corruption raised. In Indonesia, the corruption is a very annoying factor for the reconstruction of the national politics and economics after the regime of New-Order. This is an important issues that has been long time for the nations to struggle with and made the nation become retarded in the development of supra-structure of the society. The rest of the paper will model the generic situational aspects of the society regarding the corrupt bureaucracies.

3. Building The Model: The Money-Scape

We will start from the definition that shall we make of the terminology of corruption. However, it is rather hard to determine whether one action is a corruption or not. We will make this succinct on the remarking of the properties of the corruption terminology. There are at least three factors becoming the primary properties of corruption, i.e.:

1. Corruption must have benefit economically for the agent that corrupting.
2. Corruption must have the bad impacts macro-economically. The corruption itself is the micro-state of the economical system, but it must have bad impact to the economical growth in macro-view, whether big or small.
3. Corruption must have socio-legal consequences to the corrupt agent.

By the three definitions we will build the model we can make to analyze the usual corruption in Indonesia.

The model we use in the paper regards to the bureaucracies exploiting the economical positions. We will have the money-scape distributed normally in the landscape where the agents to be placed on. It will be rather different with the model built in the several previous papers since we will analyze the exploitation of the economical positions of the money-scape and see the micro-view perspectives. The bureaucrats (as agents) are placed in every cell. We assume that all of the agents are in the same political and economical positions. In this case, we can see our system model as regional peer-to-peer governmental system in Indonesia, whether the regional governments are in the same positions but facing the different economical potential to be exploited for the people.

However, there will be some difference in the properties of the exploiting agents, i.e.: the level of honesty (distributed randomly among agents) with the value between 0 and 1. The value $[0,1]$, representing how honest the agents are. The honesty level of 1 is the most dishonest and the 0 is the most honest. The honesty level will be constant throughout the game.

The other primary property of the agents is the risk-aversion level. This level is also distributed as the initial condition randomly. The value is $[0,1]$. The level of risk aversion 0 is the most averse and the 1 is the irrationally corrupting in the danger and big risks. In the simulation, the level of risk aversion will be changed over time. We will use the Von-Neumann neighborhood (4 neighbors: up-down-left-right, no diagonal influences). This will represent the limited social networks among the agents, concerning the regional state of Indonesia separated by many obstacles as an archipelago. The jailed corrupting agents in her social networks will mostly influence the level of risk aversion. The more the neighbors to be in jailed the more the risk aversion level.

The agents are placed on the money-scape, and the agents will exploit the money in her spatial environment/cell. Whether they use the political and economical power to produce what the people wants in their cells will mostly depend upon the level of honest and risk aversion. Figure 1 showed how the agents distributed, while the cell (with gradating color represents the poor or rich cells; the more black the cell the more the cell to be poor and vice versa).

In the model, we assume that the whole agents tend to corrupt, as a realistic representation of Indonesia bureaucrats getting out of the dictator Soeharto regime.

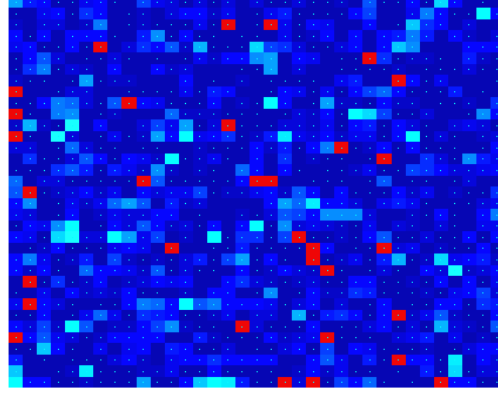


Figure 1

The splash-screen of the money-scape. The darker is the poorer. The red cells represent the jailed bureaucrats.

The exploitation process every round of iteration will be in the simple equation:

$$Y = E(1-X)$$

Where Y is representing the output of the process whether the regional/spatial cell is better economically or not. The E is representing the initial condition before the cell exploited, and X is the corruption factor. The bigger the corruption factors the worse the economical level of the cells.

The X factor is however depends upon the level of honesty and risk aversion of the agents. $X=h.r$, where h is representing the honesty level and r is the risk aversion. It is obvious that when the agent is fully honest, or fully afraid of the socio-legal factors, the corruption level will be turned to zero. Apparently, we can see that the maximum or best output of the cell system in every round turns out to be the same with the previous state.

The risk aversion level (r), will be changed all over the rounds. It will strongly influenced by the social network, whether or not there are jailed agents in her neighborhood. The more the jailed agents the smaller the value of risk aversion. In this model, we use the $r=\exp(-n)$, as n represents the number of jailed agent surrounding.

In macro-view, we find computationally: the number of jailed corrupter, the money left after each round of iteration, the total money stolen by each agents, and the evolution of corruption index. The corruption index will be shown every round and will become the value of

$$\frac{1}{K} \sum_i x_i = \frac{1}{K} \sum_i h_i r_{ij}$$

where the K is the total population built the matrix cells. The index i is representing the agent and j representing the round of iteration.

The law-enforcement process will hold jail after seize the corrupt agent and the agent will have no idea about how he can be taken. The random process throughout the whole cells represents the process of the law-enforcement. One important note that shall be added is that the simulation was done in the toroidal scape, henceforth the edge of one side will be continued by the opposition side, respectively. Eventually, the money-scape will be "grown", as the economical value of each cell is increasing. This is consistent to the fact of some economical activities possible although in high-level corrupting society. By the increasing of the economic value, the risk aversion will be reset to some values respect to the fact of the bigger amount of money for corrupting.

4. Simulation Results

By the model, we will do some experiment on how the corruption emergent is and how the process of moral force (inner the agent) versus the process of the law-enforcement. Thus, the law-enforcement process will be represented by the probability of corrupt agent to be caught.

Using the high probability of the jailed agent (0.1) does the first experiment. We use 80 rounds of iterations with 35x35 matrix, and the result is showed by the figure 2. . It is apparent that by using the constant law-enforcement the stolen resources will be oscillated in some certain value. Henceforth the strategy of the constant law-enforcement somehow made the corruption is taken away but cannot be totally gained as the oscillated the stolen money by un-jailed agents.

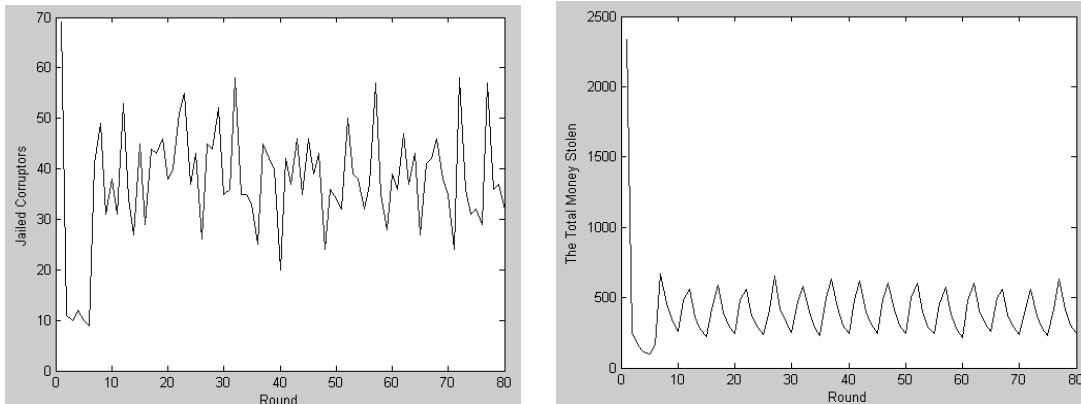


Figure 2

The simulation result with high constant law-enforcement. The jailed agents are represented in the left figure and the graph of the total money stolen by the whole agents in the right side. It is apparent that by using the constant law-enforcement the stolen resources will be oscillated in some certain value.

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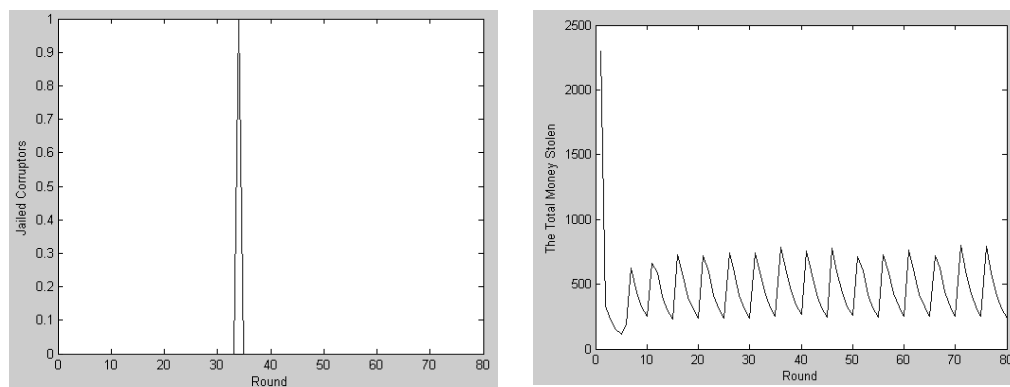


Figure 3

The simulation result with low constant law-enforcement. The jailed agents are represented in the left figure and the graph of the total money stolen by the whole agents in the right side. It is apparent that by using the constant law-enforcement the stolen resources will be oscillated but diverged. The lower the law-enforcement, the worse the level of stolen resources by the regional political power.

We can easily compare the situation with the low constant law-enforcement (about 0.0000001). By using the constant law-enforcement the stolen resources will be oscillated but diverged. The lower the law-enforcement the worse the level of stolen resources by the regional political power

The second experiment is modeled the revolutionary forces of combating the corruption. We run this simulation by making a linear increasing of the law-enforcement by multiplying the factors of the number of jailed agents in the previous round. The jailed agents are hiking fast and the corruption index is decreasing fast too.

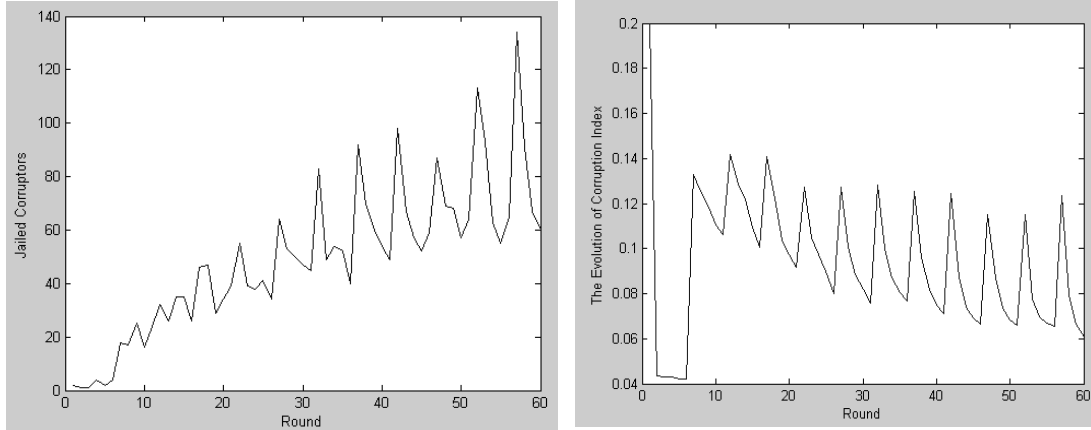


Figure 4

The revolutionary model of the corruption combat. The jailed agents are hiking fast and the corruption index is decreasing fast too.

The last experiment we can use by the model is by making the central government to be smarter using the law-enforcement. The law enforcement is obviously taking a lot of money to spend. In our experiment we will use how the government use the law enforcement economically but effective. Making the learning system to comprehend and evaluate the estimated loses money and the number of the previous jailed agents and appropriating the evaluation with the level of law-enforcement to be taken is the best strategy combating the corruption more effective. The result is figured in figure 5.

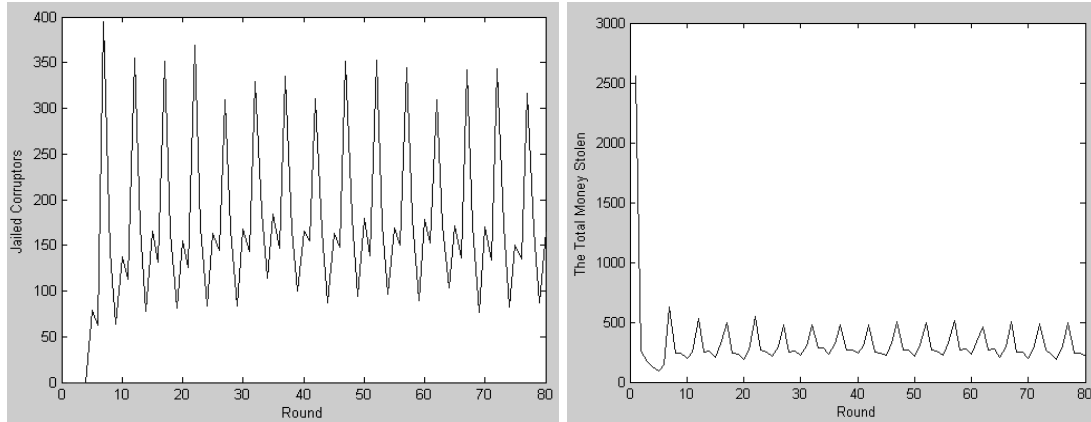


Figure 5

The wiser method of using the level of law-enforcement. In this experiment the level of law enforcement is evaluating the number of the jailed agents and the stolen money. This is made by simple function such as $(\text{corruption_index}(t-1) + (\text{stolen_money}(t-1)/(\text{stolen_money}(t-2)))$ as a function for the level of law enforcement. By this function there is a big number of jailed agents and the low decreasing linearly the total money stolen by the corruption.

5. Further Works

The simulation created here is apparently lack of data. It should be acknowledged that there are probably too far assumption made. However, it is

not degrading the value of the results as the generic model. In advanced, the more qualitative and quantitative data on constructing the decision rule will much improve the simulation. Some other simulation for further advancement is the usage of the game theoretic decision rule in some specific cases leading to corruption.

6. Concluding Remarks

Corruption is an inevitable and inherent way of the life of the modern bureaucracy. The moral force or altruistic social norm is a good way for combating the corruption, as the honesty is also the primary significant aspect of the corrupting actions. But however the way of moral force is hardly to be accepted as the only way for combating the corruption. The law enforcement in general is the only rational and efficient way combating the corruption. In order to gain the efficacy of the usage of the badly high-price law-enforcement some learning law-enforcement strategies should be applied.

In some cases, revolutionary way of combating the corruption is sounding. Even though it is not the only way, the revolution for combating corruption is good enough and effective. Formally, the revolutionary way is the way of the brute (linearly or non-linearly increasing law-enforcement) to seize all the corrupt bureaucrats.

The data and survey based researches on constructing the simulation is apparently can gain the researcher possibility to forecasting some aspects around the corruption.

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