

# The Mafia Model

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This work intends to simulate a market which can perceive the influence of a parallel power, which challenges the governmental influence, imposing its own statements, rules and behavior codes of a common life: the Mafia's control.

For this purpose, we used NetLogo, a multi-agent programmable modeling environment (<http://ccl.northwestern.edu/netlogo/>) written in Java which permits the creation and simulation of different contexts in many different knowledge areas (In this work's case: Applied social sciences).

The interactive environment consists of a display with three different kinds of agents in a green or red patch (further explanation about the behavior of the patch will arise in the text). The agents, or *turtles* in the logo language, have three different colors, according to their respective function in the agent-based model:

- The black ones are the mafious.
- The white ones are the storeowners.
- The blue ones are the police agents.

Generally, the mafious are not a huge share of the society. It is in consonance with the idea of 'famiglia' inherent to the classic concept of Mafia: few individuals, with financial, influential and fearless of external coercion power sufficient to submit and control a community, controlling its economic activities, offering additional protection in situations and areas where the law of the State does not have value anymore. This kind of power is consolidated through generations, due to the fact that people in these communities realize that this parallel power can be useful, although sometimes violent, opportunistic and oppressive. Hence: *If government cannot help me, I'll ask the Mafia. If the bank cannot borrow me money to begin my enterprise, I'll ask for Mafia's flotation.*

Despite the Mafia's illegal activities (The scope of this work is not evaluating activities related to drugs or prostitution or illegal games, which empirically is a part of the mafias portfolio) the population enhances the influence because they know (And due to fear in some cases) that if they ask for help, they will get it. Thus, this creates a

government ridden by social norms raised from the joint influencing factors of the Mafia and the State previously neglected – turning in a vicious cycle.

The storeowners are usually a huge share of the total amounts of agents in each interaction. They get profits by walking around randomly in the patch. The green part of the patch represents an endowment with money, the red part is the absence of money. If the storeowner arrives in a green part of the patch, he'll get profit, otherwise not. This simplification in the model simulates market dynamics; it's neglected, thus we can keep focus on the main part of the model; the interaction between the agents.

The police agents represent the governmental power in the model. The police can fight against the Mafia, or even help the Mafia in controlling the society, this will be explained more afterwards.

### The interaction among the agents

The turtles walk randomly in the patch; as the storeowners arrive in a green patch, they get profits. Only storeowners can get (or not) profits just by walking in the patch. When a mafious finds a storeowner, he tries to make money from this meeting. The payment or not to the mafious by the storeowner is conditioned by the global variables; storeowners-thrust-in-govs-ability-to-fight-mafia and police-power, and the endogenous variable ProbRefuse-myself (further explanation about this variable will be given in the text). If the linkage of these variables would be less than the influence of the mafia in that area of the patch (Named mafia-power), the storeowner cannot refuse to pay the mafious and has to give him a share of his profits.

In the case where a storeowner pays a mafious, he obtains the advantage of new temporary green patches growing around him, simulating the benefits regarded profits of cooperating with a mafia-community. Otherwise, if he refuses to pay, he loses a share of his money, and during this interaction the green patches won't grow around him, impeding the attainment of profits. This context is in accordance with the real situation of storeowners getting advantages or punishments according to cooperating with the Mafia or not. Both, storeowners and mafious, can get out from the market if they don't have any more money (In these cases the turtles die).

When a cop finds a mafious, the mafious must pay a bribe for not being arrested. This bribe is conditioned of the global variables storeowners-thrust-in-govs-ability-to-fight-mafia and police-power, which means that the joint effort between storeowners

and government can reduce the power of the Mafia. If the storeowners are involved in a fight against the Mafia due to the belief in the power and efficiency of the government, and if this is not corruptible (Hypothesis captured in the model by the police-power variable – if positive, ethical; if negative, corruptible), then the police takes the money from the mafious' bribe and gives it to some philanthropic activity. Otherwise, if a government is corruptible, the police don't take any bribes, but instead helps the Mafia with controlling the market so the influence and thus wealth of the Mafia becomes stronger. It will be easier for the Mafia to make more profits as "Mafialaws" will rule the society.

If a storeowner turtle has sufficient money, if it's an optimist regarding whether the government is ethic, and if this exceeds the power of the Mafia in a given area of the patch, it can "reproduces", which according to economic theory means that as long as there is profit in the market, new storeowners will arise. These new agents are "born" with the possibility of paying the so called 'pizo' to the Mafia or not, conditioned by the endogenous variable ProbRefuse-myself, which depends on the wealth of the cops in the local area.

## The main variables

The simulation has some variables that are extremely important for the effectiveness of its scope, which are related to the short-term policies ridden by a government in the way to change the personal- and social norms of a population or community in a long-term pattern. They're explained as follows:

- Storeowners-thrust-in-govs-ability-to-fight-mafia: This is a global variable which represents the behavior of citizens as they believe or not in the ethics, efforts and abilities of their government in protecting them from illegal activities, here represented by the Mafia. It's related with the public interventions the government can induce, to affect personal- and social norms. If the results of these interventions are norms which will induce a non-mafia-friendly behavior, or increase the thrusts in the governments abilities, effort and ethics to fight the mafia, then this variable will assign a higher value.

The more a storeowner thrusts in the government, the less appealing the mafious help and protection will be.

- **Police-power:** This global variable represents the total power of the government to fight the Mafia, which is an increasing function of the total amount of governmental resources used for this purpose, and the efficiency per unit used. So police-power will be total efficiency units used by government. It can assume negative values, in the case which simulates a corruptible government, which means that the police will help the Mafia.
- **ProbRefuse-myself:** Is an endogenous variable related to the new generations of storeowners' turtles. It intends to demonstrate the belief the storeowners have in being protected by the government against the Mafia. The bigger the resources of the police are in the nearby area will affect economic power, influence, and engagement in the populations' security (which is enhanced by the police-power variable), the bigger the probability of refusal for a new storeowner to pay the Mafia who recently started joining the market will be.
- **Endowment-rate:** This global variable tries to simulate, in a simple way, the different economic contexts in which a market can be inserted. It controls the rate of regrowth of the green patch, which means that it can simulate the level of difficulties for the storeowners to make profits. Zero indicates an optimistic prediction for the market, and 100 represents a market in crisis, in which there's difficulties getting profit. This variable is interesting in the way that it permits the user to verify how the behavior of the agents are in calm and stressful economic situations, and even testing the effectiveness of the policies applied in the reconfiguration of social norms ridden by an engaged government.

### **“Social norms and global environmental challenges: The complex interaction of behaviors, values and policy”**

The paper evaluates the biggest threat of our time, environmental problems, and tries to give arguments for what some people believe is the only way to save the environment, through changing personal- and social norms, thus change the way behaviors act.

The responsibility of changing personal- and social norms is placed on the government saying that public intervention is needed when the market doesn't behave optimally. This is correct according to the first welfare theorem that states that an open market with free-access, costless full information about prices and without externalities,

will have a pareto-optimal solution. In accordance to the environment we know that internalizing externalities to make consumer-prices reflect social-welfare costs is a second-best solution. When people who get lower utility due to worse environmental quality (Low air quality, polluted drinking water, ++), without getting compensation to reach the same utility level as before, we have an externality. This is the core problem of environmental issues. Agents who are not a part of a transaction will get reduced utility due to lack of compensation. Why? Because the agents, who are a part of these transactions, have no incentive to do so.

So Societies and countries don't have the incentives to reduce their pollution as their own disutility of pollution is too low. Changing prices through taxes and subsidies will make distortions in the market due to changes in relative costs which will no more reflect the real costs; a social efficiency loss will arise, although it may be the best solution. Although not discussed properly in the paper, the author takes this knowledge as given and proposes changes in personal- and social norms as one part of the total solution to save the environment.

Policymakers are lacking information of how to target personal- and social norms in an effective way. In accordance to solving the environmental issues the social norms that increases the collaboration among behaviors, and those who're proenvironmental, should be targeted.

We know that values influence behavior. What policymakers need to exploit is that behavior can also influence values. Computer simulations have showed that people with a strong belief and certain behavior can induce a tipping point as low as a 10% of the population. If policymaking were targeted according to estimated benchmarks for long-term changes in social norms, policy interventions would be more cost effective which would benefit the environment.

There are many ways in which public interventions can influence personal- and social norms. Active norms management like advertising, information and appeals, or changing the architecture by making behavior more convenient or visible, or by financial interventions like taxes, fines, allowances and subsidies, or through regulations such as laws and standards. They all have their different pros and cons even with a potential boomerang effect making behavior and outcome worse. This can occur if;

- The intervention is revealing that others are not doing their part. Which can justify worse behavior.

- The effect of a financial intervention can change the issue to an economic rather than a moral calculus making norms weakened and changed in the opposite direction of first intended.
- Regulations can create incentives to regain lost freedoms, which will increase social costs.

Especially according to affecting descriptive norms one should be aware of the distribution of behaviors and norms so that the total improvement of behavior exceeds the opposite. And the total benefits should exceed the total costs related to the public intervention to make it social-economic efficient. When you add uncertainty to benchmarks and behavior, there will be an even higher benchmark for approval of the public intervention.

Uncertainty justifies the lack of targeting personal- and social norms for policymakers. The only way to reduce the uncertainty is through econometric studies and contributions from several disciplines which will secure the best possible predictions about behavior. Anyhow, finding the marginal effects on environmental improvements/decreases in social costs due to change in norms may be difficult. This is probably one of the reasons norms and public interventions have been neglected in the economic literature, the uncertainty is too high. Finding cost effective benchmarks which will induce long-term effects of short-term public interventions is, given today's knowledge of norms and behavior, very difficult.

### **The interaction between public interventions and norms regarding efficiency**

- Policies can become more cost effective in the long-run if they tend to influence social norms, so that behaviors become self-reinforcing even in the absence of external regulations or penalties.
- When using an active norm management; the probability of a boomerang effect is low, anyhow this intervention of influencing norms has a limited empirical effect.
- Active normchanges will be at its most efficient if it tends to affect social norms which will induce social sanctions. E.g. Information about third-hand smoking in public areas.

- Changing architecture can be effective with regards to more convenient installations; social acceptability for disapproval will be reduced through increased social sanctions.
- Changing architecture can be effective in the cases where individuals by experience induces a norm as a personal norm before affecting social norms. E.g. Making recycling easier and more convenient has increased the social sanctions for disapproval.
- Financial interventions might change personal- and social norms in the long-run through individuals' experience of different consumption patterns. Although interventions are made temporary it might give long-term beneficial effects for the social planner if the tipping point is reached. But short-term financial interventions are political impossible. Also the social costs regarding unpredictable changes in relative prices will be significant. All in all the evaluations are too complex, too difficult, and efficiency costs are too high. The only exception would be if there were strong beliefs and evidence that the norms are already close to a tipping-point, which is difficult to imagine.
- Tipping points are extremely difficult to measure as there are no (Or only some few) statistics available. Locating these will be costly. Also norms are dynamic, so time-series analysis may give (If any) a very unsure prediction about tipping points. Although empirics may be used, the situation in whether a public intervention should be used will always be differentiated according to the specific situation.
- Given the pros and cons, a combination between fines and communication is the most efficient way to solve social problems.
- To target public interventions in an efficient way, with the purpose to make proenvironmental behavior, we need a higher level of collaboration between many disciplines. The Behavior of agents is complex, and the need of collaboration across disciplines is thus necessary to decrease the uncertainty of public interventions.
- We need a closer collaboration between scientists and politicians, to make politicians able to make the best and most efficient judgments at all time.

**There are five important ways to widen the usage of normbased economic evaluations, with the goal to decrease the uncertainty and increase the efficiency of public interventions.**

- Scientists should introduce disturbances in their models to mimic political processes. By doing so they can increase the level of timing of a public intervention.
- Deception in collective-action problems known as tragedy of the commons, as seen in prisoner's dilemma, provides incorrect descriptive norms. This may lower the capacity for social norms to emerge and persist. A research regarding this effect can therefore lower the uncertainty regarding effects of public interventions.
- Effects regarding public interventions will be more precise if they were adapted to present network structures. The spread of social norms, introduced by the I.T. revolution has changed dramatically, and is still changing due to introduction of new applications such as Instagram, Twitter, Facebook, Blogs ++.
- Many scientists are assuming absolute payoff, which contradicts the way people and even nations behave. The relationship between absolute versus relative payoffs has been neglected, exploring when and under what circumstances they prevail will be useful. That prevalence influences perceptions of fairness and adoption of cooperative strategies which are integrated parts of social norms. More precise knowledge of behavior and social norms would make it easier to target efficient public interventions.
- The knowledge of viscous and fluid norms and behaviors are insufficient. Knowledge could make more efficient timing.

**Agent-based Modeling in crime**

Maybe the biggest challenge in simulating crime can be considered the difficulty to capture the micro-level interactions in a social system, due the fact that many approaches currently used in this scope cannot introduce behavioral variables in such interactions. Qualitative studies that intend to suppress this conceptual deficiency generally suffer from a lack of rigorous empirical testing, due their samplings of small populations (Malleon; Heppenstall & See; 2009). In another way, the quantitative

studies work with a big amount of data and can't express the micro-level interactions and simulate the specific environments where crimes occur.

Thus, the agent-based modeling technique represents an advanced approach due its characteristic of working in the individual level. ABM permits a previous analysis of each policy against crime a government intends to introduce in the real system and even tests the different crime theories behind them. An efficient crime ABM is considered that one which can model the crime and the dynamics among space, time, and its motivations to occur. Malleson, Heppenstall and see point an important characteristic of this approach, which is that "Every agent must make decisions at every iteration which can lead to very large execution times".

ABM is useful not just for those who want to test crime prevention policies, but also for the experimentation of criminological ideas (case of this work, for example). Is interesting point the same that pointed Malleson, Heppenstall and See (2009): "Because this model is more advanced in other areas, the first challenge is to ensure that the dynamics are fully understood before increasing the complexity", what means that, although our simulation model of a market influenced by Mafia could be considered simple, it is a first step in understanding how it works, how the agents behave and how short-term policies could be reflected in a long-term pattern.

## Introducing human behavior in a model: the difference between BDI and PECS frameworks

There are two main modeling behaviors architecture: BDI and PECS.

BDI is the abbreviation to Beliefs-Desires-Intentions, which starts from the presupposition that the individuals always act rationally. Although it's widely used in simulation, it has been criticized due the fact that the core features are too difficult to be captured in a real situation, and then it has been considered as a "lab technique".

Anyway, BDI has the advantage to be a more practical approach, in the sense which assumes agents taking rational decisions in a contextual set. Then, the agents goals, and the environment conditions can be more precisely modeled, without too many subjective assumptions.

Padgham, Scerri, Jayatilleke and Hickmott do a simple explanation of how this architecture works: "BDI agents are programmed using goals (or events) representing

what the agent wants to achieve or respond to, which then trigger plans describing (possibly at an abstract level), different ways to achieve these goals.

Plans are then made up of sub-goals, which have associated plans, and actions. Agent beliefs are used to select which plan to instantiate in order to achieve a goal in a particular situation.”

This technique is very powerful, in the sense that can generate useful outputs and is capable to organize quite complex environments, by introducing a lot of variables and situations in their agents (the next architecture is useful in micro-interactions but has a “utility lack” in the construction of more complex models).

The other behavioral modeling technique, less utilized in practice, is the PECS, which is an abbreviation to Physical conditions, Emotional states, Cognitive capabilities and Social status. This framework does not require rational decision making, and can construct agents with individuals characteristics; thus, it’s considered an improvement to the BDI architecture. As point Schmidt and Urban: “The view of human beings as rational decision makers who are perfectly informed and maximize an exogenously given utility function turns out to be too restrictive. At the same time in psychology more complex theories about human behavior come into the foreground”.

PECS subdivides the behavior of an agent in reactive and deliberative. The reactive behaviors are those which are instinctive and don’t require any deliberation, like hungry or the survival instinct.

The deliberative behaviors are those more complex, that require judgment by the agent (rational or not). In the case of this work, the storeowners agents were constructed with deliberative behaviors, and they must decide in each interaction how deal with the mafious (in some aspect it can be quite similar to an agent created under the BDI approach), given some situations modeled by probabilistic features. The mafious and the cops turtles, on the other hand, were constructed under reactive behaviors, and they act quite similar in instinctive ways in their interactions.

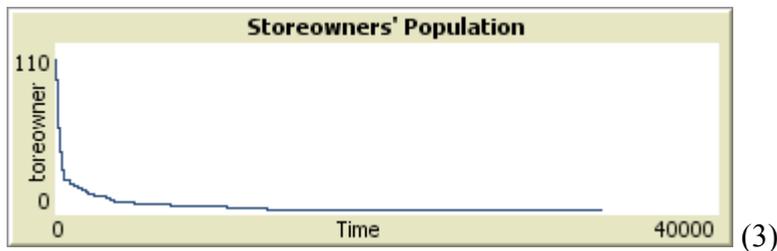
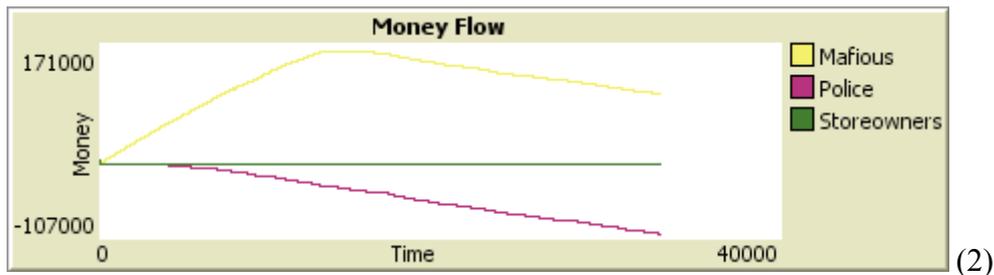
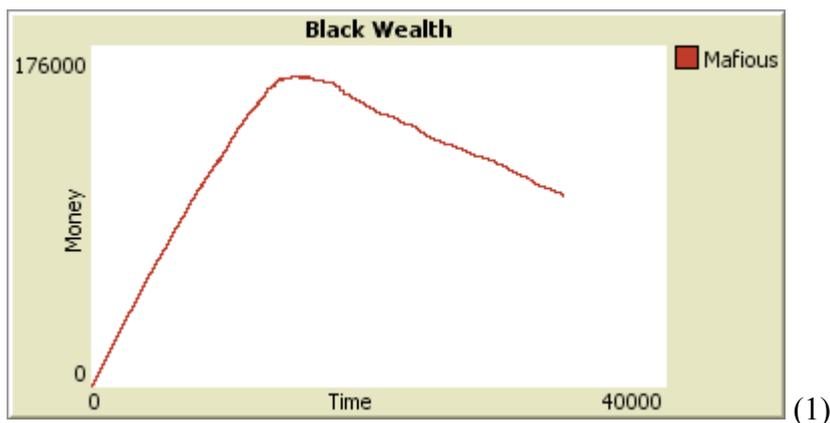
Although the model seems to be too much quantitative, in the way that the behavior is simulated under some probabilistic context assumptions, these probabilities and variables were constructed and their parameters were made according the Social Norms theoretical approach, which theory intends to show how short-term policies can affect a population behavior in a long term pattern, in the way that it suppose to enhance the common welfare.

## Model Experimentation

Four different contexts were chosen to simulate the behavior of the agents in a market influenced by Mafia, as follows:

- *Corruptible Police, Cheated Storeowner*

These graphs represent the context in which the storeowners accept plenary the social norms policy diffused by the government, but don't have neither the police protection nor its support.

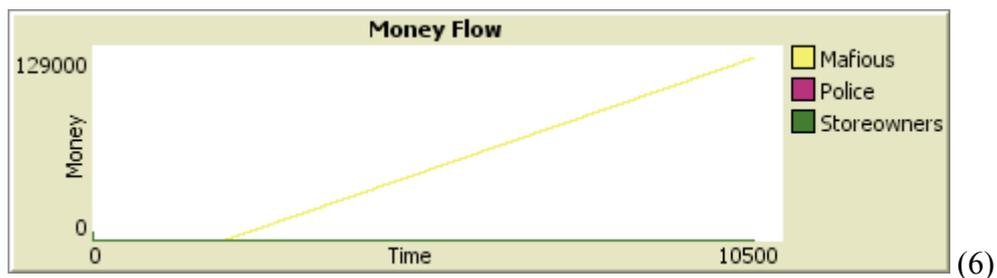
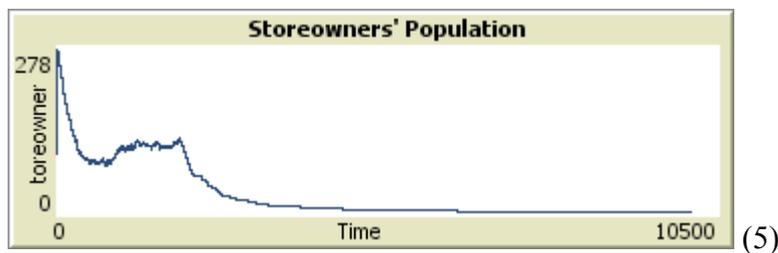
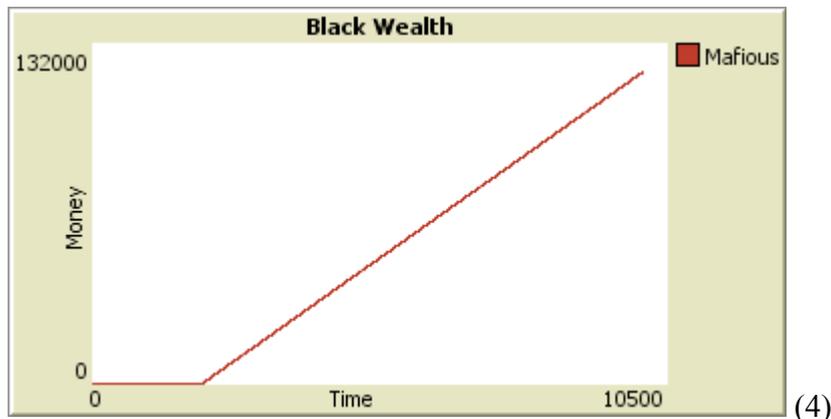


When police is corruptible, the money of Mafia increases through time (1) and it affects the storeowners profits and reduces the governments efficiency (2). We can see that the storeowners' population decreases severally. It means that the presence of Mafia in a market does not spur the join of new agents in it and affect their own gains. In a long-term pattern, the own Mafia wealth is affected. A kind of "black equilibrium" is reached, in which a little contingent of

storeowners keep in the market obtaining profits, and the Mafia wealth starts decreasing due this context adverse to the development of new activities.

- *Ethic government, incredulous storeowner*

These following graphs simulate an initial context, in which the government is ethical, the police fights against Mafia, but the storeowners aren't convinced of that yet and keep paying the pizzo.



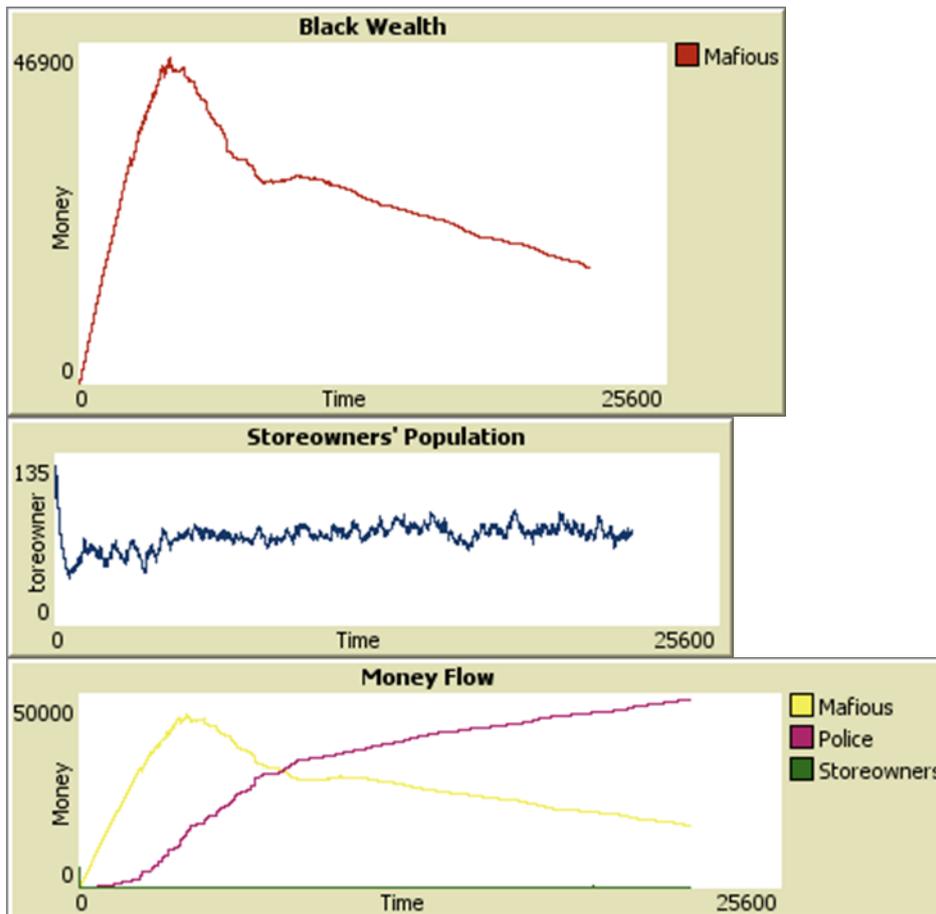
This case is even worse than the previous one. When the social norms policy is not effective, even if the government intentions are positive, the power of Mafia keeps increasing, and the same phenomenous of storeowners' population decreasing can be observed. It means that the social norm policy must be well constructed, in a way that really could change the behavior of the population, for the own welfare of this and for the market's development.

- *A temporary public intervention can change the long-term social norms and the outcome of black wealth. Growing black wealth, ethic police*

In this case we simulate a situation where the governments abilities to fight mafia is weak, but present, and the storeowners perception of the governments abilities to do so is also weak. The initial money of the cops is normal, but mafias have a larger initial endowment, to simulate an area with Mafia domaining the market. So storeowners will find the mafia community appealing and is willing to pay the mafia a share of his profits.

As the simulation starts, the black wealth will therefore increase. The amount of storeowners will be reduced as their profit in this mafia community is insufficient, until an amount of storeowners equilibrium is reached. Too much competition made storeowners with small(Zero) profit quit the market.

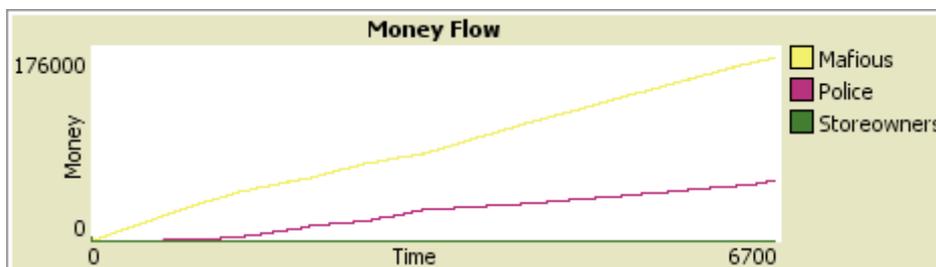
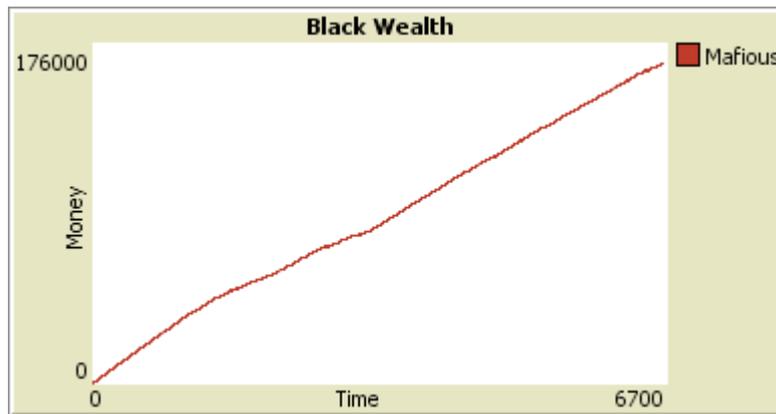
If the government is not satisfied with the tendencies in the economy, by doing some public interventions (Through changes in Storeowners-thrust-in-govs-ability-to-fight-mafia ), the storeowners will more often refuse to pay the mafia, which after some-time will result in a tipping point beeing reached where the governments abilities to fight the mafia, the storeowners perception of the governments abilities to do so, and police-power is larger than the mafia-power, so the tipping point for not paying the mafia a share of the profit is reached. The black wealth of the economy will thus decrease through a short-term change in social norms, induced by a short-term public intervention.



If a public intervention is made for a short period, the money of the mafia will decrease and the money of the cops will increase due to more storeowners refusing to pay the mafia.

When the short-term public intervention is over, represented as the slider storeowners-thrust-in-govs-ability-to-fight-mafia getting back to its initial position, the long-term social norms will now have changed so that black wealth will still decrease. The efficiency of this intervention is high. Same concept is valid for proenvironmental norms and behavior, and thus it's one of the most efficient ways to decrease the environmental damages.

- *The case in which governmental policy in affecting social norms will not affect the long term social norms*



People's belief of the governments' ability to fight crime and their ability to do so is present. Yet black wealth is increasing. The competition in the market ruled by the Mafia is too high, thus many storeowners will quit the market.

A public intervention decreases the growth rate of money for the mafious for the amount of time of the public intervention, and increases the growth rate of the money for the police. When the intervention expires the black wealth will continue to increase, and the government has not achieved any changes in long-term social norms. This can represent a situation where the benchmark is unknown and the government is trying to achieve it, but it turns out to be too costly, so it stops the intervention. This may be due to insufficient timing, size of the intervention, significant boomerang effects, lack of collaboration of disciplines to predict behavior, too high benchmark (If any), or lack of collaboration between scientists and politicians, which each will reduce the uncertainty of an intervention.

## Conclusions and suggestions for further research

The model is able to capture the core of the scientific paper about social norms: Changing social norms for a limited amount of time can make long-term effects in behavior to improve the efficiency of the economy and the environmental quality.

The relationship between the variables could be estimated and implemented in the model to make it more realistic, as a part of the syntax or as a slider according to uncertainty. The interaction between the agents could be more complex, storeowners could affect each other, and police could have interacted with the storeowners to check if their business was legal. The public interventions affecting social norms, here through storeowners-thrust-in-govs-ability-to-fight-mafia, could be separated into different types of expenditures in public interventions, norms management, regulations, financial interventions and changing architecture, to make it more suitable for real life. Then the storeowners' propensity to adapt these norms could be adjusted by a slider, to simulate different network structures and societies.

The most effective way to influence social norms is through information and fines. Anyway, they all work efficiently in specific situations. This knowledge should be exploited more comprehensive across countries.

The discipline is not established yet due to several lacks of scientific contributions. The lack of collaboration between scientists and politicians are crucial. Understanding the norms of behavior requires collaboration between several disciplines, which present is insufficient. All these points have to be improved, to establish this as an integrated part of economic science.

With this work, we perceived that the joint efforts between government and people can eliminate the problem of parallel powers. The simulations presented in the paper did suppose a stable economy. Other experimentations can be done stressing the variables, like simulating the interactions in a crisis context and in an optimist context, and we concluded that the economic context does not interfere in the effectiveness of the policies applied since they had be done serious and perfectly.

For further researches we can suggest the introduction of new behavioral variables and interactions among the agents, like introducing some kind of market competition among the storeowners, or even introducing a new probabilistic feature in which the mafious can corrupt the police endogenously, not like a global variable that could be

controlled by the user. Also the relationship between the variables could be estimated and implemented in the model to make it more realistic, as a part of the syntax or as a slider which can be adjusted according to different network structures. In this way we could improve the output results.