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Organized Crime and Economic Growth:

a System Dynamics Approach to a Socio-economic Issue

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Abstract

This paper describes the potential of system dynamics models to support policy decisions and macroeconomics strategies aimed at reducing the level of organized crime in a country and promoting further economic growth. A causal loop diagram will elicit the main links found between organized crime, investment safety expectations and economic growth. Additionally, it will suggest the need to focus the attention on what has been defined as the "risk fraction", that is unemployed people which constitute the recruitment base for crime organizations. This concept sets the groundwork for the main dynamic hypothesis of a system dynamics model. Central in the structure of the model is the attempt to identify the most relevant variables defining the "crime attractiveness", to emphasize a dynamic conceptualization of "risk fraction", and to suggest alternative ways to quantify and evaluate the effectiveness of various socio-economic policies.

KEYWORDS: organized crime, perceived investment safety, public policy, crime attractiveness, system dynamics, risk fraction, economic growth

Introduction

One of the major problems that most modern countries face today is organized crime;[1] its effects on a society are pervasive. They allow drugs to be sold in schools and seduce the poor with easier illegal incomes. The inside battles for power in this underground society and its continuous fight with the authorities are amplified by the media decreasing the country's level of perceived safety for investors.

Specifically, organized crime greatly slows down the economic growth of a country. In countries characterized by high corruption, a large portion of public investment will be consumed by criminal organizations, resulting in deficient public services and infrastructure which will lower the general competitiveness of the country and will fail in creating the expected employment. Crime organizations such as the "Mafia" will finance their illegal activities (drugs, weapons, and alcohol) by requiring "protection" payments from private businesses. They will also launder their illegal incomes by starting private businesses characterized by high capital intensity (trucking, construction, etc.) which will not operate according to the same rules as their competitors (no financial constraints, profitability is not required, etc.) and will hence lower the profits of those

[1] Organized crime has had different definitions depending on the time and socio-economic area in which the phenomenon has been analysed. While the concepts that will be developed in this paper do not require one clear

industries. Organized crime will lower the propensity of existing companies to reinvest their profits in the same sector (if not force them to leave) and will create an eroding goal situation where local firms will find it more convenient to stay small. Also, organized crime significantly hinders the ability of a country to attract international investments, further decreasing employment opportunities [1].

Among these effects, a minimum common denominator may be identified in the expected future safety of the investment environment. There is a clear link between the presence of criminal organizations in a country, the safety expected by the business community and the amount of investments made in the country. This relationship is well known to public policy makers; however, in many countries policies implemented to defeat criminal organizations have shown little effect and the low investment level constitutes a serious obstacle to their economic development [2].

This paper will suggest the structural factors that allow organized crime to survive and even prosper in certain societies and, through hypotheses that will need to be further discussed and validated, will show the potential of system dynamics models to support policy makers in setting objectives and strategies to combat organized crime.

definition, a large literature has been developed on this issue [see Schelling, T., 1984 *Choice and consequence. Perspectives of an Errant Economist.* Harvard University Press, Cambridge, (Ma) *at all.*].

Developing a causal loop diagram

An intuitive diagram

With a great deal of simplification, the traditional mental model that drives the decisions made in the public safety sector is summarized in the causal loop diagram showed in Figure 1:

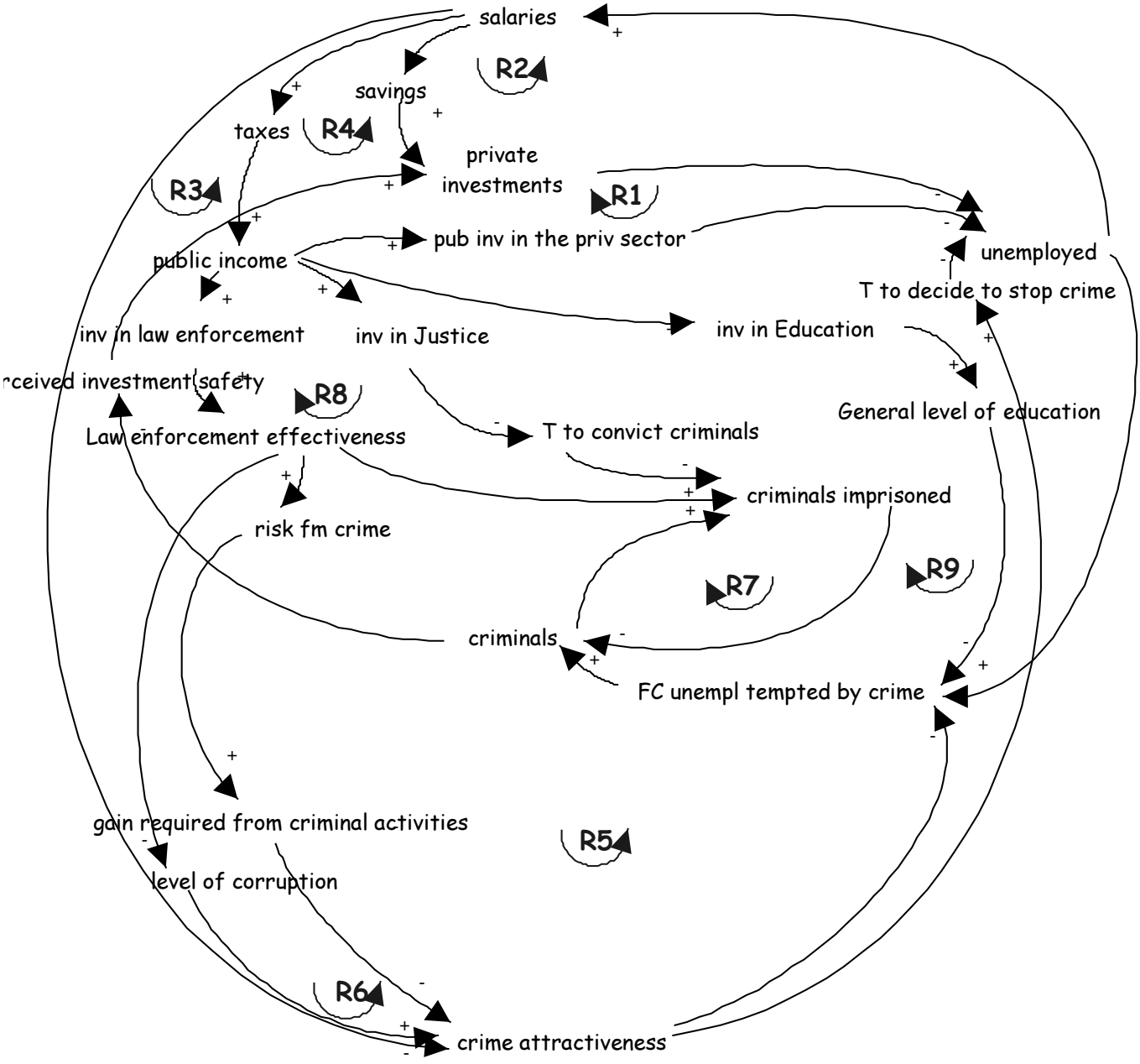


Figure 1 – An intuitive causal loop diagram

The diagram clearly reflects a mental model dominated by reinforcing loops, which will now be described in greater detail.
There are three reinforcing loops driven by increasing private investments made in a country:

R1) more investments => less unemployed => less unemployed tempted by crime => less criminals => higher perceived investment safety => more investments

R2) more investments => less unemployed => higher salaries => more savings => more investments

R3) more investments => less unemployed => higher salaries => less crime attractiveness => less criminals => higher safety perceived => more investments

Possible policies against organized crime also have reinforcing effects on the above loops, however they constitute reinforcing loops themselves as described below:

Government investments in the private sector:

Government investments in the private sector represent public money allocations aimed to finance new investments, mainly in infrastructures. Besides the mid term benefits deriving from better infrastructure in a country (e.g. higher business efficiency and hence higher attractiveness for new businesses), these initiatives determine a sudden creation of new jobs, hence so reinforcing the R1, R2 and R3 loops, and generating the R4 reinforcing loop:

R4) more public income invested in the private sector => less unemployment => higher salaries => higher income from taxes => higher public income => more public income invested in the private sector

Investments in the law enforcement system:

Investments in the law enforcement system traditionally consist of higher salaries, higher hiring rate, better training, more research and development of new technologies aimed at increasing the effectiveness of investigations. The reinforcing loops showed in the diagram are:

R5) more public income invested in the law enforcement system => higher police effectiveness => higher risk perceived from criminal activity => higher gain required from criminal activities => lower crime attractiveness => lower fraction of unemployed tempted by crime

=> less criminals => higher perceived investment safety => more investments => less unemployed => higher salaries => higher income from taxes => higher public income => more public income invested in the law enforcement system

R6) more public income invested in the law enforcement system => higher law enforcement effectiveness => lower level of corruption => lower crime attractiveness => lower fraction of unemployed tempted by crime => less criminals => higher perceived investment safety => more investments => less unemployed => higher salaries => higher income from taxes => higher public income => more public income invested in the law enforcement system

R7) more public income invested in the law enforcement system => higher police effectiveness => more criminals imprisoned => less criminals => higher perceived investment safety => more investments => less unemployed => higher salaries => higher income from taxes => higher public income => more public income invested in the law enforcement system

Investments in the justice system:

Investments in the justice system consist of all kinds of investments (both in human resources and new technologies) aimed to increase the justice system's efficiency. While this efficiency could be viewed both in terms of ability to identify the guilty and in terms of higher speed, only the latter will be taken into consideration.

The intuitive reinforcing loop generated by a more efficient justice system is:

R8) more public income invested in the justice system => less time required to convict criminals => more criminals imprisoned => less criminals => higher perceived investment safety => more investments => less unemployed => higher salaries => higher income from taxes => higher public income => more public income invested in the justice system

Investments in the education system:

Are represented by annual public expenditures such as higher salaries for public school teachers, more scholarships, lower university taxes and alternative policies to increase the level of elementary education in a country (e.g. financial incentives to poorer families to encourage them to send their children to school, which could be determined by the children's grades). A fraction of these expenditures could also be invested in technologies, libraries, etc.

The reinforcing loop generated by such investments has been described as:

R9) more public income invested in the education system => higher general level of education => lower fraction of unemployed tempted by crime => less criminals => higher perceived investment safety => more investments => less unemployed => higher salaries => higher income from taxes => higher public income => more public income invested in the education system

A more complex and dynamic view

The following considerations will explain the necessity of a more thoughtful description of the system, explain why a more complete evaluation and quantification of the effects that a policy has on a society needs to go through the concept of delays and feedback loop dominance, thus justifying the introduction of a system dynamics methodology.

- A causal loop understanding of this complex system could be useless or even misleading if it is not followed by an accurate quantitative analysis; in fact, the number of reinforcing loops generated by each policy does not necessarily reflect its strength and effectiveness.
- In order to better evaluate the consequences of a certain policy on the system it is necessary to search for eventual balancing loops and take them into proper consideration. Some are fairly easy to identify and are often considered unavoidable side effects (e.g., every society has a certain level of corruption, a clear obstacle to the efficient allocation of public finances), while others are less clear, sometimes counterintuitive, and often linked to a long term perspective.
- The above mentioned policies do not necessarily show their effects right after their implementation, and these effects may have a different short, medium and long term strength and intensity.

Consistent with the above considerations, the remaining part of this paragraph will describe some "missing" loops that have been found and implemented in a system dynamics model. Figure 2 is a direct consequence of the *rent-seeking* strategies that often characterize criminal organizations [5]. Figures 3a and 3b show the long-term effects of policies based on repression and punishment, and portray the partial inability of such policies to determine structural changes in a society. Figure 4 shows one long term effect of higher investments in education (B6), but also describes the reinforcing loops determined by the effects on what has been defined *embeddedness* [6], as it will be better explained in other parts of this paper (see page 16).

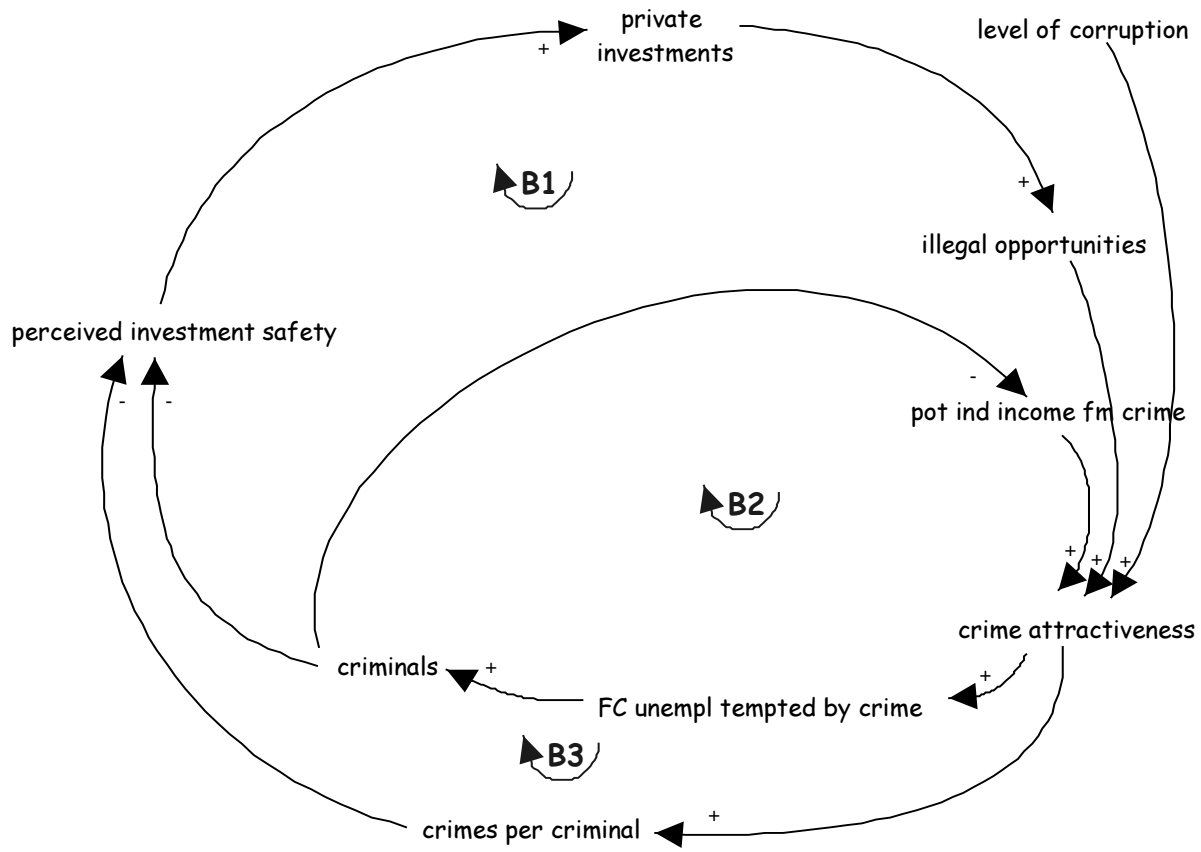


Figure 2 – Consequences of the rent-seeking organized crime strategies

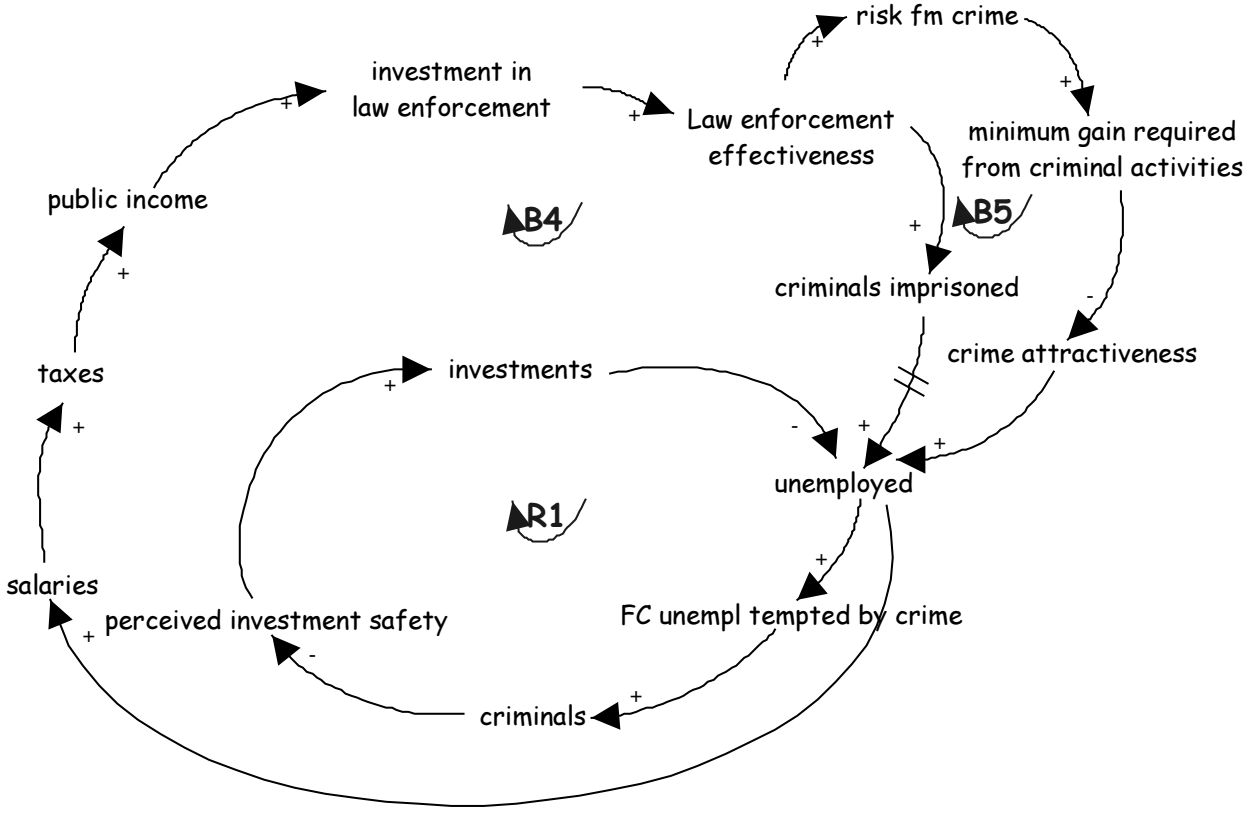


Figure 3a - Long term effects in the law enforcement system

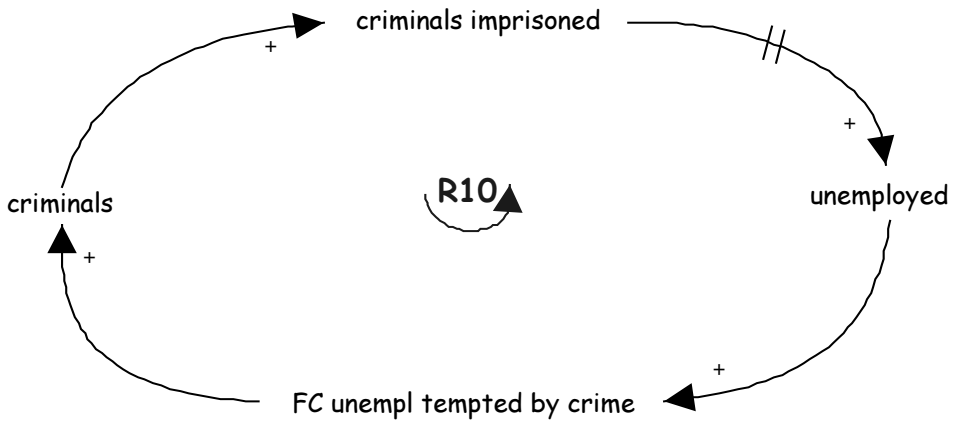


Figure 3b – Long term effects in the justice system

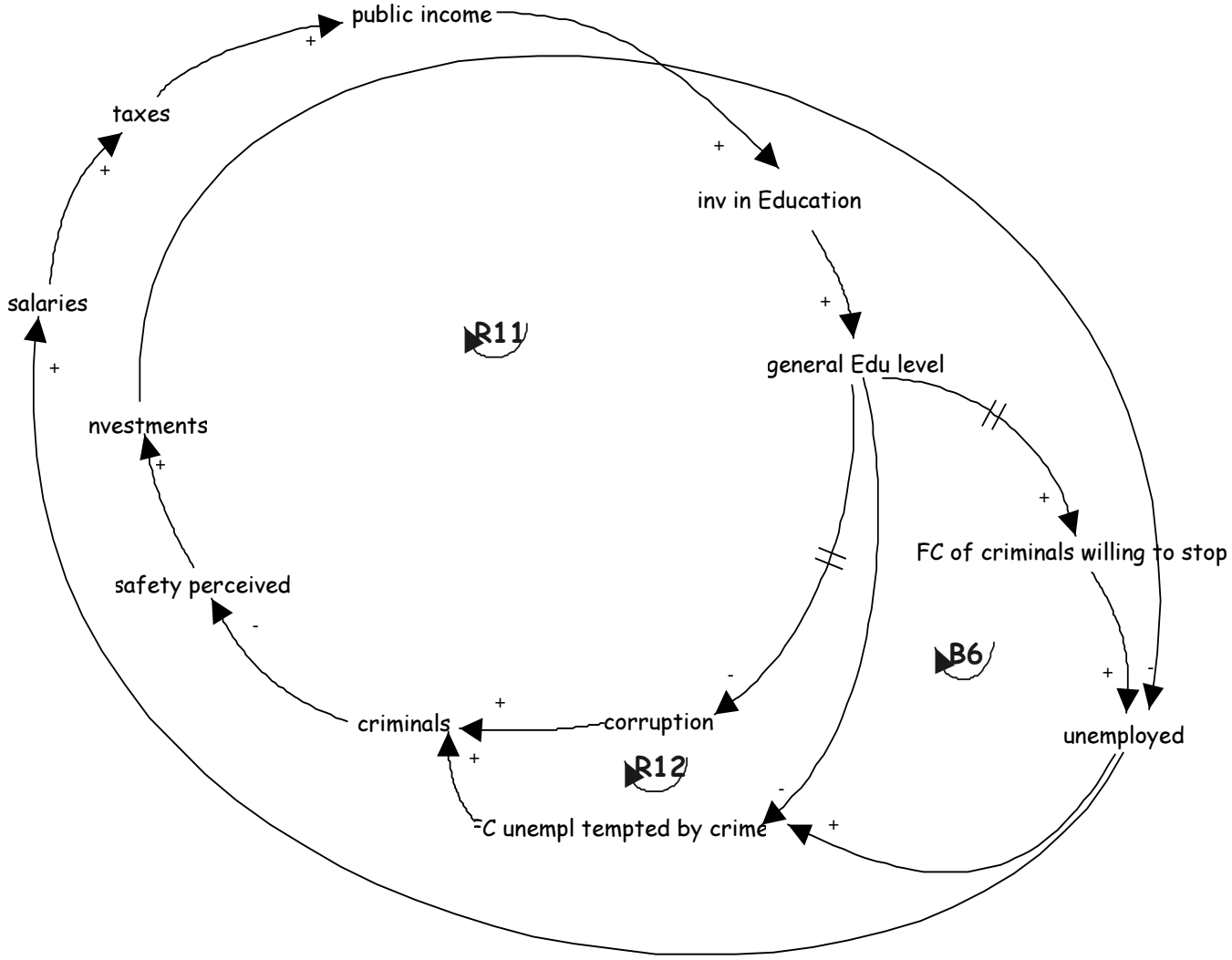


Figure 4 – Effects of investments in the education system on the level of organized crime's embeddedness in a society

As the diagrams show, each policy has a different impact on “crime attractiveness” and generates balancing loops in the system through what has been defined “Fraction of unemployed tempted by crime” and “Fraction of criminals willing to stop”. Both categories constitute what will be defined in the rest of this paper as the “risk fraction”, whose conceptualization becomes central for a correct evaluation and implementation of the feedback loop diagram in a system dynamics model and the formulation of its dynamic hypotheses.

The following pages will focus on this concept and on its implementation in a system dynamics model.

A dynamic hypothesis: the risk fraction

The concept of the risk fraction originates from the long ago observed existence of an *underworld* and an *upperworld* in almost every society [3]. In system dynamics terms it could be inferred that, in most societies, there is a continuous flow between unemployed and criminals, as well as there are irreducible criminals and there are unemployed whose ethics will prevent them to commit illegal actions.

What is left is therefore a fraction of unemployed and a fraction of criminals, people that are currently unemployed and can choose between searching for employment and what has been defined as the *criminal option* [4]. This fraction constitutes the recruitment base for crime organizations, and can determine their strength and presence in a given society.

As such, the risk fraction can greatly influence the safety perceived by potential investors and the potential growth of a country, hence assuming a central role.

Furthermore, in a simplified setting where there is no direct flow between workforce and criminals, there is no in and out migration, and no other forms of criminality are taken into consideration, the dynamics of this risk fraction set the basis for the dynamic hypothesis of the model.

Using a system dynamics perspective, the fraction of unemployed tempted to commit criminal actions is influenced by variables such as the unemployment rate, the average cultural level of the society, the availability of opportunities to commit crime (which depends on the level of corruption of the society and the economic growth of the country). The size of this fraction as well as the time that it will take to actually become an inflow into the stock of criminals depend on the attractiveness of the potential income deriving from illegal actions compared to other income opportunities and discounted by the gain expected from crime which depends on the risk perceived. Similar thoughts can be formulated for the fraction of people abandoning the criminal lifestyle.

Is it possible to identify and quantify this fraction in a society? If yes, how homogeneous is it? In other words, would it be correct to generalize the causes that determine its size and determine its changes in a society?

System dynamics cannot answer these questions. But while the validity of the hypotheses developed in this paper greatly depends on these answers, a system dynamics approach can greatly contribute to a more profound understanding of its dynamics and of its socio-economic consequences. Lets assume that it is indeed possible to identify this fraction and generalize its dynamics: the next paragraph will then describe one way in which this fraction could be "scanned" using a system dynamics perspective.

Defining crime attractiveness and modeling the risk fraction

Figure 5 shows the role and meaning of "crime attractiveness" as is intended in this work.

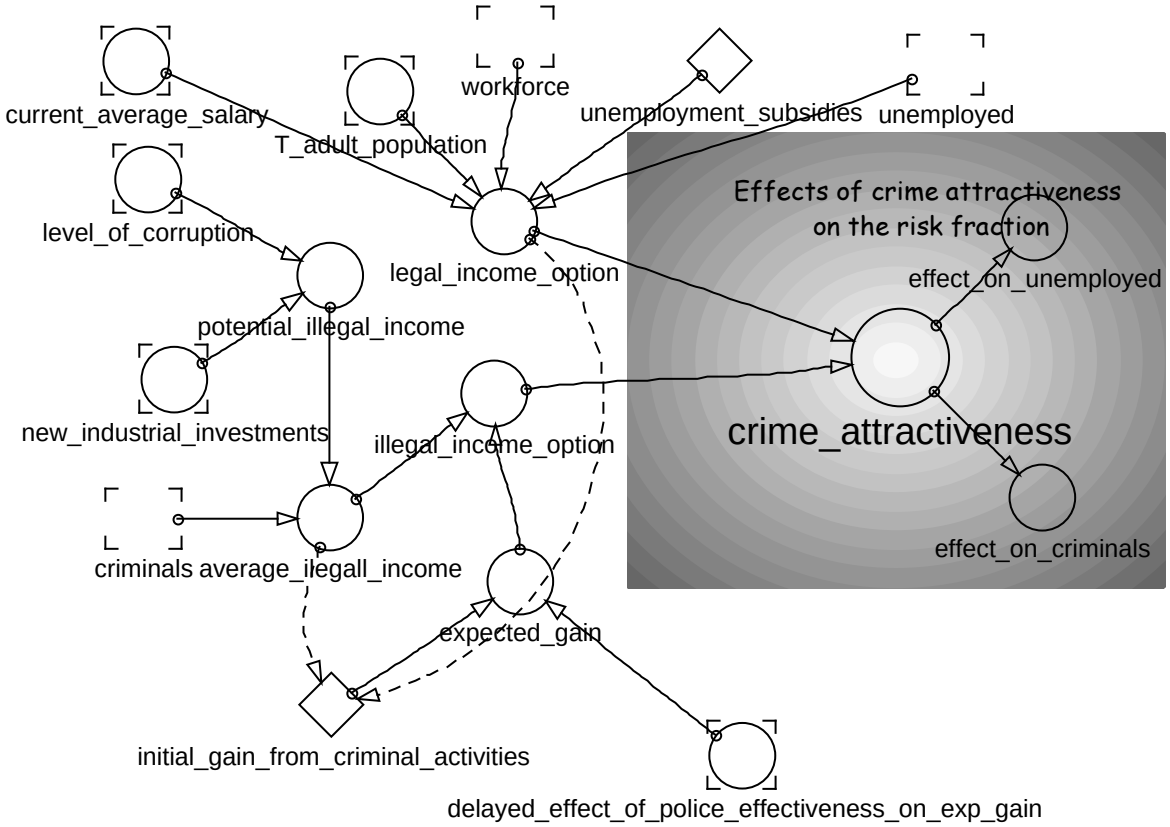


Figure 5 – The crime attractiveness sector of the system dynamics model

The main variables are:

Crime attractiveness

units dimensionless

aux crime attractiveness = discounted average criminal income/average income option

doc crime attractiveness depends on the potential income deriving from illegal activities discounted by the risk of crime and compared to a weighted average of the average legal salary and the unemployment subsidies.

Criminal income option

Units $ per person per month

aux criminal income option = average potential illegal income/required gain from criminal activities

doc criminal income option represents the potential individual illegal income discounted by the perceived risk deriving from criminal activities.

Gain required from criminal activities

Units dimensionless

aux gain required from criminal activities = delayed effect of law enforcement effectiveness on the gain required from criminal activity * reference gain required from criminal activities

doc gain required from criminal activities is the gain required from criminal activities represents the multiple of average legal income required to compensate for the risk involved in the crime, causing one to choose criminal activity over legal employment. It can be influenced by the law enforcement effectiveness. It is assumed that stronger penalties will not have a relevant influence on the risk perceived and hence on the gain required.

Average illegal income

Units $ per person per month

aux average illegal income = potential illegal incomes / (1+criminals)

doc average illegal income is the fraction of the potential illegal incomes divided by the number of criminals determines the individual average illegal income of the average criminal enrolled in a criminal organization. Under extreme conditions, if there are no criminals we must assume that the entire fraction represents the potential income and can therefore attract new criminals into the system.

Potential illegal income

Units $ per month

aux potential illegal incomes = new industrial investments * corruption

doc potential illegal incomes represent the fraction of new investments that could potentially become a source of illegal revenues for criminal organizations. The higher the corruption is in a country, the higher this fraction will be. No corruption means that no fraction of the capital accumulated in a region can be "taken away" by criminal organizations. Many criminal organizations drain money from private businesses to finance their illegal activities. In this microworld, no corruption would also mean no more drainage, hence no financial resources, no profitability for organized crime and, ultimately, no organized crime.

Legal income option

Units $ per month per person

aux legal income option = (unemployed * unemployment subsidies + current average salaries * workforce) / Total adult population

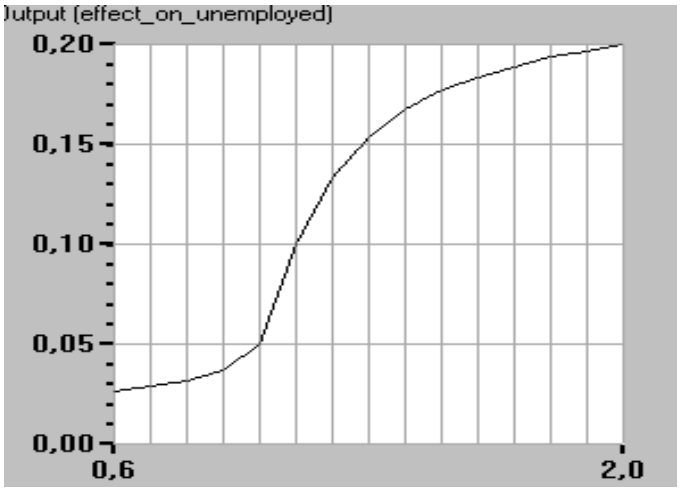
doc legal income option represents a synthetic indicator of the potential salary available to an unemployed as an alternative option to an illegal “career”. It is calculated as a weighted average of the unemployment benefits and the salary available with a normal job: the unemployment rate represents the probability (hence the weight) to earn either one.

Effects of crime attractiveness on the risk fraction

a) Effect on unemployed

aux effect on unemployed = GRAPH

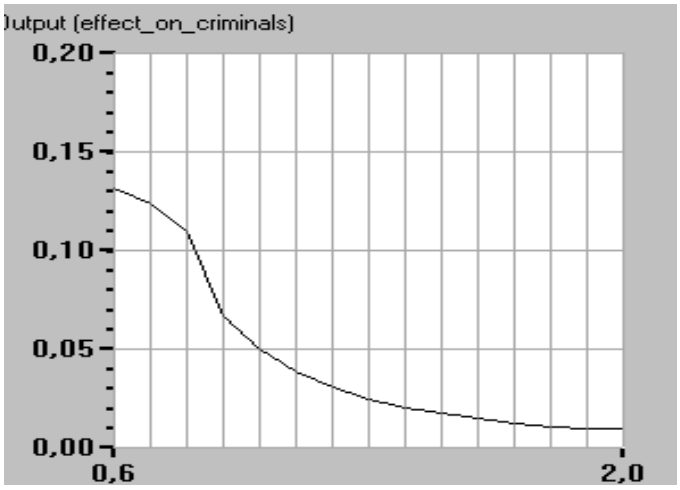
doc effect on unemployed is the effect of crime attractiveness on the fraction of unemployed tempted by crime as described by the graph below. When attractiveness is 1, a 5 % of the total unemployed will be tempted by crime. This fraction will sensibly grow as the attractiveness increases above its reference value of 1 and will be less sensitive to attractiveness changes below 1. Under extreme crime attractiveness values, it is assumed that a maximum 20% of unemployed will consider the possibility of joining organized crime; on the other hand a minimum 3 % approx. will continue to be tempted by organized crime even when its attractiveness is very low (in other words, it is assumed that there will always be a small percentage of unemployed that for various reasons will join organized crime regardless the fact that the crime option is not attractive: people generally are not as rational, and one can only model the way "most" of the people behave under normal circumstances).



b) Effect on criminals

aux effect on criminals = GRAPH

doc effect on criminals originates from the hypothesis that, at any moment in time, there is a certain fraction of criminals who, for various reasons, chose to stop committing crime and will enter the stock of unemployed. The way this fraction responds to changes of crime attractiveness is described by the curve below; when attractiveness of crime is 1, 5 % of the criminals is assumed to stop crime; this percentage increases and saturates at approximately 13 % when attractiveness is very low, meaning that crime attractiveness has a weak influence on the percentage of criminals choosing to stop crime. This percentage will decrease to a minimum of approximately 1 % if crime attractiveness reaches very high values.



As stated in other parts of this paper, lack of empirical evidence does not allow to verify the hypotheses behind the described effects. The main purpose is to evaluate their effects on the system and to create a basis for further discussions and research in the field.

Figure 6 below gives an overview of how the “risk fraction” has been represented.

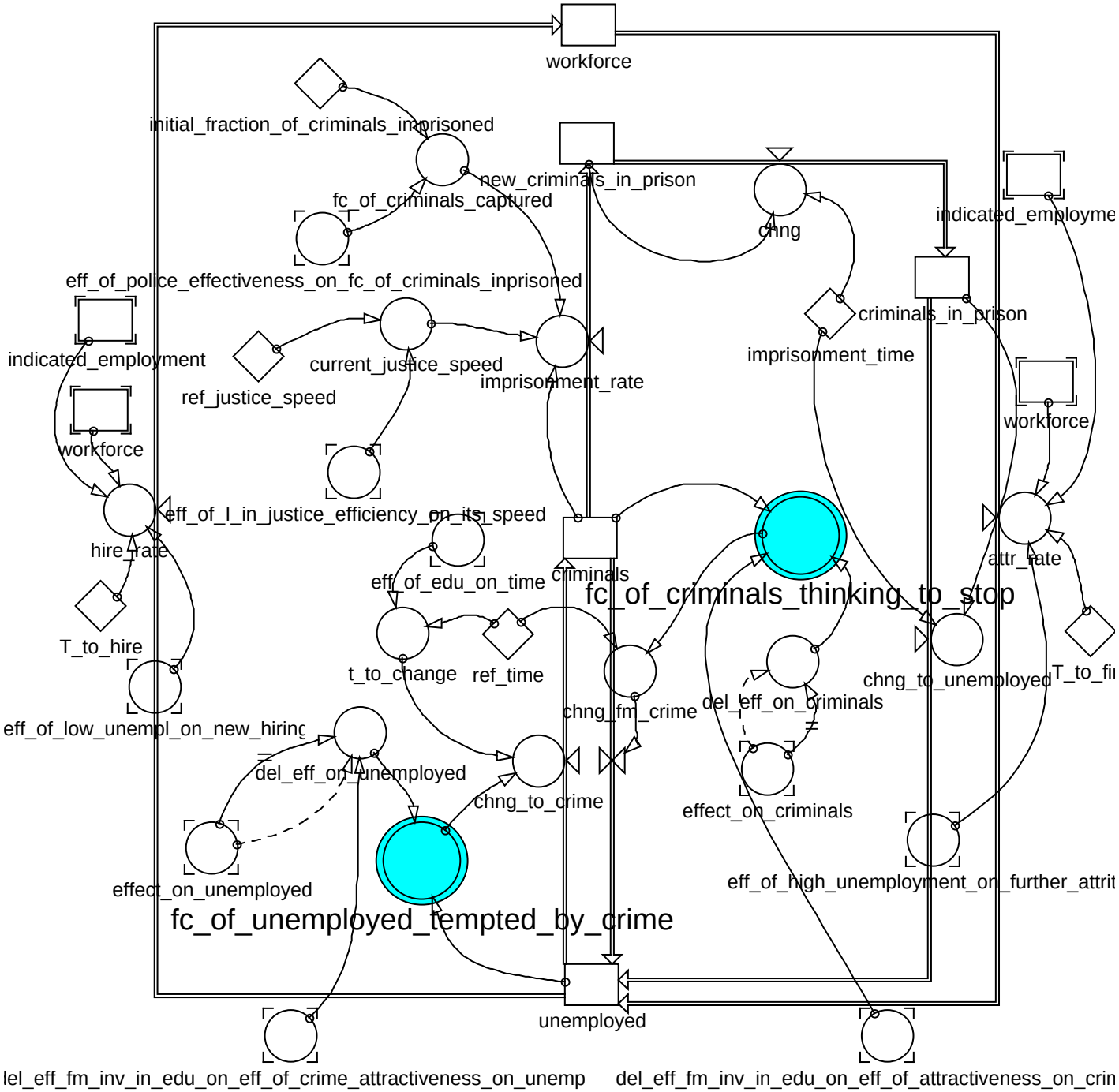


Figure 6 – Modeling the risk fraction

Alternative measures of policies effectiveness

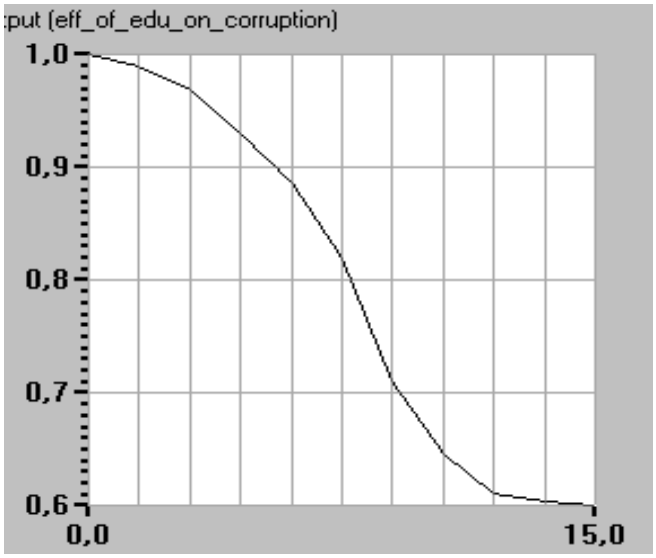
Using a system dynamics perspective and according to the definition of crime attractiveness and risk fraction that has been described, the effectiveness of the various policies, hence their ability to deplete the stock of criminals and allow the economic system to grow, depends on how they influence these variables over time.
The causal loop diagram previously developed describes some of the effects that additional investments in the education, justice and law enforcement have on the entire system. The effects that have been taken into consideration are:

Effect of investments in education on corruption
Effect of investments in education on time to become criminal
Effects of investments in education on the risk fraction
Effect of investments in law enforcement on corruption
Effect of investments in law enforcement on gain required from illegal activities
Effect of investments in law enforcement on criminals imprisoned
Effect of investments in the justice system on its speed

Each one of these effects raises questions and concerns regarding their estimation and quantification. Those effects that have been found most pertinent and may stimulate interesting discussion will now be described in detail.

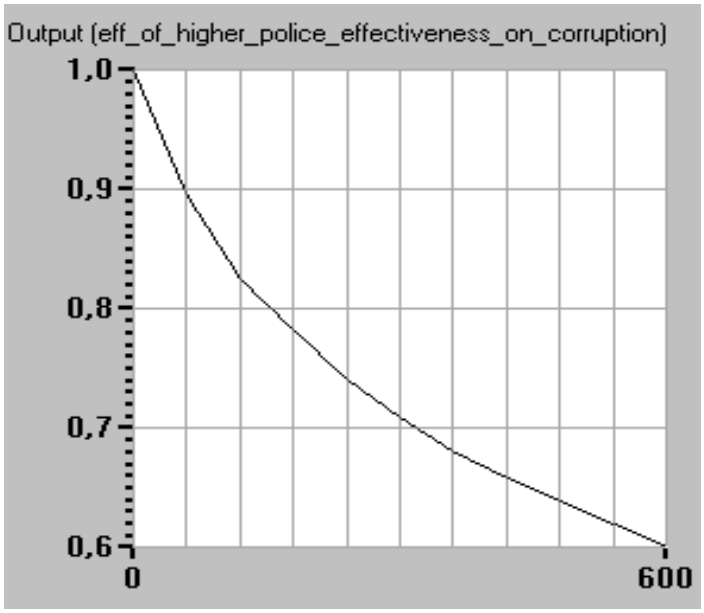
1) Effect of education on corruption

The assumption underlying the curve below is that a policy aimed at increasing the level of general education will create a better society where corruption will be much less accepted and business owners will generally be more reluctant to comply with requests for money from organized crime organizations. The curve describing these effects is a mere hypothesis. It implies that, regardless of the efforts concentrating on an education policy, 40% of corruption can be eliminated in this fashion. It can be reasonably inferred that a policy focused on higher general education will start to influence the level of corruption of a society only when younger generations will become part of the workforce. This delayed effect is simulated through a third order information delay with a ten-year adjustment time.



2) Effect of law enforcement on corruption

The function relies on the assumption that higher technologies available to the police can significantly help reduce the level of corruption. Initial additional efforts result in remarkable decreases in the corruption level, but as corruption decreases it becomes more and more difficult to eliminate the remaining layers of corruption. The model assumes that only 50% of corruption can be eliminated through police investigations.

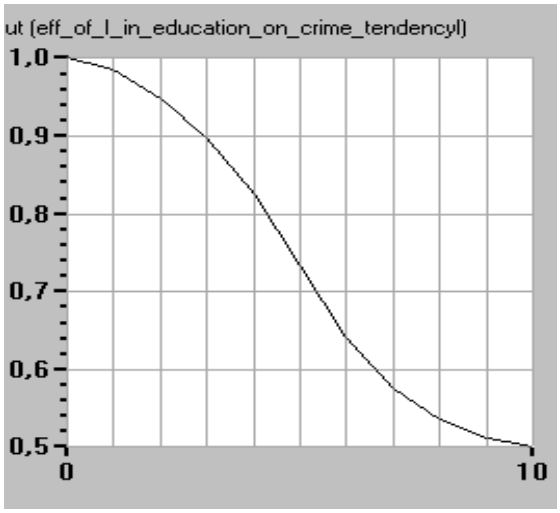


3) Effects of education on the risk fraction.

As previously shown (see R11 and R12 loops at page 8) a high level of investments in education in a society has positive long term effects on its shared values, and contributes to decrease the level of embeddedness of criminal organizations. In fact, the embeddedness does not represent here those values able to promote the competition and co-operation which set the basis of the social structure of a market, hence becoming a basic ingredient in the process of development of any society. In this context it indicates a perverse mechanism that almost makes a criminal option appear socially acceptable and that promotes rent-seeking behaviors, legitimizing protection, violence and even certain forms of racketeering [7]. The more organized crime is embedded in a society, the less traditional policies to contrast crime will prove to be effective.

a) Effect of education on unemployed

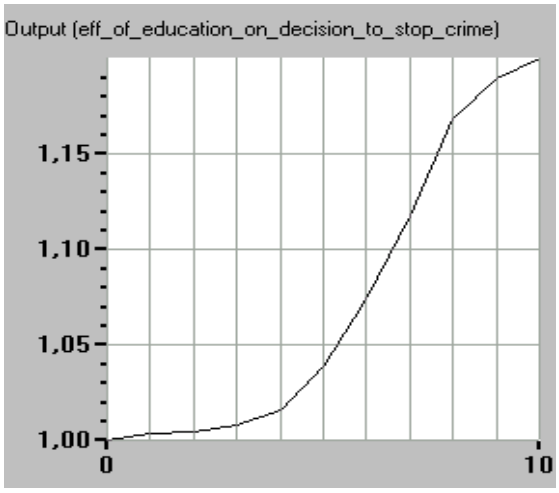
The assumption in the model is that, ceteris paribus, the higher the cultural level of a country the lower the crime attractiveness will be. It is assumed that 50% of the fraction of unemployed tempted by crime can be prevented from deciding to actually become criminal when maximum effort is put on this policy. Initial efforts will results in encouraging results, but as the policy is implemented increasing marginal efforts need to be put in order to achieve remarkable results: we get close to the fraction of unemployed tempted by crime that cannot be reached or influenced by this policy.



The delay between the implementation of such a policy and its impact on society has been modeled as a third order, with a five-year adjustment time.

b) Effects of education on criminals

Investments in the education system can also influence the fraction of criminals that could stop crime. Here the effect is more subtle, and is also less remarkable that the effect on unemployed. It is easier to prevent an unemployed person from starting crime than to convince a criminal to abandon crime. In this respect, investments in the education system are not very efficient. Higher investments in this sector will probably not change the ethical values of a criminal. A general increase in the level of culture and education, in other words a higher civil awareness in the poorest classes of our society, could nonetheless influence the decision of a criminal to stop crime when less opportunities are available. It takes a remarkable financial effort for an extended period of time to achieve meaningful results. The curve is hence sensitive to high levels of financial resources invested in this policy; it is assumed that a maximum 20% of the fraction can successfully be forced out of it through this policy. It is hence assigned a maximum value of 1,2 to this curve.



Building civil awareness is a process that takes generations, therefore this effect has been modeled as a third order information delay with a 25-year adjustment time.

Policy evaluation

Given the above described assumptions and hypotheses, different policies have been evaluated through their impact on the microworld that has been portrayed. The outcome of the simulations that will be shown very much depends on the shape of the curves, however some indications and learning can be inferred also at this early stage of development.

The results have been evaluated in the model through an “instant welfare indicator”, a synthetic socio-economic score-keeping indicator which grows as the economy grows and decreases as the level of crime increases. It has been calculated as follows:

(industrial investments + investments from savings + consumption)/relative number of crimes,
where
relative number of crimes = number of crimes / reference number of crimes.

Time is measured in months and when each simulation starts the instant welfare indicator equals 158.

Simulation 1 portrays the base behavior, where no additional investment in either sector is made. The model endogenously generates the financial resources available for each policy; they result from the taxation of the average salaries earned by the workforce. It is assumed that each policy utilizes 100% of the available resources.

Figure 7 shows the changes of the instant welfare indicator over an 800 month (67 years approximately) time horizon as a consequence of each policy implemented, while Table 1 summarizes the results.

The policies have been indicated with the following indications:

I: additional investments in Infrastructure

L: additional investments in the Law enforcement system

E: additional investments in the Education system

J: additional investments in the Justice system

Sim.	Policies mixes over time % I – E – L – J				Score
	Time 0	Time 200	Time 400	Time 600	
1	0 – 0 – 0 – 0	0 – 0 – 0 – 0	0 – 0 – 0 – 0	0 – 0 – 0 – 0	190
2	1 – 0 – 0 – 0	1 – 0 – 0 – 0	1 – 0 – 0 – 0	1 – 0 – 0 – 0	176
3	0 – 1 – 0 – 0	0 – 1 – 0 – 0	0 – 1 – 0 – 0	0 – 1 – 0 – 0	199
4	0 – 0 – 1 – 0	0 – 0 – 1 – 0	0 – 0 – 1 – 0	0 – 0 – 1 – 0	200
5	0 – 0 – 0 – 1	0 – 0 – 0 – 1	0 – 0 – 0 – 1	0 – 0 – 0 – 1	187
6	0 – 0,5 – 0,3 – 0,2	0 – 0,5 – 0,3 – 0,2	0 – 0,5 – 0,3 – 0,2	0 – 0,5 – 0,3 – 0,2	576
7	0 – 0,7 – 0,2 – 0,1	0,1 – 0,6 – 0,2 – 0,1	0,2 – 0,4 – 0,3 – 0,1	0,3 – 0,3 – 0,3 – 0,1	724

Table 1 – Policies specification

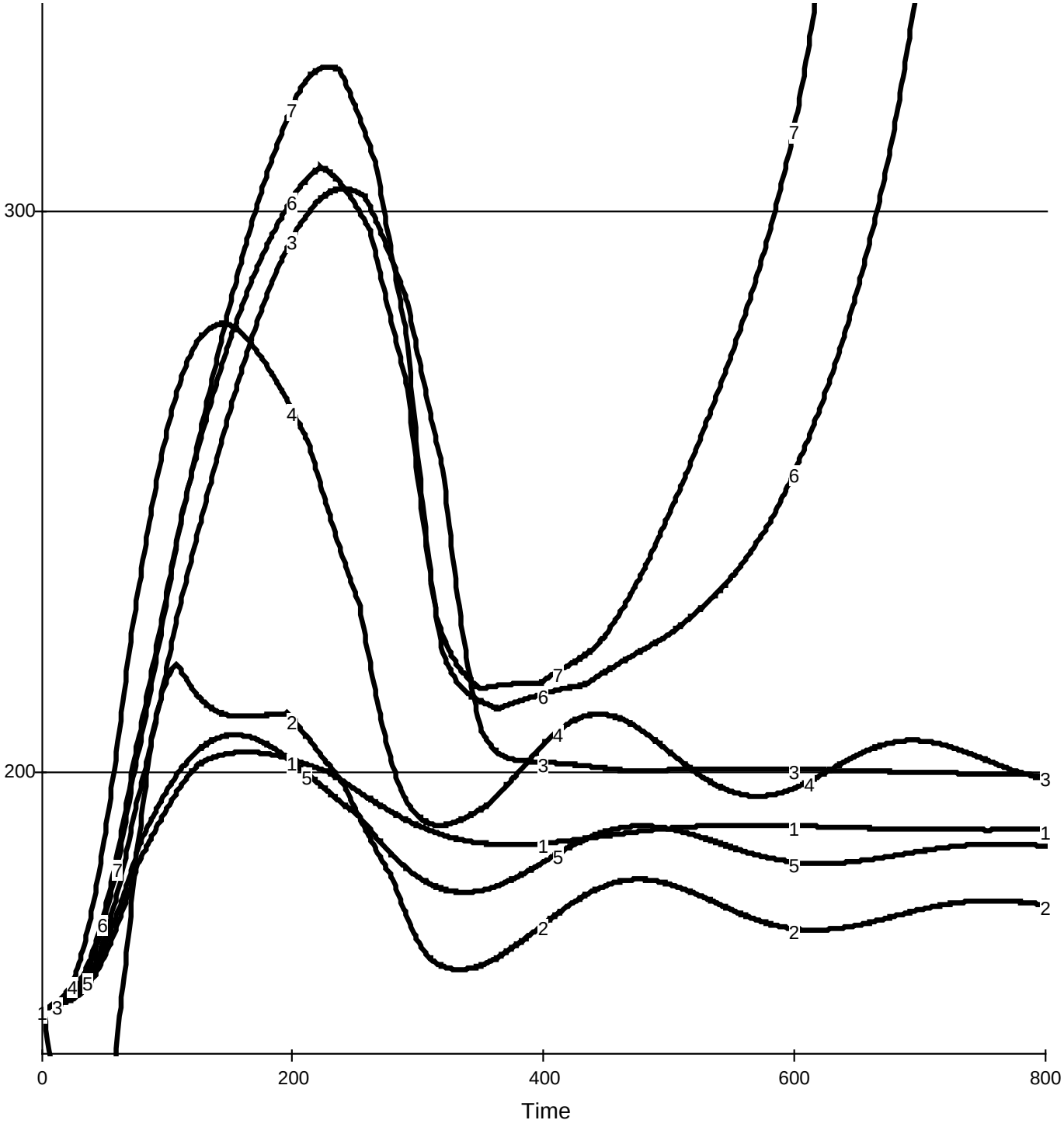


Figure 7 – Welfare indicator responses to policies

The results showed in figure 7 suggest that in the long run, after a transient behavior due to the initial conditions, the system finds its own equilibrium. In addition to this, the other runs suggest that various policies most likely have a destabilizing effect on the system or, as in Simulation 3, will stabilize it at a slightly higher level. Finally, Simulation 7 suggests that the most effective results are products of a profound understanding of the dynamics of the environment in which they are implemented and by the ability of policy makers to correctly change their strategies over time.

Conclusions

This paper suggests that system dynamics modeling has much to offer the field of political economy and that it can be a powerful tool to help policy makers understand the role of feedback in complex dynamic systems, quantify their effects in a social environment and choose the most effective policies over time. Each effect described in the paper underlines hypotheses that need to be validated and that raise questions which have not been answered or even sufficiently explored. From this respect, this paper has ventured to prove once again the vast potential for system dynamics methods to communicate ideas, compare views, and stir thinking.

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