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MODELING GOVERNMENT INVESTMENT AND PERFORMANCE IN PUBLIC SECURITY

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ABSTRACT

Governments have tried to implement budget methods like PPBS (Planning Programming Budgeting System), ZBB (Zero Base Budget) and RBB (Results Based Budgeting) for decades. However, in practice budgeting has been mostly incremental in most areas, and the results obtained have seldom been linked to the investment made years before. This paper tries to create models to make the investment more rational and proactive and less based on political pressures and results guessing.

The public policy selected for this study is the public security.

Two models are created to study this public policy under the modelling method.

The first model is a simulator and its focus is on four crime rates with reasonable data and studies: homicide (murder), robbery, burglary and motor vehicle theft. These variables are normally used to determine government performance in the public sector.

Initially the study surveys the literature for which factors have evidence that affect these crime rates, and them builds a model on how the investment of the public sector will affect these variables during a period that may be a budget cycle of one year or longer. Some of the factors found to be relevant include hiring more policemen, increasing inmate population, street lightning, drug consumption by population, abortion and technology usage by police.

This model serves as a basis for discussing the budget in a more rational way even when optimization is not possible due to political constraints. This is an important move toward implementing RBB, since the model allows for forecasting the results based on the size and type of investment eliminating the need for guessing the results. Performance and results intended in a given period can serve as a basis for the simulation of investments and therefore evaluation of possible policies of investment, and whether the results intended are realistic, or just a wishful thinking.

From this point the study tries to develop a second more systemic model for public policy involving factors outside this policy, like the effect of crime in the economy and society and these back into crime allowing to understand the positive and negative feedbacks of the system.

This systemic model is not as strong mathematically but serves the purpose of understanding the phenomenon of public policy in a larger context and thus allowing for integration of policies and strategic projects that support public security indirectly.

This allows for a better PPBS and RBB method usage since it can be used to search for synergies in the various projects and programs in several public policies, but also to design new programs and projects to support public security.

Keywords: Strategy, Budget, Performance, Public administration, Forecast

INTRODUCTION

BACKGROUND OF THE RESEARCH

Governments have tried to implement budget methods like PPBS (Planning Programming Budgeting System), ZBB (Zero Base Budget) and RBB (Results Based Budgeting) for decades. However, in practice budgeting has been mostly incremental in most areas, and the results obtained have seldom been linked to the investment made years before.

GOAL OF THIS ARTICLE

This paper tries to create models to make the investment more rational and proactive and less based on political pressures and results guessing.

The public policy selected for this study is the public security.

Two models are created to study this public policy under the modelling method.

The first model is a simulator and its focus is on four crime rates with reasonable data and studies: homicide (murder), robbery, burglary and motor vehicle theft. These variables are normally used to determine government performance in the public sector.

The second model is more systemic for public policy involving factors outside this policy, like the effect of crime in the economy and society and these back into crime allowing to understand the positive and negative feedbacks of the system. Although not as strong mathematically it serves the purpose of understanding the phenomenon of public policy in a larger context and thus allowing for integration of policies and strategic projects that support public security indirectly.

RELEVANCE

These models are important moves toward implementing RBB, since the model allows for forecasting the results based on the size and type of investment eliminating the need for guessing the results.

They allow for a better PPBS and RBB method usage since it can be used to search for synergies in the various projects and programs in several public policies, but also to design new programs and projects to support public security.

QUESTION TO BE ANSWERED

The main research question is “how can we model the effect of public investment in the public security?”

OVERVIEW OF PREVIOUS RESEARCH

This study involves three bodies of knowledge: public budget, systems modeling, and public security. Each of these three has extensive previous research. We intend here to give a brief overview of each one.

PUBLIC BUDGET

Public budget is a major them of public administration and has been used as a planning tool since at least mid XXth century. The PPBS method has been introduced in the 1960`s was a major step toward rationalization of the budget and formally implement it as a tool for planning. The idea of PPBS was to tie budget to programs instead of departments. This method tries to break to the departamentalization of governments by creating program that involved many budgetary units, and also stop the incrementalism in budget by tying the budget to a more clear purpose.

Despite being a relative success worldwide, the political forces manage to adapt to the PPBS and created department specific programs and the problems of departamentalization and incrementalism reappeared.

Then ZBB was introduced, also in the 1960`s. It was trying to eliminate incrementalism in the most radical way, by not making a new budget from the previous one, but rather “zeroing” the budget from year to year. It did not attack departamentalization straightforward but rather indirectly as the departments needed to justify its budget each year.

ZBB made some advance but in the public sector the existing infra-structure could not be zeroed from year to year and the long term nature of some public services and prevented it to be of widespread use. ZBB never became very important in the public sector.

RBB or PBB (Performance based budget) has been introduced at least since 1990`s around the world in both public and private sector. The idea here is that we

should not spend more money but rather better spend the money and get more results from it. It's a direct attack on incrementalism and an indirect attack on departamentalization. It can be viewed as a new tentative of creating programs but this time viewing for results and not means.

RBB has been on the rise in the last decades but it's hard to implement mainly because it's not ease to create consistent cause-effect relationships. In the public sector some of these relations are even more complex and sometimes with a lag of many years between budget use and its results.

BSC (Balanced Score Card) has been a form of RBB that appeared in the 1990`s and became fashionable in the private sector has found its way to the public budgeting. BSC was not created for the public sector and therefore it needed adaptations to it.

The main cause of failure in RBB (including BSC) is due to systems modeling problems, as will be explained below.

SYSTEMS MODELLING

Systems modeling derive from the Systems Theory (Bertalanffy, 2001). It is a mathematical model to describe how parts of a system interact with each other. It can either be just a description done on paper or implemented in a spreadsheet or even in a computer model.

The main purpose of a model is to understand the interactions but some of the behaviors of a system are very complex, even as simple equations interact with each other. This has led to the development of theories as the complexity theory (or chaos theory) as a subset of system theory.

Some interactions form loops of positive and negative feedback. Negative feedbacks are self-controlling and create stable systems, while positive feedbacks are self-reinforcing leading the system into a direction or other all the way. Mapping such loops is an important part of system modeling.

In social sciences there has been much literature to find the causal links and finding the elasticities between variables as well as the correlation coefficients. But there has been very little attention to try to form the loops by looking at the chain of causalities. Mapping such loops can lead to new understanding why some systems are stable (negative feedbacks) while other are unstable (positive feedbacks).

In public policy history there are many examples of policies that were insignificant because they acted upon self-regulating systems. In contrast policies acting upon self-reinforcing systems can be either very successful or disastrous depending on what the system reinforces.

This leads us to the importance in understanding those loops before starting a policy or more specifically before spending money on it. Mapping such loops and models can lead us to better understand the models and how much effort is needed to achieve some goals.

Another question central to the system model is the causality. In creating models establishing the causality is not very easy. In natural sciences we use laboratories to test hypothesis and verify causalities and elasticities and interaction formulas. That's not so easy in social sciences because there's no laboratories and experiences are hard to execute. This is why models can help us predict outcomes before they happen reducing the risks involved in implementing public policies, but also why they are hard to create.

There are four main problems in creating those: intuition, positive relations bias, number of variables bias and time lag.

First, most RBB models are created using intuition in Planning departments and strategic planning sessions where solid mathematical modeling does not find its way due to time-pressures and lack of scientific training. Many causal relations pictured in RBB models (and BSC in particular) are not tested and either false or too weak.

Second, many RBB (and most BSC) have only positive feedback links that create an illusion that acting upon a few variables will lead to a prosperity cycle. The negative feedbacks that prevent growth are neglected.

Third, a lot of variables are left outside, which is inevitable otherwise the number of variables would grow too fast and became unintelligible. Those variables can create loops on their own and create disastrous positive feedbacks or new negative feedbacks that are not even being monitored.

Fourth, there is a time lag between one variable change and its effect on the other. Some time lags can be of years or decades, so the political fruition of a policy can be sometimes be perceived on a different administration. This brings a bias of implementing only short time-lag policies for political reasons, and adds to the stress between the bureaucracy and the politicians.

This has contributed to the frustration with the use of RBB systems, and as said before this is due to poor understanding of systems modeling and a naïve approach of complex situations.

PUBLIC SECURITY

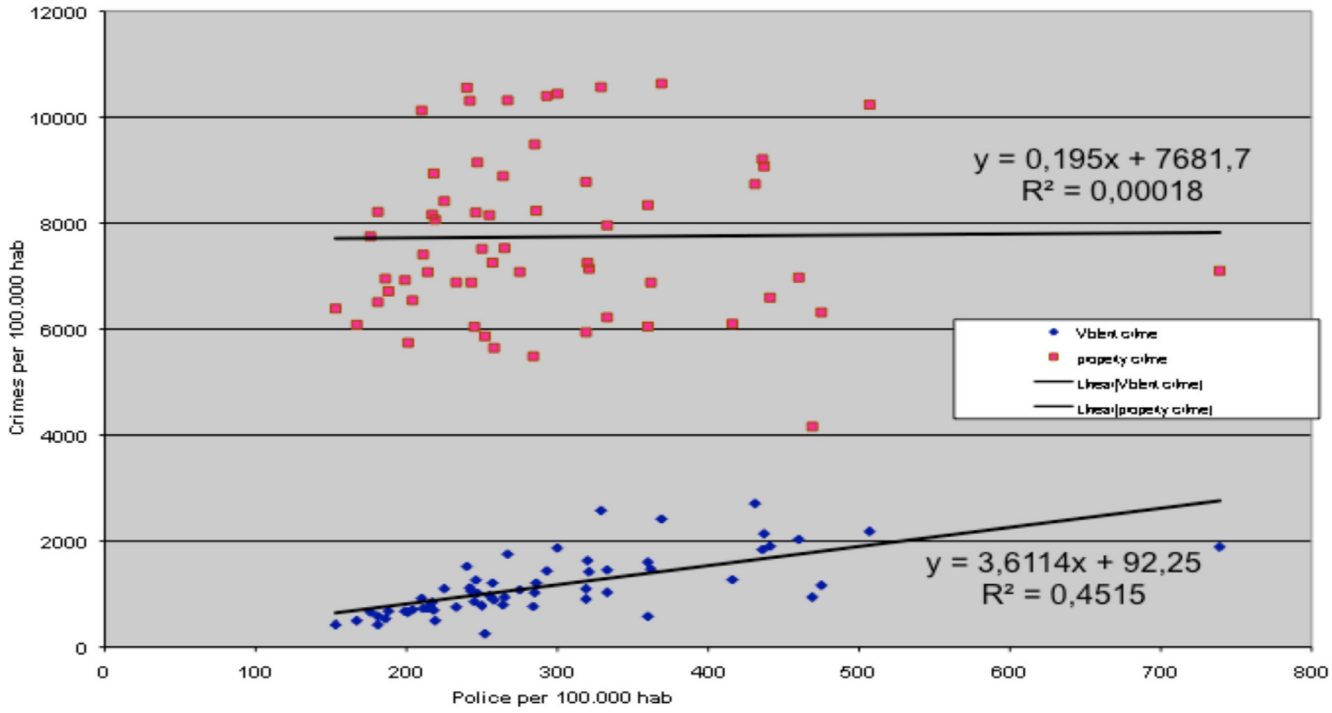
We have chosen public security as our focus in this study for a number of reasons. Firstly it's undeniably a public policy and a central function of the State. Secondly, it has some research with some causalities and elasticities already identified. Thirdly, its importance in budget is high and many decisions can be done based on modeling it.

The study of criminality as an economic activity and its modeling can be traced back to Becker (1968) with the theory of crime. Becker rationalizes that the probability of a crime being performed is dependent on three variables: the punishment, the reward and the probability of being punished. Therefore it can be applied to the public policies very well by creating policies that affect all three variables.

There are however many crimes as defined by law and a full understanding of them would not be possible. We have selected four crimes to analyze basically because of the existing literature on them: homicide (murder), robbery, burglary and motor-vehicle theft.

Direct investment on public security does not warrant a reduction on them. Levitt (1997) has shown that hiring more policemen (and thus enhancing spending) does not correlate to crime reduction. In fact the causality may be inverse. The more crimes in a city the more policemen are hired creating a positive correlation whereas a negative one would be expected. The Figure 1 below shows how the data of Levitt 1997 correlates. In property crime there is almost no correlation at all and in violent crimes the correlation is positive, which is counter intuitive. The data used is from the US cities, each point corresponding to a different city.

Figure 1 – Correlation between crimes and policemen



Source: Adapted from Levitt (1997)

Corman and Mocan (2000) have analyzed the effects of three variables on these four crimes. Levitt (2004) has indicated that the legalization of abortion has affected all these crimes with a time lag of at least ten years. Farrington and Welsh (2002) have pointed that street lightning can affect roberry. Table 1 summarizes this data found from those authors.

It can be observed that increasing effective has an impact on Robbery and burglary but not homicide and motor vehicle theft. The same can be said of increase in drug use but this time a positive elasticity. Increasing inmate population can affect all four crimes. Abortion is the most controversial of those actions because its elasticity is estimated, its time lag and it goes against the religious beliefs of many citizens. The net result is that a politician is rarely in favor of paying the price of legalization for a reward that will be collected in another administration by anther politician, perhaps even a political enemy. The least controversial is increase in street lightning, which is not even considered a public security action or budget. Its effect on other crimes is not analyzed by the authors and thus listed as zero elasticity.

Table 1 – Elasticities of actions affecting selected crimes

Action	Homicide	Motor-vehicle theft	robbery	burglary
Increase in effective *	0	0	-0,41	-0,52
Increase in inmate population *	-0,31	-0,37	-0,39	-0,71
Increase in drug use*	0	0	0.04	0,18
Legalization of abortion**	-0,1	-0,1	-0,1	-0,1
Increase in street illumination***	0	0	-0,3	0

* - Corman e Mocan, 2000
** - Levitt, 2004
*** - Farrington e Welsh , 2002

There are a number of variables that can be thought of but could not be found in the literature to be analyzed, like the effect of better salaries, better management and intensification of use of technologies both for vigilance and investigation.

All those factors allegedly will affect those crimes, but cannot be sure due to some counterintuitive factors and lack of data. For example when some monitoring and vigilance technologies are installed into a certain neighborhood it is likely that the crime rates will go up, not because there's will be more crimes, but because you will start to perceive crimes that went undetected beforehand. Mathematical modeling will them tie the increase of technology to and increase in crime rate that cannot be assured since you comparing two very different situations. This is related to the difficulties in experimentation in social sciences.

METHODOLOGY

The method used for this work is the simulation.

Simulations evolved fro the systems theory as a way of creating artificial systems to work and study them. They are applicable to systems that are either to expensive to test in real world or even impractical to do so.

In social sciences simulations are very useful to circumvent the limits of testing and experiencing. Bruyne et al (1977) describe four methods of investigation in which are from he most open to the most controlled: case studies, comparisons, experimentation and simulation. Management sciences have concentrated in cases studies and comparisons and neglecting simulations since they are more complex and require some knowledge in systems theory and preferably spreadsheets and computer programming.

Kleiboer (1997) indicates the use of simulation in five cases: research tool, teaching instrument, planning method, decision support tool and a method for selection of personnel. Our interest here is to use it as a planning method and decision support tool.

Chussil and Reibstein (1999) describe the simulation techniques as an important tool for planning and decision support and include in them: computer analyzes, wargames, war rooms, and war councils. His main interest is in forecasting results of actions.

Alves (2005) indicates the possible situations in which simulations can be used. The table 2 below shows the description.

Table 2 – Modes of use of a simulation in social sciences research

		Do empirical data exist?	
		Yes	No
Do a model exist?	Yes	Confirmatory	Forecast
	No	Search of a Model	

Source : adapted from Alves (2005)

This article is trying to "search for a model". We will develop two models. One more formal will use established correlations and elasticities to create a model that can later be used for forecast. A second less formal model will try just to establish a model for later confirmation.

The main source of data is secondary sources in literature as is typical in simulations.

FINDINGS

We have created so two models for modeling the government investment and performance in public security.

MODEL 1

The first model was implemented in excel for ease of use but could have been implemented in any spreadsheet or in a simple programming code. The model can be reached by e-mailing the author.

It has used three panels of data: inputs, actions and outcomes.

All equations used the correlations and elasticities shown in table 1.

More relations could be speculated but could not be based on existing literature.

Figure 2 shows the input table with dummy factors of a hypothetical political entity (HPE).

Our Hypothetical political entity (HPE) has a population of 10 million people, the size of a state of a metropolitan area and a relatively low crime rate.

Only four crime rates are considered because of the existing data.

It current budget for security is evaluated in $1.1 billion. This includes street lightning budget, which is normally not considered in these calculation so the user must be careful in comparisons.

Real data would substitute the data provided as default.

Figure 2 - Inputs table for model 1

General Data					
	People	per 100k Pop	Yes/no	% covered	$/person-year
Population	10.000.000				
Policemen	20.000	200			
Inmate population	20.000	200			
Abortion is legal?			no		
Drug use					10
Street Lighting				50	

Crime data	Homicide	motor vehicle theft		Burglary	Roberry
Crimes	1.000	1.000		1.000	1.000
Crime /100k population	10	10		10	10

Crime elasticities	Homicide	motor vehicle theft		Burglary	Robbery
Increase in effective	0	0		-0,41	-0,52
Increase in inmate population	-0,31	-0,37		-0,39	-0,71
Increase in drug use	0	0		0,04	0,18
Legalization of abortion	-0,1	-0,1		-0,1	-0,1
Increase in street illumination	0	0		-0,28	0

Costs	individual salaries ($/year)	total salaries (millions)		infrastructure (millions)	Total
Policemen per year	20000	400		100	500
Inmate per year	20000	400		100	500
Total security spending					1000
Cost of street Lightning				100	100
Total spending					1100

Figure 3 shows the actions that could be implemented.

These include only five possible actions: increase the policemen effective, increase the inmate population, increase in drug usage by consumer population, legalization of abortion and increase in street lightining. Each of these requires a small explanation.

Increase in policemen effective will expand expenditure of salaries and infrastructure, but the model does not take into account the investment to expand infrastructure. Also it does reflect only one police type whereas some political entities have more than one. For example in US federal government have several agencies like FBI, CIA, USSS, USCG, DEA, NSA, CBP and others. In Brazil the states have two police types, the Polícia Militar (PM) and Polícia Civil (PC). So the model will need adaptation to the specifics of the reality.

Increase in inmate population will expand costs of inmate's maintenance, which includes the salaries of guards operating the system and also the cost of infrastructure, but the model does not take into account the investment to expand infrastructure.

Increase of drug usage by consumer population is not a action any political or bureaucrat would take by himself but by the population and can occur in a period. It is an average of the consumption and the model can be further refined into market segments. This variable is show as a percentage, and can be made negative reflecting a reduction of consumption.

Legalization of abortion has an effect but we don't recommend it to be used. It would have a lag time to create its effects and this lag time is not well measured. Our own estimate is ten years, but it's only an estimate, not a reliable number.

Increase in street lighting will impact the cost of maintaining the lightning grid in infrastructure, but the model does not take into account the investment to expand infrastructure. It's show as a percentage.

Figure 3 – Actions or decisions table

Actions		
		unit
Increase in effective	1000	new policemen hired
Increase in inmate population	1000	new inmates
Increase in drug use	5	% growth
Legalization of abortion	no	yes or no
Increase in street illumination	10	% growth

Figure 4 shows the outcomes, or effects table. It's very similar to the inputs table but now showing the reduction in crime rates and the increase in costs and manpower of police force and inmate population.

The default numbers are result of the default decisions on the Hypothetical political entity (HPE). It would of course change accordingly depending on real data inserted in input table and planned decisions on the action table.

In our example the growth in Budget was 50 millions (less than 5%) and the crime rates dropped with varying degrees but at an average of about 3%.

The model does not take into account the natural growth of the population and the inflation. Of course it could be adapted to include these factors.

Figure 4 – Outcomes or effects Table

General Data					
	People	per 100k Pop	Yes/no	% covered	$/person-year
Population	10.000.000				
Policemen	21.000	210			
Inmate population	21.000	210			
Abortion is legal?			no		
Drug use					11
Street Lighting				55	

Crime data	Homicide	motor vehicle theft		Burglary	Roberry
Crimes	985	982		934	948
Crime /100k population	9,8	9,8		9,3	9,5

Crime Change	Homicide	motor vehicle theft		Burglary	Robbery
Increase in effective	0	0		-20,5	-26
Increase in inmate population	-15,5	-18,5		-19,5	-35,5
Increase in drug use	0	0		2	9
Legalization of abortion (lag time)	0	0		0	0
Increase in street illumination	0	0		-28	0

Costs	individual salaries ($/year)	total salaries (millions)		infrastructure (millions)	Total
Policemen per year	20000	420		105	525
Inmate per year	20000	420		105	525
Total security spending					1050
Cost of street Lightning				110	110
Total spending					1160

In general this model is of limited use for public administration but can be very useful to acquire a feeling on how the factor are impacted. It can be adapted to the specific situation of the real political entity and further developed.

As it is it can be used to validate results expected in a RBB or to estimate the effects of the RBB.

One important aspect is that even with a limited number of variables it includes other public policies such as street lightning into the account to show that this is a multidisciplinary problem. As research progress and more elasticities can be taken into account the model can be expanded.

Some extrapolations could be made and incorporated into the model such as assuming that technology is s force multiplier. In this case by spending more with infrastructure it could have similar effects as to expand the policemen effective. Another assumption could be that a more efficient educational system could reduce criminality. In general cost of education is cheaper by individual than the costs of maintaining him or her in a correctional facility.

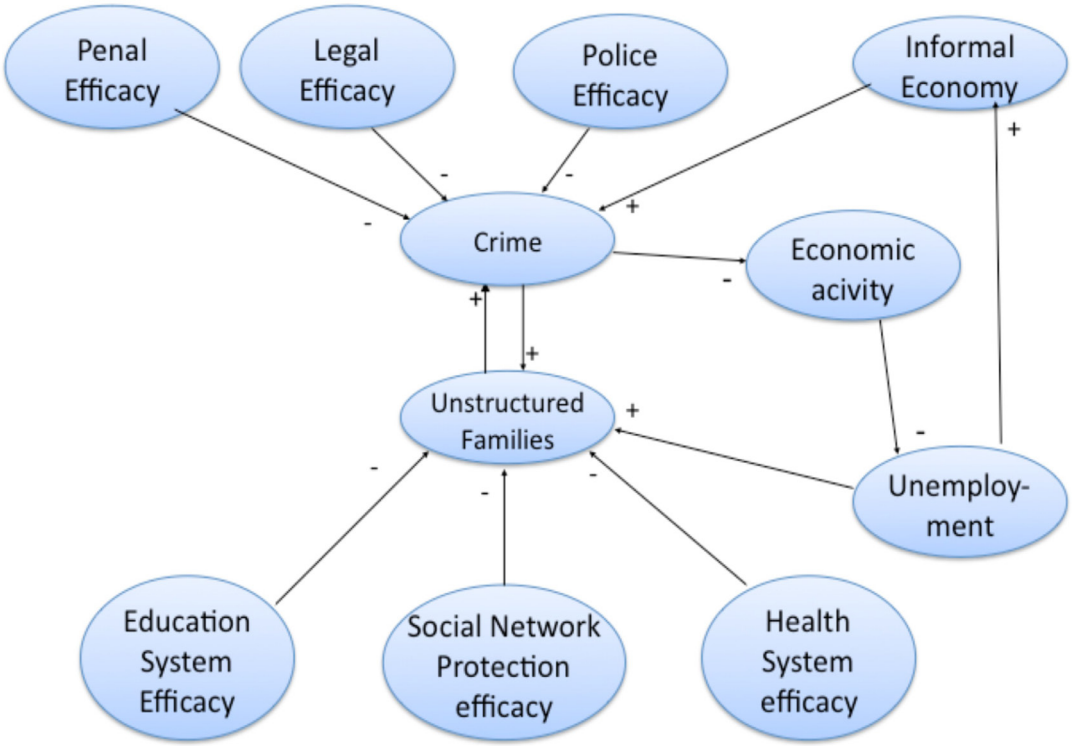
However these assumptions can only be guessed and their effectiveness estimated which leads us to the second model.

MODEL 2

This model is created based on general perception of the crime effects and causes. It contains 11 variables correlated as positive or negative effects. Arrows with a plus symbol are positive feedbacks or correlations and those with a minus symbol are negative feedback or negative correlations.

The central knot is that crime have a positive feedback o unstructured families and those have a positive feedback on crime creation a positive feedback loop that can spiral out of control. Levitt (2004) offers support to this relation.

Figure 5 – Model 2



Furthermore crime creates two other positive feedback loops by reducing economic activity, which its own increases unemployment. This has a double effect of unstructuring families and increasing informal economy, which by it own increases crime. These relations are supported by common economic hypothesis.

Left alone these Positive feedback loops would spiral the society into anarchy. A number of possible actions can be put out to reduce both sides of this model by reducing crime and by structuring families. Another number of actions not covered in the model relate to affecting the economic variables shown here.

The control of crime includes three variables that are found in Becker`s theory of crime (1968). These are the police system, which increases probability of being caught, legal system, that ensures a proper penalty due to the crime, and the penal system, which ensures the penalty will be properly applied.

On the other side there are a number of social policies out of which three have been elected and more could be included. The education system reduces the probability of someone engaging in criminal activities. The social network system reduced the trend that a unstructured family will engage in crime activity in short term due to economic needs. The health system reduces the vulnerability of citizens to diseases and than their needs for large spending in health that may lead to engaging in criminal activity, also it can prevent drug usage due to depression and other psychological needs as well as recovering users from drug usage.

However there are no hard numbers in those correlations and a simulation cannot be implemented at this moment.

This model serves the purpose of reducing the myopia that crime is a police problem only. This myopia has dragged more and more policemen into service only inflating the police system without reducing the crime itself.

There are a number of other activities that can control crime and within many social policies as well as security policies, and economic policies.

CONCLUSIONS

At this point we should return to the goal of the paper and ask if we could properly modeled the effects of public investment on public security.

The models presented are not finished products and need careful use by readers that will need to adapt them to their reality.

However these are important steps to implementing RBB, since the model allows for forecasting the results based on the size and type of investment eliminating the need for guessing the results.

They also allow for a better PPBS and RBB method usage since it can be used to search for synergies in the various projects and programs in several public policies,

but also to design new programs and projects to support public security.

Further improvement may be context specific depending on the political entity using them.

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