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VLADIMIR KUHL TELES

JOAQUIM ANDRADE

FGV
EESP

Crime and Punishment with Habit Formation

Vladimir Kühl Teles
Getulio Vargas Foundation*
vladimir.teles@fgv.br

Joaquim Andrade
University of Brasilia
Department of Economics†

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Abstract

Moral concepts affect crime supply. This idea is modelled assuming that illegal activities is habit forming. We introduce habits in a intertemporal general equilibrium framework to illegal activities and compare its outcomes with a model without habit formation. The findings are that habit and crime presents a non linear relationship that hinges upon the level of capital and habit formation. It is possible to show that while the effect of habit on crime is negative for low levels o habit formation it becomes positive as habits goes up. Secondly habit reduces the marginal effect of illegal activities return on crime. Finally, the effect of habit on crime depends positively on the amount of capital. This could explain the relationship between size of cities and illegal activity.

Key-Words: Crime, Habit formation, Punishment.
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*Getulio Vragas Foundation, Sao Paulo School of Economics (EESP-FGV), Rua Itapeva, 474, 12o. andar, 01332-000, Sao Paulo-SP, Brazil

†Universidade de Brasiia, Campus Universitário Darcy Ribeiro, Asa Norte - Brasília - Brazil, 70910-900, e-mail - jandrade@unb.br

Crime and Punishment with Habit Formation

"Ah, well, men holds the remedy in his own hands, and lets everything go its own way, simply through cowardice - that is an axiom. I should like to know what people fear most: whatever is contrary to their usual habits, I imagine." (Fiódor Dostoiévski, 1866, *Crime and Punishment*, Chap I)

"Those, on the contrary, who have had the misfortune to be brought up amidst violence, licentiousness, falsehood, and injustice; lose, though not all sense of the impropriety of such conduct, yet all sense of its dreadful enormity, or of the vengeance and punishment due to it. They have been familiarized with it from their infancy, custom has rendered it habitual to them, and they are very apt to regard it as, what is called, the way of the world, something which either may, or must be practised, to hinder us from being the dupes of our own integrity." (Adam Smith, 1759, *The Theory of Moral Sentiments*, Part V, Chap 2)

1 Introduction

In the seminal paper of Becker and Murphy (1988) habit was included in the utility function to describe consumption behavior of harmful goods, notably drugs. In the present paper we merge the Becker and Murphy insight about this link between illegal behavior and habit with the traditional crime and punishment approach due to Becker (1968) in a general equilibrium framework.

The existence of habit formation due to factors such as social interactions may affect the behavior of agents in crime supply. Factors such as culture or religion provide social incentives that may induce habits in illegal activities. For example, surveys in Britain and the United States have indicated that at least a third of the citizens in both countries believe that religion provides a sociocultural and/or spiritual foundation for curtailing criminal behavior (Banks, Maloney and Wittrock, 1975; Jensen, 1981). Ellis and Peterson (1996) find that more religious countries have lower crime rates than less religious countries, at least regarding property crimes, using data from 13 industrial nations.

On the other hand Gaviria (2000) demonstrates, using a myriad empirical evidence — both statistical and anecdotal — that the daily contact of youth with criminal adults and criminal peers results in the erosion of morals and hence in a greater predisposition toward crime.

The insight that through the process of habit formation, one´s own past decisions might influence the utility yielded by current decisions is hardly new; see, for example, Pareto (1897) and Marshall (1898).

In fact the habit formation hypothesis has been applied in many issues such as endogenous growth models (Carroll et al, 2000), cyclical consumption (Dockner and Feichtinger, 1993), aggregate savings (Alessie and Lusardi, 1997), money and growth (Faria, 2001), environment (Ono, 2002), fiscal policy (Burnside et al, 2004) and monetary policy (McCallum and Nelson,1999, Amato and Laubach, 2004), to mention a few. All these papers introduce habit in consumption. Nonetheless, Faria and León-Ledesma (2004) uses habits in number of hours worked to study labor supply. In fact, it is not only in consumption that habits may occur. Becker and Murphy (1988, p. 695), for example, explain that: "Not only cigarettes, alcoholic beverages, and cocaine are obviously addictive, but many other goods and *activities* have addictive aspects".

In this paper we assume that social incentives create an ethic that affects the number of hours allocated to criminal activities by a representative agent. This is modelled by assuming that crime is habit forming. The idea is quite intuitive: past crime forms a stock of habits that affect agents' disposition towards present crime.

This paper is organized as follows. Section 2 develops the model and characterizes equilibrium. Section 3 shows the main result and section 4 provides concluding remarks.

2 The Model

While agents are stimulated to engage in criminal activities according to the expected positive returns, they are also subject to the effects of crime, with loss in income. According to this idea, we may argue that the total expected income (Y) of a representative agent of this economy will be given by (1).

$$\pi P + (1-\pi)[f(k,o)(1+\phi(o,\bar{o}))] \tag{1}$$

where

$$\phi\left(o,\bar{o}\right)\begin{cases} =0, & if\ o=\bar{o} \\ >0, & if\ o>\bar{o} \\ <0, & if\ o<\bar{o} \end{cases}$$

Thus, $f(k,o)$ represents the production function, where k is the capital stock and o the number of hours spent on criminal activity. On the other hand, $\phi(o,\bar{o})$ represents the net income function of the criminal activity, where the agent chooses the number of hours that will be dedicated to crime, when faced with the average number of hours of the other agents, $\bar{o}$. This type of function is commonly used in illicit activity models such as in Ehrlich and Lui (1999) and Teles (2004). Complementarily, π is the probability of punishment, and P is the payoff of the punishment. In fact, P may represent

the consumption supplied for criminals by the society in prisons, for example. (see Fender, 1999).

The production function may be represented by,

$$f(k,o) = Ak^{\beta}(1-o)^{1-\beta} \tag{2}$$

where agents devotes the fraction $(1-o)$ of his non-leisure time to current production, A is the level of technology, and β is the capital-share.

If we consider that criminal activity (o) directly affects the well-being of an agent, and if we incorporate this in his utility function, and that the individual cares not only about consumption (c) and the instantaneous flow of offenses (o), but also takes into account his past criminal activities, captured by his stock of habits (h), then the instantaneous isoelastic utility function proposed by Abel (1990) is adapted to introduce o:

$$U(c,o,h) = \frac{\left[(h^{\gamma}/o)^{\alpha} c^{1-\alpha}\right]^{1-\sigma} - 1}{1-\sigma} \tag{3}$$

where α is a positive parameter that lies in the unitary interval, σ is the coefficient of relative risk aversion, and $\gamma \in [0,1)$ indexes the importance of habits. If $\gamma = 0$, then habit stock has no relevance, and the utility function reduces to the traditional case. While if $\gamma = 1$, crime relative to habit stock is very important.

Following Carroll et al. (2000) it is assumed that the stock of habits is a weighted average of past offenses. The stock of habits evolves according to:

$$\dot{h} = v(o-h) \tag{4}$$

where v is a positive parameter determining the relative weights of offenses at different times. The smaller is v, the less important is offenses in the recent past.

Equations (3) and (4) provides a picture of the relationship between crime and habits. The agents have a disutility of practice crimes, but when he does it the stock of habit increase, diminishing, in a second moment, the disutility of crime. Then while the agent engage in criminal activities he "accustoms" to them, what diminish his disutility in the practice of the crime. When the value of γ is high this effect occurs quickly, however, if is equal to zero, this effect simply does not occur.

The individual maximizes a discounted, infinite stream of utility:

$$\begin{aligned} \underset{c,o}{Max} & \int_0^{\infty} U(c,o,h)\, e^{-\rho t} dt \\ & \dot{k} = Y - c - P \\ & \dot{h} = v\,(o-h) \end{aligned} \tag{5}$$

By substituting (1) and (3) in (5) and solving the problem, and applying the equilibrium condition $o = \bar{o}$, the following first-order conditions are obtained,

$$\lambda_k = \left[\left(\frac{h^\gamma}{o}\right)^\alpha c^{1-\alpha}\right]^{-\sigma} \left[\left(\frac{h^\gamma}{o}\right)^\alpha (1-\alpha)c^{-\alpha}\right] \tag{6}$$

$$-\upsilon\lambda_h = \left[\left(\frac{h^\gamma}{o}\right)^\alpha c^{1-\alpha}\right]^{-\sigma} \left[\left(\frac{h^\gamma}{o}\right)^\alpha (-\alpha)\left(\frac{1}{o}\right) c^{1-\alpha}\right] + \lambda_k \left\{(1-\pi)\, f_0 + f\phi_0\right\} \tag{7}$$

$$\frac{\dot{\lambda}_k}{\lambda_k} = \rho - \left\{(1-\pi)\, f_k\right\} \tag{8}$$

$$\dot{\lambda}_h = \rho\lambda_h - \left[\left(\frac{h^\gamma}{o}\right)^\alpha c^{1-\alpha}\right]^{-\sigma} \left[\left(\frac{h^\gamma}{o}\right)^\alpha \gamma\alpha\left(\frac{1}{h}\right) c^{1-\alpha}\right] + \lambda_h \upsilon \tag{9}$$

where λ_k and λ_h are the co-state variables of k and h respectively.

By substituting (6) in (7), and then this result in (9) and considering that in this model's steady-state the per capita variables remain constant, meaning that the shadow-price of capital and habits remains constant, we will have that the following equations establishes the steady-state condition.

$$\rho = \left\{(1-\pi)\, f_k\right\} \tag{10}$$

$$\rho = \upsilon \left\{\frac{\gamma\,\alpha\,(1/h)\, c}{\left[\alpha\,(1/o)\, c - (1-\alpha)\,\left[(1-\pi)\, f_o + f\,\phi_o\right]\right]} - 1\right\} \tag{11}$$

$$\pi P + (1-\pi) f = c + P \tag{12}$$

$$o = h \tag{13}$$

It is possible to analyse, through these equations, the main effects of habit formation in the illegal activity and assess the efficacy of the policies used to bend the crime.

3 Results

3.1 Crime and Habit

To examine how the habit formation affects the criminal activities dynamics we should solve the system (10) to (13) and calculate the first derivative of o in relation to γ, the importance of habit in the utility function. This brings us to the following results:

$$\frac{do}{d\gamma} = \frac{B}{A - \left(\frac{1-\alpha}{\alpha}\right)(C+D)} \tag{14}$$

where,

$$A = (1-\pi)f_{ko}(f-P) + [(1-\pi)(f_k+v) - v\gamma]f_o$$

$$B = v(f-P)$$

$$C = \{[(1-\pi)f_k + v] + o(1-\pi)f_{ko}\}[f_o + \tfrac{f\phi_o}{(1-\pi)}]$$

$$D = o[(1-\pi)f_k + v][f_{oo} + \tfrac{f\phi_{oo}}{(1-\pi)} + \tfrac{f_o\phi_o}{(1-\pi)}]$$

The value of B is clearly positive, and the value of D is negative. The signs of A and C however depend on the values of the parameters of the model. For instance, an increment of the importance of habit in the model does not imply necessarily a positive or negative effect on crime.

It is important to note that the key parameters to determine the sign of the relationship between the habit formation and the criminal activity are γ and k, and the last one determines the value of f, f_o, f_k and f_{ko}. Henceforth it is possible to use equation (14) to understand how these parameters affect this relationship.

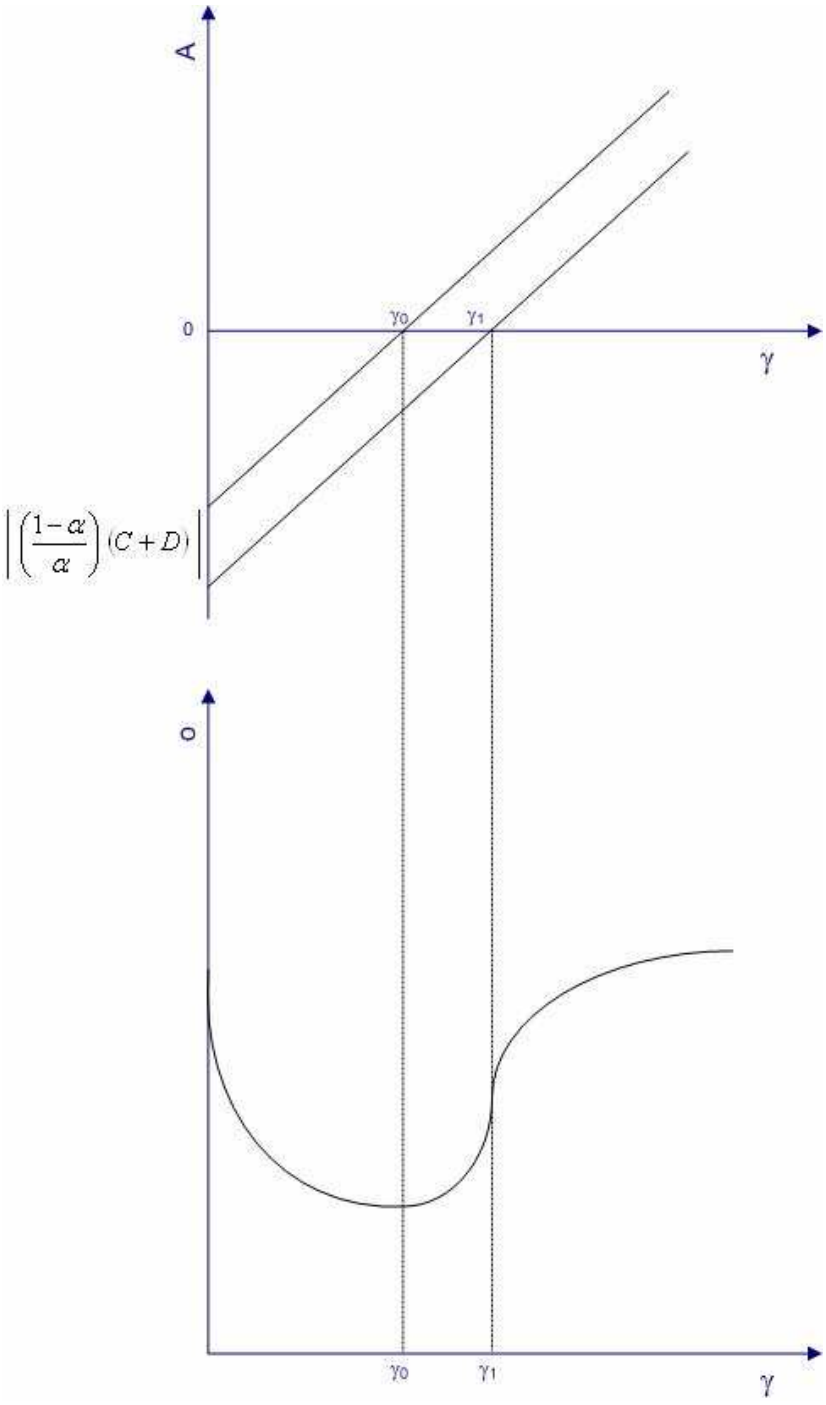
As an example we will consider a value for k such that $(C+D) < 0$. In this case the relationship between γ and crime can be illustrated by figure 1. It should be noted that, initially, when γ is equal to zero A takes a negative value, and that A goes up when γ goes up. At the same time, equation (14) indicates that $do/d\gamma$ may be negative if $|A|$ is big enough when A is negative. In this case, figure 1 tells us that, when γ overshoot the value γ_0 the value of $do/d\gamma$ becomes positive, since when this value is reached $A - \left(\frac{1-\alpha}{\alpha}\right)(C+D)$ becomes positive.

Henceforth, when γ takes values between zero and γ_0 an increase of γ reduces the equilibrium value of o. Since we are considering a representative agent model the value of γ is the same for all individuals. Consequently, increases of γ in this stage may be taken as the cause of the negative impact on the worked hours of society as a whole, reducing therefore the return of crime. At the same time, in this stage, the habit does not reduce significatively the disutility of crime, and, as a result, the habit does not lead to an increase in criminal activity. This explain the sign of $do/d\gamma$ in this first stage.

On the other hand, when γ pass over γ_0, the function becomes convex up to the value of γ_1. In this interval $do/d\gamma$ is positive and increases in γ raise the value of $do/d\gamma$. The disutility of crime falls strongly when crime is practiced because of habit and any variation in γ leads to increases in the number of hours spent in crime activity more than proportional.

Finally, when γ pass over the point γ_1 relationship becomes concave. Now A becomes positive, and $do/d\gamma$ positive as well. Nonetheless increases in γ lead to smaller $do/d\gamma$. This happens because, when o increases the number of hours spent on work fall, increasing the opportunity cost of crime. Thus, while the disutility of

Figure 1: Crime and Habit



crime falls quickly, the value of o tends to a limit value. This is due to the existence of a trade off between time spent in crime activity and work.

Though this example was designed for specific values of k it is a general case about the possibilities of the relationship between the importance of habit and the crime dynamics. Changes in the value of k that implied changes in the sign or magnitude of $(C + D)$ would only eliminate some of the three stages discussed above.

3.2 Crime, Habit and Capital Stock

The equilibrium value of o does not depend on γ only, but fundamentally on the value of k, as can inferred from the previous section. Therefore it is necessary to analyse how this relationship is affected by k. It follows from equation (14)that an increase in k affects the marginal effect of the importance of habit on the number of hours spent on criminal activity. This effect is illustrated in figure 2.

The economic effects of the capital stock on crime can be observed from the analysis of the behavior of crime when γ is equal to zero. Nonetheless let us focus on the differences in the relationship of habit-crime of an increase in k. Figure 2 displays this net effect in such a way that o of the economy with high k and of the with low k are the same when γ is zero.

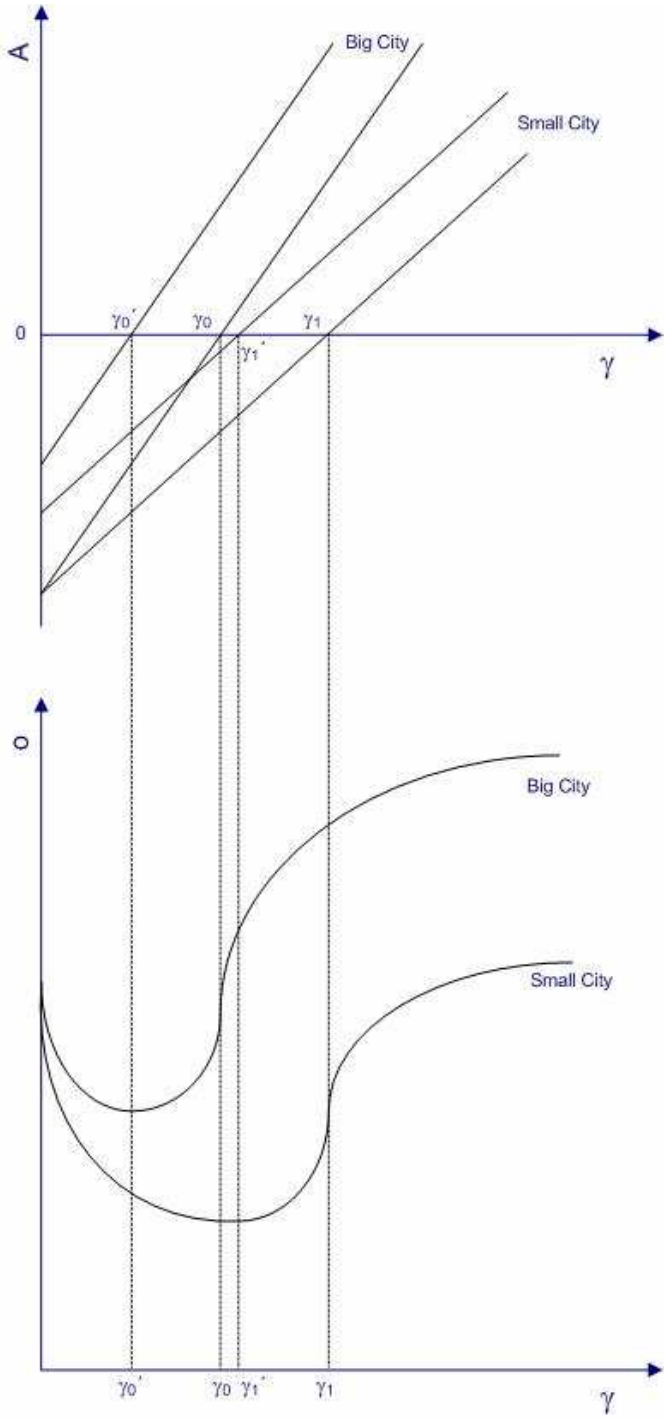
Two effects are presented. Firstly, the point where $do/d\gamma$ becomes positive is smaller in the economy with high k than in the economy with low k, since the shift of the constant in the diagram on the top of figure 2 is larger for the economy with high k than for the with low k. To see this it is sufficient to note that larger values of k change the values of B and C in equation (14), raising their absolute values.

Secondly, the slope in the top of figure 2 of the relationship between A and γ changes in a way that increases in γ have a marginal impact successively stronger on o in the economy with high k than in the other. Henceforth, the difference between the behavior in relation to crime in the economy with high k vis a vis the economy with low k increases as γ increases.

These two points present a practical result well established: two persons with the same moral behavior, that is, with the same γ, can have different conducts in relation to crime depending on the value of k. Simplifying, the same person that is a peaceful worker in a small city becomes a violent an criminal one in a big city, since the habit dynamics would be quite different because of differences in k, considering that on average an increase in the size of the cities is followed by an increase in the stock of capital per capita.

The increase in the criminal rate that accompanies the increase in the size of the cities is a well established fact in the empirical literature. A very good reference on the subject is Glaeser and Sacerdote (1999) that brings a comprehensive discussion on these empirical facts. This study points out the three main reasons: for the increase in the criminality rate in the big cities. Two of the reasons are based in economics: a lower probability of punishment and a greater expected value of crime in the big cities. The third reason is essentially moral. Based in empirical evidences raised by studies

Figure 2: Crime and Habit in Big Cities



made by criminologists, the argument is that in big cities a moral degradation reduces the disutility of crime and consequently leads to an increase in the criminal activity of big cities vis a vis small cities.

Therefore, the crime rate will be determined by the interaction of moral and social values that determine γ and by economic incentives represented by different values of k. Such result is confirmed by several empirical and anedoctical evidences. Empirical results confirm that the criminal behavior has a strong relationship with social interactions (e.g. Akerlof and Yellen, 1994; Glaeser, Sacerdote and Scheinkman (1996); Carneiro, Loureiro and Sachsida (2005)). This idea explains not only the relation of habit formation to criminal activity but also its relation to criminal behavior. It is noteworthy that when an individual enters a criminal activity by external influence, as in a gang, for instance, his difficulty to exit is due to the external coercion of the peers group. This interaction raises the importance of habit in criminal activity.

3.3 Crime and Punishment

An important question to be answered is: How the importance of habit in criminal behavior affects the efficacy of punishment? To answer this question we should go to equation (14) and analyze the sign of $d^2o/dPd\gamma$. In this case its is clear that $dA/dP > 0$ and that $dB/dP < 0$, what implies that $d^2o/dPd\gamma < 0$. Thus, when γ increases, the marginal effect of punishment on crime is reduced. In other words, more important is habit to human behavior towards crime, less efficacious is punishment to reduce criminality. As a result of that more punishment will be necessary to contain criminality.

3.4 Crime and Law Enforcement

Finally, it is possible to verify the effects of public policies, as for instance the increase in investment to combat the crime in the model. In this case, going again to equation (14) it is possible to show that $dA/d\pi > 0$ and $dD/d\pi < 0$. Henceforth, if $dC/d\pi < 0$ or small enough, $d^2o/d\pi d\gamma < 0$. This result implies that the investment in the combat of criminal activity may reduce its effectiveness greater is the stock of habit towards criminal activity similarly to the effect of punishment. Indeed, this result does not depend on the size of $dC/dpi > 0$.

4 Conclusions

The tradition of the models addressing the economics of crime defines the decision of an agent participating in an illicit activity as a rational one, since it is an economic decision in which the benefits and costs of crime are weighted along with the alternatives. (Fender, 1999). From this perspective, this study has introduced habit in an intertemporal general equilibrium framework and demonstrates that habit affects the rationality

of crime. It was shown that the importance of habits towards criminal activity depends on the opportunities of criminal activities. These on the other hand are affected by the amount of capital of the economy. The relationship of crime to the importance of habit is non linear. For small values of k the importance of habit is more than compensated by the disutility of crime, after a critical k the opposite occurs and the habit affects positively criminal activity. On the other hand, the effect of punishment and law enforcement become less efficacious greater the importance of habit.

Comparing these results with the traditional result due to Becker and Murphy (1988), that built a model of drugs consumption with habit formation some considerations may be due. In Becker and Murphy framework, an increase in permanent punishment implies an increase on price of drugs, and, consequently, a decrease on its long run demand. Thus, the drugs traffic will fall, as crime related. In our model, where another type of crime (property crime)is considered, this relationship will not occur. If the punishment rises, the effects on crime level may not change significantly, as demonstrated in proposition 3.

Considering education programs, Becker and Murphy argues that greater efforts to educate the population on the harms of the use of drugs may not offset the effects of the reduction on dugs price on the long run . Contrarily, according to our model education policies may be important to break increases on long run crime level if it is able to build an ethics pattern to avoid illegal activities. Summarily what this paper shows is that different kinds of crime may have opposite forms of combat, and the theoretical dynamic path of crime will change drastically if we consider habit formation in alternative ways.

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