After-School Programs and Juvenile Delinquency: An Economic Model of Crime Reduction

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Abstract

Since 2005, the United States has experienced a significant and sustained decline in juvenile delinquency, often attributed to increased arrest and incarceration rates. However, scholars have sought alternative, non-punitive approaches to further reduce delinquency. One such approach is after-school programs, which have been tested for effectiveness. This article develops a theoretical framework using a utility-maximizing decision model that incorporates uncertainty and time allocation to analyze victims' and offenders' opportunities and payoffs within the market equilibrium. The model suggests that extended school hours and improved after-school programs reduce juvenile delinquency by limiting opportunities for criminal behavior, which further decreases the number of potential victims and lowers the real crime rate. In addition, the model suggests that aligning school hours with societal working hours strengthens the effectiveness of delinquency prevention policies. The findings also offer valuable perspectives for countries with weak law enforcement, where juvenile delinquency disrupts education and lowers its returns.

I Introduction

Juvenile delinquency, the violation of law by people under 18 years of age, has played a critical role in criminal studies from various fields of the academy. Federal data, as shown in Figure 1, have demonstrated a persistent and drastic decrease in juvenile delinquencies.

Although juvenile delinquency only takes up a minimum share of total criminal activities, that is, the number of youth incarcerated only accounts for 8% or an estimated 424300 of total imprisonment (Puzzanchera 2022). Even taking into account unobserved cold cases, juvenile crime in general is still relatively insignificant. However, people are afraid that juvenile delinquency might further deteriorate into serious offenses, increasing gang activities and drug usage, which further imposes financial challenges to society,

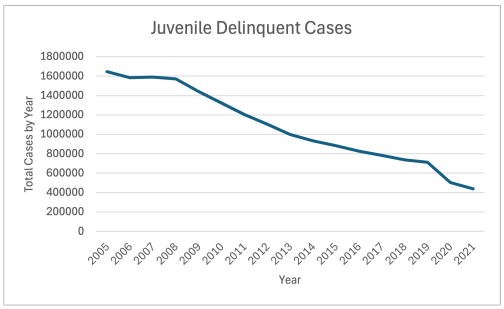

Figure 1: Declined Juvenile Delinquency Court Cases Each Year

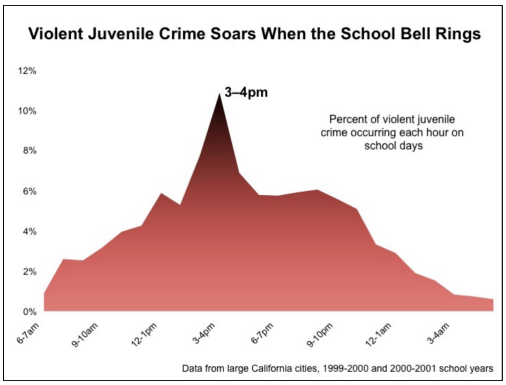

Figure 2: Juvenile Delinquent Time Distribution

especially to taxpayers. There exists political demand for continuing the downward juvenile delinquency trend.

The declination of crime, in general, is often explained by the crime opportunity and rational choice theory, where offenders evaluate their expected marginal benefit against the potential marginal cost (Farrell, Tilley, and Tseloni 2014), but the mechanism behind the downward trend of juvenile cases, however, has not been explicitly investigated.

Nevertheless, pure observation provides us with invaluable data to diagnose juvenile delinquency during weekdays. In 2019, Fight Crime: Invest in Kids released a report documenting the peak juvenile criminal activities between 2 pm and 6 pm (Fight Crime: Invest in Kids 2015), which suggests a different story. Since juvenile delinquency concentrates on a particular time period, perhaps time constraints were the reason for declining juvenile delinquencies. Before analyzing the method for imposing time constraints, it is vital to analyze the existing programs and strategies for their effectiveness.

One such strategy, according to some hypotheses, is linked to a "broken-window" policing technique where police are expected to execute stricter enforcement to prevent minor crimes from deteriorating into severe offenses later in the future. Some research has shown its effectiveness by establishing a strong positive correlation between an increased incarceration rate of misdemeanors and a decline in violent crimes, but

the same phenomenon is not ubiquitous (Kelling and Sousa 2001; Skogan 1992). Although demonstrating some effectiveness, putting kids in jail has become increasingly worrying, both for their development and for public finance.

Justice Policy Institute analyzed the cost of juvenile incarceration in the years 2014 and 2020, showing a tremendous upsurge in per juvenile incarceration cost in many states, even with a persistent declination of juvenile delinquency rate (Petteruti, Schindler, and Ziedengerg 2014). The author draws out some of the most expensive incarceration and rehabilitation programs for further discussion.

States with the Highest Yearly Cost Per Juvenile Incarceration			
State	Per Day	Per Year	Percentage Change from 2014
Alaska	$1542.49	$563,008.85	N.A.
California	$833.59	$304,259.00	46%
Connecticut	$750.00	$273,750.00	23%
Maine	$689.22	$251,565.30	12%
Maryland	$1,136.79	$414,929.00	41%
Montana	$1,111.00	$405,515.00	131%
Nebraska	$734.70	$268,165.50	111%
New Hampshire	$1,479.45	$540,000.00	152%
New Jersey	$794.05	$289,827.00	48%
New York	$2444.40	$892,206.00	153%
Rhode Island	$722.60	$263,750.00	42%
Vermont	$1447.00	$528,155.00	135%

Table 1: Selected States with the Highest Per Youth Incarceration Cost.

Table 1 lists 12 states where the yearly cost of incarceration per person is higher than $250,000.00. Except those, other 40 states spend their tax money at least $100,000 per year for a single youth's confinement (*Sticker shock 2020: The cost of youth incarceration* 2020). The same amount of money could have been spent on other community-based training programs or higher education for better net returns. After-school programs, another strategy that is often suggested by law enforcement, usually cost from $140 to $750 per month. Showing great cost-effective potential as an alternative to the existing policy, if it is as effective as the policing strategies.

Given this context, after-school programs (ASPs) are investigated. Many advocates believe that ASPs provide alternatives to street crimes and drug consumption, causing ASPs to be increasingly invested by the federal government under a variety of acts (*Federal Afterschool Policy*). Research has shown that juveniles who left the program are more likely to be arrested than program participants during the initial intervention period because lacking supervision and boredom lead to poorer choices made, thus more likely to be involved in risky illegal behaviors (LaFrance et al. 2001; Addiction, Columbia University (CASA), and America 2003). Naturally, several hypotheses were formed to inquire about the rationale. Juvenile delinquencies, however, are a complex social phenomenon involving malleable youth who are generally considered to be incapable

of distinguishing socially acceptable behaviors from those that are unacceptable. To understand this multidimensional problem, the author draws assumptions from rational crime theory and crime opportunity theory that work closely with rational decision-making under the economics framework. Based on those assumptions, the author provides a theoretical rationale for ASPs' effectiveness by showing that those programs reduce deviant behaviors by imposing time constraints on both offenders and victims, which increases opportunity costs for potential offenders and lowers the real crime rate. Another major contributor is the change in preference through the improved quality of some ASPs that guide juveniles to a trajectory out of the criminal path.

II Literature Review

In the discussion of the effectiveness of After-School Programs, there is no disagreement on the effectiveness of ASPs among different researchers. However, one controversial issue diverges the consensus, which has been the underlying rationale that defines the nature of their effectiveness. Several ASPs are promoted by law enforcement for their exceptional effectiveness in reducing deviant behaviors, those include Chicago's Becoming a Man (BAM) program, Wisconsin's 21st Century Community Learning Center (CCLC) program, and many more of the like. The essential theme shared among those programs, in the eyes of law enforcement, is the continuation of supervision from trustworthy and responsible adults after the school period, when students are more susceptible to street crimes, such as assault, theft, and drug-related crimes, etc (Manheimer and Spaulding 2020). From this perspective, supervision and regulation are emphasized, which may further fan the flame of criticism towards paternalism, and even fuel disagreement among scholars studying criminology and education. For this reason, Gottfredson et al. argue for a different explanation that contradicts common sense.

Gottfredson argues that "reductions in unsupervised time of the magnitude realized through these programs did not translate into reductions in delinquent behavior." In addition, her article also found no evidence supporting the claim that delinquencies drop because of the alternative activities provided to youth, which is often considered to be the second most propelling explanation. From her perspective, ASPs increased students' awareness not to use drugs and provided positive peer association(Gottfredson et al. 2004). Time constraints, in her study, do not play a critical role.

From a theoretical perspective, various economists considered time constraints as the key to behavioral decisions, even in criminal settings. Becker (1965) introduced time allocation and provided a theoretical model. Following the idea, Ehrlich (1973) created a model studying offenders' behavior under time constraints. Balkin and McDonald (1981) expanded Ehrlich's idea and incorporated victims' behavior under a

time constraint to formulate a general equilibrium analysis in which they focus on how legal punishment and apprehension reduce the real crime rate. Their model provides a route for general criminal behavior analysis, upon which this model is built to study a particular subset of their domain and modified to investigate the rationale for crime reduction through ASPs.

III Behavioral Model

III.A Assumptions

For the purpose of analysis, several assumptions must be imposed on the mathematical model to simplify the matter and to derive meaningful mathematical results.

The author assumes that juvenile delinquency cases are the ones involving victims, rather than victimless cases such as drug consumption. Furthermore, each individual case is the result of a matching function between victims who demand time either to expose themselves to the environment which has a probability of being victimized or to stay in after-school programs for safety and perhaps other qualities the program has to offer; and offenders who supply time to look for potential victims.

In this juvenile delinquency market, the calibrator or the price signal is the real crime rate, an index that determines the probability of victimization per unit of time spent in a dangerous environment. This index is produced by offenders and to which victims react.

The critical assumption that allows the author to utilize the economic model for behavioral analysis is that juveniles are rational utility-maximizing agents who are risk-neutral on their potential economic gain. Imposing rationality is aligned with the rational choice theory that is suitable for the model setup.

To simplify the matter and expand the domain of juvenile delinquency cases, the author assumes that juveniles do not enter the labor market, which is a reasonable assumption considering that most juveniles below age 16 are not allowed to work officially, which subsequently allows the author to further assume that time spent in ASPs or public space are the only possible options in their consumption bundle.

In general, people observe that a higher level of investment comes with a higher level of quality. A similar idea could be applied to the after-school programs. The time spent in ASPs is also determined by their quality, denoted as ϕ, which is a production function of capital and labor available for each school. Higher quality increases the victim's marginal utility of time spent in ASPs.

III.B Real Crime Rate

The concept of real crime rate follows the definition provided by Balkin and McDonald (1981). The author defines the nominal crime rate as the following

$$C \equiv pX_T \tag{1}$$

where C is the nominal crime rate, p denotes the real crime rate, and X_T is the amount of exposure time to crime that citizens choose.

The nominal crime rate in this context is the number of crimes per capita. Since the definition of crimes varies, in this model, the author interprets it as the FBI's Uniform Crime Report (UCR), which only consists of Part I crime, including murder and non-negligent manslaughter, rape, robbery, aggravated assault, burglary, larceny (theft), motor vehicle theft, and arson. Theoretically speaking, the nominal crime rate is less important because it produces biased results. To see this result, we derive conditions that lower the nominal crime rate. Based on the identity, the nominal crime rate decreases either through reducing the real crime rate p or limiting exposing time X_T. However, lowering the nominal crime rate does not eliminate the existing threats.

From equation (1), the mathematical definition of real crime rate is

$$p = \frac{C}{X_T}, \tag{2}$$

Since the real crime rate is also functionally related to victims' exposure decisions, it has two effects on the nominal crime rate. Reduced p directly reduces C, but it also stimulates X_T which then subsequently increases C via identity.

The net effect of changes depends on the elasticity of exposure to changes in the real crime rate, which can be derived by differentiate equation (1) with respect to p, then we obtain that

$$\frac{\partial C}{\partial p} = X_T(1 + e), \tag{3}$$

where e is the elasticity of demand for X_T with respect to p.

From equation (3), we could see that $\partial C/\partial p < 0$ if $e < -1$, that is, elastic demand for X_T implies a negative relationship between nominal crime rate and real crime rate. In other words, decreases in the nominal crime rate are the result of a lowered number of crimes, possibly due to reduced X_T, but the real crime rate p relatively increased and imposes a greater threat to the people who choose to spend time in

public spaces where danger exist.

III.C Victim's Behavior

Following the assumptions enumerated in the previous section, the author modifies a behavioral model under time constraints proposed by Balkin and McDonald (1981), which was based on Becker (1968) and Ehrlich (1973).

Assuming the victim's utility function taking the following form:

$$U = U(y, X_T, A_T; \phi) \tag{4}$$

where

$y :=$ Income net of losses from crime.

$X_T :=$ The amount of time spent in activities in public spaces which exposes one to the risk of crime.

$A_T :=$ The amount of time spent in ASP which do not expose one to the risk of crime.

$\phi :=$ The quality of ASP which affects marginal utility ofA_T.

Since victimization, as previously shown, involves probability. Victims are in fact maximizing utility with respect to the expected value of net income, which is assumed to have the following expression:

$$E[y] = G - psX_T \tag{5}$$

where

$G :=$ Initial endowment, non-wage income.

$p :=$ the probability of becoming a victim of crime per unit of X_T, the real crime rate.

$s :=$ the value of the losses suffered each time one is a victim.

From the structure and assumptions, victims maximize expected utility subject to time constraints $T = X_T + A_T$, which is the period of time (from 2 pm to 6 pm) when juvenile delinquencies skyrockets. Therefore, victims are solving the constrained utility maximization problem summarized as:

$$\max E[U] = \max U\left(E[y], X_T, A_T; \phi\right)$$
$$s.t. \quad T = X_T + A_T$$

or simplify by substituting X_T by $T - A_T$:

$$\max_{\{A_T\}} \quad U\left(G - ps(T - A_T), T - A_T, A_T; \phi\right)$$

Maximizing with respect to A_T produce the following first-order condition:

$$psU_1 - U_2 + U_3(\phi) = 0 \tag{6}$$

where

$$U_1 = \frac{\partial U}{\partial y}$$
$$U_2 = \frac{\partial U}{\partial X_T}$$
$$U_3(\phi) = \frac{\partial U}{\partial A_T} \text{ with } \frac{\partial U_3}{\partial \phi} > 0$$

Rearranging the first-order condition,

$$\frac{U_2}{U_3(\phi)} = 1 + ps\frac{U_1}{U_3(\phi)} \tag{7}$$

We obtain the marginal rate of substitution between time spent in public space and ASP is greater than 1 with the presence of crime ($p > 0$). That is, if crime presents, people are willing to trade more X_T for A_T, which is in line with the economic intuition and societal mechanism in which people demand more safety in the presence of danger.

Total differentiation of the first-order condition yields

$$\begin{aligned} -\left[U''\right] dA_T &= \left[psU_{11} - U_{21} + U_{31}\right] dG \\ &+ \left(sdp + pds\right)\left[U_1 + ps(T - A_T)U_{11} + (T - A_T)(U_{21} - U_{31})\right] + U_{3\phi} d\phi, \end{aligned} \tag{8}$$

For simplicity, we have assumed that victims are risk neutral, which implies that $U_{11} = 0$, then equation (8) can be simplified to

$$-\left[U''\right] dA_T = \left[-U_{21} + U_{31}\right] dG + \left(sdp + pds\right)\left[U_1 + (T - A_T)(U_{21} - U_{31})\right] + U_{3\phi} d\phi.$$

The solutions for the demand functions for A_T are

$$\frac{\partial A_T}{\partial G} = \frac{U_{21} - U_{31}}{U''}$$

$$\frac{\partial A_T}{\partial p} = \frac{sU_1}{-U''} - s(T - A_T)\left(\frac{\partial A_T}{\partial G}\right)$$

$$\frac{\partial A_T}{\partial s} = \frac{pU_1}{-U''} - p(T - A_T)\left(\frac{\partial A_T}{\partial G}\right)$$

and

$$\frac{\partial A_T}{\partial \phi} = -\frac{U_{3\phi}}{U''}$$

It is generally true that a higher income yields higher utility, $U_1 > 0$, and realizing the condition for convex optimization where $U'' < 0$, signs for $\partial A_T/\partial p$ and $\partial A_T/\partial s$ become ambiguous. If the income effect is negative ($\partial A_T/\partial G < 0$), then the signs for $\partial A_T/\partial p$ and $\partial A_T/\partial s$ will invariably be positive. This is true when $U_{21}/U_{31} > 1$, meaning the marginal utility of X_T increases more rapidly than does the marginal utility of A_T. The implication followed in this scenario is that families possessing wealth would demand more utility from the time spent in public space, but once potential monetary loss or crime occurs, they shift immediately to ASP or other similar programs due to safety concerns.

We could also suppose that the income effect is positive ($\partial A_T/\partial G > 0$), then the signs for $\partial A_T/\partial p$ and $\partial A_T/\partial s$ will depend on their relative magnitude between the income and substitution effect. However, with the presence of monetary loss (s) and the rate of victimization (p), as we have seen from equation (7), the demand for A_T increases by the MRS condition, thus, we assume substitution effect is dominant in this case. Thus, both signs for $\partial A_T/\partial p$ and $\partial A_T/\partial s$ are positive.

In addition, $\partial A_T/\partial \phi$ is unquestionably positive.

The analysis hitherto can be summarized by the demand function for A_T as

$$A_T = A_T(p, s, \phi) \tag{9}$$

III.D Offender's Behavior

Juvenile delinquency cases involving victims are the consequence of the interaction between two opposite forces. The other side of the market is determined by the offender who possesses what can be considered in societal understanding as criminal intent, but in the eye of economic analysis, intention is merely a result of utility through which offenders are indifferent between potential actions with no regard of their nature reflected upon the society. Here, we impose a strong assumption that juveniles do not differentiate different behaviors based on morality, but rather the marginal utility potentially generated.

The following model is proposed by Balkin and McDonald (1981), and the author provides justification and further assumptions for the upward-sloping supply function.

Based on the assumption that juveniles who possess criminal intent after school spend their time in two forms. They either actively look for potential victims and commit juvenile delinquencies, or they enjoy their leisure. Thus, they face the following $T_o = O_T + L_T$, where O_T is the time spent in offending, and L_T denotes time spent in leisure.

Since victimization involves uncertainty, we let q to denote the probability of finding a victim per unit of O_T, therefore, we have the following identity $q \equiv \frac{C}{O_T}$.

In a typical juvenile delinquency case where victims suffer monetary losses, their sufferings are, in general, much larger than the potential financial gain to the offender. However, considering the heterogeneity among each individual, there could be cases where marginal financial losses reach infinity. Bear this in mind, the author simplifies the reality by imposing a strong assumption that assumes victims' losses are offenders' gain, therefore, s in the previous section denoting suffering can be used to denote offenders' potential gain.

In the presence of uncertainty, offenders are maximizing expected return, which comes with two stages:

If they are not apprehended:

$$E[y_A] = qsO_T$$

If they are apprehended:

$$E[y_B] = qsO_T - F$$

where F is the discounted value of punishment for entire illegal activities and other losses.

The probability of apprehension is an exogenous variable determined by government policy and policing efficiency. Let J be the probability of apprehension, this probability can be mathematically defined as

$$J \equiv jO_T \tag{10}$$

where j is the probability of apprehension per unit of O_T.

Differentiate equation (10) with respect to j, we obtain the following

$$\frac{\partial J}{\partial j} = O_T + \frac{j\partial O_T}{\partial j}$$

This equation states that it is possible that an increase in j, the real apprehension rate, does not increase

the nominal one. Suppose $\partial O_T/\partial j < -1$, that is, O_T is highly sensitive to real apprehension rate, then it leads to a fall in nominal apprehension ($\partial J/\partial j < 0$). It implies that if offenders are sensitive to punishment, then we should expect the deterrence effect of efficient policing policy to yield fewer apprehensions as fewer offenders would participate in juvenile delinquencies. The converse is also true that if $\partial O_T/\partial j > -1$, then nominal apprehension is positive ($\partial J/\partial j > 0$), meaning less sensitive offenders would still contribute to the apprehension data.

Since the apprehension rate is largely dependent on the type of offenders, the author only treats apprehension as the possibility to distinguish whether offenders would face legal punishment.

Let the utility function for offenders to be the following and continuing to assume risk neutral:

$$U[E[y], L_T] = U[(1 - jO_T)(qsO_T) + jO_T(qsO_T - F), T_o - O_T] \tag{11}$$

Maximizing the utility with respect to O_T yields the following first-order condition:

$$qs = \frac{U_2}{U_1} + jF \tag{12}$$

Equation (12) states that expected gain from one more unit of time spent in juvenile delinquency (qs) equals the marginal value of leisure ($\frac{U_2}{U_1}$) plus potential monetary value loss due to punishment jF.

Total differentiate equation (12) yields the following equation:

$$\begin{aligned} -\left[\frac{U_{21}U_2}{U_1^2} - \frac{U_{22}}{U_1} - \frac{U_2^2U_{11}}{U_1^3} + \frac{U_2U_{12}}{U_1^2}\right] dO_T = \\ \left[\left(\frac{U_{21}}{U_1} - \frac{U_2U_{11}}{U_1^2}\right)(O_T - 1)\, s\right] dq + \left[\left(\frac{U_{21}}{U_1} - \frac{U_2U_{11}}{U_1^2}\right)(O_T - 1)\, q\right] ds \\ + \left[-\left(\frac{U_{21}}{U_1} - \frac{U_2U_{11}}{U_1^2}\right) O_T F\right] dj + \left[-\left(\frac{U_{21}}{U_1} - \frac{U_2U_{11}}{U_1^2}\right) jO_T\right] dF \end{aligned}$$

Risk neutrality condition implies that $U_{11} = 0$. We can simplify the equation and solve for O_T.

Let

$$\frac{(U_{21} + U_{12})U_2}{U_1^2} - \frac{U_{22}}{U_1} = \frac{\partial^2 U}{\partial O_T^2} = U''$$

We have following solutions

$$\frac{\partial O_T}{\partial q} = \frac{U_{21}}{U_1} \cdot \frac{(O_T - 1)\, s}{-U''}$$

$$\frac{\partial O_T}{\partial s} = \frac{U_{21}}{U_1} \cdot \frac{(O_T - 1)\, q}{-U''}$$

$$\frac{\partial O_T}{\partial j} = \frac{U_{21}}{U_1} \cdot \frac{O_T F}{U''}$$

and

$$\frac{\partial O_T}{\partial F} = \frac{U_{21}}{U_1} \cdot \frac{j O_T}{U''}$$

Similar to the victim's behavioral analysis, further assumptions must be imposed upon the offenders' behavior for a meaningful and comprehensive analysis. We know that $U_1 > 0$ and $U'' < 0$ are the maximization conditions, therefore, $\partial O_T/\partial q$ and $\partial O_T/\partial q$ are greater than 0 if $sU_{21}(O_T - 1) > 0$. The result is ambiguous because the substitution effect of increase in wage (s) tends to increase the labor supply ($\frac{(O_T-1)s}{-U''} > 0$), but if leisure ($U_{21}$) is a normal good, income effect tends to lower the labor supply ($\frac{U_{21}}{U_1} < 0$).

In economics, we often consider leisure as normal goods, but in the criminality setting, it is more reasonable to have leisure as inferior goods. This assumption is in line with other criminology theories, such as broken window theory where a misdemeanor gradually progresses to a felony. Although we have assumed that offenders are rational utility maximizing agents, what perception they have with regards to leisure does not interfere with the rationality we impose on their misdeed, and we've often observed that juveniles who tend to commit juvenile delinquencies can easily be motivated by financial incentive and psychological excitement. For this purpose, we argue that leisure in this setting is inferior. Furthermore, empirical evidence also suggests that policing strategies, including apprehension and legal punishment, often reduce criminal activities due to deterrence effects, thus, $\partial O_T/\partial j < 0$ and $\partial O_T/\partial F < 0$ implies that $U_{21} > 0$.

Given the inferior leisure assumption, we have $U_{21} > 0$ which implies that offenders have a positively sloped supply function, through which increases in potential illegal gain or more frequent matching with suitable victims stimulate their incentive for further offenses.

To summarize the analysis as a production function of O_T, we have the following

$$O_T = O_T(q, s, j, F) \tag{13}$$

III.E The Market for Juvenile Delinquency

Following the assumptions, we assume juvenile delinquency cases involving victims are the result of the interactions between victims and offenders. During the interactions, victim determines the amount of time

demanded to expose themselves to dangerous environments, and due to time constraints, which consequently determines their quantity demanded for time being spent in after-school programs (A_T). Offenders, on the other hand, determine the time spent in looking for victims and committing crimes, O_T. So the market clearing condition for the juvenile delinquency "market" can be considered as a matching function between number of victims to the number of offenders as the following

$$p(T - A_T) = qO_T \tag{14}$$

Furthermore, the probability of victimization or the real crime rate p is functionally related to offenders' behaviors and assuming that they are positively correlated; equally, the probability of finding the victim, q, is also determined by victims' decisions and they tend to have a positive correlation, then our model thus far, including the equilibrium condition, can be summarized as the following system of equations:

$$\begin{aligned} A_T &= A_T(p, s, \phi) \\ p &= p(O_T) \quad \frac{\partial p}{\partial O_T} > 0 \\ O_T &= O_T(q, s, j, F) \\ q &= q(A_T) \quad \frac{\partial q}{\partial A_T} < 0 \end{aligned}$$

where the dependent variables are A_T, X_T, O_T, p, q, C, and J.

To derive the comparative statics of the model, we could totally differentiate the system of simultaneous equations to obtain the Jacobian matrix as the following

$$\begin{bmatrix} 1 & -\frac{\partial A_T}{\partial p} & 0 & 0 \\ 0 & 1 & -\frac{\partial p}{\partial O_T} & 0 \\ 0 & 0 & 1 & -\frac{\partial O_T}{\partial q} \\ -\frac{\partial q}{\partial A_T} & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} dA_T \\ dp \\ dO_T \\ dq \end{bmatrix} = \begin{bmatrix} \frac{\partial A_T}{\partial s} ds + \frac{\partial A_T}{\partial \phi} d\phi \\ 0 \\ \frac{\partial O_T}{\partial s} ds + \frac{\partial O_T}{\partial j} dj + \frac{\partial O_T}{\partial F} dF \\ 0 \end{bmatrix}$$

For comparative statics, we hold F, j, and ϕ constant, and examine the effect of s by backward substitution to the system of equations. We can have a similar process for the other three variables. 2 summarizes the results from calculation. Among all the dependent variables, the author is mostly interested in the effect on real crime rate, or the probability of victimization, as the nominal crime rate is a biased index shown in section III.B. From the table, we can see that only the quality of after-school programs can unambiguously reduce the real crime rate, demonstrating a great positive potential for crime reduction.

Differing from Balkin and McDonald's work, the effect of increasing the expected probability of apprehension and legal punishment is ambiguous. This is due to the fact that the contribution of legal activities causes two consequences in opposite directions. From the previous section and empirical evidence, we conclude that legal punishment and apprehension reduce the desire of juveniles to spend time in delinquent activities; nevertheless, this trade-off for offenders creates an illusion of safety for victims and motivates them to expose themselves more often to the environment that may induce danger, which cancels out the deterrence effect from legal punishment, so the result is unknown.

For apprehension and penalty to invariably reduce the real crime rate, the deterrence effect must outweigh the stimulus from the indirect safety illusion. To achieve this result, we must have offenders who are really sensitive to legal punishments and their supply for juvenile delinquency become very elastic, or we could have the government increase investment in legislation and legal entities such as criminal courts and police departments to strengthen and amplify their existing policing strategies. However, the issue might be that the investment may bifurcate as a treatment for other existing crimes.

Table 2: Comparative Statics Results: Positively Sloped Supply of Offender Time

Dependent Variables	s Loss per Crime	j Probability of Apprehension	F Penalty	ϕ Quality of ASP
X_T Victim's exposure time	$-$	$+$	$+$	$-$
A_T Time in ASP	$+$	$-$	$-$	$+$
p Prob. of victimization	?	?	?	$-$
O_T Criminal's time in crime	?	?	?	$-$
q Prob. of finding a victim	$-$	$+$	$+$	$-$
$C = pX_T = qO_T$ Nominal crime rate	?	?	?	$-$
$J = jO_T$ Prob. of apprehension	?	?	$-$	$-$

IV Summary

This theoretical model imposes several strong assumptions on the behavioral decisions made by juveniles, through which the decisions of victims and offenders have been considered. Differing from the traditional time allocation theory where scholars focus on decision-making in consuming time that induces danger, this model particularly focuses on the demand for safety as a substitute good. Through the general equilibrium and the time constraint, the effect of deliberately chosen exogenous variables could be simultaneously studied

and evaluated.

This article proposed a hypothetical rationale for after-school programs and crime reduction. Following the analysis of previous theoretical models, this model specifically investigates under what condition the real crime rate, or the probability of victimization, decreases by altering the exogenous conditions. The model proposes that the improvement in the quality of after-school programs has an unambiguous reduction effect, due to victims' spontaneous demand for safety when facing potential financial loss and indirect demand when the marginal utility of ASP outweighs that of the public space. Legal punishment and apprehension, on the other hand, deliver the desirable effect under strict conditions which is largely outside the control of policymakers.

The analysis suggests that providing after-school programs with sufficiently desirable quality would reduce the existing threat of criminal activities. The implication of this follows that if resources could be manipulated to extend the existing after-school programs to the full concentration of juvenile delinquency period, the general equilibrium in the market would shift victims' demand to ASP and sufficiently reduce the real crime rate by decreasing marginal utility of offending and possibility of finding the victim. For now, the model has provided a plausible and logical route toward the rationale of how ASPs might reduce juvenile delinquency, concrete evidence, however, demands more effort.

Since the real crime rate is difficult to measure, more empirical evidence is needed to verify its relationship with the nominal crime rate, only through which can the nature of juveniles be determined as to whether they are sensitive to legal punishment or not. Following that result, the analysis of crime reduction can go further. Given all else fixed, if assuming the deterrence effect from legal punishment and apprehension work effectively as desired, the marginal deterrence effect between those and that of ASP should be compared.

It is also possible to determine the optimizing conditions for ASP investments given the total cost of juvenile delinquencies and the cost of policing. If we suppose that the effectiveness of ASP in terms of deterrence effect should be the same at the minimum level as the policing strategies, then the low average cost of ASP would be a strong piece of evidence for policy implication.

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