

A Dynamic Model of Criminal Behavior of Youth

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Abstract

This paper presents a dynamic model of young people's criminal decision assuming the utility of individuals depends on their earnings from legal work and illegal activities. Young agents may increase their earnings through criminal activities but lose some when punishment occurs. There are two types of punishment. Criminals have to pay a fine if arrested but need to serve sentences from months to years with no earnings if incarcerated. The model parameters are estimated through the Simulated Method of Moments(SMM) using a sample of young individuals from the National Longitudinal Survey of Youth 1997(NLSY97). Estimation results show that the persistent wage rate is the highest to people without criminal records, and the expected wage of people with prison records highly depends on the wage shock, which is explained by a large wage gap before and after prison. If the expected income from illegal activities is very low, people with no records have a lower propensity to commit a crime than ex-offenders, which explains why most young people with no work or low wage do not commit a crime. Since the probability of being punished is higher for offenders who recidivate, they will avoid crossing the line to jeopardize their future wage once their earning from legitimate market is over a certain level. An increase in the probability of incarceration or arrest of all criminals, a decrease in the probability of being released of prisoners with long sentences and an increase in the probability of a long sentence term can decrease the overall crime involvement and recidivism. Strictly sealing the criminal records of youth may reduce recidivism but slightly increase the crime involvement of people without records.

Keywords: Economics of Crime, Structural Model, Criminal behavior, Prison, Work, Wage, Youth, Sentence

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1 Introduction

Pioneering work in economics by Becker (1968) and Ehrlich (1973) describe criminal participation as an optimal response to economic incentives. Since those contributions, many empirical studies have examined the relationship between work, wage, illegal income, punishment and crime.¹ There are over 13,000,000 arrests every year in the United States. More than 5,000,000 of those arrests come from people aged 14 to 24. These cohorts are only about 15% of the total population but have more than 40% of the arrests.² Although family breakdown, abnormal systems of family functioning, living environment, the changing social structure and peer pressure are thought to be important factors contributing to juvenile crime, research shows that young individuals are sensitive to economic incentives similarly to adults.³

In the United States, a high proportion of people start working when they are teenagers. According to the Bureau of Labor Statistics (2003-2008), 20-27% of people aged 16 to 17 are employed. The rate goes up to 40-47% for people aged 18 to 19, and to 60-65% for people aged 20 to 24. Given that most young people have low earnings from the legitimate labor market, and a higher arrest rate compared to adults, it is important that we understand how economic incentives affect the behavior of young population. This will allow us to understand and predict the effects of policy changes on crime involvement rate or recidivism of young

¹Lott (1992) finds significant negative effects of conviction on future income. Waldfogel (1994) finds depressing effects of conviction on future employment. Uggen (2000) finds that providing jobs to criminals significantly reduced recidivism among adults and concludes that work is a turning point for adult offenders.

²Uniform Crime Reports, FBI(1998-2009)

³Freeman (1991) examines the effects of incarceration on employment of young male, and finds that incarceration decreases the probability of future work by 15 to 30% and the number of weeks worked per year by 8 to 16 %. Grogger (1995) concludes that convictions have little effect on future earning while probation has no effect on arrestee's subsequent earning by analyzing a sample of male arrestees from California. Nagin and Waldfogel (1998) find that conviction increase the job instability of young British Offenders. Although they find a positive effect of conviction on youths' later earnings, they believe that such effect is due to the fact that convicted youths take jobs that have higher initial wage with lower growth rate. Besides, young offenders from high income families might not be affected by their conviction, while people from low income families might have difficulty finding a job once they are released. Grogger (1998) finds that the falling of real wage is an important determinant of crime involvement. Besides, wage differentials considerably explain the racial differences in youth crime. Mocan and Rees (2005) suggests that juveniles respond to incentives and sanctions. They believe that providing more employment opportunities and greater deterrence would reduce juvenile crime. Warren et al. (2006) claim that receiving a conviction when young would lower subsequent adult earnings by 13%. They also find that the effect of having been charged but not convicted decreases over time while the effect of having been convicted persists over ten years.

population, which can also be used in welfare analysis to evaluate the desirability of different policies.

More recent research has analyzed criminal choices within a dynamic framework, in which individuals maximize their expected lifetime utility subject to economic constraints. Flinn (1986) and Lochner (2004) introduce dynamic models of criminal behavior in a human capital approach within a time allocation framework. They stress the role of wages and opportunity costs in the determination of criminal behavior, arguing that older, more intelligent, and more educated individuals commit less crimes. Mocan et al. (2005) build a structural model assuming that there are two types of human capital, legal and criminal, which are accumulated through different choices. In their model, the endogenous relationship between differentiated human capital and labor markets explains why criminals may or may not engage in criminal activities after they are released. However, it is not easy to measure the amount of time spent on crime and the human capital from criminal activities. The lack of data prevents them from performing an empirical analysis. Although the amount of working hours of individuals is available in the NLSY97, there is no information about the time spending on criminal activities. The idea that individuals process two types human capital, legal and crime, seems reasonable but cannot be identified empirically.

Williams and Sickles (2006) estimate the continuous hours of criminal behavior using the Euler equation GMM method and the 1958 Philadelphia Birth Cohort Study. They account for the influence of social norms on the decision of crime participation with the assumption that social capital provides a flow of services with a good reputation and social acceptance which would be reduced through the arrests. They find that initial social capital is important in determining the pattern of criminal involvement in adulthood. Using the same data, Imai and Krishna (2004) construct a dynamic model with different structural elements. They assume that the direct utility under different behavior, committing a crime or not, is different. They argue that future punishment comes mainly from the labor market and conclude that early prevention is more effective than redemption, which shows the importance of early

intervention programs. Both of their research focus on males.⁴ Due to data restrictions, their research only includes arrests, but cannot identify who is convicted. Although including some disutility terms link the criminal behavior and the data better, it is not clear if it is necessary. Therefore, I simply assume initially that the utility of individuals depends on their earnings from legal work and illegal activities. I also includes the punishment of incarceration and different sentence terms into the model.

In this paper, a dynamic model is estimate to analyze the effect of economic incentives on crime involvement and recidivism of young people. The model assumes that the utility of individuals depends on their earnings from legal work and illegal activities. Young agents may get extra earnings through criminal activities but lose some when punishment occurs. There are two types of punishment: arrest and incarceration. Criminals have to pay a fine if arrested but need to serve sentences from months to years with no earnings if incarcerated. The model is estimated through the SMM using data from the NLSY97, a nationally representative survey of 8984 individuals with employment records, criminal information, illegal income, and detailed arrest and sentence records, as well as other sociodemographic information. This is the first paper that estimates the effect of expected wage, illegal income, arrest, incarceration, and sentence terms on the crime involvement of young population. The ability of the model that incorporates the wide variety of sentence terms and types of punishment allows me to evaluate the effect of different policies on the crime participation and recidivism of youth.

Although crime can be caused by many other factors, this paper shows that economic incentives explain well the behavior of individuals. Since the negative impact of punishment increases as the wage level goes up, people with lower wage levels from the legitimate labor market are more likely to commit a crime. People without criminal records have the highest persistent wage rate, while the wage of ex-prisoners highly depends on the wage shock, which is explained by a large wage gap before and after prison. Compared with ex-offenders, people with no criminal records have lower propensity to commit a crime if their expected income from illegal activities is very low, which explains why most people with no work or low income

⁴Imai and Krishna (2004) also exclude people going to college

do not commit a crime. However, people without any record are more likely to commit a crime as their expected illegal income increases. If the expected illegal income becomes high enough, they will always commit a crime. Since the probability of being punished is higher to ex-offenders once they recidivate, they are less likely to be involved in criminal activities if the expected wage is over a certain level. The threshold is lower to people with criminal records than people with arrest records.

The model shows that an increase in the probability of incarceration or arrest of all criminals, such as an increase in the police force or the incarceration rate, a decrease in the probability of being released of prisoners with long sentences and an increase in the probability of a long sentence term can decrease the crime involvement and recidivism of youth. Removing the negative effect of criminal records, such as strictly sealing the criminal records of youth, may reduce recidivism but slightly increase the crime involvement of people without records. Compared with all the other policies, an increase in the probability of arrest of all criminals decreases the crime participation better, both the overall crime involvement and the recidivism. The overall crime involvement rate would decrease 2.18% within the nation and 2.35% in urban areas if the probability of arrest increases by 50%. Today, the United States has the highest documented incarceration rate in the world,⁵ and the prison expenditure is very large.⁶ Considering the high cost of incarceration, we might be able to decrease crime involvement and reduce government expenditures by increasing the probability of arrest through stricter police enforcement instead of putting more criminals in prison.

The remainder of this paper is organized as follows. Section 2 presents the dynamic model of criminal choice. Section 3 describes and analyzes the data used in the estimation. Section 4 shows the estimation method. Section 5 discusses the estimation results. Section 6 shows the effects of different policies on the crime involvement rate, and Section 7 concludes.

⁵According to International Centre for Prison Study, the rate was 743 per 100,000 of national population in 2009.

⁶According to the State Prison Expenditures from the Bureau of Justice, the average operating costs per inmate varies by states. In 1996, the annual costs per inmate was the highest in Minnesota, \$37800, and the lowest in Alabama, \$8000. In 2001, the highest annual costs per inmate went up to \$44379 in Maine and the lowest increased a little bit to \$8128 in Alabama.

2 Model

In this model, young agents maximize their expected lifetime utility by making a choice, committing a crime or not. Their utility only depends on the earnings from legal income and illegal activities. Agents are active, committing a crime or not if they are not in prison, for $T = 15$ years.⁷ They may increase their earnings through criminal activities but lose some when punishment occurs. The model assumes that agents can never be arrested or go to prison if they do not commit a crime.⁸ If agents are involved in criminal activities, they will face a probability of being punished. There are two types of punishment: arrest and incarceration. People can never be punished for the crime they commit if they are not caught in the same year. They are free to make a decision in the next year, and their total earnings will be their wage from legal work and income from illegal activities. If they are arrested, these young people will lose part of their wage, $(1 - \gamma)W_L^t$, and their income from illegal activities will be forfeited. Since they do not have sentences, these criminals are free to make a choice in the next year. However, "the arrest records" may affect their wage in the next period. The model assumes that "the effect" will last for a year and then fade away.

If the young criminals are incarcerated, they need to serve a prison term from months to years.⁹ Like those who are arrested, these people will lose part of their wage, $(1 - \gamma)W_L^t$ and all of the income from the illegal activities. In addition, they will lose the wage that they were supposed to earn if they were not in prison. If the sentence is no more than a year, they will be free to make a choice after being released. Like the arrest records, the prison records may affect their wage after prison. The model also assumes that the effect only lasts for a year. If the sentence is more than one year, criminals will have to stay in prison in the next year without earnings. At the end of the next year, they will face a probability, $(1 - \kappa)$, of being released.

Every year, agents who are not in prison at the beginning face an expected wage from

⁷The model assumes the utility of each individual after $T=15$ is 0, which is similar to econometric studies of job search process with the assumption of an exogenously given search horizon as in Wolpin (1987).

⁸The model does not consider the possibility that the police may arrest the wrong person or put innocent people in prison.

⁹In the final period, T , criminals will not have a sentence more than 12 months.

work, W_L^t , which is a function of their actual wage and their records in the previous year, $t - 1$.¹⁰ Based on their expected wage, young agents make their decision to commit a crime or not. Agents who are not involved in criminal activities will not face any punishment in the same year. Their utility is equal to their expected wage, $U_L(t) = W_L^t$.

Agents with criminal behavior, however, will face three different outcomes: away without punishment(IN), being arrested(IA), and going to prison(IJ). Based on the outcomes, there are 3 different states: no records(N), arrest records(A), and prison records(J). People who do not commit a crime or get away from their criminal behavior without any punishment are in the group "N". People who only get arrested but do not have sentences are in the group "A". People who need to serve sentences belong to the group "J".

For people who commit a crime, the probability of no punishment(IN) is $P_{IN} = \alpha_m$, the probability of being arrested(IA) is $P_{IA} = \delta_m$, and the probability of going to prison(IJ) is $P_{IJ} = \tau_m$, where $P_{IN} + P_{IA} + P_{IJ} = 1$. The model assumes that agents with the same states face the same probability of being punished if they commit a crime.

$$(P_{IN}, P_{IA}, P_{IJ}) = (\alpha_m, \delta_m, \tau_m) = \begin{cases} (\alpha_1, \delta_1, \tau_1), & \text{if } S^{t-1} = \text{No Records(N)}; \\ (\alpha_2, \delta_2, \tau_2), & \text{if } S^{t-1} = \text{Arrest Records(A)}; \\ (\alpha_3, \delta_3, \tau_3), & \text{if } S^{t-1} = \text{Prison Records(J)}; \end{cases}$$

For people who commit a crime at t , their utility is their expected earnings under different outcome. If they can get away with no punishment, their utility is $U_I(t) = W_L^t + W_I^t$, where W_I^t is the expected income from illegal work at time t , which is assumed to be i.i.d. that follows a distribution with the mean μ_{W_I} and the standard deviation σ_{W_I} . If they are arrested, their utility is $U_I(t) = \gamma W_L^t$, where γ is the proportion of wage that the criminals can keep once they are arrested, which is between 0 and 1. If they need to serve sentences, their utility depends on the sentence terms(TJ). The model assumes that the probability of a prison term is the same for each prisoner regardless of their records.

¹⁰The minimum wage is 0, meaning that the agents do not work. Since young people may work part time, I do not consider the reservation wage.

	TJ=1...12	TJ> 12
U_I^t	$\frac{12-TJ}{12}\gamma W_L^t$	0
Probability	$\varphi_1 \dots \varphi_{12}$	φ_{13}

The following table summarizes the outcomes, utility and the expected utility of people with and without criminal behavior.

	Outcome	Prob.	Utility	Expected Utility
No Crime	Away	1	W_L^t	W_L^t
Crime	Away	α	$W_L^t + W_I^t$	$\alpha(W_L^t + W_I^t)$
	Arrest	δ	γW_L^t	$\delta\gamma W_L^t$
	Sentence	$\tau\varphi_{i,i=1\dots 12}$	$\sum_{i=1}^{12} \frac{12-i}{12}\varphi_i\gamma W_L^t$	$\tau \sum_{i=1}^{12} \frac{12-i}{12}\varphi_i\gamma W_L^t$
		$\tau\varphi_{13}$	0	0
$\alpha + \delta + \tau = 1; \varphi_1 + \dots + \varphi_{13} = 1$				

Since people without criminal behavior can never be arrested or put into prison, their expected utility is $EU_I(t) = W_L^t$, while the expected utility of criminals is

$$EU_I(t) = \alpha(W_L^t + W_I^t) + \delta\gamma W_L^t + \tau \sum_{i=1}^{12} \frac{12-i}{12}\varphi_i\gamma W_L^t.$$

Young agents face three different kinds of expected wage at $t+1$ based on their states at t ¹¹. The expected wage of people with no records or arrest records is assumed to be their wage in the last period times a persistent wage rate plus an error term, while the expected wage of ex-prisoners is their initial wage level times a persistent wage rate plus an error term. People with different records face different persistent wage rate.

$$W_L^{t+1} = \begin{cases} \rho_N W_L^t + \varepsilon_N, & \varepsilon_N \sim (\mu_N, \sigma_N^2) \text{ if } S^t = \text{No Records(N)}; \\ \rho_A W_L^t + \varepsilon_A, & \varepsilon_A \sim (\mu_A, \sigma_A^2) \text{ if } S^t = \text{Arrest Records(A)}; \\ \rho_J W_L^0 + \varepsilon_J, & \varepsilon_J \sim (\mu_J, \sigma_J^2) \text{ if } S^t = \text{Prison Records(J)}. \end{cases}$$

where ρ is the persistent wage rate, μ is the mean of the error term, and σ is the standard

¹¹If they need to stay in prison the next year, meaning that their sentences is more than 12 months, their expected wage in the next year is 0.

deviation of the error term.

To maximize the expected present value of their lifetime utility, people make their own choice simply by comparing the value of staying in the legitimate labor market with the value of committing a crime. Their value function is

$$V(W_L^t, S^{t-1}, t) = \text{Max}[V_L(W_L^t, t), V_I(W_L^t, S^{t-1}, t)].$$

Since agents who behave legally are able to make a choice in the next year, their value function is simply the current utility plus the expected function.

$$\begin{aligned} V_L(W_L^t, t) &= W_L^t + \\ &+ \beta \int \text{Max}[V_L(W_L^{t+1}, S^t = L, t + 1), V_I(W_L^{t+1}, S^t = L, t + 1)]dF(W_L^{t+1}|W_L^t, S^t = L). \end{aligned}$$

The value function of criminals depends on the probabilities of the outcomes and their expected earnings. If the sentence is more than 12 months, criminals need to stay in jail the next period.

$$V_I(W_L^t, S^{t-1}, t) = P_{IN}(S^{t-1})V_{IN}(W_L^t, t) + P_{IA}(S^{t-1})V_{IA}(W_L^t, t) + P_{IJ}(S^{t-1})V_{IJ}(W_L^t, t).$$

where P_{IN} is the probability of no punishment(IN), P_{IA} is the probability of arrest(IA), and P_{IJ} is the probability of incarceration(IJ).

$$\begin{aligned} V_{IN}(W_L^t, t) &= (W_L^t + W_I^t) + \\ &+ \beta \int \text{Max}[V_L(W_L^{t+1}, S^t = N, t + 1), V_I(W_L^{t+1}, S^t = N, t + 1)]dF(W_L^{t+1}|W_L^t, S^t = N). \end{aligned}$$

where $V_{IN}(W_L^t, t)$ is the value function of criminals with no punishment(IN) at t .

$$\begin{aligned} V_{IA}(W_L^t, t) &= \gamma W_L^t + \\ &+ \beta \int \text{Max}[V_L(W_L^{t+1}, S^t = A, t + 1), V_I(W_L^{t+1}, S^t = A, t + 1)]dF(W_L^{t+1}|W_L^t, S^t = A). \end{aligned}$$

where $V_{IA}(W_L^t, t)$ is the value function of criminals with arrest(IA) at t .

$$\begin{aligned}
V_{IJ}(W_L^t, t) &= \sum_{i=1}^{12} \varphi_i \left[\left(\frac{12-i}{12} \right) \gamma W_L^t + \right. \\
&\quad \left. + \beta \int \text{Max}[V_L(W_L^{t+1}, S^t = J, t+1), V_I(W_L^{t+1}, S^t = J, t+1)] dF(W_L^{t+1} | W_L^0, S^t = J) \right] + \\
&\quad + \varphi_{13} [0 + \beta F_J(t+1)].
\end{aligned}$$

where i is the sentence term from 1 month to 12 months, φ_i is the probability of each sentence term, φ_{13} is the probability of a long sentence (more than a year), $V_{IJ}(W_L^t, t)$ is the value function of criminals with sentence(IJ) at t , and $(1 - \kappa)$ is the probability of being released.

$$\begin{aligned}
V_J(t) &= 0 + \kappa \beta V_J(t+1) + \\
&\quad + (1 - \kappa) \beta \int \text{Max}[V_L(W_L^{t+1}, S^t = J, t+1), V_I(W_L^{t+1}, S^t = J, t+1)] dF(W_L^{t+1} | W_L^0, S^t = J).
\end{aligned}$$

where $V_J(t)$ is the value function of prisoners at t .

The value function of non-criminals and criminals in the final year only depends on the utility in the corresponding period. The model assumes that after $t = T$, everyone faces the same utility.

$$V_L(W_L^T, T) = U_L(T) = W_L^T.$$

$$V_I(W_L^T, S^{T-1}, T) = EU_I(T) = P_{IN}(S^{T-1}) \gamma W_L^T + P_{IA}(S^{T-1}) \gamma W_L^T \left(\sum_{i=1}^{12} \frac{12-i}{12} \varphi_i \right) + P_{IJ}(S^{T-1}) (W_L^T + W_I^T).$$

Active agents solve a dynamic problem with a finite time horizon $T = 15$. The solutions will be explained in Section 5.

3 Data

The data I use come from the NLSY97, a nationally representative sample of 8,984 youths, which provides basic demographic information, employment records and schooling records. The first round took place in 1997. All individuals were 12 to 16 years old at the end of 1996. Since all interviewees were teenagers when they first joined the survey, the data set

contains extensive information about the transitions of the youth from school to work and into adulthood. The first round also contains a parent questionnaire that generates information about family background and history of the youth. Additionally, from 1998¹² to 2003¹³, the survey collected self-reported information about criminal activities, expected illegal income from criminal activities with potential earnings and arrest records of each respondent since the last interview. The information of illegal behavior includes the most common misdemeanors such as stealing money, attacking people, selling or help selling drugs, and other property crimes. From 1998 to 2002, the survey also collected self-reported information of conviction, charge and sentence records of each respondent for each arrests since the last interview.¹⁴

To reduce the potential reluctance to respond to these sensitive questions about criminal activities, all respondents are surveyed by a computer interface. They enter the answers directly into the computer without any intervention by the interviewer. It is possible that people underreport criminal activities because they might feel embarrassed to put them into public or to avoid the possibility of being punished. However, over-reporting also can be a problem for some respondents who may wish to brag or exaggerate their criminal exploits. In the NLSY97, the probability of arrest and incarceration is easy to be obtained since the information of criminal behavior, arrest and prison is provided. However, criminals can only be observed when they are caught and reported. Therefore, it is not possible to know how many people actually commit a crime in the US and count the actual probability of arrest and incarceration. Since the total arrests are reported in the Uniform Crime Reports from the FBI annually, I compared the arrest rate of the NLSY97 with the arrest rate of the UCR. The arrest rate is defined as the total number of arrests over the resident population of the U.S

[Table 1 here]

Table 1 shows the age-specific arrest rate of the NLSY97 and the UCR.¹⁵ An age-specific

¹²In the first round, the survey collected the history of their criminal activities until the date of interview in 1997.

¹³Since 2004, NLSY97 only collected the relevant information of a control group. Crime questions were asked only of respondents who had ever reported being arrested, along with a control group for comparison.

¹⁴See Appendix 1.1

¹⁵The age-specific arrest rate is not directly from the FBI website, which only include certain kinds of

arrest rate is defined as the number of arrests made over the inhabitants belonging to a defined age group. The first two columns report the arrest rate of NLSY97 with and without sample weight, and the third column reports the arrest rate of the UCR. Compared with the arrest rate of the UCR, the arrest rate of the NLSY97, with or without sample weighted, is higher for people aged 12 but lower for people aged 15 and more, meaning that the NLSY97 overestimates the arrest rate of people aged 12 and underestimate arrest rate of people aged 15 or more. One possible reason is that the NLSY97 is the survey with longitudinal data while the UCR contains cross sectioned data. The other possible reason could be the way that the NLSY97 collected information. The NLSY97 only asked about the participation of certain criminal activities which include most misdemeanors but no felonies, but the information of arrest was collected separately, meaning that the questions of arrest were asked to everyone, not only to people who commit a crime. Respondents was asked about the involvement of the six types of criminals activities before the arrest records. Therefore, they may skip the arrest questions if the criminal activities they were involved in do not belong to the crimes that were list in the survey. Although the arrest rate of the NLSY97 and the UCR are different, both of them show that the arrest rate gradually increases as the age goes up from early to late teens and then decreases. The result is consistent to most study that the crime rate rises in early teens, peak during the mid to late teens and then decreases (Hirschi and Gottfredson (1983)). The table also shows the juvenile arrest rate from the Office of Juvenile Justice and Delinquency Prevention(OJJDP) in the last row, which is defined as the number of arrests of persons under age 18 over the residents aged 10 through 17. The juvenile arrest rate was 9.2% in 1997 and gradually decreased by year. In 2001, the rate reduced to 6.89%.

There are 6 types of illegal activities in the NLSY97.¹⁶ People are defined as criminals if they are involved in at least one type of illegal activity. Since the information of behavior is

offenses. Instead, I first counted the estimated age-specific arrests, which is the total arrests of each age group times the age-specific population from the BLS over the estimated age-specific population from the UCR. Then I count the age-specific arrest rate, the estimated age-specific arrests over the estimated age-specific population from the BLS

¹⁶To avoid the problem that the survey center might be compelled by law to give information to law enforcement and save time, the survey does not ask about serious crimes like murder or rape. Please see the Appendix. 1.2

from 1997 to 2003 and the information of punishment is from 1997 to 2001. I only include the observations from 1997 to 2001. People who were not continuously interviewed or did not report sufficient information, such as their wage and their behavior, for at least two years are excluded from the sample. I also exclude people without consistent information, such as no work but positive wage. Besides, people who claimed that they did not commit a crime but was arrested in the same year are removed from the sample.¹⁷ People are defined in prison if they are sentenced to spend time in a correctional institutions, like a jail, prison or a youth institution like juvenile hall or reform school or training school in the NLSY97.¹⁸ The annual wage and illegal income are adjusted by consumer price index; the base year is 1985. There are 7051 people in my data, 5543 for 5 year, 557 for 4 years, 508 for 3 year and 443 for 2 years. 51.23% of people are males and 48.77% are females.

[Table 2 here]

Table 2 shows the descriptive statistics by the year that young individuals are in my data. In the first year, 29.40% of people confessed that they committed a crime. The crime involvement gradually decreased. By the fifth year, only 14.56% of people were involved in criminal activities. The percentage of people being arrested, however, varied by year. In the first year, 4.85% of people reported being arrested. The rate decreased to 3.79% in the second year but increased to 6.11% in the third year. In the fourth and fifth year, the rate decreased to 5.45%. The percentage of people being in prison was 1.13% in the first year and slightly increased to 1.33% in the fifth year. Since all the observations were 12 to 16 at the end of 1996, most of them were students. They might not work or work part time. Therefore, the annual wage was very low on average. In the first year, 46.25% people worked and the average annual wage was \$1253. Until the fifth year, 73.64% of people worked and the annual wage went up to \$5127 on average. The average income from illegal activities, however, varied from year to year. In the first year, people committed a crime claimed that their average

¹⁷See the Appendix 1.3 for sample selection.

¹⁸Although the intention of juvenile justice is the provision of treatment and regenerative care for its clients, critics have contented that the juvenile justice system delivered much the same kinds of punishment and coercion as did the adult system(Manski and Nagin (2002)).

earning from illegal activities was \$594. The amount went up to \$1020 in the second year and \$3394 in the third year. In the fourth and fifth year, the average income from illegal income decreased to \$1641 and \$886. More than 72% of young people are living in urban areas.¹⁹

[Table 3 here]

Table 3 shows the behavior transitions of individuals. In this table, people are split into three groups based on their choice: no crime(NC), crime(C) and no choice(NA). People who are not involved in criminal activities are in group NC. People who commit a crime are in group C. People who are not able to make a choice in the current year are in group NA. For people who do not commit a crime at t (NC), only 10.93% of them would commit a crime at $t + 1$. For people who commit a crime at t (C), 1.19% need to serve long sentence at $t + 1$. Of all the others who are able to make a choice, 39.60% would commit a crime at $t + 1$. The rate increases to 50% for people who are just released for a long sentence(NA) at t , indicating that young people are easy to recidivate once they are involved in criminal activities. Most of the transitions are quite similar in both urban and national areas, except the last three. The transition from no choice to no choice is 12.20% in urban area but 10% in all area, meaning that prisoners are less likely to be released in urban areas. Besides, of all the people who are just released from a long person term, people in the urban area are less likely to commit a crime.

[Table 4 here]

Table 4 shows the states transitions of the young agents. Based on their behavior and outcomes, people are under three kinds of states: No records(N), Arrest Records(A) and Prison Records(J). For people with no records at t , only 2.03% will get arrest records at $t + 1$, and 0.41% of people need to serve sentences at $t + 1$. For people with arrest records at t , 17.06% will have the same records in the next year, and 4.26% of people will be put in prison at $t + 1$. For people with prison records, only 7.76% of them will have arrest record in the

¹⁹Some people moved in and out the urban area very often. In the simulation of urban population, I exclude people not staying in urban areas in the 5 years. There are 5028 people first. Until the fifth year, only 3536 of people kept staying in the urban areas.

next year, but nearly 43% have sentences at $t + 1$. The results indicate that people are more likely to get the same result in the next period, once they decide to commit a crime. These transitions are quite similar in both urban and national areas.

[Table 5 here]

Table 5 shows the probabilities of no punishment(IN), arrest(IA) and incarceration(IP) when people are involved in criminal activities. For people without any record, about 87% can get away without any punishment, and 11% would be arrested. Only 2% of them need to serve sentences. For those with arrest records, the rate of getting away decreases to 60%, but the probability of arrest increases to 32%. 8% of them are put in prison. For people with prison records, the probability of no punishment decreases to 53%. The probability of arrest is 21% and the probability of incarceration is 26%. These facts show that people without any record are easily to get away if they commit a crime. Even if they are caught, the probability of going to prison is very low. Criminals with arrest records, however, have lower chance to get away but higher chance to prison, 20%, once they are caught. Criminals with prison records have the lowest chance to get away and face the highest probability of going to prison. Most of the transitions are quite similar in both urban and national area, except the probability of arrest and incarceration. In urban area, 41.66% of criminals with prison records will return to prison once being caught, lower than the national data, 55.26%

4 Estimation Methodology

This section describes the estimation strategy of the paper. I construct a criterion function that measures the distance between observed and simulated transitions and wage level. The estimation is a Simulated Method of Moments(SMM) procedure in which the parameter estimates of the theoretical model minimize the criterion function. The method is developed by Pakes and Pollard (1989) The estimated parameters are $\phi = \{\Theta^N, \Theta^A, \Theta^J, \beta, \gamma, \lambda, \mu_{W_I}, \varepsilon_{W_I}\}$,

with $\Theta^h = \{\mu_h, \rho_h, \varepsilon_h\}$. The criterion function is as follows:

$$S(\phi) = \sum_{j=1}^3 \sum_{i=1}^{N_j} WT_{ij} (R_{ij}^{obs} - R_{ij}^{sim})^2$$

where $N1 = 9$ are the states transitions, $N2 = 8$ are the behavior transitions²⁰, and $N3 = 6$ are the wage levels. WT is a weighting matrix.

In the simulation, the probabilities of no punishment (P_{NP}), arrest (P_{IA}) and incarceration (P_{IJ}) are all based numbers in the full samples for simplification.

	P_{NP}	P_{IA}	P_{IJ}
No records(N)	0.87	0.11	0.02
Arrest (A)	0.60	0.32	0.08
Prison (J)	0.54	0.22	0.24

In addition, sentence terms(TJ) are split into 5 categories, and the probabilities are all based on the full samples. For agents with sentences more than a year, I simply assume that they need to stay in prison for at least 2 years. After 2 years, the probability of being released is $(1 - \kappa) = 90\%$.²¹

Type	Sentence	Probability	U_i^t
1	1 month	0.46	$11/12\gamma W_L^t$
2	3 months	0.09	$3/4\gamma W_L^t$
3	9 months	0.11	$1/4\gamma W_L^t$
4	12 months	0.04	0
5	>12 months	0.30	0

I use the model to simulate 7051×4 behavioral trajectories and wage levels at each time period for the national areas. The simulation numbers are 5028×4 for urban areas. Therefore, each person in the real data has 4 representatives. The wage and behavior of each individual

²⁰Excluding the transition from No Crime to No Choice

²¹People were not asked about their sentence terms if were in prison or other correctional institutions when they were interviewed. Therefore, there is no information when they were in and out the prison. To simplify the model, they are included to Type 5.

at $t = 1$ is from the real data. To minimize the function, I use the Powell's method , which require function evaluations but not derivatives. The algorithm is proposed by Powell (1964).

5 Estimation Results

This section discusses the estimated parameters and compare the the transitions and wage distribution of the actual and simulated data. Table 6 represents the estimated parameters.

[Table 6 here]

The persistent wage rate for people without any record is 91.69% within the nation and 93.08% in urban area, meaning that the expected wage in the next period is almost the same as their current wage, excluding the effect of wage shock. The rate is slightly higher in urban area. The persistent rate decreased to 84.44% for people with arrest records and 13.20% for people with prison records in national area. Both of the values are a little bit higher in urban area. These results implies that the uncertainty of expected wage increases as the punishment from illegal activities becomes severe. The expected wage of people with prison records highly depends on the wage shock, with the mean 1566.339 and error term 3881.186 within the nation and a little bit lower in urban areas which are much lower to people with no records or with arrest records. The estimation is consistent to the previous study that criminal records affect the wage growth of individuals. Since there is nothing to lose, people with low wage or no work are more likely to commit a crime if there expected income from illegal activities is not low. The negative impact of uncertainty that caused by arrest or incarceration increases as the wage level increase, especially for people with arrest or prison records. Therefore, they are less likely to recidivate as their expected wage after arrest or prison goes up, as shown in Figure 1.

[Figure 1 here]

Figure 1 shows the crime decision of people by their expected wage and illegal income within the nation. People without any criminal records would never commit a crime in any

wage level given the expected illegal income is 0. This result explains why most young people with low wage or not work do not commit a crime, since the expected illegal income are mostly 0. However, they will always commit a crime once their expected earning from illegal activities is higher than \$2105 in both urban and the nation. People with arrest record, however, will never recidivate once the expected wage is higher than \$16950, . The threshold is even lower to \$7458 for people with prison records. For young people in the urban areas, the threshold is a little bit lower, \$15254 for people with arrest records and \$6778 for people with prison records. These results are related to the low persistent wage rate, high wage shock of ex-offenders, and high probability of being punished, especially to people with prison records. Once their wage after prison is high enough due to the positive wage shock, they will never recidivate to jeopardize their expected wage in the future.

[Table 7 here]

Table 7 compared the states transitions of real and simulated data. The first three rows shows the transitions of people without criminal records at t . Most of them are still clean in the next period. less than 3% of them have arrest or jail record at $t + 1$. This result is about 1% point higher than the real transitions. The next three rows are the transitions of people with arrest records at t . The rate of no record decreases to 83.07% in the next period, about 4% point higher than the real transition, which implies that the simulation overestimates the transitions from arrest records to arrest records and to prison records. The last three rows are the transitions of people with prison records. The simulation slightly underestimate the transition from prison records to prison records.

[Table 8 here]

Table 8 shows the behavior transitions of real and simulated data. The first three rows shows the transitions of people do not commit a crime at t . Since they do not have any chance to be punished, the transition from NC to NA is 0. The simulated results overestimate the crime involvement of these people by 9% point, in bout national and urban area. The next three rows are the transitions of people with criminal behavior at t . About 1% of them need

to serve long sentences Therefore unable to make a choice. The crime involvement rate goes up to nearly 48% for the rest, implying that people involved in criminal activities before are more likely to recidivate later. The simulation slightly overestimates the rate by 1% point. The last three rows are the transitions of people who are not able to make a choice at t . 90% of them will be released within the nation, and 88% will be free in the urban area. The simulation results overestimate the percentage within the nation but slightly underestimate the percentage in the urban area. Of all the people who are released at $t + 1$, The simulated crime involvement rate is slightly overestimated in both national and urban areas.

[Figure 2 here]

Figure 2 shows the cumulative wage distribution of young population in all areas. The green bar from the actual data, and the red bar from the simulation. Since all respondents are from mid teens to mid twenties, most of their wages are not high. The simulation underestimates the percentage of people in low wage level but overestimates the percentage in middle wage level.

6 Policy Experiments

After recovering the parameters, I explore the change of predicted trajectories under different scenarios: (1) increasing the probability of incarceration, (2) increasing the probability of arrest, (3) increasing the probability of a long sentence term, (4) decreasing the probability of being released, (5) increasing the fine rate, and (6) removing the effect of criminal records on future wage. Table 9 report the crime involvement rate under different policies. Policy 1 to Policy 4 focus on the probability of incarceration, and Policy 5 to Policy 8 work on the probability of arrest. Policy 9 increases the probability of a long sentence term, Policy 10 decreases the probability of being released, Policy 11 increases the fine rate when criminals are arrested, and Policy 12 removes the effect of criminal records. The overall crime involvement rate can be reduced by any one of the policy. The decrease rate is the largest in Policy 8

when the probability of arrest of all criminals increases 50%. The overall crime involvement would decrease 2.18% within the nation and 2.34% in urban areas.

[Table 9 here]

However, an increase in the probability of being punished to a certain group not only affect the behavior of them but also others. The side effect might sometimes cause other problems. Table 10 reports the crime involvement rate under different states and policies. some policies ameliorate the overall crime involvement but deteriorate or have ambiguous effect on the recidivism. In Policy 1, the probability of incarceration of criminals without criminal records increases 50%, from 2% to 3%, while the probability of arrest remains the same. The overall crime involvement rate decreases, but the effect on recidivism is ambiguous. The crime involvement of people with prison records decrease, but the crime involvement of people with arrest records increases in both national and urban areas. In Policy 2, the probability of incarceration of criminals with arrest records increases 50%. This policy has no effect on the crime involvement of people without criminal records, but significant decreases the recidivism within the nation. In urban areas, the policy slightly decrease the crime participation of people with no records, but the effect on recidivism is ambiguous. In Policy 3, the probability of incarceration of criminals with prison records increases 50%. The crime involvement of people with and without criminal records slightly decreases in urban areas, but the effect on recidivism is ambiguous within the nation. In Policy 4, the probability of incarceration increases 50% to all criminals, and the crime involvement of every groups decreases in both national and urban areas.

[Table 10 here]

In Policy 5, the probability of arrest of criminals with no records increases 50% . The effect on recidivism is ambiguous within the nation but worse in urban areas. Ex-offenders in urban areas are more likely to recidivate under this policy. In Policy 6, the probability of arrest of criminals with arrest records increases 50%. Crime involvement decreases in every groups in both national and urban areas. In Policy 7, the probability of arrest of criminals with prison

records increases 50%. The effect on recidivism is ambiguous within the nation. In urban areas, however, the policy has no effect on the crime involvement of people without criminal records, but slightly decreases the recidivism. In Policy 8, the probability of arrest increases 50% to all criminals, and the crime involvement of every groups significantly decreases in both national and urban areas.

In Policy 9, the probability of a long sentence term, more than a year, increases from 30% to 45% and the probability of the shortest sentence term, 1 month, decreases from 46% to 31%. The crime involvement of every groups decreases, especially to people with prison records. The reason comes from the higher probability of incarceration of criminals with prison records. When the probability of a long sentence term goes up, people with prison records would face severer punishment than before, if they decide to commit a crime. Therefore, the decrease in crime involvement rate of people with prison records is the largest. In Policy 10, the probability of being released decreases from 90% to 85%, which can be seen as a simple parole system to prisoners with very long sentences. Since the probability of incarceration is the highest to criminal with prison records, once the probability of being released decreases, the value of committing a crime becomes lower than before. Therefore, it is reasonable to see that people with prison records have lower propensity to commit a crime than before. The results show that a decrease in the probability of being released to prisoners with long sentences has almost no effect to the crime involvement of people with no records but decrease the recidivism of ex-offenders, especially to people with prison records. In Policy 11, the fine rate of arrest goes up by a 5% point. The policy has no effect on people with no records or with arrest records but slightly decrease the recidivism of people with prison records in national area. In policy 12, the wage persistent rate is assumed to be the same to people with or without criminal records. Since criminal records do not affect the future wage, the negative impact of punishment is smaller than before, which would increase the crime involvement, but the expected wage of ex-offenders becomes higher, which would decrease the crime involvement. The results show that the crime involvement rate of people without criminal records slightly increases but the recidivism of ex-offenders significantly decreases if

the criminal records do not affect the future wage.

All the policies can decrease the overall crime participation, but only four of them could ameliorate the recidivism as well: a 50% increase in the probability of arrest of all criminals or criminals with arrest records, a 50% increase in the probability of incarceration of all criminals, and a 50% increase in the probability of a long sentence term. Compared with all the others, an 50% increase in the probability of arrest of all criminals decreases the crime participation better, both the overall crime involvement and the recidivism.

7 Conclusions

This paper follows the economics tradition initiated by Becker (1968) and Ehrlich (1973) that assumes that criminal participation is an optimal response to economic incentives. Since more than 40% of arrests come from people aged 14 to 26 and most people start working when they are in the mid to early twenties, it is important that we understand how economic incentives affect the criminal behavior of young people. I set up a model that in which the utility of individual depends on their earnings from legal work and illegal activities. People are aware of the fact that they might get caught and punished if they decide to commit a crime. The punishment not only affects their current earnings but also their future wage. Although crime can be caused by many other factors, the paper shows that economic incentives explain well the behavior of young individuals. The model explains the low propensity of people without criminal records to commit a crime by the low expected income from illegal activities. Since the persistent wage rate is low and the probability of being punished is high to ex-offenders who recidivate, people with criminal records are less likely to commit a crime to risk their future wage if their expected wage after prison becomes higher.

The ability of the model that incorporates the wide variety of sentence terms and types of punishment allows me to evaluate the effect of different policies on the crime participation and recidivism of youth. An increase in the probability of incarceration or arrest of all criminals, such as increasing the police force or the incarceration rate, can decrease the overall crime involvement and recidivism, which explains the crime drop in the past ten

years. The policy experiments also show that a decrease in the probability of being released of prisoners with long sentence terms and an increase in the probability of a long sentence term can ameliorate the overall crime involvement and recidivism. Although removing the negative effect of criminal records on future wage, such as strictly sealing the criminal record of youth, significantly reduces recidivism, it slightly increases the crime involvement of people without records. Compared with all other policies, the model shows that an increase in the probability of arrest of all criminals decreases the crime participation better, both the overall crime involvement and the recidivism. Today, the United States has the highest documented incarceration rate in the world. The prison expenditure is vary large. Considering the high cost of incarceration, we might be able to decrease crime involvement and reduce government expenditures by increasing the probability of arrest through stricter police enforcement, by the use of cameras, for example, instead of putting more criminals in prison. Once people believe that they are more likely to be arrested when committing a crime, they will have a lower propensity to get involved in criminal activities.

The model does not discuss the effect of economic incentives on the criminal behavior of young population of different races and gender. Since the incarceration rate, the arrest rate, and the wage distribution vary by gender and race, I would like to analyze how economic incentives affects their criminal behavior separately. Considering the reality that people might commit multiple crimes within a year, I will also include the quantity of crime. Besides, the effect of education investment is not analyzed in the model, which is believed to be an important factor in wage expectation and youth crime. In the next step, I will include the investment of education into the model.

Appendix

1. Questions of Arrests and Punishment

From 1998 to 2002, the survey also collected self-reported information of conviction, charge and sentence records of each respondent for each arrests since the last interview. The questions and steps are as follows.

1. In total, how many times have you been arrested since the last interview on [date of last interview]?
2. (For each arrest), did the police charge you with an offense?
3. (For each arrest), as a result of these charges, did you go to juvenile or adult court?
4. (For each arrest, if you went to court), were you convicted of, or found delinquent (adjudicated delinquent) of any charges, or did you plead guilty to any charges?
5. (For each arrest, if R was convicted,) were you sentenced to spend time in a corrections institution, like a jail, prison or a youth institution like juvenile hall or reform school or training school or to perform community service?
6. (For each arrest, if R was in jail, correction s institution, reform school or training school), what month did you begin your sentence?
7. (For each arrest, if R was in jail, correction s institution, reform school or training school), what year did you begin your sentence?
8. (For each arrest, if R was in jail, correction s institution, reform school or training school), are you still in a corrections facility?
9. (For each arrest, if R was in jail, correction s institution, reform school or training school and was released), what month were you released?
10. (For each arrest, if R was in jail, correction s institution, reform school or training school and was released), what year were you released?

2. Types of Criminal Activities

There are 6 types of criminal activities in the NLSY97. People are defined as criminals if they participate in at least one type of following crimes in the year.

1. Purposely damaged or destroyed property not belonging to the respondent
2. Stole something worth less than \$50
3. Stole something worth \$50 or more (including a car)
4. Other property crimes, including fencing stolen property, possessing or receiving stolen property, or selling something for more than it was worth
5. Attacked or assaulted someone
6. Sold or helped to sell marijuana, hashish, or other hard drugs

3. Sample Selection

Since the information of behavior is from 1997 to 2003 and the information of punishment is from 1997 to 2001. I only include the observations from 1997 to 2001. People who were not continuously interviewed or did not report sufficient information, such as their wage and their behavior, for at least two years are excluded from the sample. I also exclude people without consistent information, such as no work but positive wage. Besides, people who claimed that they did not commit a crime but was arrested in the same year are removed from the samples.

Initial samples	8984
– Work no wage/ wage no work	185
– Without sufficient information	161
– Not continuously being interviewed	60
– Nor continuously in the survey for at least 2 years	1527
Total Observations	7051
– Not continuously in urban area or unknown	2023
Urban Observations	5028

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Table 1: Age-Specific Arrest Rate by Year

Age	1997		1998			1999		2000		2001					
	NLSY		FBI	NLSY		FBI	NLSY		FBI	NLSY		FBI			
	W	N		W	N		W	N		W	N				
12	5.82	6.09													
10-12			1.85												
13	6.75	6.70		7.50	7.96										
14	8.67	9.51		10.53	11.86		10.28	10.02							
13-14			8.66			7.93			7.40						
15	8.91	9.25	14.79	9.47	9.99	13.05	7.88	8.38	12.17	9.51	9.95	11.45			
16	8.51	8.53	17.05	7.74	8.50	16.68	9.94	10.73	14.82	8.29	8.41	13.90	10.85	10.23	13.18
17				8.72	8.38	17.48	9.09	9.03	17.13	8.84	9.15	15.57	10.00	9.61	14.33
18							9.37	9.27	18.13	7.38	8.28	17.53	7.27	7.87	16.46
19										6.67	7.32	17.76	6.80	7.34	16.83
20													7.27	7.60	15.68
21															
ave	7.73	8.02	7.83	8.78	9.36	12.65	9.33	9.49	12.86	8.14	8.66	14.33	8.47	8.56	15.30
Juvenile			9.2			8.36			7.85			7.27			6.89

W: weighted, N: non-weighted

the juvenile arrest rate is from Office of Juvenile Justice and Delinquency Prevention(OJJDP)

Table 2: Descriptive Statistics

Year	1	2	3	4	5
Male (%)	51.23	51.23	50.89	50.51	50.14
White (%)	58.61	58.61	58.72	59.10	59.21
Illegal (%)	29.40	23.98	20.49	17.03	14.56
Arrest (%)	4.85	3.79	6.11	5.41	5.45
Jail (%)	1.13	1.01	1.25	1.34	1.33
Work (%)	46.25	46.95	58.98	68.33	73.64
Urban (%)	72.92	72.64	72.47	72.35	74.29
Annual Wage	1253	2247	3089	4095	5127
Illegal Income	594	1020	3392	1641	886
Total Observations	7051	7051	6608	6100	5543

Table 3: Behavior Transitions of NLSY97

t \ t+1	All Areas			Urban			Sum
	No Crime	Crime	No Choice	No Crime	Crime	No Choice	
No Crime	89.06	10.94	0.00	88.90	11.10	0.00	100(%)
Crime	51.76	47.05	1.19	50.37	48.39	1.24	100(%)
No Choice	45.00	45.00	10.00	48.78	39.02	12.20	100(%)

Table 4: States Transitions of NLSY97

t \ t+1	All Areas			Urban			Sum
	No Records	Arrest	Prison	No Records	Arrest	Prison	
No Records	97.56	2.03	0.41	97.60	2.01	0.39	100(%)
Arrest	78.69	17.05	4.26	79.48	16.73	3.78	100(%)
Prison	49.32	7.76	42.92	48.00	9.33	42.67	100(%)

Table 5: Probabilities of Different Punishment

States\Outcome	All Areas			Urban			Sum
	Away	Arrest	Prison	Away	Arrest	Prison	
No Records	86.55	11.18	2.27	87.24	10.68	2.07	100(%)
Arrest Records	60.42	31.66	7.92	62.82	30.32	6.86	100(%)
Prison Records	53.66	20.73	25.61	54.72	26.41	18.87	100(%)

Table 6: Estimated Parameters

Parameters	$\hat{\phi}$	Estimates	
		All Areas	Urban
Discount Rate	β	0.8234220	0.8517889
1-Punishment Rate	γ	0.8154779	0.8487719
Persistent Wage Rate (N)	ρ_N	0.9168735	0.9308359
Persistent Wage Rate (A)	ρ_A	0.8444309	0.8755086
Persistent Wage Rate (J)	ρ_J	0.1319994	0.1578385
Error Term (N)	ε_N	1946.141	1597.956
Error Term (A)	ε_A	1573.209	1295.360
Error Term (J)	ε_J	3881.186	3047.752
The Set Up of Wage Range	λ	20.51894	17.02625
Mean of Illegal Income	μ_{W_I}	1107.539	1097.621
Error Term (W_I)	ε_{W_I}	4279.083	3472.046
Mean of Wage Shock (N)	μ_N	98.66164	90.26054
Mean of Wage Shock (A)	μ_A	109.9248	88.30539
Mean of Wage Shock (J)	μ_J	1566.339	1404.590

N: without any criminal record

I: with the record of being arrested last year

J: with the record of going to jail last year

Table 7: Real and Estimated States Transitions

Transitions	All Areas		Urban		Sum
	Real	Estimated	Real	Estimated	
No Records/No Records	97.56	96.51	97.6	96.41	100(%)
No Records/Arrest	2.03	2.94	2.01	3.02	
No Records/Prison	0.41	0.55	0.39	0.57	
Arrest/No Records	78.69	83.07	79.48	83.34	100(%)
Arrest/Arrest	17.05	13.95	16.73	13.11	
Arrest/Prison	4.26	2.97	3.78	3.55	
Prison/No Records	49.32	53.36	48	53.18	100(%)
Prison/Arrest	7.76	8.18	9.33	8.84	
Prison/Prison	42.92	38.45	42.67	37.98	

Table 8: Real and Estimated Behavior Transitions

Transitions	All Areas		Urban		Sum
	Real	Estimated	Real	Estimated	
No Crime/No Crime	89.06	79.95	88.90	79.58	100(%)
No Crime/Crime	10.94	20.05	11.10	20.42	
No Crime/No Choice	0.00	0.00	0.00	0.00	
Crime/No Crime	51.76	52.71	50.37	52.29	100(%)
Crime/Crime	47.05	46.28	48.39	46.57	
Crime/No Choice	1.19	1.01	1.24	1.14	
No Choice/No Crime	45.00	45.45	48.78	44.61	100(%)
No Choice/Crime	45.00	47.73	39.02	41.67	
No Choice/No Choice	10.00	6.82	12.20	13.73	

Table 9: Overall Crime Involvement under Different Policies(%)

Policy	All Areas	Urban
Bench	27.9525	28.5105
P1: $\tau_N : 2\% \rightarrow 3\%$	27.9215	28.4809
P2: $\tau_A : 8\% \rightarrow 14\%$	27.9229	28.4735
P3: $\tau_J : 26\% \rightarrow 39\%$	27.9376	28.4861
P4: $\tau_N, \tau_A, \tau_J \uparrow 50\%$	27.8657	28.4079
P5: $\delta_N : 11\% \rightarrow 16.5\%$	27.8073	28.3842
P6: $\delta_A : 32\% \rightarrow 48\%$	27.5928	28.1658
P7: $\delta_J : 21\% \rightarrow 31.5\%$	27.9175	28.4704
P8: $\delta_N, \delta_A, \delta_J \uparrow 50\%$	27.3433	27.8435
P9: $\varphi_5 : 30\% \rightarrow 45\%, \varphi_1 : 46\% \rightarrow 31\%$	27.8403	28.4477
P10: $\kappa : 10\% \rightarrow 15\%$	27.9439	28.4980
P11: $\gamma : \downarrow 5\%$ points	27.9494	28.5045
P12: $\rho_A = \rho_N = \rho_J$, no record effect	27.7178	28.3162

τ : the probability of incarceration
 δ : the probability of arrest
 φ_1 : the probability of the shortest sentence, a month
 φ_5 : the probability of a long sentence, more than a year
 $1 - \kappa$: the probability of being released
 γ : the fine rate of arrest
 ρ : the persistent wage rate

Table 10: Crime Involvement under Different States and Policies(%)

Policy \ Status	All Areas			Urban		
	N	A	J	N	A	J
Bench	26.78	42.68	56.80	27.27	43.15	50.72
P1: τ_N : 2% \rightarrow 3%	26.65	43.12	56.61	27.17	43.77	50.45
P2: τ_A : 8% \rightarrow 14%	26.78	33.01	52.86	27.25	42.07	50.87
P3: τ_J : 26% \rightarrow 39%	26.77	42.93	51.20	27.26	42.94	48.09
P4: τ_N, τ_A, τ_J \uparrow 50%	26.58	33.49	52.42	27.14	42.30	47.36
P5: δ_N : 11% \rightarrow 17.5%	26.30	44.78	55.31	26.85	44.73	51.88
P6: δ_A : 32% \rightarrow 48%	26.77	30.26	52.52	27.25	32.37	48.41
P7: δ_J : 21% \rightarrow 31.5%	26.77	42.79	49.05	27.27	42.99	45.24
P8: $\delta_N, \delta_A, \delta_J$ \uparrow 50%	26.20	34.83	48.58	26.64	34.96	45.44
P9: φ_5 : 30% \rightarrow 45%, φ_1 : 46% \rightarrow 31%	26.77	40.01	51.01	27.26	42.53	46.30
P10: κ : 10% \rightarrow 15%	26.77	42.64	53.86	27.27	42.92	50.09
P11: γ : \downarrow 5% points	26.78	42.68	54.20	27.27	42.91	50.82
P12: $\rho_A = \rho_N = \rho_J$, no record effect	26.83	39.08	26.46	27.35	40.11	24.95

τ : the probability of incarceration

δ : the probability of arrest

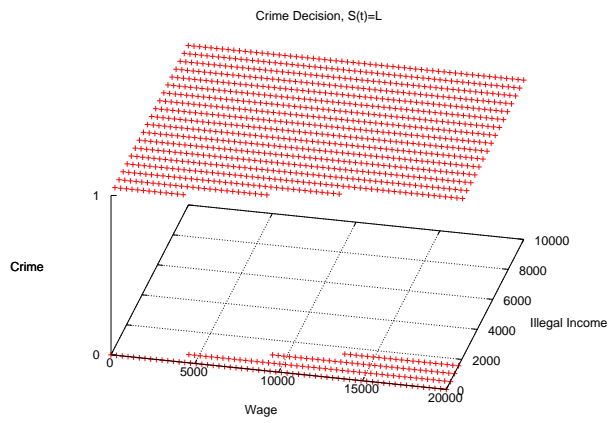
φ_1 : the probability of the shortest sentence, a month

φ_5 : the probability of a long sentence, more than a year

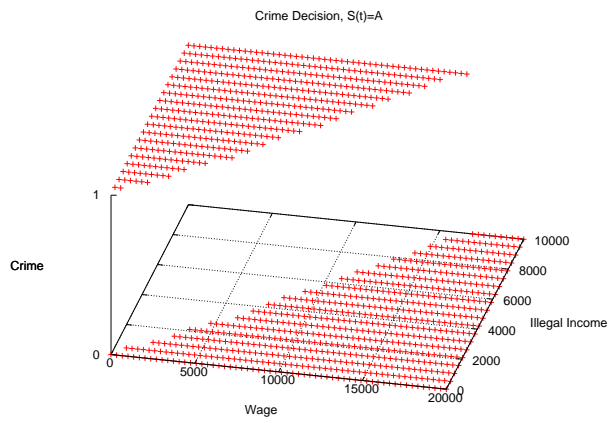
$1 - \kappa$: the probability of being released

γ : the fine rate of arrest

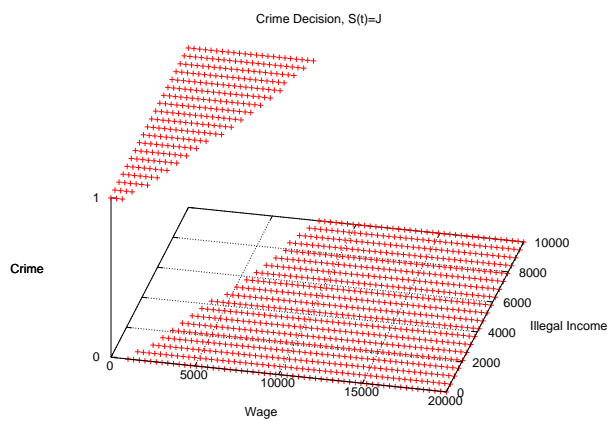
ρ : the persistent wage rate



(a) No Records



(b) Arrest Records



(c) Prison Records

Figure 1: Crime Decision of People Under Different Status

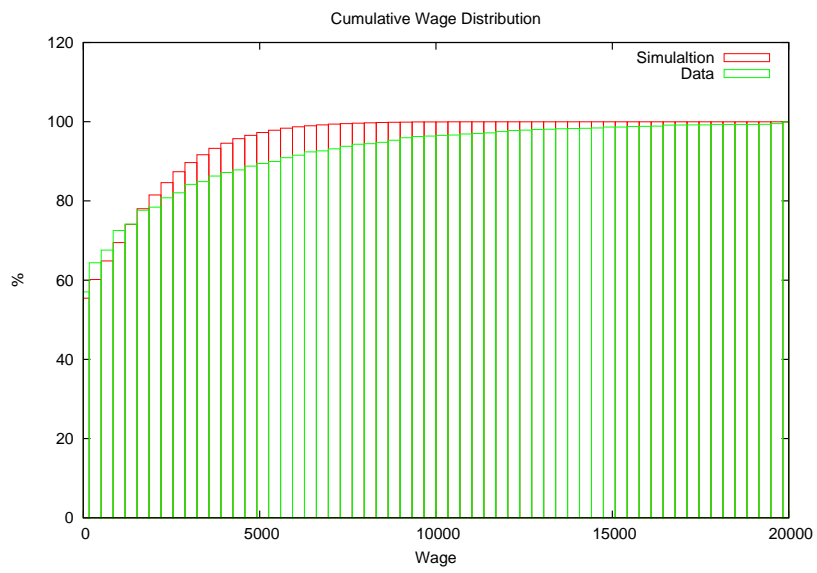


Figure 2: Wage Distribution