

Juvenile Crime and Mental Health and Substance Abuse Treatment: A Study of Foster Care Children in Urban Areas of Colorado

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All responsibility for the contents of this paper resides with the author.

Abstract

The purpose of this project is to examine the effectiveness of mental health and substance abuse treatment in reducing crimes committed by juveniles living in urban areas of Colorado. The observed high correlation between crime, substance abuse and poor mental health suggests that factors which reduce substance abuse and improve mental health may also be effective in reducing criminal activities. This project uses arrest data in conjunction with substance abuse and mental health treatment data for children enrolled in the Colorado state foster care program to analyze the impact of treatment in delaying or preventing this group of at-risk urban youth from engaging in criminal behavior. Results show a negative effect, i.e., longer duration before detention, for youth who receive treatment and for youth in areas with high treatment rates.

1. INTRODUCTION

Criminal behaviors are highly prevalent among adolescents. In 2000, teenagers aged 13 to 19 accounted for 10 percent of the population, but 25.8 percent of all arrests, 23.8 percent of arrests for violent crime, and 40 percent of arrests for property crime (FBI 2000). There is a large body of literature examining the determinants of juvenile crime, which concludes that factors such as gender, education, socio-economic status, and family environment are all strong correlates of criminal behavior. Two factors, substance abuse and mental illness, have received less attention in the crime literature, but are also potentially important. This paper examines the effectiveness of mental health and substance abuse treatment in reducing crimes committed by juveniles.

A number of studies have shown that youth with substance abuse or mental health problems consistently have higher offending and prevalence rates than those without mental health problems (Elliott and Huizinga 1984; Elliott and Huizinga 1989; Elliott et al. 1989; Elliott et al. 1986). For example, Vander Stoep et al. (1997) show that youth enrolled in a public mental health system had three times as many police referrals to the juvenile justice system as those in the general child population. Others have shown higher rates of violence and aggression among youth with mental health problems (Ellickson et al. 1997; Arseneault et al. 2000).

Similarly, a number of studies have shown that children in the juvenile justice system have a high prevalence of mental health disorders (Garland et al. 2001; Randall et al. 1999; Myers et al. 1990). Some evidence suggests that mental illness may have contributed in part to youths' illegal behavior (Loeber et al. 1998; Lynam 1996; Loeber et al. 2000; Link and Stueve 1995). The overrepresentation of mental disorders among youth in the legal system may reflect a greater risk of criminal behavior.

As with mental illness, existing research shows a strong positive relationship between substance use and violent crime (see Miczek et al. 1994, and Forrest and Gordon 1990 for reviews of the literature). For example, the Bureau of Justice Statistics (1998) reports that 41 percent of violent male inmates in local jails reporting drinking at the time of the offense compared to 35 percent of property crime inmates. Other studies comparing violent and non-violent criminals also find higher rates of alcohol use among violent offenders (Roslund and Larson 1979; Myers 1982; Myers 1986). When illegal drugs are considered, Chaiken and Chaiken (1982) find that 83 percent of violent inmates used drugs during the same period as the crime, although they find no association between juvenile crime and juvenile use of marijuana or experimentation with hard drugs.

It is important to note that the studies showing a high correlation between alcohol use, drug use, and crime do not establish causality. These behaviors may be observed together for a variety of reasons. If, however, consumption directly causes violent crime, then one way to lower crime would be to lower consumption. Indeed, a number of studies have shown that crime can be reduced by raising price of drugs or alcohol (Chaloupka and Saffer 1992; Cook and Moore 1993; Markowitz 2000; DeSimone 2001; Markowitz 2001).

Despite such policy tools as high taxes, minimum legal drinking ages, and strict enforcement of drug laws, previous research shows that youth continue to access drugs and alcohol, and face substance-related health problems, including addiction. Furthermore, epidemiologic data on adults show a high rates of comorbidity between psychiatric disorders and alcohol and other substance use (Leshner 2001, Kessler et al. 1996). As a result, increased availability of mental health and substance use treatment programs may be an effective means by which to reduce the demand for drugs and alcohol and, ultimately, crime. This study focuses on

the effectiveness of treatment for substance abuse and mental illness in reducing juvenile crime in order to inform policymakers about the potential effects of health care access in reducing crime.

2. RELEVANT LITERATURE

There has been very little research examining the effectiveness of mental health treatment in preventing crime by youths, although one form of intensive treatment, multisystemic therapy (MST), has been shown to have beneficial effects and reduce rates of subsequent arrests for youth with serious antisocial behavior (Henggeler et al. 1996; Henggeler et al. 1998). The MST intervention provides highly coordinated and organized services whereby therapists involve parents, teachers, and friends to focus on environmental change. Although MST has been tested in randomized trials, thereby dealing with the problem of sample selection, these studies have been limited to small study populations with serious disorders in controlled environments. Broader effectiveness of less intensive mental health services on youth crime has not been established.

There are however, a number of studies focusing on substance abuse treatment in reducing crime, but this literature applies mostly to adults. This literature tends to focus on limited samples of individuals in restricted geographic areas. The studies primarily fall into two main types: those which look at rates of criminal behavior by substance abusing individuals before and after treatment, and those comparing a control group of criminals to a treatment group of criminals. One drawback to the first type of study design is that it is difficult to attribute behavioral changes to the program or the passage of time. Both types may also suffer from biases in sample selection, and the results may not be applicable to a larger population.

There are a number of different kinds of treatment programs for substance abuse, although most evaluation studies have focused on four primary types: methadone maintenance, therapeutic communities, outpatient drug free programs and civil commitment programs. Methadone maintenance programs provide methadone to drug-dependent individuals as an oral substitute for heroin. These types of programs seem to be successful in reducing both drug consumption and crime (Anglin and Hser 1990). For example, Hser Anglin and Chou (1988) show that for heroin addicts, time spent involved in property crimes decreased from 18 percent of the time when not in treatment to 11 percent during treatment. Hunt, Lipton and Spunt (1984) compared clients at a methadone maintenance clinic with narcotic users who were not in treatment. They find that those in treatment are less involved in burglary, robbery and drug dealing. Maddux and Desmond (1979) find that crime rates in San Antonio, Texas decreased as methadone treatment rates increased, and that crime rates increased when budget cutbacks forced the premature discharge of patients.

Therapeutic communities are residential drug and alcohol treatment facilities designed with the goal of helping the individual maintain a drug-free lifestyle. Programs include encounter group therapy, and education sessions. In a study of one such community, DeLeon et al. (1979) tracked males who entered the Phoenix House program in 1970-1971, and found that the percent arrested fell from 72 prior to treatment to 41 after treatment. DeLeon (1984) shows similar results.

Outpatient drug-free programs, which provide counseling and training in social skills, seem to be less effective in reducing crime than other types of programs. Hubbard et al. (1984) report that the same proportion of clients engaged in illegal activities before and after treatment.

Finally, a number of researchers have examined the effectiveness of civil commitment programs. Typically, a drug addict will be ordered by the court to complete one of these programs as an alternative to prison. McGlothlin, Anglin and Wilson (1977) compared addicts who completed a court ordered program to those addicts who did not complete the court ordered program. Results show the former group reduced their criminal activity by 18.6 percent as compared to a 6.7 percent reduction by the latter group. Van Steel et al. (1994) look at recidivism to the criminal justice system for criminals who entered Wisconsin's Treatment Alternative Program (TAP) over a one year period. They find that offenders who completed TAP were less likely to be rearrested during the follow-up period than offenders who did not complete TAP. Sealock et al (1997) use data from offending youths assigned to substance abuse treatment in a resident facility in Maryland. Results show that youths in residential treatment facilities were not less likely to be arrested during the follow-up period than those not receiving treatment. However, the treatment youths remained arrest-free longer.

In the one existing study which looks at the impact of state-level expenditures for drug treatment facilities on illicit drug consumption, Saffer et al. (2001) find that more expenditures will reduce drug use. These expenditures include hospital facilities operated by state or local governments, and for payments to private facilities. Saffer (2001) also looks at the impact of state-level expenditures for drug control activities on crime. Drug control activities include police, courts, prosecution, public defense, education, and drug treatment. He finds that states which spend more per capita on drug control activity have lower arrests, lower reported property damage and fewer individuals selling drugs.

3. Methods

3.1. Data

The above literature review suggests a model where crime is determined in part by drug and alcohol consumption and poor mental health. If treatment for substance abuse or mental health problems is successful, then such treatment may also reduce criminal activities. We test this hypothesis by estimating a structural model of crime for a group of at-risk teenagers who are in the Colorado child welfare system (i.e. foster care). The child welfare population is an interesting and relevant population to study because the majority of the children in foster care programs across the country come from abusive homes, and as a result, these children exhibit more chronic medical, emotional, and psychological problems than other youth (DosReis et al. 2001). These children are considered at-risk for criminal behaviors because of the link between mental health and substance abuse problems and crime as discussed above. In our sample, 38 percent of youths are detained by the department of corrections at least once during the three year sample period. As a comparison, the arrest rate for all teenagers between the ages of 13 and 18 was 8 percent in 2000.

The child welfare encounter data come from the Colorado Division of Child Welfare, and records are collected for all youth who received child welfare services in Colorado between July 1994 and June 1997. These data include date of entry, age, gender, race, ethnicity, and county of residence. Children under age 13 or over age 18 are excluded from the analysis. All children in foster care are entitled to benefits under Medicaid, and these benefits include treatment for substance abuse and mental health problems. Medicaid claims and encounter data provide the information on mental health and substance abuse treatment for the teenagers in our sample.¹

¹ Services that are reimbursed through managed care contracts are reported using “encounter data,” while services reimbursed on a fee-for-service basis are reported using claims. The Medicaid claims and encounter data were analyzed over a year after the state submission deadline, allowing time for delayed records to be processed.

These data include individual identifiers and dates of treatment service. Lastly, data on crime come from the Department of Youth Corrections, which collects information on all youths who are detained. These data also include individual identifiers and dates of detention. Teenagers in the child welfare system during the study period were matched to their Medicaid and detention records using unique identifiers. When an individual was observed to have multiple detentions, only the initial spell up to the first detention was included in the analysis. Consequently, we do not address the issue of recidivism in this study.

The sample is composed of 9,333 youth, 81 percent of whom live in metropolitan areas. The mean characteristics of the sample are shown in Table 1. Data for each individual are aggregated to monthly discrete observations. Consequently, the detention variable takes on a value of 1 if that individual was detained in the respective month and zero if not. Individuals are assumed to occupy only two states, detention-free and detained. The transition rate from one state to the other is the probability of leaving the detention-free state at any time period, given that the individual is not detained up to that time period.

Explanatory variables that do not change over time include demographic variables. Age by category (age 13 – omitted, age 14 to 15, and age 16 to 17) is defined as the age when the individual is first observed, that is, at entry into the child welfare system. We also control for race (whether the individual is white, black, with other races as the omitted category) and for whether the individual is Hispanic or not.

The provision of mental health and substance abuse treatment is our primary explanatory variable of interest. Treatment is defined as equal to one if the individual was treated in a given month and zero otherwise. Note that none of the treatment visits recorded in this data results from a court-ordered sentence. Estimating this model will show the propensity of treatment to

reduce crime, although a problem will arise if the decision to receive mental health or substance abuse treatment is influenced by the same individual characteristics as the decision to commit a crime. In this case, treatment will be endogenous and its coefficient will be biased. In order to correct for this potential endogeneity, we will use an estimation strategy which accounts for unobserved individual heterogeneity (described below).

A second method of avoiding the problems associated with the endogeneity of treatment is to estimate a reduced form model of crime which substitutes the exogenous determinants of the demand for treatment in for actual treatment. Ideally, the price of treatment would serve as such an instrument given that a number of studies have shown that the demand for mental health and substance abuse services is responsive to price (Frank and McGuire 2000). However, since all children in foster care are eligible for Medicaid, the monetary price of treatment faced by each individual is zero and does not vary. Instead, we use a measure of the full price of treatment, which includes travel and waiting times. This can be represented by county-level treatment rates which capture the supply of treatment available. We expect that as county treatment rates rise, the full price of treatment falls.

In a model where crime is determined in part by alcohol consumption, treatment may not be the only determinant of alcohol consumption. A number of studies have shown that the consumption of alcohol varies with its price (Leung and Phelps 1993). We include the price of beer in all models to gauge the effectiveness of higher beer prices in reducing crime, holding treatment constant. Beer prices are available for a number of different cities across Colorado. These data are published quarterly from the American Chamber of Commerce Research Association. Each individual in the sample is assigned a beer price based on the county of residence.

3.2. Estimation Strategy

Duration models are used to examine the structural determinants of crime. These models analyze the decision to make a transition from one discrete state to another. We estimate the conditional probability that an individual observed in the first period will commit a crime in a subsequent period. In particular, we estimate the extent to which characteristics of the individual, alcohol prices, and treatment affect the length of time spent crime-free. Therefore, these methods will quantify the impact of changes in the determinants of crime on the conditional probability of engaging a crime. The starting hazard rate is the probability of engaging in a crime in period t , conditional on being a non-criminal prior to t . The starting hazard should rise and fall over time in response to different stimuli. In particular, the results will show how changes in prices of alcohol and the provision of treatment affect length of time an individual remains crime-free.

We model duration using several specifications. The unit of analysis is a spell, which may be right-censored. Right-censoring occurs if we do not observe an individual being detained during the study period. Within each spell we observe from 1 to 36 spell months. Conditional exit probabilities in each spell month depend on observed fixed and time-varying covariates.

For our specifications the log likelihood is given by:

$$\log L = \sum_{i=1}^n \{y_i \log h(X_i) + (1 - y_i) \log[1 - H(X_i)]\},$$

where y_{it} is an indicator variable equal to one if person i exits the state during the interval $[t-1, t]$, $h(\cdot)$ is the density function and $H(\cdot)$ is the cumulative distribution function. The first term is the contribution of an individual who is detained during the study period and the second term is the

contribution of an individual who is not detained. The log-likelihood can be rewritten in terms of the hazard function.

The first model assumes the baseline hazard, the time until detention, conditional on the individual's characteristics has a Weibull distribution. The hazard function is $\gamma \exp(X_i \beta) \alpha^{\alpha-1}$. The parameter γ is absorbed by renormalizing the β s. The Weibull allows the hazard rate for a given individual to change monotonically over time. The parameter α estimates duration dependence, i.e., the hazard rate increases if α is less than one and decreases if it is greater than one.

This is a proportional hazard model in which the covariates are multiplied by the hazard rate. However, the Weibull constrains the baseline hazard rate to be monotonic. If the Weibull parameterization fits the data badly, the coefficient estimates may be adversely affected. Consequently, we also estimate the complementary log-log specification of Prentice and Gloeckler (1978).² This is a semi-parametric model, where we estimate a fully non-parametric baseline hazard with a separate parameter for each duration interval. That is, we assume the form of the baseline hazard is a step function with a step at each interval.

4. RESULTS

Table 2 presents estimates of the probability of exit into detention using the Weibull functional form for the hazard. Results show coefficients, not exponentiated coefficients or hazard ratios. Column 1 shows that black and Hispanic youth have significantly higher probabilities of exiting into detention (i.e., their spells are shorter), as do youth who are older.

² It is implemented using `pgmhaz` command in Stata (Version 7).

This is consistent with evidence from other data, such as the FBI arrest data and data from the National Longitudinal Survey of Youth. The parameter p , which measures duration dependence is close to one, implying near-constant hazard. The key policy variables in this analysis also behave as predicted. Youth who receive treatment have significantly lower probabilities of exiting into detention (i.e., their spells are shorter). Beer prices also have significant, negative effects on exit into detention.

Column 2 uses county treatment rates, the proxy for price of treatment, rather than individual treatment. Coefficients on the demographic variables are similar to Column 1. The coefficient on beer prices is significant and implies a stronger negative effect on detention exits than the first specification. The parameter p is greater than one, implying decreasing duration dependence. The coefficient on treatment rates is positive and significant. This implies that youth in counties with higher treatment rates have higher conditional exit probabilities counter to the theoretical model's prediction.

Table 3 presents estimates from the complementary log-log specification of Prentice and Gloeckler which does not depend on assumptions about the shape of the baseline hazard function. Column 1 shows that higher ages have a significantly higher probabilities of detention as do Hispanics, while whites have lower probabilities of exit. In contrast to the Weibull models, the effect of black is negative but not significant. As with the Weibull models individual treatment and beer prices have a negative effects on the detention hazard.

Column 2 shows similar results for the demographic variables and the effect of beer prices. The coefficients on the duration dummy variables (not shown) indicate that the pattern of variation of the baseline hazard with duration is not monotonic. In contrast to the Weibull models, when we allow for a more flexible specification of the baseline hazard, there is a strong

negative effect of treatment rates on detention exits.

The models in Tables 1 and 2 do not include a term representing unmeasured heterogeneity. Unobserved heterogeneity leads to overstated duration dependence (i.e., underestimates of the extent to which the hazard rate increases with duration) and attenuates the magnitude of the impact of covariates on the hazard rate (Lancaster 1990, Kiefer, 1988). Consequently, our results may be biased. We incorporate a gamma mixing distribution to capture unobserved heterogeneity as proposed by Meyer (1990). Results when including unobserved heterogeneity show that males and youth of older ages have detention exit rates (see Table 3). Being black has a positive, significant effect on detention exits. Unlike previous specifications, the effect for Hispanics and whites is positive, but not significant. The pattern of duration dependence is not monotonic (coefficients not shown). The effect of individual treatment on detention exits is similar to models that do not account for unobserved heterogeneity (column 1). However, the effect of beer price is no longer significant. Similarly, in column 2, when accounting for unobserved heterogeneity, treatment rates have a negative and significant effect on detention exits. Here, too, however, the effect of beer prices is no longer significant.

5. SUMMARY AND CONCLUSIONS

This paper examine the effectiveness of mental health and substance abuse treatment in reducing juvenile crime. The sample used consisting largely of urban youth, all of whom are entered in the Colorado child welfare program. Our analysis indicates that a relative high proportion of youth in child welfare are detained. Among youth in child welfare those who are male, black, and older were more likely to be detained earlier than other youth. The results

suggest treatment can be an effective strategy to delay youth detention. Specifically, the analysis finds that individual-level treatment and the supply of treatment services lower youth's probabilities of exiting into detention. The results of higher beer prices on detention are mixed. In models which do not account for unobserved heterogeneity, the coefficients on beer prices are negative and statistically significant. Accounting for the unobserved heterogeneity makes this coefficient no longer significant. These results suggest that once treatment and individual characteristics are accounted, alcohol consumption no longer has an impact on crime.

References

- Anglin, M.D. and Y. Hser. "Treatment of Drug Abuse," in *Drugs and Crime*, M. Tonry and J.Q. Wilson, editors. The University of Chicago Press: Chicago, IL pp 393-460, 1990.
- Bureau of Justice Statistics, U.S. Department of Justice. *Report to the Nation on Crime and Justice. Second Edition.* NCJ-105506, March 1988.
- Chaiken, J.M. and M. R. Chaiken. *Varieties of Criminal Behavior: Summary and Policy Implications.* Santa Monica, CA: Rand, 1982.
- Chaloupka, F.J., and H. Saffer. "Alcohol, Illegal Drugs, Public Policy and Crime." Presented at the annual meeting of the Western Economic Association, San Francisco, CA, July 1992.
- Cook, P.J., and M.J. Moore. "Economic Perspectives on Reducing Alcohol-Related Violence." In *Alcohol and Interpersonal Violence: Fostering Multidisciplinary Perspectives*, edited by Susan E. Martin. National Institute on Alcohol Abuse and Alcoholism Research Monograph 24. NIH Publication No. 93-3469, Washington, DC: U.S. Government Printing Office, 1993.
- DeLeon, G. "Program-based Evaluation Research in Therapeutic Communities." In *Drug Abuse Treatment Evaluation: Strategies, Progress and Prospects*, edited by F.M. Tims and J.P. Ludford. National Institute on Drug Abuse Research Monograph no. 51. Rockville, MD.: U.S. Department of Health and Human Services, National Institute on Drug Abuse, 1984.
- DeLeon, G. M.P.A. Andresw, H.K. Wexler, J. Jaffe, and M.X. Rosenthal. "Therapeutic Community Dropouts: Criminal Behavior Five Years after Treatment." *American Journal of Drug and Alcohol Abuse*, 6:253-71, 1979.
- DeSimone, J. "The Effect of Cocaine Prices on Crime" *Economic Inquiry*, 39:4, 2001.
- Fagan, J. "Interactions Among Drugs, Alcohol and Violence." *Health Affairs*, 12:4, 65-79, Winter 1993.
- Forrest, G. G., & Gordon, R. H. *Substance Abuse, Homicide, and Violent Behavior.* New York: Garden Press, 1990.
- Frank, R.G. and T.G. McGuire, "Economics and mental health", in: A.J. Culyer and J.P. Newhouse, eds., *Handbook of health economics*, Vol. 1B. Amsterdam: Elsevier, 2000.
- Goldstein, P.J. "The Drugs/Violence Nexus: A Tripartite Conceptual Framework." *Journal of Drug Issues*, 15, Fall 1985, 493-506.
- Henggeler, E.M., Cunningham, P.B. Picrel, S.G., Scheonwald, S.K., Brondino, M.J., "Multisystemic Therapy: An Effective Violence Prevention Approach for Serious Juvenile Offenders. *Journal of Adolescence* 1: 47-61, 1996.
- Henggeler, E.M., Scheonwal, S.K., Borduin, C.M., Rowland, M.D. and Cunningham, P.B. *Multisystemic Treatment of Antisocial Behavior in Children and Adolescents* New York: Guilford Press, 1998.

- Hser, Y., M.D. Anglin and C. Chou. "Evaluation of Drug Abuse Treatment: A Repeated Measure Design Assessing Methadone Maintenance." *Evaluation Review*, 12(5): 547-70, 1988.
- Hubbard, R.L., J.V. Rachal, S.G. Craddock, and E.R. Cavanaugh. "Treatment Outcome Prospective Study (TOPS): Client Characteristics and Behaviors Before, During and After Treatment." In *Drug Abuse Treatment Evaluation: Strategies, Progress and Prospects*, edited by F.M. Tims and J.P. Ludford. National Institute on Drug Abuse Research Monograph no. 51. Rockville, MD.: U.S. Department of Health and Human Services, National Institute on Drug Abuse, 1984.
- Hunt, D.E., D.S. Lipton and B. Spunt. "Patterns of Criminal Activity among Methadone Clinets and Current Narcotics Users Not in Treatment." *Journal of Drug Issues*, 14(4): 687-702, 1984.
- Jenkins, S. P. "Easy estimation methods for discrete-time duration models." *Oxford Bulletin of Economics and Statistics* 57(1): 129-138, 1995.
- Jenkins, S. P. "Estimation of discrete time (grouped duration data) proportional hazards models: pgmhaz," *Stata Technical Bulletin Reprints*, STB 17, 7: 109-121, September 1997.
- Kessler, R., R. Crum, L. Warner, C. Nelson, J. Schulenberg and J. Anthony. "The Lifetime Co-occurrence of DMS-III-R Alcohol Abuse and Dependence with Other Psychiatric Disorders in the National Comorbidity Survey." *Archives of General Psychiatry*, 45: 313-321, 1996.
- Kiefer, N.M., "Economic Duration Data and Hazard Functions," *Journal of Economic Literature* 26:646-679, June 1988.
- Lancaster, T., *The Econometric Analysis of Transition Data*, Econometric Society Monograph No. 17, Cambridge University Press, Cambridge, 1990.
- Leshner, A. "Drug Abuse and Mental Disorders: Comorbidity is Reality." *NIDA Notes*, 14:4, June 2001.
- Leung, SF and Phelps, CE. "My Kingdom for a Drink....?" A Review of the Price Sensitivity of Demand for Alcoholic Beverages," in *Economic and Socioeconomic Issues in the Prevention of Alcohol-Related Problems*, edited by G. Bloss and M. Hilton. Washington, DC: U.S. Government Printing Office, 1993.
- Maddux, J.F. and D.P. Desmond. "Crime and Drug Use Behavior: An Areal Analysis." *Criminology*, 19: 281-302, 1979.
- Markowitz, S. "An Economic Analysis of Alcohol, Drugs, and Violent Crime in the National Crime Victimization Survey". NBER working paper No. 7982, October 2000.
- Markowitz, S. "Criminal Violence and Alcoholic Beverage Control: Evidence from an International Study," in *The Economic Analysis Of Substance Use And Abuse: The Experience of Developed Countries and Lessons for Developing Countries*, edited by Michael Grossman and Chee-Ruey Hsieh, Edward Elgar Limited, United Kingdom, 2001.
- McGlothlin, W.H., M.D. Anglin and B.D. Wilson. "An Evaluation of the California Civil Addict Program." Rockville, Md.: National Institute on Drug Abuse, 1977.

- Meyer, B. D. "Unemployment insurance and unemployment spells." *Econometrica* 58(4): 757-782, 1990.
- Miczek, K.A., J.F. DeBold, M. Haney, J. Tidey, J. Vivian, and E.M. Weerts. "Alcohol, Drugs of Abuse, Aggression, and Violence" in *Understanding and Preventing Violence, Volume 3*, edited by A.J. Reiss and J.A. Roth. Washington, D.C.: National Academy Press, 1994.
- Myers, T. "Alcohol and Violent Crime Re-examined: Self-reports from two Sub-groups of Scottish Male Prisoners." *British Journal of Addiction*. 77:4, December 1982, 399-413.
- Myers, T. "An Analysis of Context and Alcohol Consumption in a Group of Criminal Events." *Alcohol and Alcoholism*. 21:4, 1986, 389-395.
- Pernanen, Kai. "Theoretical Aspects of the Relationship Between Alcohol Use and Crime." in *Drinking and Crime: Perspectives on the Relationships between Alcohol Consumption and Criminal Behavior*, edited by James J. Collins Jr. New York, NY: The Guilford Press, 1981.
- Prentice, R. and L. Gloeckler. "Regression analysis of grouped survival data with application to breast cancer data." *Biometrics* 34: 57-67, 1978.
- Roslund, B. and C.A. Larson. "Crimes of Violence and Alcohol Abuse in Sweden." *International Journal of the Addictions*, 14:8, November 1979, 1103-1115.
- Saffer, H. "Substance Abuse Control and Crime: Evidence from the National Household Survey of Drug Abuse." In *The Economic Analysis Of Substance Use And Abuse: The Experience of Developed Countries and Lessons for Developing Countries*, edited by M. Grossman and C. Hsieh, Edward Elgar Limited, United Kingdom, 2001.
- Saffer, H., F.J. Chaloupka, and D. Dave. "State Drug Control Spending and Illicit Drug Participation." *Contemporary Economic Policy*, 19(2):150-161, 2001.
- Sealock, M.D., D.C. Gottfredson, and C.A. Gallagher, "Drug Treatment for Juvenile Offenders: Some Good and Bad News." *Journal of Research in Crime & Delinquency*, 34(2): 210-237, 1997.
- Van Stelle, K.R., E. Mauser and D.P. Moberg. "Recidivism to the Criminal Justice System of Substance-Abusing Offenders Diverted Into Treatment." *Crime & Delinquency*, 40(2): 175-197, 1994.

Table 1: Mean Values, first spell

	Mean (Standard Errors)
Detention	38.0%
Treatment	12.6%
Avg. County Beer Price [^]	4.27 (.21)
Age 14-15	33.2%
Age 16-17	14.8%
White	77.6%
Black	12.5%
Hispanic	29.0%
N	9,333

[^] mean for sample period.

Table 2: Estimates from Weibull Model

	Model 1	Model 2
Treatment	-0.18** (0.07)	
Treatment Rate		13.30** (0.45)
Average County Beer Price	-0.86** (0.10)	-1.33** (0.10)
White	-0.01** (0.07)	-0.15* (0.07)
Black	0.26** (0.08)	0.29** (0.08)
Hispanic	0.27** (0.05)	0.44** (0.05)
Male	0.96** (0.04)	0.94** (0.04)
Age 14_15	0.99** (0.04)	1.00** (0.05)
Age 16-17	0.94** (0.05)	1.02** (0.05)
N	141,588	141,588
Log likelihood	-7787	-7286

*Significant at p>.01 level **Significant at p>.05 level

Table 3: Estimates from Prentice Gloeckler Model

	Model 1	Model 2
Treatment	-0.49** (0.07)	
Treatment Rate		-3.30** (0.73)
Average County Beer Price	-0.40** (0.10)	-0.33** (0.10)
White	-0.31** (0.07)	-0.31** (0.07)
Black	0.03 (0.08)	0.04 (0.08)
Hispanic	0.40** (0.05)	0.40** (0.05)
Male	0.93** (0.04)	0.90** (0.04)
Age 14_15	0.91** (0.04)	0.91** (0.04)
Age 16-17	1.01** (0.05)	1.08** (0.05)
N	141,588	141,588

Coefficients on time dummies not shown

*Significant at p>.01 level **Significant at p>.05 level

Table 4: Estimates from Prentice Gloeckler Model With Unobserved Heterogeneity

	Model 1	Model 2
Treatment	-0.51** (0.16)	
Treatment Rate		-5.35** (1.88)
Average County Beer Price	0.10 (0.30)	0.02 (0.29)
White	-0.06 (0.27)	-0.04 (0.26)
Black	0.75* (0.32)	0.64** (0.32)
Hispanic	0.21 (0.18)	0.17 (0.17)
Male	2.04** (0.17)	1.97** (0.17)
Age 14_15	1.33** (0.20)	1.33** (0.15)
Age 16-17	1.39** (0.20)	1.53** (0.19)
N	141,588	141,588

Coefficients on time dummies not shown

*Significant at $p > .01$ level **Significant at $p > .05$ level