



Research and Data Analysis Division
Briefing Paper 4.34bp

Net Impact Analysis of Substance Abuse Treatment

Boqing Wang, Ph.D., Gordon Liu, Ph.D.

Question: Does substance abuse treatment in Washington have an impact on clients' employment and earnings?

Introduction

Some previous studies on substance abuse in Washington have focused on the link between substance abuse treatment and subsequent employment outcomes. These studies were based on small samples of clients receiving ADATSA-funded treatment. For example, a 1994 study was limited to a small sample of 909 ADATSA clients from August 1 through November 30, 1989. A recent study (1997) employed only a small cohort of ADATSA clients, with a comparison group (detoxification) of 138 clients and a treatment group of 287.

This study, therefore, makes three major contributions as follows:

- 1. Investigates Labor Market Outcomes:** It investigates the effectiveness of substance abuse treatment programs in a larger scope, covering three labor market outcomes: employment, earnings, and hours of work.
- 2. Analyses All DASA Clients:** It examines **all** the substance abusers in Washington State who completed a treatment program or had detoxification and were monitored through the Division of Alcohol and Substance Abuse (DASA), Washington State Department of Social and Health Services. DASA data contain many clients other than ADATSA clients. Our study sample is thus different from previous studies that focused on ADATSA clients only.
- 3. Employs Methodological Improvement:** It develops an econometric model that captures both the pre-treatment difference and more importantly, a two-year dynamic change of treatment program impact. To better identify the net effects of interventions, potential confounding factors are controlled for in our analytical model, including pre-existing difference across comparison groups, individual demographic and socioeconomic variables. The model also considers the endogenous nature of the choice of treatment in sample selection.

Data and Estimation

Sample: Data in this study are derived from a follow-up sample containing information for all clients who received complete treatment, incomplete treatment, or detoxification only from the third quarter of 1993 through the second quarter of 1996. Clients in this sample are monitored by DASA. In the original sample data, there are 67,308 clients.

Over this three-year period, some of the clients recorded more than one treatment event. For this treatment outcome analysis, it was important to define client groups in which the earliest and most intensive treatment event was analyzed for each person. Detoxification is the least intensive treatment modality, incomplete treatment is the middle, and complete treatment is the most intensive. These treatment Intensities were used with the rules defined in Appendix V, to define client group status and date of treatment unambiguously for persons with more than one event.

After this regrouping, the 67,308 clients were divided into three groups depending on their most intense treatment episode during the three-year period:

1. 24,079 persons who only had detoxification or assessment and no treatment begun or completed.
2. 29,105 persons who had at least one incomplete treatment episode and no completed treatment.
3. 14,124 persons who had at least one complete treatment.

For the purposes of this analysis, we needed to compare treatment completers with people who did not even begin treatment during this three-year period. So the incomplete group was dropped from the analysis.

Seventeen percent of the remaining 38,203 persons had more than one event recorded during the three years. With such small proportion of multiple events, it is difficult to model their additional impacts on outcomes, because the multiple event effect is “washed out” by the overwhelming single event effects. Therefore, the seventeen percent multiple events were reserved for future analysis. This paper concentrates upon analyzing the impact of a single episode of detoxification or assessment only, as compared to a single episode of treatment completion. The final sample size therefore is 31,770 persons.

Employment Data and Controls: Four quarterly observations prior to the first treatment or detoxification were kept as baseline data to control for any pre-treatment differences in employment status between the groups. Eight quarterly observations after the first treatment or detoxification were employed to identify the post-intervention effect. Since different clients received treatment or detoxification at different times, the total number of observations varies from client to client during our study period, averaging around 9 per client. That is, while some clients may have 12 quarterly observations, contributing the most to the estimation of our model, others could have just one observation.

Controls for Endogeneity of Treatment: This study differs from other studies of treatment effects by dealing with all DASA clients. DASA clients come to the decision to seek treatment in many ways: some are court-ordered into treatment, some are referred by a physician; and others have perhaps experienced some life crises. Also, DASA has state and federally mandated priority treatment populations (such as youth and pregnant women) which affect treatment availability. In this situation, the decision to seek and complete treatment rather than detoxification only is not likely to be a random event, and clients who receive treatment will differ in a systematic way from clients who only receive detoxification. Technically, this problem is called “endogeneity of

treatment” variable. In this analysis, the technical problem of “adjusting” for endogenous treatment is handled using the instrumental variable approach (Train, 1994)¹. This approach first predicts the client’s probability of seeking and completing alcohol or drug use abuse treatment (using a logit model). This predicted probability adjusts for all the systematic differences between completers and detoxification only groups. Then the predicted probability replaces the observed treatment completion variable in the three employment performance equations.

Modeling the Labor Market Outcomes: In the context of the neoclassical model of labor supply, one’s performance in labor market would involve two steps: whether or not to work as the first step; and then how much to work and how much to earn as the second step for the employed group. This two-step decision mechanism leads to a two-part model approach to the estimation of our three-equation model

In the first part, a logistic probability function of employment (E_{it}) is estimated using both the employed and the unemployed clients in each quarter (Figure 1 and Appendix I). In the second part, both the earnings function and hours to work functions are estimated for the employed only (Figures 2,3 and Appendices II, III).

Findings

Pre-existing Differences

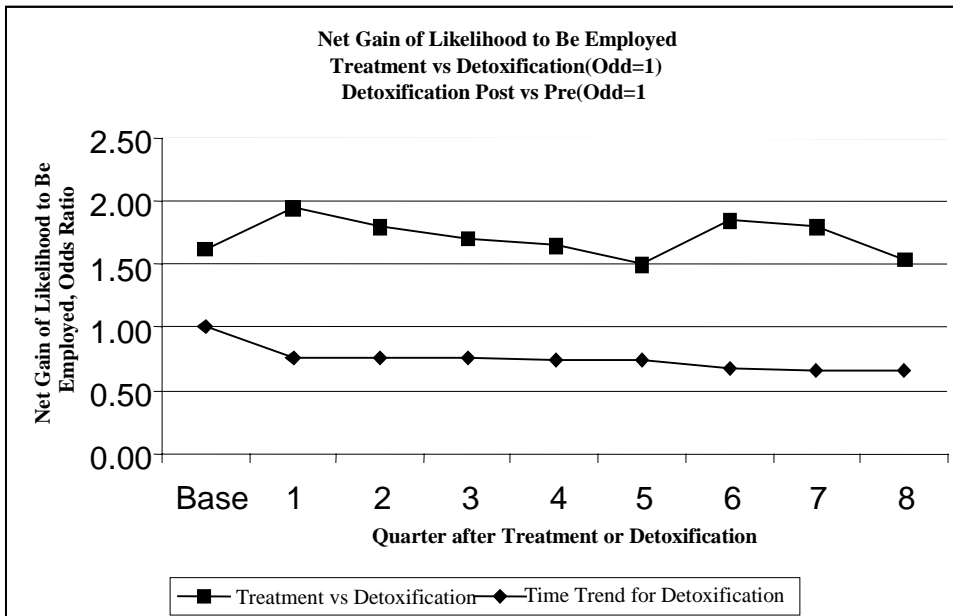
There are pre-existing differences across the two comparison groups in terms of their labor market outcomes.

- **Employment Opportunities:** Clients in the treatment group are approximately 60% more likely to have a job prior to receiving treatment than clients in the detoxification group. In other words, employed clients are more likely to obtain further treatment, while the unemployed tend to go with the option of detoxification-only.
- **Earnings and Hours of Work:** Given being employed, clients in the treatment group earn **less** than clients in the detoxification group by about \$644 per pre-quarter, 23% of the average quarterly earnings of \$2860. Likewise, clients in the treatment group work 40 hours less, per pre-quarter, than those in the detoxification group, 14% of the average quarterly hours of 292

¹ *This is a pooled analysis. Each person’s quarterly observation is treated as one observation for that quarter’s sub-sample.

Treatment Effects

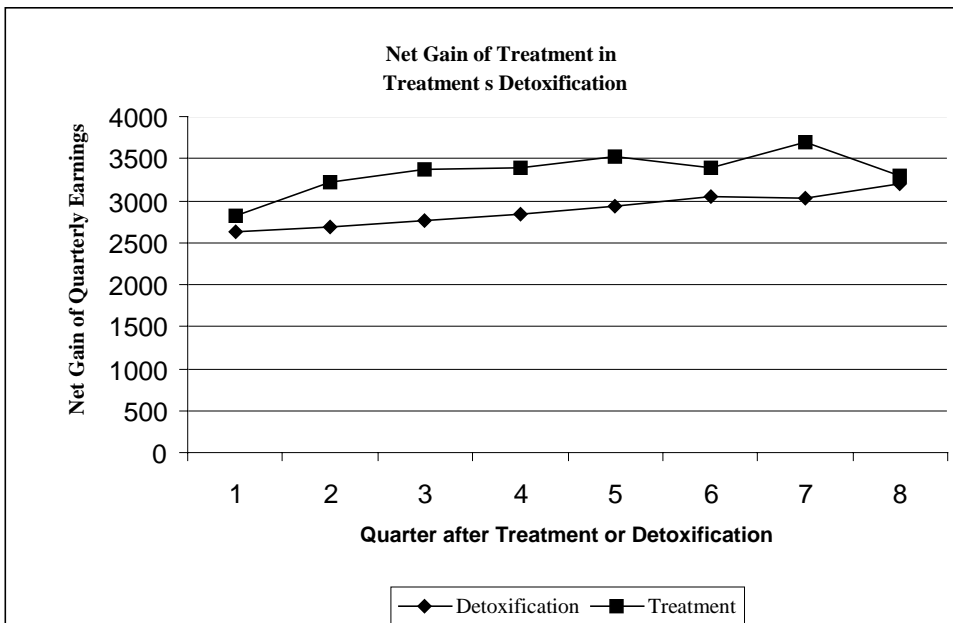
Figure 1



Note: Base is the average of two years before treatment.

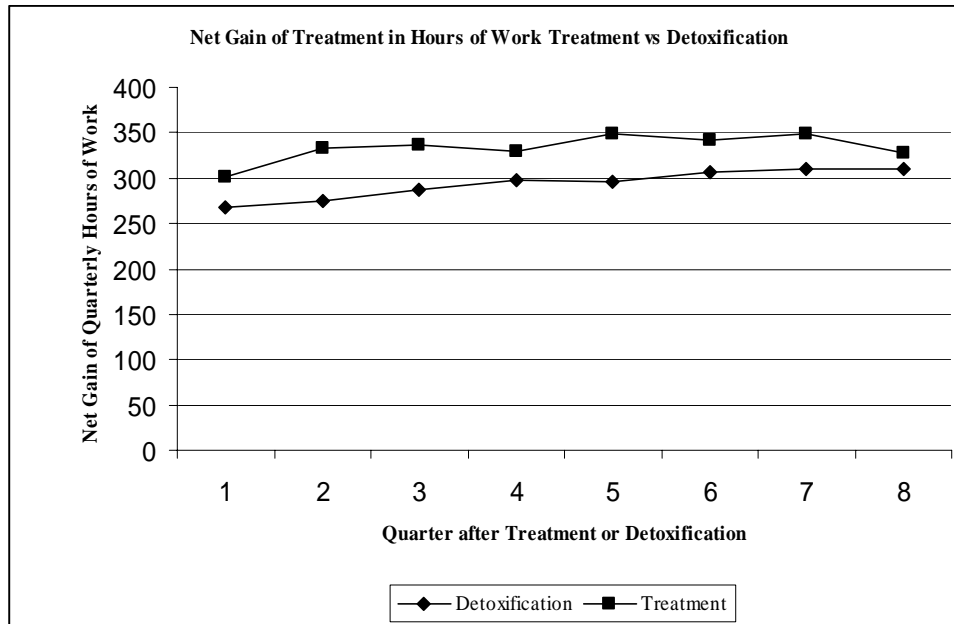
- Employment Opportunities:** Clients are more likely employed after treatment than what would have been likelihood of employment if they hadn't received treatment: ranging from approximately 94% (likelihood) in the first quarter, to 50% (likelihood) in the fifth quarter. The treatment impact on employment is significant and positive throughout eight quarters.

Figure 2



- **Earnings:** Clients earn more after treatment they would have been earned if they hadn't received treatment: ranging from \$683 (24% increase over the average of \$2860) in the seventh quarter, to \$518 (18% increase) in the second quarter. The treatment impact on earnings is significant from the second quarter to the seventh quarter (except the sixth quarter).

Figure 3



- **Hours of Work:** Clients work more hours, ranging from 53 to 31 more hours of work per quarter after treatment than they would have if they hadn't received treatment. The treatment impact on hours of work is significant throughout all quarters except last one after treatment.

Discussion

This study has found that:

- Substance abusers, after receiving treatment, appear to regain their productivity very effectively in labor market throughout six quarters of the post-treatment period.
- Compared to their pre-treatment status, clients after receiving treatment are more likely to find a job, earn more, and work longer hours. While the effects in all three areas seem to diminish over time, the effect of treatment on earnings and hours of work remain statistically significant for five and seven quarters respectively.
- The employed are found to be more likely to receive treatment than the unemployed. One explanation for this observation may be that employment could provide the employed better access to treatment programs. For example, the employed may benefit from better information, assistance, or understanding of available treatment programs through colleagues or facilities at work.

- Clients in the treatment group are shown to be poorer in terms of pre-treatment earnings and hours of work than those on the detoxification-only group who were employed. This finding may suggest that clients obtaining treatment had developed more severe substance abuse problems. This may also be a result of the clinical screening process for treatment eligibility. This finding provides strong evidence that the treatment selection is endogenous to the model, warranting the use of the Instrumental-Variable approach.

Appendix I

Table 1
Definition of the Variables

E	Dummy variable, being 1 for the employed, and 0 for the unemployed before receiving any interventions
W	Quarterly earnings (\$)
Ln(W)	Logarithm of quarterly earnings
Ln(WP)	Predicted logarithm of quarterly earnings using exogenous variables as instruments
H	Quarterly hours of work
TREAT	Dummy variable, being 1 for those completed one detoxification followed by formal treatment, and 0 for those completed one detoxification-only
TREATP	Predicted treat probability using exogenous variables as instruments
QT1	Dummy variable, being 1 for post-intervention quarter one, and 0 otherwise
QT2	Dummy variable, being 1 for post-intervention quarter two, and 0 otherwise
QT3	Dummy variable, being 1 for post-intervention quarter three, and 0 otherwise
QT4	Dummy variable, being 1 for post-intervention quarter four, and 0 otherwise
QT5	Dummy variable, being 1 for post-intervention quarter five, and 0 otherwise
QT6	Dummy variable, being 1 for post-intervention quarter six, and 0 otherwise
QT7	Dummy variable, being 1 for post-intervention quarter seven, and 0 otherwise
QT8	Dummy variable, being 1 for post-intervention quarter eight, and 0 otherwise
TREATP*QT1	1 st quarter after treatment
TREATP*QT2	2 nd quarter after treatment
TREATP*QT3	3 rd quarter after treatment
TREATP*QT4	4 th quarter after treatment
TREATP*QT5	5 th quarter after treatment
TREATP*QT6	6 th quarter after treatment
TREATP*QT7	7 th quarter after treatment
TREATP*QT8	8 th quarter after treatment
TRADE	Dummy variable, being 1 for those working in whole sale and retail industry, and 0 otherwise
MANUFA	Dummy variable, being 1 for those working in manufacture industry, and 0 otherwise
TRANSP	Dummy variable, being 1 for those working in transportation industry, and 0 otherwise
FINANC	Dummy variable, being 1 for those working in financial industry, and 0 otherwise
SERVICE	Dummy variable, being 1 for those working in service industry, and 0 otherwise
HEALTH	Dummy variable, being 1 for those working in health care industry, and 0 otherwise
AGE	Age at receiving detoxification or detoxification plus formal treatment
RURAL	Dummy variable, being 1 for those living in rural area, and 0 those in urban area
FEMALE	Dummy variable, being 1 for female, and 0 for male
DRUG	Dummy variable, being 1 for drug abusers, and 0 alcohol abusers
NONWHITE	Dummy variable, being 1 for non-white, and 0 for white
REGION1-40	40 Dummy variables of different counties, measuring access to treatment facility

Table 2
Descriptive Statistics of Key Variables
(Sample of Employment)

VARIABLES	Mean/frequency 4 qtrs before intervention (N=107,893)	Standard Deviation /Percent	Mean/frequency 8 qtrs after intervention (N=164,616)	Standard Deviation /Percent
E	37,968	35.19%	53,494	32.49%
W	\$947	2027	\$968	2072
H	91	174	92	179
TREAT	32,905	30.50%	60,662	36.84%
TRADE	20,722	19.21%	29,835	18.12%
MANUFA	8,743	8.10%	13,434	8.16%
TRANSP	2,539	2.35%	3,843	2.33%
FINANC	1,973	1.83%	2,882	1.75%
SERVICE	17,563	16.28%	24,728	15.02%
HEALTH	8,771	8.13%	13,927	8.46%
AGE	35.5	10.53	35.5	10.48
RURAL	46,695	43.28%	70,678	42.92%
FEMALE	34,267	31.76%	50,963	30.95%
DRUG	37,516	34.77%	51,888	31.51%
NONWHITE	29,405	27.25%	45,896	27.87%

Table 3
Descriptive Statistics of Key Variables
(Employed Sample before Regression)

VARIABLES	Mean/frequency 4 qtrs before intervention (N=37,968)	Standard Deviation /Percent	Mean/frequency 8 qtrs after intervention (N=53,494)	Standard Deviation /Percent
W	\$2,695	2642	\$2,985	2686
H	276	207	305	210
TREAT	12,975	34.17%	24,121	45.09%
TRADE	10,637	28.02%	14,284	26.70%
MANUFA	4,863	12.81%	7,409	13.85%
TRANSP	1,411	3.72%	2,113	3.95%
FINANC	959	2.53%	1,384	2.59%
SERVICE	7,964	20.82%	10,149	18.97%
HEALTH	4,227	11.13%	6,772	12.66%
AGE	33.5	9.43	33.2	9.04
RURAL	17,556	46.24%	25,446	47.57%
FEMALE	10,634	28.07%	14,501	27.11%
DRUG	12,028	31.68%	15,349	28.69%
NONWHITE	10,456	27.54%	15,450	28.88%

Table 4
Employment Probability Function (E)

	Parameters	S. E.	Pr>χ^2	Odds ratio
INTERCEPT	0.5686	0.0222	0.0001 ***	
Pre-Existing Difference				
TREATP	0.4806	0.0352	0.0001	1.617
Treatment Effect by Quarter				
TREATP*QT1	0.6648	0.0786	0.0001 ***	1.944
TREATP*QT2	0.5799	0.0820	0.0001 ***	1.786
TREATP*QT3	0.5361	0.0862	0.0001 ***	1.709
TREATP*QT4	0.5001	0.0907	0.0001 ***	1.649
TREATP*QT5	0.4054	0.0971	0.0001 ***	1.500
TREATP*QT6	0.6076	0.1048	0.0001 ***	1.836
TREATP*QT7	0.5819	0.1142	0.0001 ***	1.789
TREATP*QT8	0.4330	0.1304	0.0009 **	1.542
Time Trend by Quarter				
QT1	-0.2944	0.0293	0.0001 ***	0.745
QT2	-0.2650	0.0307	0.0001 ***	0.767
QT3	-0.2778	0.0323	0.0001 ***	0.757
QT4	-0.3006	0.0342	0.0001 ***	0.740
QT5	-0.2992	0.0366	0.0001 ***	0.741
QT6	-0.3823	0.0399	0.0001 ***	0.682
QT7	-0.4002	0.0437	0.0001 ***	0.670
QT8	-0.4017	0.0499	0.0001 ***	0.669
Demographic Variable				
AGE	-0.0345	0.0005	0.0001 ***	0.966
RURAL	0.1599	0.0089	0.0001 ***	1.173
FEMALE	-0.3384	0.0098	0.0001 ***	0.713
DRUG	-0.2600	0.0097	0.0001 ***	0.771
NONWHITE	0.0043	0.0098	0.6645	1.004

*** Statistically significant at 1% level;

** Statistically significant at 5% level;

Table 5
Earnings Function (E)

	Parameters	S. E.	T-Test	Prob>T
INTERCEPT	2275.05	49.70	45.77	0.0001 ***
Pre-Existing Difference				
TREATP	-643.70	71.78	-8.97	0.0001 ***
Treatment Effect by Quarter				
TREATP*QT1	189.27	158.22	1.20	0.2316
TREATP*QT2	518.16	165.25	3.14	0.0017 ***
TREATP*QT3	612.67	175.00	3.50	0.0005 ***
TREATP*QT4	548.31	184.99	2.96	0.0030 ***
TREATP*QT5	577.06	201.46	2.86	0.0042 ***
TREATP*QT6	346.75	216.25	1.60	0.1088
TREATP*QT7	682.86	235.95	2.89	0.0038 ***
TREATP*QT8	94.58	273.64	0.35	0.7296
Time Trend by Quarter				
QT1	-65.19	61.37	-1.06	0.2882
QT2	-3.93	64.15	-0.06	0.9512
QT3	69.21	68.02	1.02	0.3090
QT4	147.01	72.18	2.04	0.0417 **
QT5	242.31	78.17	3.10	0.0019 ***
QT6	351.77	85.42	4.12	0.0001 ***
QT7	326.81	93.58	3.49	0.0005 ***
QT8	506.35	107.87	4.69	0.0001 ***
Industry Type				
TRADE	-535.89	26.89	-19.93	0.0001 ***
MANUFA	656.98	30.98	21.20	0.0001 ***
TRANSP	627.38	49.52	12.67	0.0001 ***
FINANC	-388.56	59.53	-6.52	0.0001 ***
SERVICE	-1100.11	28.69	-38.34	0.0001 ***
HEALTH	-180.65	33.86	-5.34	0.0001 ***
Demographic Variable				
AGE	35.10	0.98	35.76	0.0001 ***
RURAL	117.02	18.33	6.38	0.0001 ***
FEMALE	-593.53	21.25	-27.93	0.0001 ***
DRUG	-254.23	19.80	-12.84	0.0001 ***
NONWHITE	-194.78	19.98	-9.75	0.0001 ***

*** Statistically significant at 1% level;
 ** Statistically significant at 5% level;
 * Statistically significant at 10% level;

Table 6
Hours of Work Function (H)
(Reduced Form)

	Parameters	S. E.	T-Test	Prob>T	
INTERCEPT	233.71	3.98	58.67	0.0001	***
Pre-Existing Difference					
TREATP	-40.02	5.74	-6.97	0.0001	***
Treatment Effect by Quarter					
TREATP*QT1	34.16	12.67	2.70	0.0070	***
TREATP*QT2	58.05	13.26	4.38	0.0001	***
TREATP*QT3	49.26	14.00	3.52	0.0004	***
TREATP*QT4	30.81	14.80	2.08	0.0374	**
TREATP*QT5	52.68	16.09	3.27	0.0011	***
TREATP*QT6	34.97	17.30	2.02	0.0433	**
TREATP*QT7	38.90	18.91	2.06	0.0396	**
TREATP*QT8	17.44	21.95	0.79	0.4269	
Time Trend by Quarter					
QT1	-8.47	4.93	-1.72	0.0859	*
QT2	-1.84	5.15	-0.36	0.7207	
QT3	11.95	5.45	2.19	0.0282	**
QT4	22.10	5.79	3.82	0.0001	***
QT5	20.66	6.25	3.30	0.0010	***
QT6	30.26	6.84	4.43	0.0001	***
QT7	33.90	7.51	4.52	0.0001	***
QT8	34.75	8.66	4.01	0.0001	***
Industry Type					
TRADE	12.04	2.15	5.61	0.0001	***
MANUFA	61.31	2.47	24.81	0.0001	***
TRANSP	26.18	4.00	6.54	0.0001	***
FINANC	1.46	4.77	0.31	0.7595	
SERVICE	-45.25	2.30	-19.64	0.0001	***
HEALTH	25.86	2.70	9.56	0.0001	***
Demographic Variable					
AGE	1.35	0.08	17.11	0.0001	***
RURAL	31.26	1.47	21.29	0.0001	***
FEMALE	-25.83	1.70	-15.16	0.0001	***
DRUG	25.67	1.59	-16.15	0.0001	***
NONWHITE	18.50	1.60	11.54	0.0001	***

*** Statistically significant at 1% level;
 ** Statistically significant at 5% level;
 * Statistically significant at 10% level;

Appendix II

A three-equation model is developed to capture the dynamic changes in clients' probability of being employed (E_{it}), hours to work (H_{it}), and quarterly earnings (W_{it}). Specifically, a linear model is derived from an underlying individual utility function as follows:

$$\begin{aligned}
 E_{it} &= \alpha_E + \beta_{E0}TRT_i + \sum_{t=1}^8 \beta_{Et}TRT_i * PQT_{it} + \sum_{t=1}^8 \lambda_{Et}PQT_{it} + \Gamma_E * X_{Eit} + v_{Eit} \\
 W_{it} &= \alpha_W + \beta_{W0}TRT_i + \sum_{t=1}^8 \beta_{Wt}TRT_i * PQT_{it} + \sum_{t=1}^8 \lambda_{Wt}PQT_{it} + \Gamma_W * X_{Wit} + v_{Wit} \\
 H_{it} &= \alpha_H + \beta_{H0}TRT_i + \sum_{t=1}^8 \beta_{Ht}TRT_i * PQT_{it} + \sum_{t=1}^8 \lambda_{Ht}PQT_{it} + \delta_w \ln w_{it} + \Gamma_H * X_{Hit} + v_{Hit}
 \end{aligned}$$

In specifying this model, three groups of explanatory variables are employed to measure intervention-related effects including a) pre and post detoxification-only effect for all clients, captured dynamically through eight quarterly time dummy variables (PQT_{it}); b) further treatment effect for clients in treatment group, whose dynamic effects are differentiated by the treatment interactions with the eight-quarter dummy variables ($TRT_i * PQT_{it}$); and c) pre-existing difference across the treatment and detoxification-only groups, measured by the treatment dummy variable (TRT_i). Three random variables (v_{Eit} , v_{Hit} , v_{Wit}) are also included to control for all other unobserved factors in each equation. Parameters, α , β , λ , δ , Γ , measure the effects of their corresponding variables in each equation.

In addition, vectors of characteristics variables (X_{Eit} , X_{Hit} , X_{Wit}) are also included to control for impacts due to variations in individual demographic and socioeconomic status. These variables include age, sex, race (white vs. non-white), residence (rural vs. urban), whether abusing drug, and occupation. The industry variable has specified 7 types of industries including trade, manufacture, transportation, finance, service, health care, and others.

Appendix III: Procedures of Data Cleaning

We have clients from January of fiscal year 1994 to December of fiscal year 1996. Correspondingly, employment security data is the third quarter of calendar year 1993 to the second quarter of calendar year 1996. Over this three-year period, more than one type of treatment event may have been recorded for a single individual. For example, a person may have had a detoxification not followed by treatment within 90 days in Year 1. In the third quarter of Year 2, he completed a course of treatment. In analyzing treatment outcomes, we want to define the person as a treatment completer, and the date of completion as third quarter Year 2. There are many such examples.

Conceptually, we wish to define client groups in which the earliest and most intensive treatment event is analyzed for each person. Detoxification is the least intensive, incomplete treatment is the middle, and complete treatment is the most intensive.

These treatment intensities were used with the following rules, to define client group status and date of treatment unambiguously for persons with more than one event.

- A client might have more than one detoxification, and detoxification only. Event time of the client is defined at the earliest one so that pre-earnings is not contaminated.
- A client might have more than one treatment incompleteness, and incompleteness only. Event time of the client is defined at the earliest one so that pre-earnings is not contaminated.
- A client might have more than one treatment completion, and completion only. Event time of the client is defined at the earliest one so that pre-earnings is not contaminated.
- A Client might have an intensive treatment earlier and a less intensive treatment later. For example, a client completed a treatment and came back for a detoxification. Or a client had an incompleteness treatment and later detoxification. The client is defined as the earliest intensive treatment so that post-earnings of an intensive treatment is not used as pre- or post-earnings of a less intensive treatment.
- A client might have a less intensive treatment early and intensive one later. For example, a client had detoxification and completed a treatment later. Post-earnings for a less intensive treatment (detoxification for example) are set as missing while an intensive treatment started so that post-earnings of an intensive treatment is not used for the less intensive treatment.

References

Anglin, M. D. and Hser, Y. I. "The Treatment of Drug Abuse," in Tonry M & Wilson JQ Eds., *Drugs and Crime*. Chicago: University of Chicago Press, 1990, pp. 393-460.

Becker, F. W. and Sanders, D. K. "The Illinois Medicare/Medicaid Alcoholism Services Demonstration: Medicaid cost trends and utilization patterns - managerial report." Center for Policy Studies and Program Evaluation, Sangamon State University, 1984.

Blose, J.O. & Holder, H.D. "The Utilization of Medical Care by Treated Alcoholics: Longitudinal Patterns by Age, Gender and Type of Care". *Journal of Substance Abuse*, 3, 13-27., 1991.

Brown, M.; Longhi, D. and Luchansky, B. "ADATSA Employment Outcomes: Chemical Dependency Treatment and Additional Vocational Services. A Four and a half Year Follow-up Study of Indigent Persons Served by Washington State's Alcoholism and Drug Addiction Treatment and Support Act." Washington State Department of Social and Health Services, Research and Data Analysis Division, Olympia, WA, 1997.

Buchmueller, T., and Zuvekas S. H., "Drug Use, Drug Abuse, and Labor Market Outcomes," *Health Economics*, 7: 229-245, 1998.

Center for Alcohol Studies Rutgers University. "Socioeconomic Evaluations of Addictions Treatment." Piscataway, NJ, 1993.

Dayhoff, D.A., Pope, G.C. & Huber, J.G. "State Variation in the Public and Private Alcoholism Treatment at Specialty Substance Abuse Treatment Facilities". *Journal of Studies on Alcohol* 55(5): 549-560, 1994.

Duan, N., W. Manning, et al. "A Comparison of Alternative Models of the Demand for Medical Care." *Journal of Business and Economic Statistics* 1, (1983): 115-126.

Finigan, M. "Societal Outcomes and Cost Savings of Drug and Alcohol Treatment in the State of Oregon." Oregon State Department of Human Resources, Office of Alcohol and Drug Abuse Programs, Salem, Oregon, 1996.

Gerstein, D. R.; Johnson, R. A. and Harwood, H. J. et. al. "Evaluating Recovery Services: The California Drug and Alcohol Treatment Assessment (CALDATA) Report." California State Department of Alcohol and Drug Programs, Sacramento, CA, 1994.

Harwood, H. J.; Napolitano, D.; Kristiansen, P. and Collins, J. "Economic Costs to Society of Alcohol and Drug Abuse and Mental Illness: 1980", Research Triangle Park, NC: Research Triangle Institute, 1984.

Harwood, H. J.; Hubbard, R. L.; Collins, J. J. and Rachal, J. V. "The Costs of Crime and the Benefits of Drug Abuse Treatment: A cost-benefit analysis using TOPS data." in Leukefeld, CG & Tims FM Eds., *Compulsory Treatment of Drug Abuse: Research and Practice*, NIDA Research Monograph No. 86, U.S. Department of Health and Human Services, 1991, pp. 81-98.

Harwood, H., Fountain, D. and Livermore, G. "The Economic costs of Alcohol and Drug Abuse in the United States, 1992". Report Prepared for the National Institute on Drug Abuse and the National Institute on Alcohol Abuse and Alcoholism. Bethesda, MD: National Institutes of Health, 1998.

Hausman, J. "Specification Tests in Econometrics." *Econometrica*, 46: pp. 1251-71, 1978.

Hester, R.K. and Miller, W.R. "Handbook of Alcoholism Treatment Approaches: Effective Alternatives", Allyn & Bacon, Massachusetts, 1995.

Holder, H. D. "Alcoholism Treatment and Potential Health Care Cost Savings." *Medical Care*, 25: pp. 52-71, 1987.

Holder, H. D. and Blose, J. O. "Alcoholism Treatment and Total Health Care Utilization and Costs." *Journal of the American Medical Association*, pp. 256:1456-1460, 1986.

Hubbard, R. L.; Marsden, M. E.; Rachal, J. V.; Harwood, H. J.; Cavanaugh, E. R. and Ginzburg, H. M. "Drug Abuse Treatment: A motional study of effectiveness." Chapel Hill, NC: University of North Carolina Press, 1989.

Institute of Medicine. "Broadening the Base of Treatment for Alcohol Problems." Washington, DC: National Academy Press, 1990.

Jones, K. and Vischi, T. "Impact of Alcohol, Drug Abuse and Mental Health Treatment on Medical Care Utilization." *Medical Care*, 17 (Suppl. No. 12): pp. 1-82, 1979.

Longhi, D.; Brown, M. and Comtois, R. "ADATSA Treatment Outcomes: Employment and Cost Avoidance: An Eighteen Month Follow-up Study of Indigent Persons Served by Washington State's Alcoholism and Drug Addiction Treatment and Support Act." Washington State Department of Social and Health Services, Research and Data Analysis Division, Olympia, WA, 1994.

Luxenberh, M. G.; Christenson, M.; Betzner, A. E., et al. "Chemical Dependency Treatment Programs in Minnesota: Treatment Effectiveness and Cost Offset Analysis." Minnesota Department of Human Services, St. Paul, MN, 1996.

Manning, W.G., Keeler, E.B., Newhouse, J.P., Sloss, E.M. & Wasserman, J. "The Costs of Poor Health Habits". Cambridge, USA, Harvard University Press. 1991.

Mullahy, J. "Alcohol and the Labor Marketa". In Hilton, M.E., and Bloss, G., eds. *Economics and the Prevention of Alcohol-Related Problems*. NIAAA Research Monograph No. 25. NIH Publication No. 93-3513. Bethesda, MD: National Institutes of Health, National Institute on Alcohol Abuse and Alcoholism, pp. 141-174, 1993.

Mullahy, J., and Sindelar, J. "Life-cycle Effects of Alcoholism on Education, Earnings, and Occupation". *Inquiry* 26(2): 272-282, 1989.

Mullahy, J., and Sindelar, J.L. "Alcoholism, Work and Income". *Journal of Labor Economics* 11(3): 494-520, 1993.

National Institute on Alcohol Abuse and Alcoholism. "Alcoholism Treatment Impact on Total Health Care Utilization and Costs: Analysis of the federal employee health benefit program with Aetna Life Insurance Company." Rockville, MD: U.S. Department of Health and Human Services, 1995.

National Institute on Alcohol Abuse and Alcoholism. "Benefit-Cost Analysis of Alcoholism Treatment Centers." NIAAA Pub. No. (ADM), pp. 281-75-0031. Washington, DC: U.S. Government Printing Office, 1976.

Office of Drug Control Policy. "Understanding Drug Treatment." Washington, DC: U.S. Government Printing Office, 1990.

Plotnick, D. E.; Adams, K. M.; Hunter, H. R. and Rowe, J. C. "Alcoholism Treatment Programs within Prepaid Group Practice HMOs: A final report." Washington, DC: Group Health Association of America, 1982.

Rice, D.P., Hodgson, T.A., and Kopstein, A.N. "The Economic Costs of Illness: A Replication and Update". *Health Care Financing Review*, 7(1): 61-80. 1985.

Rice, D.P., Kelman, S. Miller., L.S. & Dunmeyer, S. “The Economic Costs of Alcohol and Drug Abuse and Mental Illness: 1985”. Report submitted to the Office of Financing and Coverage Policy of the Alcohol, Drug Abuse and Mental Health Administration, U.S., Department of Health and Human Services, San Francisco, California: Institute for Health and Aging, University of California, 1990.

Rundell, O. H. and Paredes, A. “Benefit-Cost Methodology in the Evaluation of Therapeutic Services for Alcoholism.” *Alcoholism: Clinical and Experimental Research* 1979; 3: pp. 324-333.

Sells, S. B., ed. “Effectiveness of Drug Abuse Treatment.” Vols. 1 and 2., Cambridge, MA: Ballinger, 1974.

Simpson, D. D.; Joe, G. W.; Lehman, W. and Sells, S. B. “Addiction Careers: Etiology, Treatment, and 12-year Follow Up Outcomes.” *Journal of Drug Issues* 1986, 16, pp. 107-122.

Simpson, D. D. “The Relation of Time Spent in Drug Abuse Treatment to Post-Treatment Outcome.” *American Journal of Psychiatry* 1979, 136, pp. 1449-1453.

Simpson, D. D. and Friend, H. J. “Legal Status and Long Term Outcomes for Addicts in the DARP Follow-up Project,” in Leukefeld, CG & Tims FM Eds., *Compulsory Treatment of Drug Abuse: Research and Practice*, pp. 81-98. NIDA Research Monograph No. 86. Rockville, MD: U.S. Department of Health and Human Services, 1991.

Simpson, D. D. and Sells, S. B. “Evaluation of Drug Abuse Treatment Effectiveness: Summary of the DARP Follow-up Research.” National Institute on Drug Abuse Treatment Research Report, DHHS Pub. No. (ADM) 82-1209. Washington, DC: U.S. Government Printing Office, 1983.

Thompson, Jr. Robert. “Substance Abuse and Employee Rehabilitation.” The Bureau of National Affairs, Inc., Washington, D.C., 1990.

U.S. Department of Health and Human Services (US DHHS). “Ninth Special Report to the U.S. Congress on Alcohol and Health”. DHHS Pub. No. 97-4017. 1997.

Washington State Department of Social Health Services, “The ADATSA Program: Clients, Services and Treatment Outcomes”, manuscript, 1990.

Wickizer, T. M.; Wager, T. and Atherly, B. “Economic Costs of Drug and Alcohol Abuse in Washington State.” Washington State Division of Alcohol and Substance Abuse, Olympia, WA, 1994.

Wickizer, T. M. “Economic Benefits and Costs Associated with Substance Abuse Treatment Provided to Indigent Clients through the Washington State’s Alcoholism and Drug Addiction Treatment and Support Act (ADATSA) Program.” Washington State Division of Alcohol and Substance Abuse Olympia, WA, 1997.

Wu, De-Min. “Alternative Tests of Independence Between Stochastic Regression and Disturbance”. *Econometrics*, 41 (3), pp. 733-50, 1973.



Research and Data Analysis Division
Briefing Paper 4.34bp