

NBER WORKING PAPER SERIES

THE IMPACT OF PSYCHIATRIC
DISORDERS ON LABOR MARKET OUTCOMES

Susan L. Ettner
Richard G. Frank
Ronald C. Kessler

Working Paper 5989

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
April 1997

The authors wish to acknowledge the Glaxo Research Institute and the Women's Research and Education Institute (WREI) for financial support. Carolyn Dewa provided excellent research assistance. A data appendix with additional results and copies of the data and computer programs used to generate the results presented in the paper are available from Susan L. Ettner at the Department of Health Care Policy, Harvard Medical School, 25 Shattuck Street, Parcel B, 1st floor, Boston, MA 02115. Phone: 617-432-4031. Fax: 617-432-0173. Email: ettner@hcp.med.harvard.edu. This paper is part of NBER's research program in Health Economics. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

© 1997 by Susan L. Ettner, Richard G. Frank and Ronald C. Kessler. All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

The Impact of Psychiatric Disorders on Labor
Market Outcomes
Susan L. Ettner, Richard G. Frank and Ronald C. Kessler
NBER Working Paper No. 5989
April 1997
JEL Nos. J24, I12
Health Economics

ABSTRACT

Data on 2225 men and 2401 women from the National Comorbidity Survey were used to examine the impact of psychiatric disorders on employment and conditional work hours and income. Two-stage instrumental variables methods were used to correct for the potential endogeneity of psychiatric disorders. The instruments used (the psychiatric disorder history of the respondent and respondent's parents) passed tests of the overidentifying restrictions. Psychiatric disorders significantly reduced employment among both men and women. Evidence was also found of small reductions in the conditional work hours of men and a substantial drop in the conditional earnings of men and women, although these findings were somewhat more sensitive to the estimation methods and specification of the model.

Susan L. Ettner
Department of Health Care Policy
Harvard Medical School
25 Shattuck Street
Parcel B, 1st floor
Boston, MA 02115
ettner@hcp.med.harvard.edu

Richard G. Frank
Department of Health Care Policy
Harvard Medical School
25 Shattuck Street
Parcel B, 1st floor
Boston, MA 02115
and NBER
frank@figaro.med.harvard.edu

Ronald C. Kessler
Department of Health Care Policy
Harvard Medical School
25 Shattuck Street
Parcel B, 1st floor
Boston, MA 02115

This study examines the impact of psychiatric disorders (both mental and substance use disorders) on employment rates, work hours and personal income. Although physical disability is known to be an important determinant of labor market outcomes, less is known about the influence of mental and substance use disorders. Diagnosable psychiatric disorders are highly prevalent, affecting about 30% of the noninstitutionalized U.S. population in any given year and almost 50% over the lifespan (Kessler et al., 1994). Many of these illnesses are chronic and cause severe impairment. Psychiatric disorders have been shown to reduce educational attainment and lead to teenage pregnancy, early marriage, and marital instability (Kessler, forthcoming).

Even after accounting for differences in early life experiences such as schooling, persons with a psychiatric disorder may experience lower productivity on the job as a result of impaired concentration, reduced cognitive abilities or absenteeism. Poor productivity may translate into lower labor force participation rates through the offered wage rate. Psychiatric disorders may also affect employment rates directly, through involuntary unemployment in an imperfect labor market or the person's inability to seek out or maintain a job.

Information on the magnitude of these effects is necessary to inform public policy debates over questions such as the appropriateness of psychiatric disability-related transfers, or the desirability of mandating minimum insurance coverage for psychiatric services. Certain private sector decisions, such as

the funding of employee assistance programs, also depend on the degree to which psychiatric disorders impair workplace performance, relative to the costs of implementing such programs.

Despite the theoretical reasons for expecting psychiatric disorders to have significant adverse effects on labor market outcomes, this hypothesis has not always been supported by empirical studies (see references in Appendix 1). Several studies found that better mental health is associated with higher employment rates, although the effect is more consistently significant for men than for women. Studies have also shown that in general, mental illness leads to reductions in income, but the magnitude and sometimes direction of the effect depends on the respondent's age and sex, the type of disorder, and whether the condition was self-reported, treatment-related or based on a diagnostic interview. The substance abuse literature has contained inconsistencies as well. Although two studies based on Epidemiologic Catchment Area data showed negative effects of alcoholism on employment rates, the larger body of literature focusing on income effects produced diverse estimates that ranged from negative and significant to positive and significant, depending on the sample, specification of the model, and definition of alcohol use/abuse. Drug use is also positively associated with wage rates in two studies based on the NLSY, even after correcting for sample selection effects.

This study extends the previous literature on the effect of psychiatric disorders on labor market outcomes in two important

ways. First, we use a unique database, the National Comorbidity Survey, that was mandated by Congress and is the first survey to administer a structured diagnostic interview administered to a representative national sample of the non-institutionalized U.S. population. The interview questions were designed to permit clinical diagnosis of a comprehensive array of psychiatric disorders. Previous studies either used diagnoses based on self-reports or the receipt of treatment or were based on samples drawn from small numbers of urban sites.

Second, our analysis emphasizes the statistical treatment of potential simultaneity in the relationship between labor market outcomes and psychiatric disorders. Earlier studies on the impact of mental disorders generally did not address this issue, other than using lag structures. Most of the substance abuse studies used selection models to control for unobservable differences between users and non-users. However, because these studies relied on exclusion restrictions that are often implausible, identification was achieved primarily through distributional assumptions, a procedure shown to yield non-robust estimates (Goldberger, 1983; Manning et al., 1987). For this reason, we pay close attention to the quality of the instruments used to identify the effects of psychiatric disorders in our analysis.

DATA

The National Comorbidity Survey (NCS) is a two-part survey that collected information from a random sample of the non-

institutionalized civilian population aged 15-54 living in the 48 coterminous states (with a supplemental sample of students living in campus group housing). The following provides a brief methodological overview of the NCS; references and further details can be found in Kessler et al. (1994 and 1995).

The first part of the survey is a diagnostic interview and the second part is a risk factor interview. The NCS was designed to allow DSM-III-R diagnosis (American Psychiatric Association, 1987) of a number of psychiatric disorders, including major depression, dysthymia, mania, generalized anxiety disorder, panic disorder, simple phobia, social phobia, agoraphobia, alcohol abuse, alcohol dependence, drug abuse, and drug dependence. These diagnoses were assessed using a modified version of the Composite International Diagnostic Interview (CIDI), which was designed to be administered by non-clinicians and has been shown by the World Health Organization to have good interrater reliability, test-retest reliability, and validity of almost all diagnoses. Schizophrenia and other non-affective psychoses were assessed clinically for respondents who complete both parts of the survey.

With a few exceptions, all interviews were conducted in person and carried out between September 1990 and February 1992. The overall survey response rate was 82.4%, with about half of the nonresponse due to refusals and half due to the inability to make contact. 8098 respondents were administered the part I questionnaire. The subset of respondents who were administered

the part II questionnaire included (1) all part I respondents aged 15-24, (2) all older part I respondents who screened positive for a disorder based on initial questions in at least one section of the diagnostic interview, and (3) a one in six random sample of the remaining respondents. All analyses were weighted to correct for nonresponse and oversampling. A limitation of the survey is that despite the sample weighting, persons who are institutionalized or homeless were not fully represented or are excluded altogether. Because these non-respondents were likely both to be the most disabled and to have the poorest outcomes, our results probably represent a conservative estimate of the effect of psychiatric disorders.

We used only the respondents who were administered both parts of the survey (N=5877). After eliminating respondents under age 18 (N=484), students (N=614)¹, and those with missing outcome information (N=154), the final sample size was 4625. Respondents excluded due to missing data looked very similar to the final sample. Analyses were performed separately for men (N=2225) and women (N=2401).

EMPIRICAL IMPLEMENTATION

The outcomes were current employment status, usual weekly work hours and personal income during the previous year. Annual personal income served as a proxy for earnings and was

¹ Including students in the sample and estimating the probability that the respondent is either employed or still in school yielded results similar to those for employment, but the effect sizes were slightly smaller.

constructed from interval data with 23 categories by taking the midpoint of each category.² 18 respondents in the open interval were assigned \$175,000 (the lower bound was \$150,000). Because the income measure included disability-related transfer income and no information was available on the sources of the respondent's income, the impact of psychiatric disorders on earnings may be understated.

The entire sample was used to estimate employment choices. Work hours were estimated using employed respondents only, so the results should be interpreted as the impact of psychiatric disorders on the hours of respondents who work. Because income was used as a proxy for earnings, it was our intent to restrict the sample to workers for the estimation of income as well. However, because the income measure was based on information for the preceding year, a period of time in which employment status was not measured, it was necessary to limit the analysis sample based on whether the respondent had positive income during the previous year, as a proxy for being a wage earner. The individuals included in the two conditional samples differed somewhat because respondents may derive income from sources other than earnings and the respondent's work status may have changed since the preceding year.

We report conditional analyses rather than sample selection

² The question is phrased as how much of the total family income before taxes during the past year was earned or brought in by the respondent personally and how much by the spouse/partner. Response categories are in absolute dollar terms, not percentages.

models because we lack plausible *a priori* exclusion restrictions and therefore would be required to achieve identification solely through functional form. However, when selection models were investigated, they yielded results that were quite similar to the conditional estimates, and the selection term was significant only in one case.

Employment was estimated using a probit model and hours and income were estimated using linear regression. Because income was skewed, its log transformation was used and predictions were constructed using a "smearing" retransformation algorithm (Duan, 1983).³ To facilitate interpretation of the parameter estimates, we report predictions averaged across the entire sample when respondents were assumed in turn to have no disorder and the disorder under consideration, holding other characteristics constant.

The regressors of primary interest were 0-1 indicators for whether the respondent met diagnostic criteria for each psychiatric disorder during the past 12 months. The models also controlled for (1) marital status (married, separated/widowed/divorced vs. never married), (2) race (black, other race vs. white), (3) ethnicity (Hispanic vs. non-Hispanic), age and its square, (4) rural residence, (5) education (less than high school or more than high school vs. high school), (6) foreign birth, (7)

³ Statistical tests indicated that heteroskedasticity is a problem, suggesting that the smearing estimates may be incorrect. However, use of untransformed income as the outcome yielded results that were qualitatively similar to those presented here.

the number of preschool and school-age children in the household, (8) the county unemployment rate and its interactions with education⁴, (9) the education of the main support of the respondent's family while the respondent was growing up, and (10) (when relevant) the education of the spouse. For brevity, the parameter estimates for the control variables are not reported.

Psychiatric disorders may be correlated with the error term in the labor market outcome equations. Consumer choice models of utility maximization subject to a health production function (Grossman, 1972) suggest that employment, income and health are determined simultaneously, for example, because one's mental health can be improved by investing in formal or informal treatment. A number of researchers have argued that mental health is influenced both positively and negatively by intrinsic attributes of employment, such as social networks, enhanced self-esteem and stress (Waldron, 1980; Hibbard and Pope, 1985; Rosenfield, 1989; Ezzy, 1993). Measurement error in the classification of psychiatric disorders is another potential source of bias, although this bias should be minimized by our use of a diagnostic interview. For these reasons, we re-estimated the models using two-stage instrumental variables (IV) and adjusted the second-stage variance-covariance matrices for the use of predicted values. Reduced-form results are also reported.

A limitation of the instrumental variables estimation is

⁴ In 20 cases with missing county-level data, state unemployment rate was used.

that we were unable to examine the separate impact of each disorder. The cell sizes were small for many of the disorders, so aggregating into even a few categories led to a collinearity problem with the predicted values used in the instrumental variables estimation. Furthermore, separate identification of classes of disorders that are highly comorbid, such as substance abuse and mental illness, was not plausible. For these reasons, we estimated the impact of having any psychiatric disorder on the outcomes. We also estimated the impact of having three or more psychiatric disorders, to test the hypothesis of a "threshold effect", that is, that patients are able to cope with psychiatric illness up to a certain point, after which the combination of multiple disorders becomes disabling (for a discussion, see Kessler et al., 1994). Although these models may not reflect the impact of individual conditions, they allowed us to assess the overall importance of psychiatric disorders in determining labor market outcomes and examine the extent of endogeneity bias.

Because the endogenous regressor is categorical, it can be modelled either as a structural shift (Heckman, 1979) or a latent index (Mallar, 1977; Lee, 1982). We estimated both models for the purpose of comparison. Technically, the difference arises from the use of the predicted probability vs. the predicted latent index ($X\beta$) in the second stage. Intuitively, the structural shift model implies that changes in the underlying level of psychiatric disorders have no impact unless the change moves the respondent above or below the diagnostic threshold. In

contrast, in a latent index model, all changes in the respondent's underlying "propensity for psychiatric disorders" affect outcomes, allowing impairment to be a matter of degree.

The magnitudes of the ordinary and latent index IV estimates cannot be meaningfully compared, because they are on different scales.⁵ However, we provide an upper bound on the magnitude of the IV effect by showing the average prediction when the latent index variable was reset to equal first the lowest and then the highest empirical value in the sample, corresponding to the worst and best mental health. Problems of non-comparability of the estimates do not arise in the structural shift model, because both the actual and predicted measures are on the same scale.

The key consideration in the analysis is the choice of instruments. A subset of psychiatric illnesses have their origins in childhood and some psychiatric disorders have been found to have a genetic component (Tsuang and VanderMey, 1980; Kendler et al., 1995). For these reasons, we specified as potential instruments for psychiatric disorders during the previous 12 months the number of psychiatric disorders exhibited by the respondent's parents and the number of psychiatric disorders experienced by the respondent before age 18. This age was chosen to reflect the earliest time of possible entry into

⁵ Although Mallar (1977) suggests normalizing the IV estimate by the first-stage density, empirically, this procedure was equivalent to predicting out of sample and yielded implausible results. Other comparisons of the ordinary and IV effect sizes were sensitive to the magnitude of the assumed change and the choice of percent vs. absolute changes.

the full-time labor force, thereby avoiding the initial conditions problem inherent in the lag structures of some of the earlier literature. The respondent's history included the psychiatric disorders described above. Parental history of psychiatric disorders included only major depression, generalized anxiety disorder, antisocial personality disorder, and substance dependence; other parental disorders were not measured.

A unique aspect of our data set was the opportunity to use instruments that are solidly grounded in epidemiological research and likely to be exogenous. We paid particular attention in our model to the sensitivity of the results to failure of the instrumental variables criteria (Angrist, Imbens and Rubin, 1995). We viewed the assumptions of stable unit treatment value and ignorable assignment to be quite plausible. Similarly, monotonicity seemed likely to hold. It is theoretically possible that respondents whose parents were mentally ill or abused substances might have developed coping mechanisms that reduce their own risk of such disorders. Epidemiological evidence suggests that such cases will be rare, although a possible exception is alcohol use disorders. Our sample respondents are on average more likely to experience these disorders if they had an alcoholic parent, but particular individuals may respond to the alcoholism of their parents by abstaining. However, alcohol use disorders are only one component of the respondent's psychiatric status and our conclusions did not depend on the use of parental psychiatric disorder history as instruments.

We focused on testing the assumptions that the instruments have nonzero average causal effects and are excludable. We first determined that parental and respondent psychiatric disorder history were significantly related to current disorders in the first-stage equations, satisfying the requirement that the average causal effects of the instruments be nonzero. We then performed Hausman tests of the overidentifying restrictions to determine whether the instruments were excludable and examine the sensitivity of the results to the inclusion of one set of instruments at a time in the second-stage regressions. For purposes of the tests, we divided the instruments into two sets: (1) respondent's own and (2) parental (maternal and paternal) history of psychiatric disorders.

Our focus in this study is on measuring the direct effects of psychiatric disorders on labor market outcomes. We do not capture the impact on working through education, marital or parental status. We briefly summarize the results of models that exclude these regressors. However, we do not take up a detailed analysis of the impact of psychiatric disorders on potential mediators. Furthermore, the instruments are more likely to be excludable when early life experiences are controlled.

RESULTS

Descriptive statistics Table 1 presents weighted summary statistics for the dependent and independent variables. Of primary interest are the prevalence estimates for psychiatric disorders. 31.1% of women and 26.1% of men experienced at least

one diagnosable disorder during the previous twelve months; 7.0% of women and 4.3% of men suffered from three or more disorders. The most common disorders were simple phobias (13.1%), major depression (12.5%) and social phobia (8.7%) for women, and alcohol dependence (10.4%), major depression (6.9%) and social phobia (6.2%) for men.

Ordinary estimates - type of disorder Tables 2a and 2b give regression-adjusted predictions for employment rates, average weekly work hours among workers and average annual income among recipients for women and men, respectively. The sign and magnitude of the effects depended on the type of disorder, although most of the disorders were not individually significant. Some of the disorders, such as alcohol abuse and dependence among women, actually appeared to have positive effects on labor market outcomes, but small cell sizes may have made these estimates unstable. The only estimates that were statistically significant are those suggesting negative effects.

Among women, those with major depression, agoraphobia, or drug dependence were less likely to work. Among women who did work, those with schizophrenia or agoraphobia had lower income. No significant effects on work hours were found. Several of these effects were large, e.g. a reduction in employment from 81.8% to 51.9% from drug dependence, or a \$10,000 reduction in income from schizophrenia. Among men, major depression and alcohol dependence were associated with lower employment rates and dysthymia was associated with reduced conditional work hours.

No significant income effects were found.

Ordinary estimates - any disorder The top rows of Tables 3a and 3b give the ordinary estimates of the overall effect of having any psychiatric disorder. The results were similar for men and women, despite the differences in the psychiatric case-mix of these two groups. Taken in the aggregate, psychiatric disorders significantly reduced the probability of employment by about 11 percentage points, from 82.9% to 71.9% for women and from 94.1% to 83.4% for men.⁶ The magnitude of these employment effects is substantial, relative to that of physical health. For example, the impact of psychiatric disorders found here is greater than the employment effects of self-reported work limitations or functional impairment found for working-aged women (Ettner, 1996) and late middle-aged whites (Chirikos and Nestel, 1984). This result is consistent with Wells et al. (1989), who found that major depression had a greater impact on self-reported ability to work (including housework and school) than all but one of the 8 chronic physical conditions studied.

Psychiatric disorders also led to significant reductions in conditional annual income for both men and women, by \$3465 for women (an 18% decline) and \$4521 for men (a 13% decline). Predicted work hours were also reduced slightly, but the effects were small and insignificant. One interpretation of this pattern of results is that psychiatric disorders reduce the offered wage

⁶ The overall effect is larger than the effect of any of the individual disorders because of the large numbers of persons with multiple disorders.

rate, which in turn discourages employment. The insignificant hours effect may result from the inability of respondents to choose desired work hours from a continuous schedule.

We had hypothesized that the effects of psychiatric disorders on the conditional work hours and income of men and women might differ as the result of gender differences in psychiatric case-mix or occupational segregation by gender, if certain jobs are more accommodating of psychiatric disorders than others. We had further expected that for a comparable drop in the wage rate, the decline in employment rates would be greater for women, due to their higher wage elasticity. Instead, we did not find large gender differences in the effects of psychiatric disorders on any of the outcomes. The lack of a differential effect on employment might be explained either by our inability to measure the wage rate directly, or by offsetting direct effects of psychiatric disorders on employment.

IV estimates - any disorder The middle and bottom rows of Tables 3a and 3b respectively give the IV estimates from the structural shift and latent index models. The IV results were qualitatively similar to the ordinary results. As before, psychiatric disorders had a detrimental impact on all of the labor market outcomes of men and women. The effects on the conditional income of women and employment were still highly significant. Although the effect on the conditional income of men lost significance, the impact on the conditional work hours of men achieved a 5% level of significance in both IV models.

In terms of magnitudes, the structural shift estimates, which can be directly compared to the ordinary estimates, showed that with one exception, the effect of having a psychiatric disorder became larger after instrumenting. The exception was that income among male recipients declined by only \$3168 as the result of having a psychiatric disorder, although the confidence intervals of the ordinary and IV estimates still overlapped. Similar increases in magnitudes were found with the latent index model, but this comparison is misleading, because the latent index predictions represent a "worst case" scenario for the effects and are not on the same scale.

Role of mediating factors The estimates given in Tables 3a-b reflect only the direct effect of psychiatric disorders after accounting for other characteristics that are likely to be correlated with mental health. To explore the degree to which the total impact is understated by these analyses, we re-estimated the models after eliminating education (respondent's and spouse's) and its interactions with the unemployment rate, marital status, and children from the control variables.

In results not shown here, the magnitudes of the effects increased for employment and conditional income and remained virtually the same for conditional work hours, regardless of which estimation procedure was used. For example, in the ordinary models, psychiatric disorders reduced the employment of women by 14.0 percentage points instead of 11.0, and the employment of men by 12.1 percentage points instead of 10.7.

Similarly, the reduction in women's income was \$4801 instead of \$3465, and the reduction in men's income was \$6383 instead of \$4521. The IV estimates were also larger and in the case of men's income, retained their significance after instrumenting. The IV results are hard to interpret, however, because the exclusion of mediating factors from the model calls the validity of the exclusion restrictions into question.

"Piling-up effect" To determine whether multiple disorders increase the impairment associated with psychiatric illness, we re-estimated the models of Tables 3a-b using the presence of three or more disorders instead of the presence of any disorder as the regressor of interest (results not shown in tables). As expected, in almost all cases the differences between the healthy and non-healthy populations increased. The most striking results were from the structural shift models, which showed employment rates to decline by about one-third as the result of multiple psychiatric disorders.

Reduced-form models Appendix 2 shows that the instrument sets are strongly correlated with the respondent's current psychiatric health in reduced-form equations, implying that the IV estimates should be less sensitive to minor violations of the other assumptions (Angrist, Imbens and Rubin, 1995). For the most part, the effects of the instruments on the respondent's labor market outcomes were consistent with the implications of the structural estimates. An exception was the positive effect of paternal psychiatric history on men's conditional work hours.

This result suggests that paternal psychiatric history may affect men's labor supply apart from its indirect influence through current disorders; for example, growing up with a father who was mentally ill or abused substances might encourage sons to become more hardworking and responsible. To address this concern, we turn to tests of the exclusion restrictions.

Exclusion restrictions Hausman tests of the overidentifying restrictions rejected the null hypothesis in only one case: the psychiatric disorder history of the parents was not excludable from the second-stage regression of men's employment when using a latent index model. However, because these tests tend to be underpowered, we also examined the results when including the instrument set one at a time in the second-stage regressions.

The general pattern of results was the same for both men and women when relying on the respondent's history of psychiatric disorders to identify the effects of current disorders. All of the structural shift and latent index model estimates for the income and hours equations looked similar in terms of magnitudes and significance levels to those using the full instrument set. The estimated effects of current disorders on employment were reduced somewhat when using the latent index model with the respondent's psychiatric disorder history as the only instrument. However, the effects were still large and significant and the confidence intervals of the two sets of estimates overlapped.

The results were more sensitive to the use of parental psychiatric disorder history as the sole identifying instruments.

Although the magnitudes of most effects increased, the pattern of results was not easily generalizable, because the standard errors increased substantially, making the point estimates unreliable. The only effect of current psychiatric disorders that retained statistical significance is the reduction in women's employment, which actually increased in magnitude with both the structural shift and latent index models when using parental psychiatric disorder history as the sole instrument set. A similar pattern of increased magnitudes occurred with men's employment, but because the measures of parental psychiatric disorder history were less strongly correlated with men's current disorders, the second-stage estimates were measured with less precision and did not achieve statistical significance.

DISCUSSION

This study provides strong evidence that recent psychiatric disorders reduce employment rates among both men and women by about 11 percentage points or more, depending on the model. Evidence is also found of small reductions in the conditional work hours of men and a substantial drop in the conditional earnings of men and women, although these findings are somewhat more sensitive to the estimation methods and specification of the model. The larger reduction in conditional income relative to work hours implies that psychiatric disorders impact the earnings of workers primarily via a wage effect. The result that the strongest labor market effects of psychiatric disorders are through employment rates and not conditional outcomes suggests

that workers may be sufficiently self-selected or screened into employment that their on-the-job productivity is relatively unaffected by any psychiatric conditions they might have.

There is some evidence that the impact of having a psychiatric disorder varies with diagnosis, but it is difficult to draw firm conclusions about their relative impact because the estimates are imprecise. Finally, the IV estimates produced results that are both qualitatively and (when comparable) quantitatively very similar to the ordinary estimates. In all cases, the confidence intervals of the ordinary and IV structural shift estimates overlap, and instrumenting generally increases the effect sizes.

Although our findings are consistent with the bulk of the literature in this area, good comparisons do not exist. The only other studies that used diagnostic interview schedules rather than self-reports or treatment-based definitions of psychiatric disorders were based on non-nationally representative samples, and a number of the earlier studies did not include women.

Advances in pharmacotherapy have led to progress in treating even the most debilitating psychiatric disorders, such as major depression, bipolar disorder and schizophrenia. Thus, the foregone labor market productivity associated with psychiatric disorders can be contrasted with the costs of treating the disorders. For example, the ordinary estimates of the increase in the expected unconditional earnings of a person with major depression resulting from successful treatment are \$2,098 for

women and \$4679 for men. Protocol medical costs for treatment of depression have been estimated at \$920 for nortriptyline therapy (Lave et al., 1996) and efficacy rates upon initial antidepressant treatment are 60-65% (National Advisory Mental Health Council, 1993). These numbers suggest that even with a margin of error, the social benefits of treatment outweigh the social costs, despite the narrow "human capital" definition of social benefits used here. Although the ratio of costs to benefits will clearly differ by disorder, the overall per-person productivity losses associated with the presence of any psychiatric disorder are even higher than for major depression, at \$4576 for women and \$7368 for men.

These figures may either over- or underestimate the benefits of treatment. For workers with relative early onset of psychiatric disorders, part of the current wage effect may be mediated through work experience. Unless treatment is provided at the onset of the disorder, subsequent treatment cannot compensate for the loss of prior work experience that reduces current productivity. Yet for workers with more recent onset, wage rates may overestimate productivity because of stickiness in how wage rates are set and the inability of employers to adjust quickly. Hence even if we could measure wage rates and not just conditional income, societal productivity losses would be underestimated in our study if the labor market is imperfect. Studies showing an association between work loss days and psychiatric disorders (Kessler and Frank, in press; Broadhead et

al., 1990; Kouzis and Eaton, 1994) support the hypothesis that on-the-job productivity is affected by these disorders.

Some of the advantages of this study are the ability to actually diagnose psychiatric disorders among a large, national sample; the use of an estimation technique that takes into account the potential endogeneity of psychiatric disorder; and the identification of several variables that appear to be plausible instruments when tested for the IV assumptions. A limitation is that due to the paucity of potential instruments, we are unable to use IV estimation to examine the separate impact of different types of disorders. Future work in this area should focus on collecting sufficient data to estimate effects of each individual disorder that correct for potential simultaneity bias.

References

- American Psychiatric Association. 1987. *Diagnostic and Statistical Manual of Mental Disorders*. Washington, DC: American Psychiatric Association.
- Angrist, J. D., G. W. Imbens, et al. 1995. "Identification of Causal Effects Using Instrumental Variables." *The Journal of the American Statistical Association*, Vol. 91, No. 434, pp. 444 - 462 .
- Bartel, A. and P. Taubman. 1979. "Health and Labor Market Success: The Role of Various Diseases." *Review of Economics and Statistics*, Vol. 61, No. 1, pp. 1-8.
- Bartel, A. and P. Taubman. 1986. "Some Economic and Demographic Consequences of Mental Illness." *Journal of Labor Economics*, Vol. 4, No. 2, pp. 243-256.
- Benham, L. and A. Benham. 1982. Employment, Earnings, and Psychiatric Diagnosis. *Economic Aspects of Health*_V. Fuchs. Chicago: University of Chicago Press, pp. 203-220.
- Berger, M. C. and J. P. Leigh. 1988. "The Effect of Alcohol Use on Wages." *Applied Economics*, Vol. 20, pp. 1343-1351.
- Berndt, E., S. Finkelstein, et al. (1996). Workplace Performance and the Treatment of Chronic Depression. presented at the 1996 American Economic Association Meetings.
- Broadhead, W. E., D. G. Blazer, et al. 1990. "Depression, Disability Days, and Days Lost From Work in a Prospective Epidemiologic Survey." *Journal of the*

- American Medical Association*, Vol. 264, pp. 2524 - 2528.
- Bryant, R. R., V. A. Samaranayake, et al. 1992. "Alcohol Use and Wages of Young Men: Whites vs. Nonwhites." *Int. Rev. Applied Econ.*, Vol. 6, No. 2, pp. 184 - 202.
- Chirikos, T. N. and G. Nestel. 1984. "Economic Determinants and Consequences of Self-Reported Work Disability." *Journal of Health Economics*, Vol. 3, pp. 117-136.
- Duan, N. 1983. "Smearing Estimate: A Nonparametric Retransformation Method." *Journal of the American Statistical Association*, Vol. 78, No. 383, pp. 605-610.
- Ettner, S. L. Manuscript. Is Working Good For You? Evidence on the Endogeneity of Mental and Physical Health to Female Employment.
- Ezzy, D. 1993. "Unemployment and Mental Health: A Critical Review." *Social Science and Medicine*, Vol. 37, No. 1, pp. 41 - 52.
- Frank, R. G. and P. Gertler. 1991. "An Assessment of Measurement Error Bias for Estimating the Effect of Mental Distress on Income." *Journal of Human Resources*, Vol. 26, No. 1.
- French, M. T. and G. A. Zarkin. 1995. "Is Moderate Alcohol Use Related to Wages? Evidence From Four Worksites." *Journal of Health Economics*, Vol. 14, pp. 319-344.
- Gill, A. M. and R. J. Michaels. 1992. "Does Drug Use Lower Wages?" *Industrial and Labor Relations Review*, Vol. 45, No. 3, pp. 419-434.

- Goldberger, A. 1983. *Abnormal Selection Bias*. Stamford: Academic Press.
- Grossman, M. 1972. "On the Concept of Health Capital and the Demand for Health." *Journal of Political Economy*, Vol. 80, No. 2, pp. 223-255.
- Hamilton, V. and B. H. Hamilton. Manuscript. "Alcohol and Earnings: Is Drinking Good For You?".
- Heckman, J. 1979. "Dummy Endogenous Variables in a Simultaneous Equation System." *Econometrica*, Vol. 47, pp. 153 - 167.
- Heien, D. M. and D. J. Pittman. 1989. "The Economic Costs of Alcohol Abuse: An Assessment of Current Methods and Estimates." *J. Stud. Alcohol*, Vol. 50, No. 6, pp. 567 - 579.
- Hibbard, J. H. and C. R. Pope. 1985. "Employment Status, Employment Characteristics and Women's Health." *Women and Health*, Vol. 10, No. 1, pp. 59-77.
- Kaestner, R. 1991. "The Effect of Illicit Drug Use on the Wages of Young Adults." *Journal of Labor Economics*, Vol. 9, No. 4, pp. 381 - 412.
- Kendler, K. S., E. D. Walters, et al. 1995. "The Structure of the Genetic and Environmental Risk Factors for Six Major Psychiatric Disorders in Women: Phobia, Generalized Anxiety Disorder, Panic Disorder, Bulimia, Major Depression, and Alcoholism." *Archives of General Psychiatry*, Vol. 52, No. 5, pp. 374-383.
- Kenkel, D. S. and D. C. Ribar. 1994. "Alcohol Consumption and Young Adults' Socioeconomic Status." *Brookings Papers: Microeconomics*, pp. 119 - 175.

Kessler, R. forthcoming. *The Social Consequences of Psychiatric Disorders*:
Lawrence Erlbaum Associates.

Kessler, R., R. J. A. Little, et al. 1995. "Advances in Strategies for Minimizing and Adjusting for Survey Nonresponse." *Epidemiologic Reviews*, Vol. 17, No. 1, pp. 192-204.

Kessler, R., K. McGonagle, et al. 1994. "Lifetime and 12-Month Prevalence of DSM-III-R Psychiatric Disorders in the United States." *Archives of General Psychiatry*, Vol. 51, pp. 8 - 19.

Kessler, R. C. and R. G. Frank. in press. "The Impact of Psychiatric Disorders on Work Loss Days." *Psychological Medicine*.

Kouzis, A. C. and W. W. Eaton. 1994. "Emotional Disability Days: Prevalence and Predictors." *American Journal of Public Health*, Vol. 84, pp. 1304-1307.

Lave, J. R., R. G. Frank, et al. Manuscript. "Cost-Effectiveness of Treatments for Depression for Primary Care Patients."

Lee, L.-F. 1982. "Health and Wage: A Simultaneous Equations Model with Multiple Discrete Indicators." *International Economic Review*, Vol. 23, pp. 192-222.

Mallar, C. 1977. "The Estimation of Simultaneous Probability Models." *Econometrica*, Vol. 45, No. 7, pp. 1717-1722.

Manning, W. G., N. Duan, et al. 1987. "Monte Carlo Evidence on the Choice Between Sample Selection and Two-Part Models." *Journal of Econometrics*, Vol. 35, pp. 59-82.

Miller, L. S. and S. Kellman. 1992. Estimates of the Loss of Individual Productivity

- from Alcohol and Drug Abuse and from Mental Illness. *Economics and Mental Health*, R. Frank and J. Willard G Manning. Baltimore, MD: The Johns Hopkins University Press, pp. 91-129.
- Mitchell, J. M. and K. H. Anderson. 1989. "Mental Health and the Labor Force Participation of Older Workers." *Inquiry*, Vol. 26, pp. 262-271.
- Mullahy, J. and J. Sindelar. 1989. "Life-cycle Effects of Alcoholism on Education, Earnings, and Occupation." *Inquiry*, Vol. 26, pp. 272-282.
- Mullahy, J. and J. Sindelar. 1990. Gender Differences in the Effects of Mental Health of Labor Force Participation. *Research in Human Capital and Development 6*: JAI Press, pp. 125-145.
- Mullahy, J. and J. L. Sindelar. 1991. "Gender Differences in Labor Market Effects of Alcoholism." *AEA Papers and Proceedings*, Vol. 81, No. 2, pp. 161 - 165.
- Mullahy, J. and J. L. Sindelar. 1993. "Alcoholism, Work, and Income." *Journal of Labor Economics*, Vol. 11, No. 3, pp. 494 - 520.
- National Advisory Mental Health Council. 1993. "Health Care Reform for Americans with Severe Mental Illness." *American Journal of Psychiatry*, Vol. 150, pp. 1447-1465.
- Rosenfield, S. 1989. "The Effects of Women's Employment: Personal Control and Sex Differences in Mental Health." *Journal of Health and Social Behavior*, Vol. 30, pp. 77-91.
- Ruhm, C. J. 1992. The Effects of Physical and Mental Health on Female Labor Supply. *Economics and Mental Health*, R. G. Frank and W. M. Jr. Baltimore,

MD: The Johns Hopkins University Press.

Tsuang, M. T. and R. VanderMey. 1980. *Genes and the Mind: Inheritance of Mental Illness*. New York: Oxford University Press.

Waldron, I. 1980. "Employment and Women's Health: An Analysis of Causal Relationships." *International Journal of Health Services*, Vol. 10 ,pp. 435-454.

Wells, K. B., A. Stewart, et al. 1989. "The Functioning and Well-Being of Depressed Patients: Results from the Medical Outcomes Study." *Journal of the American Medical Association*, Vol. 262, No. 7, pp. 914-919.

Table 1
Weighted Summary Statistics

Variable	Women (N=2401)	Men (N=2225)
Currently employed	79.3%	91.1%
Usual number of hours currently worked during an average week (mean for workers only)	37.04 (11.91)	45.63 (11.68)
Income during past year, constructed from interval data (mean for recipients only)	17,228 (15,680)	31,155 (25,823)
Any current psychiatric disorder	31.1%	26.1%
≥3 current psychiatric disorders	7.0%	4.3%
Current diagnosis of schizophrenia	0.6%	0.5%
Current diagnosis of major depression	12.5%	6.9%
Current diagnosis of dysthymia	3.2%	2.0%
Current diagnosis of mania	1.2%	1.4%
Current diagnosis of agoraphobia	4.9%	2.0%
Current diagnosis of generalized anxiety	4.3%	2.0%
Current diagnosis of simple phobia	13.1%	4.1%
Current diagnosis of social phobia	8.7%	6.2%
Current diagnosis of panic disorder	2.9%	1.1%
Current diagnosis of alcohol abuse	1.4%	3.3%
Current diagnosis of alcohol dependence	3.7%	10.4%
Current diagnosis of drug abuse	0.2%	0.9%
Current diagnosis of drug dependence	1.7%	3.7%
Number of psychiatric disorders experienced by respondent before age 18	0.27 (0.68)	0.17 (0.55)
Number of psychiatric disorders ever experienced by respondent's mother	0.60 (0.99)	0.43 (0.82)
Number of psychiatric disorders ever experienced by respondent's father	0.55 (0.94)	0.50 (0.90)

Married	71.2%	69.8%
Divorced, separated or widowed	13.9%	10.8%
Rural residence	19.8%	23.4%
Black	12.5%	10.0%
Other race	3.5%	2.7%
Hispanic	8.3%	8.6%
Less than high school education	13.4%	16.0%
Greater than high school education	46.6%	45.6%
Age	35.82 (9.56)	35.72 (9.14)
State unemployment rate	7.8%	7.7%
Born outside the United States	7.2%	6.4%
Number of children \leq 5 years old	0.34 (0.63)	0.33 (0.64)
Number of children 6-18 years old	0.84 (1.07)	0.86 (1.18)
Main financial support while growing up had less than a high school education	30.4%	31.3%
Main financial support while growing up had more than a high school education	22.3%	22.1%
Spouse has less than a high school education (mean for married respondents only)	15.9%	13.0%
Spouse has more than a high school education (mean for married respondents only)	47.2%	44.5%

Notes: Standard deviations are in parentheses for continuous variables. Omitted categories are never married, urban/metropolitan, white non-Hispanic, high school education, U.S. born, and parent and spouse high school education.

Table 2a
Predicted Labor Market Outcomes by Type of Psychiatric Disorder, Women
Ordinary Estimation Methods

Average sample prediction with:	Percent employed	Usual weekly work hours, workers only	Annual income, recipients only
No disorder	81.8% (SE= 0.9%)	37.1 (SE= 0.3)	\$18,586 (SE= \$550)
Schizophrenia	69.2% (SE=11.4%)	44.0 (SE= 5.0)	\$8,466 ** (SE= \$2,643)
Major depression	73.7% ** (SE= 2.8%)	36.8 (SE= 1.0)	\$17,782 (SE= \$1,407)
Dysthymia	78.4% (SE= 4.6%)	36.4 (SE= 1.8)	\$17,905 (SE= \$2,558)
Mania	70.9% (SE= 8.5%)	35.9 (SE= 3.2)	\$10,549 ** (SE= \$2,343)
Generalized anxiety	79.9% (SE= 3.9%)	39.8 (SE= 1.6)	\$17,124 (SE= \$2,324)
Agoraphobia	71.8% ** (SE= 4.4%)	37.1 (SE= 1.6)	\$12,175 ** (SE= \$1,479)
Simple phobia	77.8% (SE= 2.5%)	36.9 (SE= 0.9)	\$16,548 (SE= \$1,270)
Social phobia	83.1% (SE= 2.6%)	35.8 (SE= 1.1)	\$19,717 (SE= \$1,815)
Panic disorder	87.8% (SE= 3.6%)	35.6 (SE= 2.0)	\$19,190 (SE= \$3,034)
Alcohol abuse	90.0% (SE= 4.8%)	39.2 (SE= 2.3)	\$19,463 (SE= \$3,668)
Alcohol dependence	86.8% (SE= 3.3%)	38.1 (SE= 1.5)	\$19,555 (SE= \$2,473)
Drug abuse	84.7% (SE= 13.9%)	34.9 (SE= 5.1)	\$27,051 (SE= \$11,844)
Drug dependence	51.9% ** (SE= 8.1%)	33.7 (SE= 3.0)	\$13,357 (SE= \$2,648)

* Effect of disorder is significant at $p \leq .05$

** Effect of disorder is significant at $p \leq .01$

Notes: N=2401. Predictions obtained from weighted regressions that adjust for marital status, rural residence, race, ethnicity, education, education of main financial support while growing up, education of spouse, number of pre-school and school-aged children, age and its square, foreign birth, the county unemployment rate and its interaction with education.

Table 2b
Predicted Labor Market Outcomes by Type of Psychiatric Disorder, Men
Ordinary Estimation Methods

Average sample prediction with:	Percent employed	Usual weekly work hours, workers only	Annual income, recipients only
No disorder	93.3% (SE= 0.6%)	45.8 (SE= 0.3)	\$33,245 (SE= \$687)
Schizophrenia	87.6% (SE= 7.7%)	38.5 (SE= 4.1)	\$32,656 (SE= \$8,969)
Major depression	86.9% ** (SE= 2.8%)	47.4 (SE= 1.2)	\$30,309 (SE= \$2,374)
Dysthymia	88.7% (SE= 4.3%)	41.3 * (SE= 2.2)	\$27,208 (SE= \$3,878)
Mania	90.0% (SE= 4.5%)	41.2 (SE= 2.6)	\$24,057 (SE= \$3,909)
Generalized anxiety	93.4% (SE= 3.2%)	43.4 (SE= 2.1)	\$28,919 (SE= \$3,959)
Agoraphobia	88.6% (SE= 4.4%)	47.1 (SE= 2.2)	\$35,219 (SE= \$4,802)
Simple phobia	95.1% (SE= 1.8%)	45.7 (SE= 1.4)	\$37,257 (SE= \$3,429)
Social phobia	92.1% (SE= 2.2%)	44.7 (SE= 1.2)	\$33,732 (SE= \$2,654)
Panic disorder	88.8% (SE= 5.4%)	47.2 (SE= 2.8)	\$25,610 (SE= \$4,332)
Alcohol abuse	88.8% (SE= 3.5%)	45.0 (SE= 1.5)	\$29,217 (SE= \$2,902)
Alcohol dependence	88.1% ** (SE= 2.1%)	46.1 (SE= 0.9)	\$32,823 (SE= \$1,948)
Drug abuse	88.3% (SE= 6.9%)	47.5 (SE= 2.8)	\$31,623 (SE= \$5,809)
Drug dependence	88.1% (SE= 3.3%)	43.0 (SE= 1.6)	\$28,623 (SE= \$2,833)

* Effect of disorder is significant at $p \leq .05$

** Effect of disorder is significant at $p \leq .01$

Notes: N=2225. Predictions obtained from weighted regressions that adjust for marital status, rural residence, race, ethnicity, education, education of main financial support while growing up, education of spouse, number of pre-school and school-aged children, age and its square, foreign birth, the county unemployment rate and its interaction with education.

Table 3a
Predicted Labor Market Outcomes by
Whether Any Psychiatric Disorder, Women

Ordinary Estimation			
Average sample prediction with:	Percent employed **	Usual weekly work hours, workers only	Annual income, recipients only **
No disorder	82.9% (SE= 0.9%)	37.2 (SE= 0.3)	\$18,954 (SE= \$590)
Any disorder	71.9% (SE= 1.5%)	36.5 (SE= 0.5)	\$15,489 (SE= \$710)
Instrumental Variables Estimation, Structural Shift Model			
Average sample prediction with:	Percent employed **	Usual weekly work hours, workers only	Annual income, recipients only **
No disorder	83.6% (SE= 1.3%)	37.3 (SE= 0.4)	\$19,779 (SE= \$740)
Any disorder	69.4% (SE= 2.7%)	36.3 (SE= 0.8)	\$14,070 (SE= \$974)
Instrumental Variables Estimation, Latent Index Model			
Average sample prediction with:	Percent employed **	Usual weekly work hours, workers only	Annual income, recipients only **
Latent index at minimum value	82.4% (SE= 1.0%)	37.3 (SE= 0.4)	\$19,204 (SE= \$595)
Latent index at maximum value	48.6% (SE= 8.4%)	34.8 (SE= 2.2)	\$9,156 (SE= \$1,735)

* Effect of any disorder is significant at $p \leq .05$

** Effect of any disorder is significant at $p \leq .01$

Notes: N=2401. Predictions are obtained from weighted regression models that adjust for marital status, rural residence, race, ethnicity, education, education of main financial support while growing up, education of spouse, number of pre-school and school-aged children, age and its square, foreign birth, the county unemployment rate and its interaction with education.

Table 3b
Predicted Labor Market Outcomes by
Whether Any Psychiatric Disorder, Men

Ordinary Estimation			
Average sample prediction with:	Percent employed **	Usual weekly work hours, workers only	Annual income, recipients only **
No disorder	94.1% (SE= 0.6%)	45.9 (SE= 0.3)	\$33,624 (SE= \$714)
Any disorder	83.4% (SE= 1.5%)	44.8 (SE= 0.5)	\$29,103 (SE= \$1,033)
Instrumental Variables Estimation, Structural Shift Model			
Average sample prediction with:	Percent employed **	Usual weekly work hours, workers only *	Annual income, recipients only
No disorder	93.9% (SE= 0.8%)	46.2 (SE= 0.4)	\$33,285 (SE= \$889)
Any disorder	81.3% (SE= 3.1%)	43.7 (SE= 0.9)	\$30,117 (SE= \$1,851)
Instrumental Variables Estimation, Latent Index Model			
Average sample prediction with:	Percent employed **	Usual weekly work hours, workers only *	Annual income, recipients only
Latent index at minimum value	93.0% (SE= 0.6%)	46.1 (SE=0.3)	\$33,040 (SE= \$741)
Latent index at maximum value	52.8% (SE=12.7%)	39.5 (SE= 2.7)	\$26,315 (SE= \$4,488)

* Effect of any disorder is significant at $p \leq .05$

** Effect of any disorder is significant at $p \leq .01$

Notes: N=2225. Predictions are obtained from weighted probit and linear regression models that adjust for marital status, rural residence, race, ethnicity, education, education of main financial support while growing up, education of spouse, number of pre-school and school-aged children, age and its square, foreign birth, the county unemployment rate and its interaction with education.

Appendix I. Literature review

Mental Health			
Study	Data/Sample	Mental health measure	Findings
Bartel and Taubman, 1979	NAS-NRC sample of white male veteran twins	Prior diagnoses of psychoses/neuroses from VA records and self-reports	Reduction in earnings, wage rate, weekly hours and probability of LFP from disorders incurred prior to outcome measurement
Benham and Benham, 1982	White males in St. Louis with history of psychiatric disorder	Psychosis, sociopathy, alcoholism and neurosis any time after age 18; diagnosis assigned by psychiatrist	Neurotics earned 23% more, psychotics 43% less; psychotics and sociopaths less likely to be employed
Bartel and Taubman, 1986	NAS-NRC sample of white male veteran twins	Prior diagnoses of psychoses, neuroses, and other mental illness from VA records and self-reports	All types of mental illness reduced earnings, although there was some evidence of reverse causality in this relationship
Mitchell and Anderson, 1989	ECA data on adults aged 50 and over from 3 sites	DIS/DSM mental health symptoms during previous period	Poor mental health reduces employment among older men but not women
Mullahy and Sindelar, 1990	ECA data on New Haven adults under 65	Self-reported mental health status and DIS/DSM diagnoses (prevalence during past year and time since onset)	Better self-reported mental health was associated with higher employment rates; no individual disorders were significant after having controlled for self-reports, but diagnoses had jointly significant effect on employment of men
Frank and Gertler, 1991	ECA data on Baltimore males under 65	Mental health measures based on combinations of prior DIS/DSM diagnoses, symptoms, and utilization	Persons who were mentally distressed earned 21% less than healthy individuals; utilization-based measures showed smaller effects
Miller and Kelman, 1992	ECA data on males under 65 from four sites	Time since onset of DIS/DSM diagnoses of schizophrenia and affective, anxiety, antisocial personality, alcohol abuse, drug abuse, somatization/ cognitive disorders	Alcohol reduced income by 1-10% for men and 1-21% for women; drugs reduced income from 1-9% for men, but increased income for women; the impact of mental illness on income depended on age, sex and type of disorder, with most effects other than schizophrenia ranging from 1-12%. The impact of schizophrenia ranged from 7-100% for men and 3-16% for women.
Ruhm, 1992	Massachusetts Women's Health Study	CES-D scale and use of drugs for mental problems	Women with high CES-D scores or who uses tranquilizers or antidepressants had lower labor force participation rates; mental health accounted for 34% of the total health effect on employment, with covariance between physical and mental health accounting for another 18%

Berndt et al., 1996	RCT data on chronically depressed patients	Six depression ratings scales	Antidepressant treatment both improved depressive symptoms and improved self-assessed work performance
Substance Abuse			
Study	Data/Sample	Substance abuse measure	Findings
Berger and Leigh, 1988	Adults from the Quality of Employment Survey	Whether respondent reported drinking alcohol once a week or more (other definitions explored)	Drinkers earned more than non-drinkers using sample selection model, although difference apparently insignificant
Heien and Pittman, 1989	National Survey of Attitudes and Interests in Drinking Practices and Problems	Measure of problem drinking based on self-reported behaviors	Impact of alcohol on income was negative and significant with ordinary WLS regression, positive but insignificant with sample selection model
Mullahy and Sindelar, 1989	ECA data on males aged 25-59 in New Haven	DIS/DSM diagnoses of alcohol abuse and dependence and psychiatric comorbidities (prevalence during past year and age of onset)	Alcoholism and psychiatric comorbidities during the past year had no significant effect on earnings in both ordinary and IV regressions that included disorders before age 22 among the instruments
Mullahy and Sindelar, 1991	ECA data on adults aged 30-59 from three sites	Whether ever met DIS/DSM criteria for alcoholism	Alcoholism reduces probability of labor force participation for both men and women; same reduction in personal income conditional on working for men and women, but only significant for men
Kaestner, 1991	NLSY	Self-reported frequency of use of cocaine and marijuana during past 30 days	Ordinary regressions showed a number of significant positive effects of drug use on wages of men and women; effect larger among those under 23; selection term for drug use was insignificant and did not change results; 2SLS coefficient estimates were almost all positive and often significant for men
Bryant, Samaranyake, and Wilhite, 1992	NLSY males	Self-reported number of drinks consumed in past month and lifetime use of hard drugs	Drinking increases wages of young, white male workers but lowers wages after adjusting for income effect; selection term for drinking was insignificant in all specifications
Gill and Michaels, 1992	NLSY	Whether reported using any illegal drugs, divided into "hard" and "soft" drugs	Drug use associated with greater intercept but lower returns to human capital, yielding net increase in wages. Some evidence of negative selection into both drug use and employment was found.

Mullahy and Sindelar, 1993	ECA data on males aged 22-64 in New Haven	Whether ever met DIS/DSM criteria for alcoholism, whether met criteria for alcoholism during past year	Whether ever met criteria for alcoholism reduced employment and personal income among those aged 30-59; alcoholism during past year did not add explanatory power. Correction for selection into full-time employment was insignificant but reduced significance of alcohol effect on income.
Hamilton and Hamilton, 1994	General Social Survey	Whether nondrinkers, moderate drinkers, or heavy drinkers, based on self-reported use	Moderate alcohol consumption increased earnings, but returns to heavy drinking were negative or insignificant after selection correction. Significant selection into the nondrinker and moderate drinker groups.
Kenkel and Ribar, 1994	Same-gender sibling pairs from the NLSY	Whether met DSM criteria for alcohol abuse and dependence and consumption during past 30 days	Alcohol abuse/dependence reduce men's but increase women's earnings. Heavy drinking reduces earnings of both, but only significant for men. Work hour effects negligible. Evidence of selection into hours but not earnings, but didn't change OLS effects. Family fixed effects increased effect on women's earnings, reduced effect on men's earnings. IV model showed that each alcohol measure reduced men's earnings significantly, reduced men's hours and women's earnings insignificantly, and increased women's hours significantly.
French and Zarkin, 1995	Employees at four worksites	Self-reported level of alcohol consumption, separate controls for never drank and former drinker	Impact of alcohol use on weekly wages was nonlinear, with highest earnings found among those who had between 1.69 and 2.40 drinks per day (higher for prime-age workers). Effect of being former drinker negative and significant.

Key:

- ECA = Epidemiologic Catchment Area
- NLSY = National Longitudinal Survey, youth cohort
- DIS = Diagnostic Interview Schedule
- DSM = Diagnostic and Statistical Manual of Mental Disorders

Appendix 2. Reduced-Form Parameter Estimates, Instruments

WOMEN (N=2401)			
Outcome	Psychiatric disorders before age 18	Maternal psychiatric disorders	Paternal psychiatric disorders
Probability of any current psychiatric disorder	3.89 (0.38) ** ε = 0.004	0.11 (0.04) ** ε = 0.07	0.21 (0.04) ** ε = 0.11
Probability of employment	-0.13 (0.04) ** ε = -0.02	-0.10 (0.03) ** ε = -0.03	-0.09 (0.03) ** ε = -0.02
Usual weekly work hours, workers only	-0.56 (0.43) ε = -0.006	0.41 (0.30) ε = 0.009	-0.04 (0.31) ε = -0.0008
Log of annual income, recipients only	-0.11 (0.03) ** ε = -0.03	-0.04 (0.02) ε = -0.03	-0.02 (0.03) ε = -0.01
MEN (N=2225)			
Outcome	Psychiatric disorders before age 18	Maternal psychiatric disorders	Paternal psychiatric disorders
Probability of any current psychiatric disorder	3.89 (0.52) ** ε = 0.002	0.19 (0.04) ** ε = 0.08	0.07 (0.04) ε = 0.04
Probability of employment	-0.26 (0.06) ** ε = -0.02	-0.05 (0.05) ε = -0.004	-0.05 (0.04) ε = -0.005
Usual weekly work hours, workers only	-1.49 (0.52) ** ε = -0.007	-0.06 (0.32) ε = -0.0006	0.93 (0.30) ** ε = 0.01
Log of annual income, recipients only	-0.04 (0.03) ε = -0.007	-0.01 (0.02) ε = -0.004	0.01 (0.02) ε = 0.007

* Effect of instrument is significant at $p \leq .05$

** Effect of instrument is significant at $p \leq .01$

Notes: Standard errors are in parentheses. ϵ = elasticity. The income elasticity refers to the retransformed value. Regressions control for a constant term, marital status, rural residence, race, ethnicity, education, education of main financial support while growing up, education of spouse, number of pre-school and school-aged children, age and its square, foreign birth, the county unemployment rate, and its interaction with education.