

1-1-2003

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Virginia Wilcox-Gök

Dave E. Marcotte

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### **Original Citation**

Wilcox-Gök and Dave E.Marcotte."Estimating Earnings Losses Due to Mental Illness: A Quantile Regression Approach." Journal of Mental Health Policy and Economics Volume 6, Number 3, 2003, 123-134

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**ESTIMATING EARNINGS LOSSES DUE TO MENTAL ILLNESS:  
A QUANTILE REGRESSION APPROACH**

Dave E. Marcotte  
Department of Public Policy  
University of Maryland Baltimore County  
1000 Hilltop Circle  
Baltimore, MD 21250  
U.S.A.  
(410) 455-1455  
marcotte@umbc.edu

and

Virginia Wilcox-Gök  
Department of Economics  
Northern Illinois University  
DeKalb, IL 60115  
U.S.A.  
(815) 753-6957  
vlw1@niu.edu

September 2003

This research was supported by the National Institute of Mental Health (R01-MH56463-01). The authors thank participants in seminars at Washington University, the Health Economics Research Centre at Oxford University, Northern Illinois University, and at the meetings of the Allied Social Sciences Association (Health Economics Research Organization) meetings for comments. We benefited especially from the suggestions of Philip Clarke, Will Manning, and Gary Zarkin. However, all opinions and responsibilities are those of the authors.

## ABSTRACT

In this paper, we examine the effects of mental illness on earnings by recognizing that effects may vary across the distribution of earnings. Using data from the National Comorbidity Survey, we employ a quantile regression estimator to identify the effects at key points in the [conditional](#) earnings distribution. We find that earnings effects vary importantly across the distribution. While average effects are often not large, mental illness more commonly imposes earnings losses at the lower tail of the [conditional](#) earnings distribution, especially for women. Consequently, mental illness can have larger negative impacts on economic outcomes than previously estimated, even if those effects are not uniform.

## INTRODUCTION

Tens of millions of American workers suffer from mental illness every year.<sup>1</sup> During the past decade, we have come to better understand the effects of mental illness on the economic lives of the afflicted. In general, mental illness has relatively large employment effects. However, the extent to which mental illness has negative effects on earnings has been found to be less uniform.

There has been a substantial amount of [research published in the past few decades](#) [estimating](#) the earnings effects of mental illness. Much of that research, especially the most recent, has devoted significant attention to developing instrumental variables (IV) estimators to control for unobserved heterogeneity between workers who suffer from mental illness and workers who do not. Still, much remains to be understood about the effects of mental illness on workers' earnings. Not only may workers afflicted with mental illness differ from their healthy peers in ways that are hard to measure, [but](#) once afflicted it is likely that a separate non-random process plays a role in determining who remains employed or how substantially illness impedes work.

Several factors shape the extent to which illness impairs workers' abilities to maintain employment or work effectively. First, and most importantly, there is substantial variation in access to treatment. During the past three decades, there have been remarkable advances in treatment. So, disparities in access can result in important differences in the consequences of illness. Second, employment contracts vary in the extent to which mental illness might be accommodated in the workplace. Salaried workers and those with generous leave policies may

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<sup>1</sup> Estimates of the 12-month prevalence of mental disorders in the United States (excluding alcohol/substance abuse or dependence) are about 22 to 30 per 100 persons in the adult population (see Regier et al. (1993) for estimates based on the Epidemiological Catchment Area Study and Kessler et al. (1994) for estimates from the National Comorbidity Survey).

be more likely to maintain employment and earnings even if afflicted with an episode of illness. Those paid hourly rates or with little leave may not fare as well.

Access to health care and the nature of the working environment play important roles in determining the economic consequences of mental illness. In access [In considering the earnings effects of mental illness, it is important to recognize that there is a substantial amount of variation](#) to health care and sick leave and other employment flexibilities across the earnings distribution. As a result, focusing on average earnings losses may provide insufficient information on the impact of mental illness in the labor market. Rather, this may mean that the extent to which a worker's ability to work, and how much his/her earnings from such work are impeded depend upon his/her position in the earnings distribution.

In this paper, we reexamine the effects of mental illness on earnings. We consider whether the traditional focus on mean effects provides too limited a set of information about the consequences of mental illness on earnings. We contend that such effects may vary across the earnings distribution, and that focusing on mean effects may mask important earnings losses associated with mental illness.

We employ a quantile regression approach to estimate the effects of various mental illnesses at key points in the [earnings distribution \(conditional on the values of the independent variables in the analysis\)](#). We find that earnings effects vary substantially across the conditional distribution. In general, we find negative earnings effects to be larger at the bottom of the conditional distribution. In only one case do we find an illness to have negative effects across the conditional distribution.

Below, we briefly review what is known about the labor market effects of psychiatric

disorders. We then turn to the general estimation problems confronting researchers in this area, and to our estimation model. Finally, we present our results and discuss their implications.

## **BACKGROUND**

Substantial research on the labor market consequences of mental illnesses began in the 1970s. Bartel and Taubman (1979), employing data from the National Academy of Sciences (NAS), estimated that a general indicator of mental illness is associated with earnings losses on the order of 20% per year. Using Epidemiological Catchment Area (ECA) data, Frank and Gertler (1991) estimated similar earnings losses to be 21%.

This first wave of research found that earnings losses varied both by severity and by disorder. For example, Bartel and Taubman (1986) and Benham and Benham (1981) found that mental illnesses involving the most severe symptoms are associated with large earnings losses, perhaps 40%. Those involving less severe symptoms are associated with losses of about 10%. Other researchers have found that workers suffering from schizophrenia earn substantially less than otherwise comparable workers – while the impacts of other disorders are less severe (Miller and Kelman (1992)).

Problems in the estimation of the labor market effects of mental illness were clear in Miller and Kelman's (1992) research using the ECA data. The authors found that affective disorders (which include depression and bi-polar disorders) were associated with *increased* earnings. Writing that they "do not accept the implication that, all other things equal, having an affective disorder diagnosis increases one's income" (p.121), Miller and Kelman attributed the

unexpected finding to the endogeneity of mental illness in earnings equations.

Beginning in the mid-1990s, a second wave of research made use of the National Comorbidity Survey (NCS), the first nationally representative survey to provide substantial information about symptoms and prevalence of non-substance abuse mental illnesses. Data from the NCS, conducted between 1992 and 1994, comprised a national probability sample of 8,098 Americans. All previous studies used community level data, precluding accurate generalization to the national level. Unlike other nationally representative survey datasets, the NCS included information about mental illness and labor market outcomes, as well as several exogenous risk factors for mental illness. This allowed researchers to address the problem of endogeneity in estimating the effects of various mental illnesses on labor market outcomes.

In the first study using the NCS, Ettner et al. (1997) employed an instrumental variables approach to handle the estimation problems to which Miller and Kelman (1992) attributed their counterintuitive results. The authors used the number of psychiatric disorders exhibited by the respondent's parents and the number of psychiatric disorders experienced by the respondent before the age of 18 to create instrumental variables for psychiatric disorders. The instrumental variables were used to estimate the effect of psychiatric disorders on both the probability of employment and earnings. The authors found evidence of significant earnings losses associated with mania for women and a decrease in employment probability for both men and women due to major depression.

Using instrumental variables constructed using information in the NCS describing the parental history of psychiatric disorders, Marcotte et al. (2000) found substantial earnings losses associated with selected mental illnesses – with larger negative effects for women.

Similarly, Slade and Albers (2000) \*\*\*

Both the more recent research using national probability samples and the previous research have generally concluded that a substantial component of the labor market losses due to mental illness are dis-employment effects (Ettner et al. (1997), and Ettner (2000)). This is not surprising because illnesses that can impair cognitive functioning, perception, and behavior surely limit productivity and raise the costs of working for the ill.

In the research reported here we consider whether the relationship between mental illness and labor market losses is more complicated than that assumed in the literature thus far. While allowing for the potential endogeneity of mental illness and earnings, we posit that workers with lower incomes face potentially more serious consequences if they become mentally ill. We expect this for at least two reasons. First, income is an important determinant of access to health care (Smith (1999) and Smith and Kingston (1997)). Adequate treatment and access to pharmacotherapy can have substantial positive effects on the ability of workers to regain pre-morbid levels of productivity (Berndt et. al. (1998) and Berndt et. al. (2000)). Second, workers with relatively low wages often have the least flexible working arrangements, the poorest access to sick leave, or other support in the workplace that might accommodate the ill (e.g. see McCrate (2002), Jacobs and Steinberg (1990) and Brown (1980)). Both because of poorer access to treatment and less flexible employment situations and leave benefits, lower income workers are likely to suffer relatively large economic losses. If so, previous estimates of mean earnings effects may be an inadequate characterization of earnings losses due to mental illness. In the next section, we describe the empirical difficulties associated with estimating the effects of mental illness on employment outcomes. We then describe our basic



and full estimating models and procedures - including how features of the illnesses can help us solve estimation problems, and how we employ our quantile regression approach in this context.

## EMPIRICAL MODELS

In estimating earnings losses due to illness, economists have typically specified earnings equations rooted in the human capital literature. The usual earnings model is a linear equation relating observable worker and job characteristics to the log of annual earnings. To estimate the effect of illness on earnings, simple yes/no indicators of illness are typically included among the independent variables in the regression equation, and the coefficients interpreted as the marginal earnings loss due to various illnesses.

In our context, such indicators, which we will call ( $\mathbf{M}$ ), would take on the value of one if the individual suffers from a particular mental illness, and zero otherwise. The standard earnings model is represented by the following equation:

$$(1) \quad E_i = \beta_0 + X_i \beta_1 + M_{iD} \beta_2 + C_i \beta_3 + e_i$$

where  $E_i$  is a vector of observations on annual earnings for the  $i$ th individual.  $X_i$  is a vector of socioeconomic and demographic characteristics.  $M_{iD}$  is a vector of dummy variables for a set of  $D$  mental illnesses.  $C_i$  is a vector measuring consumption of alcohol and illegal drugs.  $\beta_1$ ,  $\beta_2$ , and  $\beta_3$  are conformable vectors of coefficients relating each of these factors to earnings. Finally,  $e_i$  is the stochastic term.

Unlike many physical illnesses that may reasonably be considered exogenous, mental illness presents potentially serious estimation problems. The focus of previous research has

been the possibility that the onset of mental illness may be related to factors determined in the labor market, most importantly earnings. Other research has suggested that factors that predict mental illness also affect labor market outcomes. In particular, it is supposed that personality traits such as excessive motivation or drive, or working in high stress occupations at once increase risk of illness, and lead to higher than expected wage outcomes.<sup>2</sup>

For all of these reasons, previous research has generally treated the onset of mental illness as endogenous, concluding that a single equation model will likely misestimate the causal effects of mental illness on earnings or other labor market outcomes. One way to conceptualize the resultant estimation difficulties is to make explicit a component of the error term,  $\pi$ , measuring an individual's propensity for mental illness – arising either due to personality traits, stress, or job-outcome affected factors. Doing so yields the following model:

$$(2) \quad E_i = \beta_0 + X_i \beta_1 + M_{iD} \beta_2 + C_i \beta_3 + \pi_i + \phi_i$$

where  $\phi_i$  is assumed to be i.i.d  $\sim N(0, \sigma_\phi^2)$  and orthogonal to all regressors and  $\pi_i$ . The estimation problem arises because  $E(\pi_i | M_{iD}) \neq 0$ , for some  $d \in D$ . The solution most often employed in this context is to develop an instrumental variables estimator of the effect of mental illness on labor market outcomes. If appropriate instruments can be found, the instrument will be uncorrelated with  $\pi_i$ , and the resultant estimator will be consistent.

In our empirical analyses, we begin with this estimation strategy. We estimate a two-stage model to identify the earnings effects of four principal non-substance abuse mental illnesses; major depression, anxiety disorders, dysthymia, and anti-social personality disorders.

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<sup>2</sup> There is substantial empirical support from the medical and epidemiological literature for these claims.

<sup>3</sup> We omit workers with other, less prevalent, mental illnesses from our analyses, so that the comparison group is workers with no history of mental illness.

To develop our instruments, we utilize information on family history with these various mental illnesses. Family history of illness is a well-established risk factor for mental illness – but has no direct bearing on labor market outcomes.<sup>4</sup> So, similar to previous research, we estimate first stage models of the following type:

$$(3) \quad \mathbf{M}_{id} = \alpha_{d0} + \mathbf{X}_i \alpha_{1d} + \mathbf{C}_i \alpha_{2d} + \mathbf{H}_{id} \alpha_{3d} + \epsilon_{id}$$

Where  $\mathbf{M}_{id}$  is a dummy indicating whether individual  $i$  suffers from mental illness  $d$ .  $\mathbf{H}_{id}$  is a vector of measures of family history with the disorder  $d$ . We estimate equation 3 assuming the errors follow a cumulative logistic distribution and also as [linear probability models](#).<sup>5</sup> We then use the predicted probabilities of these disorders as instruments in regressions to identify the marginal effect of various mental illnesses on earnings:

$$(4) \quad \mathbf{E}_i = \beta_0 + \mathbf{X}_i \beta_1 + \mathbf{M}_{id}^{IV} \beta_2 + \mathbf{C}_i \beta_3 + \epsilon_{i2}$$

where  $\mathbf{M}_{id}^{IV}$  is a vector containing predicted values of each of the  $D$  mental illnesses, obtained in the first stage regressions, and  $\beta_2$  is a conformable vector of coefficients.

[In principle, this instrumental variables solution provides consistent estimates of the direct effects of various mental illnesses on conditional earnings, even in the presence of a non-random error component associated with mental illness. But the IV](#)

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<sup>3</sup> Dysthymia is a disorder characterized by a moderately depressed mood state, persisting for at least two years.

<sup>4</sup> Family history may affect the accumulation of human capital during childhood, but we will control for pre-determined levels of schooling.

<sup>5</sup> Linear probability models are used to predict the probabilities of the four mental illnesses in addition to the logistic models because logistic models may yield inconsistent estimates of the earnings losses due to mental illnesses. We find that the two models yield similar estimates of earnings losses.

solution has limitations. By estimating the second stage via least squares, IV estimates only provide information on mean earnings effects of mental illness.<sup>6</sup> We will consider whether the earnings effects of mental illness are uniform across the distribution of earnings by expanding beyond mean effects. We examine the effects of mental illness on earnings at several key points in the conditional distribution of earnings.

To estimate the effects of mental illness across the distribution, we estimate the model developed in Equation 4 using a quantile regression approach. In quantile regression, the object is to estimate the quantiles of the dependent variable conditional on the values of the independent variables. Thus, when we refer to a specific quantile or to the distribution of earnings, we are referring to the *conditional distribution* of the dependent variable. This is similar to least squares regression in which the objective is to estimate the mean of the dependent variable conditional on the values of the independent variables.<sup>7</sup>

For the  $\theta$ th quantile, we estimate  $\beta_\theta$  by solving the following minimization problem:

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<sup>6</sup> One might think of the effect of mental illness on conditional earnings as embedded in an initial decision about work. If the instrument employed here is not orthogonal to the error term in the work decision, the IV estimator may not be consistent. Moreover, restricting analysis to conditional earnings means that the underlying structural parameters of the joint relationship between mental illness and employment and earnings cannot be estimated. To estimate the structural parameters we could use a two-part model such as the Tobit model. Unfortunately, such models rely heavily on distributional assumptions that do not hold in the context of the current problem. Using the conditional moment test of normality suggested by Pagan and Vella (1989), we reject the hypothesis that the distribution of log earnings is censored normal.

<sup>7</sup> Like median regression, quantile regression finds the regression plane that minimizes the sum of the absolute residuals rather than the sum of the squared residuals.

$$(5) \quad \min_{\beta} \frac{1}{n} \left\{ \sum_{i: E_i \geq Z_i \beta} \theta |E_i - Z_i \beta| + \sum_{i: E_i < Z_i \beta} (1 - \theta) |E_i - Z_i \beta| \right\}$$

$$\text{where } Z_i = [\mathbf{1} \ X_i \ \mathbf{M}_{iD}^{IV} \ C_i] \quad \text{and} \quad \beta' = [\beta_0 \ \beta_1 \ \beta_{2D} \ \beta_3]$$

Here,  $\mathbf{M}_{iD}^{IV}$  is a vector of instrumental variables for the presence of a set of D mental illnesses.  $\beta_{2D}$  is a conformable vector of coefficients. Using this quantile regression strategy, we estimate the effects of mental illness on workers at different points in the conditional distribution. If it is the case that income is positively related to access to treatment and flexibility and accommodations on the part of employers, we expect earnings losses associated with mental illness to be larger for workers at lower quantiles.

## DATA

We carry out our estimation strategy using data from the National Comorbidity Survey (NCS). The NCS is a nationally representative survey designed to study the prevalence, causes, and consequences of comorbidity between substance abuse disorders and nonsubstance abuse psychiatric disorders (Kessler, 1994). The data are a stratified, multi-stage area probability sample of persons 15-54 years old, living in the 48 coterminous states. For our purposes, we restrict our analysis to respondents 18 years old or older. The survey was conducted between September, 1990, and February, 1992, by the Survey Research Center (SRC) of the University of Michigan. The response rate was 82.6 percent with 8098 total respondents (Kessler et al., 1994). Of the full sample, 5,877 respondents were administered Part II of the survey, which provides detailed information on individual and family history with mental illness. We use restrict our analysis to this sub-sample, and weight accordingly.

Diagnoses of mental illness are based on respondents' answers to the NCS. The NCS used a modified version of the Composite International Diagnostic Interview (CIDI), a state-of-the-art structured diagnostic interview instrument administered by trained lay-interviewers. Responses to CIDI questions are used to diagnose the lifetime and 12-month prevalence of several DSM-III-R psychiatric disorders, including substance abuse disorders.<sup>8</sup> [We use the 12-month prevalence rate in the research reported here because recent episodes of mental illness are more likely to have a significant impact on labor market performance.](#)

Because the NCS was designed to study risk factors as well as prevalence, the NCS interview included family history assessments of parental psychopathology, questions about childhood adversity, measures of social networks and support, and information about stressful life events and difficulties (Kessler et al., 1994). We use this information about clinical and family background to measure, and instrument for, the presence of mental illness.

The NCS also contains data describing individuals' labor market experiences, as well as other relevant economic and demographic information. Respondents are asked about their labor market participation and that of their partners, if relevant. We also know basic information about respondents, such as their education level, employment status, family income, and share of family income. These variables allow us to analyze the relationship between mental illness and income.

Because earnings information is not available in the NCS data, we use respondents' annual personal income as a proxy measure for earnings.<sup>9</sup> To improve the quality of this proxy,

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<sup>8</sup> Commitment and memory probes were used to minimize recall problems.

<sup>9</sup> These data are reported in interval form, with 23 possible categories. We assign to respondents the midpoint of

we limit our analyses of income to those who report participating in the work force.

Nonetheless, we cannot identify fully the sources of personal income. Because non-labor income is less likely to be affected by disabilities due to illness, we expect that our analyses may underestimate the effects of affective disorders on respondents' earnings.

## RESULTS

### *Descriptive Statistics*

In Table 1, we present descriptive statistics for the NCS sample, in total and by gender. The first several rows provide information on economic outcomes and demographic characteristics of the sample. The final set of rows provides information describing the sample's experience with mental illness. Anxiety disorders were the most commonly occurring class of mental illnesses, which include generalized anxiety disorder, panic disorders, and various phobias. Overall, 21.8 percent of the sample reported symptoms sufficient for a diagnosis of some form of anxiety disorder. 14.0 percent of the sample reported suffering from major depression; 2.9 percent suffered from dysthymia; and 12.9 percent of the sample suffered from anti-social personality disorder or a related disease.

The second and third columns of Table 1 illustrate the different 12-month prevalence rates of various mental illnesses for men and women. Women are more likely to have suffered from anxiety disorders, major depression, and dysthymia during the previous 12 months than are men. Indeed, fully 25.8 percent of women have suffered from anxiety disorders and 18.6 percent from major depression. This compares to 18.3 and 9.9 percent among men,

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the category in which they report.

respectively. Men, however, are much more likely to suffer from anti-social personality disorders than women.

### ***Ordinary and Instrumental Variable Estimates of Illness on Income***

With these findings on the prevalence and patterns of mental illness in mind, we next consider the effects mental illnesses have on respondents' incomes. Both because of the substantially different prevalence rates by gender, and because labor market experiences differ by gender, we estimate these effects separately for men and women.<sup>10</sup>

In Table 2 we present ordinary and IV estimates of the effects of various mental illnesses on the log of earnings. In the first column of Table 2, we present OLS estimates of the relationship between mental illness and earnings for women, in the third column we present estimates for men. These are estimates of the model described in Equation 1. In columns two and four we present IV estimates for women and men. These are estimates obtained from the two-stage procedure described in Equation 3 and Equation 4. The coefficients in Table 2, and subsequent tables, are interpretable in the standard way.

The results in Table 2 suggest that for women, only anxiety disorders significantly reduce earnings. We find that OLS estimates suggest that anxiety disorders are associated with a 0.124 log unit decrease in earnings. This is a 13.2 percent decrease in earnings compared to their healthy peers. The IV estimate is substantially larger. The coefficient on anxiety disorders reported in the second column suggests that women suffering from such disorders earn 95.4 percent less than their healthy peers.

The results in columns (iii) and (iv) suggest that mental illness has no significant effect



on the earnings of men. This is consistent with previous research that mental illness has relatively little average effect on men's earnings.

### *Quantile Regression Estimates*

Next, we examine whether these average effects characterize the effects of mental illness on earnings across the conditional distribution. We estimate the model summarized in Equation 5 for the 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> and 90<sup>th</sup> quantiles. Again, we do this separately for women and men. We summarize the findings from our quantile regression analyses in Figures 1 and 2. The figures present coefficients and 95 percent confidence bands for each of the mental illnesses, estimated at the various quantiles. The confidence intervals are based on heteroskedasticity-robust standard errors estimated using a bootstrap resampling method. To conserve space and to focus on the parameters of interest, we do not report the coefficients of the control variables here.<sup>11</sup>

In Figure 1, we present results for women. In an important respect, the quantile estimates give a different picture than the mean effects presented in Table 2. For each of the diseases, mental illness has significant effects on earnings at the 10<sup>th</sup> quantile. For major depression, anxiety disorders, and dysthymia these effects are negative and often substantial. However, only anxiety disorders have significant negative effects on earnings for women at higher quantiles. This is not surprising, since anxiety disorders were the only form of mental illness that was associated with negative average earnings effects in both the ordinary and instrumental variables models presented in Table 2.

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<sup>10</sup> A Chow test confirmed that the parameters of the relationship between men and women differ.

<sup>11</sup> The full set of results are available upon request from the authors.

In general however, and even for anxiety disorders, the effects of mental illness on earnings are much smaller at higher quantiles. Only at the bottom of the conditional distribution do we observe negative, significant effects of mental illness on earnings for women.<sup>12</sup>

In Figure 2, we present results for men. For men, there is some evidence that the effect of mental illness on earnings outcome varies across the conditional distribution. Consistent with the average effects obtained in the ordinary and IV estimated models, we find less evidence of any effect of mental illness on earnings for men. However, again at the bottom tail of the conditional distribution mental illness appears to have significant earnings effects. At the 10<sup>th</sup> quantile, anti-social personality disorders are associated with losses in income for men. Again, the effects of anti-social personality disorders become smaller and insignificant at higher points in the conditional distribution. In addition, the point estimates of the effects of anxiety disorders on earnings losses are relative large at the 10<sup>th</sup> quantile, though the confidence interval includes zero. Interestingly for men, it appears that dysthymia has relatively large negative effects on earnings at the median and above. Such negative effects do not occur at the 10<sup>th</sup> and 25<sup>th</sup> quartiles. This may be due to the type of tasks performed by men in higher paying positions. Compared to men working in more routine jobs, the tasks performed by men working in higher paying positions may be more complex and therefore more vulnerable to the disruptive effects of continuous low level depression (dysthymia).<sup>13</sup>

Comparison of the mean effects estimates and the quantile regression results make clear

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<sup>12</sup> The effects are not limited to the 10<sup>th</sup> quantile. Generally, they are observed at all quantiles below the 25<sup>th</sup>.

<sup>13</sup> The authors thank an anonymous referee for this insight.

that mental illness can have substantially different effects at different points in the conditional distribution. In general, mental illness appears to have large and significant effects on earnings at the bottom of the conditional distribution. We find less evidence of such effects at the median and above. Even in the case of anxiety disorders among women, where ordinary and instrumental variables estimators identified significant earnings losses at the mean, the quantile regression results find much larger losses at the bottom of the distribution. Consequently, estimators that minimize deviations around the mean miss how and where illness is associated with earnings losses.

### *Limitations*

One explanation for this relatively large impact among workers with lower earnings arises if one assumes that the onset and severity of mental illness is independent of position in the [conditional distribution](#), even if the consequences are not. If illness afflicts people similarly across the [conditional distribution](#), then the relatively large impact on those at the bottom of the distribution is consistent with the fact these workers have poorer access to health care and they are less likely to have flexible work environments or sick/disability leave on their jobs. For any disease with a given severity, we would expect that workers receiving no treatment, and for whom pay and employment are more closely linked to short-term performance, would suffer relatively large economic losses.

However, the pattern of larger earnings losses at the bottom of the [conditional distribution](#) might also arise if workers at the bottom tail of the distribution suffer from especially debilitating cases of mental illness. [However, it may also be that a selection process is occurring. This occurs if workers with especially debilitating cases fall to the bottom of the](#)

conditional distribution, perhaps moving to poorly paying positions to accommodate their illness. To the extent that this occurs, our estimated effects of mental illness at the bottom of the distribution will be biased.

The magnitude of the potential bias has important policy implications. In the absence of bias, our results suggest that illness among workers with little economic means imposes substantial losses. If this is the case, ensuring such workers get access to treatment and encouraging economic and social support during episodes of illness might be sensible responses to mitigate losses. However, if our results are largely due to selection bias, then the ill at the bottom of the conditional distribution suffer the largest losses because their illnesses are relatively severe. If this is the case, one might be dubious about whether efforts to treat or provide vocational rehabilitation could substantially improve the economic prospects of this group.

We cannot ascertain the severity of illness with the NCS data. However, we can examine whether a selection process causes mental illness prevalence rates to vary contemporaneously across the distribution. If the larger earnings effects at the bottom tail of the conditional distribution observed here arise because illness causes workers to sort into the bottom tail, we should observe higher rates of prevalence in the bottom tail of the conditional distribution. In contrast, if the onset of illness is independent of position, we may observe similar rates of prevalence across the conditional distribution. Of course, similar rates of prevalence do not indicate how the severity of illness among workers at the bottom of the distribution compares to those in higher quantiles. They do, however, suggest the absence of a selection mechanism.

In Table 3 we present overall prevalence rates of each of the mental illnesses examined here and prevalence rates at different points in the earnings conditional distribution. We present these rates separately by gender. The results are somewhat mixed. Recall that for women, depression, dysthymia, and anxiety disorders were estimated to have substantial and significant negative earnings effects at the bottom of the earnings conditional distribution. For depression and dysthymia there is no evidence that prevalence rates are higher at the bottom of the conditional distribution. Only for depression do prevalence rates vary significantly across the conditional distribution, and in this case, workers at the bottom have relatively low rates. Consequently, for these diseases among women it does not appear that the relatively large earnings effects at the bottom tail are due to a substantial effect of illness on position in the conditional distribution. For anxiety disorders among women, prevalence rates are significantly higher in the bottom tail of the conditional distribution. Thus, for this disorder it is possible that our estimated earnings effects are biased by nonrandom selection of ill persons into the bottom tail of the conditional distribution.

Among men we found negative effects of mental illness for both anxiety and anti-social personality disorders. For both of these disorders, we find significantly higher prevalence rates in the bottom tail of the conditional distribution, indicating that these illnesses may have an effect on the person's position in the conditional earnings distribution. Thus, in these two cases our estimated earnings effects may be biased by nonrandom selection of ill persons into the bottom tail of the distribution. We also found large negative earnings effects of dysthymia on earnings at and above the median. We do not find a statistically significant difference in prevalence rates for dysthymia across the conditional earnings distribution, suggesting that our

estimates for this disorder are not biased by nonrandom selection.

Finally, our analysis focuses on the impact of mental illness on the earnings of individuals who remain in the work force despite their illness. We do not attempt to include in our estimate the effect on the earnings of individuals who leave employment because of mental illness. As pointed out in the literature review, the empirical evidence indicates that a substantial component of the labor market losses due to mental illness are dis-employment effects, especially among women. This suggests that workers who remain in the workforce despite a mental illness differ in unmeasured ways from those who leave the workforce. Using only the selected group of afflicted workers to estimate our quantile regression model will certainly lead to underestimation of the earnings losses due to mental illness.<sup>14</sup> While the incorporation of dis-employment effects is beyond the focus of this paper, it can be noted that the magnitude of the bias depends upon the probability of workforce exit in each quartile. For example, assume that workers in the lower quantiles (of the conditional earnings distribution) are less attached to the workforce because of lower wage rates. Then the probability of workforce exit due to mental illness will be higher among workers in these quartiles and the underestimation of the earnings effect will be greater for these quartile estimates.

## CONCLUSIONS

In this paper we re-examine the effects of mental illness on earnings to assess the extent

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<sup>14</sup> Marcotte and Wilcox-Gök (2002) compare conditional and censored estimates of earnings losses due to depression and find a large earnings effect due to self-selection out of the labor force, especially among women. However, the use of two-stage estimators when the second stage is a probit analysis has been shown to yield inconsistent estimators (Battacharya, McCaffrey, and Goldman (1999)).

to which any such effects vary across the distribution of earnings. Heretofore, all estimates of such effects have been made using methods that minimize deviations around the mean. While average effects are often not large, our findings suggest that such estimates miss important features of the impact of mental illness on earnings. We find that the largest effects of mental illness are at the lower tail of the earnings distribution. Consequently, mental illness can have larger effects on economic outcomes than previously estimated, even if those effects are not uniform.

Presently, we are unable to fully sort out whether the relatively large earnings differences associated with mental illness at the bottom tail of the distribution are due to larger impacts of disease on poorer workers, or to the possibility that workers with more substantial illnesses are selected into the bottom of the distribution. Our analysis of contemporaneous prevalence rates across the distribution finds evidence consistent with both possibilities, depending on the disease. More fully sorting out the explanation for the relatively large earnings effects of mental illness at the bottom of the distribution will require better, longitudinal data.

Until such data become available, the present findings make clear that earnings effects of illness vary substantially across the distribution. In particular, mental illness is associated with large earnings losses among workers in the lower tail. This is especially true for women. Consequently, researchers and policy makers alike should not be placated by findings that mean earnings effects are relatively small. Such estimates miss important features of how and where mental illness is associated with real economic losses for the ill.





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