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Symptom Effects on Employment in a Structural Model of Mental Illness and Treatment: Analysis of Patients with Schizophrenia

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Abstract

Background: There is a long tradition in the health and mental health economics literatures of estimating the impacts of disorders on employment and earnings. Several analyses have associated mental illness with poorer labor market outcomes, often using indicators of disorders to measure mental illness, but it is unclear to what extent unobserved medical treatment biases the estimated impacts of disorders on labor market outcomes. In this study we argue that in order to judge the true employment costs of mental illness and the potential benefits of treatment it is necessary to account for the structural relationship between treatment, symptoms, and employment outcomes.
Aims of the Study: The study proposes a structural model for understanding mental illness impacts on employment and empirically estimates one element of this structural model that links symptoms of schizophrenia to patients' employment status. In addition, we use our empirical estimates to simulate employment consequences of more effective treatment and reductions in symptom levels.
Empirical Methods: Our empirical analyses use a sample of 1,643 adults with a schizophrenia diagnosis. We predict the likelihood of three outcomes - not employed, employed in a sheltered or supported job, and employed in a non-supported job. Analyses include measures of demographic characteristics, illness history, location differences, and detailed symptom measures.
Results: We find that negative symptoms have a substantial adverse impact on participation in both non-supported jobs and in sheltered or supported jobs. The impacts on employment of other symptoms of schizophrenia are not as large, but significant effects are also found for symptoms of depression. Simulations suggest, however, that only one-third of consumers would be employed in any type of job even given a large reduction in symptom levels.
Discussion: Negative symptoms are particularly important for role functioning and employment. The marginal effect on employment of a reduction in negative symptoms is several times greater than the effect of a comparable reduction in positive symptoms. Moreover, the effect of an improvement in symptoms on employment is stronger for non-supported employment than for working in sheltered or supported employment. Although commonly measured symptoms of schizophrenia impact employment, greater control of symptoms alone is unlikely to lead to large increases in employment for persons with schizophrenia in the near term.
Implications for Health Care Provision and Use: These findings suggest that improved treatment that results in reduced symptom levels will increase rates of employment among persons with schizophrenia, but that large employment impacts probably also require more effective rehabilitative therapies that target improvement in functioning.
Implications for Policy: Expansions of supported employment opportunities and removal of work disincentives in public income-support programs are two additional measures that may help to increase employment participation.

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Introduction

The low rate of employment among persons with schizophrenia is a forceful reminder of the disabling impact of the disease and the need for improvements in medical treatment. The vast majority of persons with schizophrenia, 73 to 89 percent, are not employed at any given time.[1,2] Of those who are employed, many work in non-competitive employment situations (such as workshop or enclave jobs) or work part-time. Although employment represents only one dimension of social functioning and quality of life, from the patient's perspective work limitation is a critical measure of the impact of schizophrenia on independence and quality of life. Despite the importance of employment as a measure of successful treatment, there is little evidence bearing on whether improvements in medical treatment would bring about improvements in employment outcomes.

There is a long tradition in the health and mental health economics literatures of estimating the impacts of disorders on employment and earnings. The simplest reduced-form estimation strategy employed in this literature is to use data on individuals to estimate a regression model of the form E = f(X,D) where E is the economic outcome measure (i.e., employment status or earnings), X is a variety of personal and "environmental" characteristics commonly used in the broader

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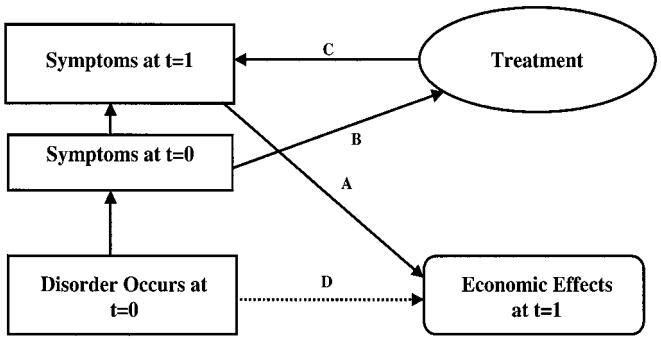

Figure 1: The Structure of Treatment Effects

literature on labor supply and earnings, and D is an indicator of the presence of the disorder. Coefficient estimates for D represent the economic impact of the disorder.*

Interpretation of such economic impact estimates is problematic, because D represents a mental disorder whose consequences can be ameliorated by treatment. **Figure 1** provides a framework for discussing the issues that arise due to this problem. The occurrence of a disorder, which could be thought of as a random decrement in the individual's health capital, produces symptoms and impairments that result in reduced market and nonmarket productivity (Arrow A). In response, the individual seeks treatment (Arrow B) that mitigates the symptoms and impairments (Arrow C) and thus diminishes the impacts of the disorder on productivity (Arrow A). Thus, when these relationships are summarized by a single reduced-form link between the occurrence of a disorder and the resulting decline in productivity (Arrow D), the measured strength of this link depends upon at least three factors that are not explicit in the reduced form model: the average level of initial symptoms and impairments caused by the disorder, the extent to which persons observed in the data with the disorder have sought treatment, and the average effectiveness of that treatment in reducing the disorder.

The implication is that estimated economic impacts of the disorder will change as access to treatment in the population changes and the effectiveness of treatment changes. Tomorrow's estimated impact may be lower than today's if more people seek treatment tomorrow or if treatment becomes more effective on average.† In other words, reported reduced form impacts are conditional on prevailing levels of treatment use and effectiveness; however reduced form studies do not provide information on these levels or on the implications of changes in these levels for the economic impact of the disorder.*

An alternative approach to estimating economic impacts of disorders is to implement a structural model that explicitly measures the relationships shown in **Figure 1**. This approach would explicitly measure the relationship between the levels of specific symptoms and impairments and the economic outcomes relating to market and home productivity. It would also incorporate information from the service use and demand literature on the relationship between the occurrence of a disorder and the treatment obtained. And it would also incorporate information from the clinical trials and effectiveness literatures on the impact of treatment on specific symptoms and impairments.

A simplified version of this structural approach collapses the various measures of specific symptoms and impairments into a single aggregated measure of health status or mental health status, and then relates the health status index to economic outcomes. Ettner[5] presents results of this type of model with a self-reported overall health status measure, as well as results obtained when this measure is included in addition to explanatory dummies for the presence of particular diagnoses. Mitchell and Anderson[6] use an overall mental health status index constructed as a count of the number of specific symptoms reported. Ruhm[7] uses a depression-specific severity index. Other variations on the diagnostic dummy specification include the use of variables for time since onset of a disorder[8,9] lifetime vs. present prevalence of a disorder,[10] and number of episodes of the disorder.[10]

There are at least two concerns about using summary mental health status measures. First, in the case of self-reported measures, measurement error may be an important source of bias,[11] Second, specific symptoms may affect economic outcomes in different ways, depending on how symptoms affect functioning or employer perception of functioning, and may respond in different ways to treatment interventions. These differences cannot be modeled in a structural model that relies on a single overall mental health status measure.

The context for the current paper is a more detailed structural approach in which treatment and a number of different symptoms and impairments are related to economic outcomes. While a complete structural model would include all the linkages shown in **Figure 1**, our empirical analysis here is limited to estimates of the relationship of symptoms to employment status (Arrow A in **Figure 1**). In particular, we present empirical estimates of this relationship specifically for the case of persons with schizophrenia.*

* See Salkever[3] for citations to, and discussion of, early examples of this approach. For a recent example of this approach, see Slade and Albers.[4]

† Note, however, that if the treatment becomes so effective that persons undergoing effective treatment are no longer classified as having the disorder, the measured impact of the disorder on individuals with the disorder may actually increase.

* Figure 1 could also be expanded to recognize that for any given level of symptoms and impairments, economic impacts may also depend upon the use and effectiveness of interventions such as job accommodations or vocational services that mitigate impacts of symptoms and impairments on market productivity. Another possible extension is to formulate a multiperiod model in which economic effects in Period 1 have a feedback influence on symptoms in Period 2. We discuss the empirical support for this possibility below.

* The types of symptoms and impairments most commonly associated with this disorder include positive symptoms, negative symptoms, and side effects of antipsychotic medications. Several studies that are based on clinical data provide evidence on the impacts of symptoms of schizophrenia on functioning.[12-16] These studies suggest that negative symptoms of schizophrenia are stronger predictors of employment and social functioning than are positive symptoms. In addition, as compared to other patients, patients with better functioning prior to onset of schizophrenia show better functioning afterwards. The empirical results of these studies cannot be used to judge the employment benefits of improved treatment, however, because they are often based on clinician ratings of productivity or functioning rather than on measures of actual employment. Also, they do not distinguish between different types of employment and they typically do not control for other factors that may affect employment outcomes, such as age, education, and race.

Recent research on the quality of care for schizophrenia suggests that improvements in quality may result in reduced levels of symptoms and improved functioning for patients.[17] We do not attempt to assess directly these potential consequences of quality improvements, but we use our estimates of the symptom-employment relationship to simulate the potential effect of improved treatment on employment rates. The simulations illustrate how the receipt of more effective treatment and physician choice of antipsychotic medication might affect rates of employment and earnings among persons with schizophrenia.*

Empirical Model

The empirical specification is based on a static model of choice wherein an individual chooses the employment state that offers the greatest utility. There are three employment states: not employed, employed in a sheltered or supported job, and employed in a non-supported job.† The likelihood of employment in each of the two job sectors can be characterized by the probabilities that a job opportunity will be available, v_j (j = 1, 2) and the quality of the job opportunity in each sector, q_j. Quality is defined here to include wages, working conditions, and non-wage costs and benefits of working. The quality of a job opportunity may be a function of consumer preferences. For example, some consumers may associate stigma with jobs in sheltered workshops.

An individual decides to work when he receives a job opportunity in either sector such that the offered job quality exceeds the utility of not working. Thus, the probability of receiving a job opportunity in the jth sector preferable to not working is $v_j \cdot [1 - F_j(q^r)]$, where F_j is the cumulative marginal density function of q_j and where q^r is the utility of not working. Analogously, the probability of receiving a job offer in the non-supported job sector, sector 1, that is preferable to a job in the supported/sheltered work sector, sector 2, is $v_1 \cdot v_2 \cdot P(q_2 < q_1)$ where $P(\cdot)$ is the cumulative probability that $q_2 < q_1$ based on the joint density function $G(q_2, q_1)$. Similarly, we can define $H(q_2 < q_1 | q_1 > q^r, q_2 > q^r)$ as the probability that non-supported employment is preferable to sheltered/supported employment when both are preferred to not working. Thus, the probability of working in the non-supported sector is:

$$c = v_1\left[1 - F_1\left(q^r\right)\right]\left[\left(1 - v_2\right) + v_2\left(1 - F_2\left(q^r\right)\right)H\left(\cdot\right) + v_2\ F_2\left(q^r\right)\right]. \quad (1)$$

Similarly, the probability of working in the sheltered/supported sector is:

$$s = v_2\left[1 - F_2\left(q^r\right)\right]\left[\left(1 - v_1\right) + v_1\left(1 - F_1\left(q^r\right)\right)\left(1 - H\left(\cdot\right)\right) + v_1\ F_1\left(q^r\right)\right]. \quad (2)$$

Finally, the probability of not working is $1-c-s$.

The probabilities v_1 and v_2, and the distribution functions F_1 and F_2, are presumably determined by the characteristics of the individual and the locality and system of care where they are treated. While each of these characteristics may influence v_1, v_2, F_1 and F_2, we do not attempt to model each of these possible structural impacts. Instead, we estimate reduced-form impacts of these characteristics on c and s.*

We estimate equations (1) and (2) using the multinomial probit model[18]. The multinomial probit model is:

$$Y_i = j \text{ if } U_{ij} = \max\left(U_{ij}, U_{ik}\right) \text{ for all } k \neq j, \quad (3)$$

where $U_{ij} = \beta_j' x_i + \varepsilon_{ij}$ is the random utility associated with choice j, j=0,1,2 indexes the three employment states, i=1,...,n indexes individuals, and x_i represents individual and local area characteristics. The choice parameters β_0 are normalized to 0, β_1 and β_2 are estimated, and ε_{ij} is the random component of utility. U_{i0} is normalized to 0, since only relative utilities are identified by the choice of employment state. Thus, we specify two random terms, ε_{i1} and ε_{i2}, as mean-zero bivariate normal error terms with variance-covariance matrix

$$\Sigma = \begin{bmatrix} \sigma_1^2 & \\ \sigma_{12} & \sigma_2^2 \end{bmatrix}.$$

Identification of the variance-covariance matrix requires the restrictions $\sigma_1 = 1$ and $\sigma_2 = 1$. The restriction that $\sigma_{12} = 0$ imposes the independence of irrelevant alternatives (IIA) assumption.† We test this assumption using the estimate of σ_{12} from the multinomial probit model.

Data

The Schizophrenia Care and Assessment Program (SCAP) database contains both employment and symptom information, which are required for implementation of our empirical approach. The SCAP is an observational, longitudinal study of treatment and outcomes for persons with schizophrenia[20]. Recruitment began in June 1997, and

* A complete implementation of our proposed structural approach would jointly model the effects of treatment on symptoms and the effects of symptoms on employment and, therefore, would require longitudinal analysis of treatment and subsequent outcomes. Such an analysis is beyond the scope of the current study.

† Note that the grouping of sheltered and supported jobs into a single sector obscures important differences among jobs. For example, some persons may hold regular competitive jobs in the community and only require occasional assistance from a job coach while sheltered workshop jobs are essentially segregated from the community workforce. As noted below, however, limitations in our data made the use of finer distinctions among types of jobs problematic.

* Receipt of disability income is not included as an exogenous explanatory variable in the empirical model of employment since consumer decisions about labor supply simultaneously influence the amount of disability income they receive (or their eligibility to receive disability income).

† The multinomial logit model, which is typically used instead of the multinomial probit model to estimate discrete choice probabilities, requires the IIA assumption.[19] This assumption may not be justifiable in this context, since the relative odds of sheltered/supported employment compared to non-employment depends on, among other things, the availability of non-supported jobs. The IIA assumption means that the relative odds of one choice (i.e., outcome) versus another should not depend on the availability of a third option. For example, if in the hypothetical situation that no sheltered or supported jobs are available the odds of being not employed versus being employed in an unsupported job are 2 to 1, then the IIA assumption implies that this ratio will stay constant following the introduction of sheltered or supported job opportunities. Clearly, this is a strong assumption, since there is no basis for the presumption that sheltered or supported jobs would not draw disproportionately from one or the other group. If the IIA assumption is violated, the multinomial logit estimates are biased and inconsistent. The multinomial probit model does not have this limitation.

participants are interviewed at regular intervals for three years. The SCAP is being implemented in six localities with organized systems of specialty care for persons with severe mental illness. They include academic health centers, community mental health centers, and Veterans Affairs (VA) providers.* All SCAP participants are over the age of 18 and had, at the time of entry into the study, a current diagnosis of schizophrenia, schizophreniform, or schizoaffective disorder. The data used here are from the baseline SCAP interviews and baseline clinical assessments.

Clinical assessments, which were conducted by trained clinical assessors, include scores on the Positive and Negative Syndrome Scale (PANSS),[21] the Montgomery-Asberg Depression Rating Scale (MADRS),[22] and the Simpson-Angus Scale (SA),[23] a rating of extrapyramidal side effects of antipsychotic treatment. We use two PANSS subscales, the PANSS Positive subscale, which measures positive symptoms (e.g., auditory hallucinations, delusions, or incoherence and illogical thought), and the PANSS Negative subscale, which measures negative symptoms (e.g., poverty of speech, affective flattening, avolition, or attentional impairment).

Each scale measures a potentially important and distinct dimension of symptoms that may impact employment for persons with schizophrenia. Positive and negative symptoms are the two defining features of schizophrenia.[24] Extrapyramidal side effects, which affect motor function and physical appearance, are associated with use of conventional antipsychotic medication.[25] Major depression is a common comorbidity of schizophrenia, and there is some evidence that its incidence among persons with schizophrenia exceeds its incidence in the general population.[26,27]

Employment information is self-reported retrospectively for the four-week period preceding the interview.† The employment instrument first asks consumers to report whether they have worked for pay in the past four weeks. Consumers who reported working at a job for pay were then asked whether the job was "in a sheltered workshop" and whether they had a "job coach or special supervisor". Sheltered workshop jobs are provided by agencies that offer vocational and rehabilitation services to persons with disabilities. Jobs with a job coach and/or special supervisor would include enclave jobs (where persons with disabilities work in a separate unit with their own supervisor within a community workplace) and supported employment jobs where the job-holder is integrated into the employer's regular workforce but also receives ongoing help on the job from a job coach.[28]

Since respondents may not clearly distinguish among the categories of supported or sheltered jobs, and preliminary analyses supported pooling of these categories, we group employed consumers in our analysis into one of two categories: non-supported jobs and supported/sheltered jobs. Employed consumers who did not report being in a sheltered workshop, or having a special supervisor or job coach, were classified as being in unsupported jobs.*

Baseline face-to-face or telephone interviews were conducted with 1,893 consumers. Eighteen consumers had no baseline clinical information, and 100 additional consumers were missing several items from one or more of the clinical symptom scales. Of those remaining, 132 consumers were missing information for one or more individual characteristics, leaving a sample of 1,643 consumers.†

The analyses of these consumers include controls for race, gender, educational attainment, age, and the number of years between age 18 and the age when symptoms began, which proxies for potential work experience and training prior to onset of the disease. Consumers range in age from 18 to 78 years old with an average age of 42. Approximately 63 percent are men, 40 percent are African-American, and 9 percent are Hispanic. Approximately 6 percent had completed 16 or more years of education, while 25 percent had completed between 13 and 15 years, 39 percent had completed 12 years, and 33 percent had completed less than 12 years. On average these consumers had 4.6 symptom-free years after turning age 18, but for many consumers (36.4 percent) symptoms began before turning age 18.

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* The North Carolina site includes the Duke University health system, nine county treatment facilities, and a VA provider. At the West Haven, Connecticut site participants are from a VA provider and a community mental health center. The Baltimore, Maryland site includes participants from the University of Maryland health system and from a mental health clinic at the Johns Hopkins University. The fourth site is located in San Diego and surrounding counties and includes patients from community mental health centers within the state mental health care system. The fifth site comprises four mental health centers in and around Denver Colorado. The sixth site is three county mental health centers in central and east Florida.

† Self-reported answers to retrospective employment questions may be subject to reporting error, though we are not aware of any assessments of error rates in self-reported employment data for persons with severe mental illness.

* The reader should note several potential ambiguities in our classification based on the available data. First, data were not collected on accommodations that may have been made by employers (e.g. flexible work schedules or modifying job content) for employees' disabilities. Similarly, data were not collected on "natural" workplace supports provided by fellow employees. Persons in jobs we have classified as "unsupported" may in fact have benefited from these accommodations or natural supports. Second, because our questions pertain to a single point in time, we cannot distinguish between persons in "transitional" employment programs, who are temporarily receiving supports such as job coaching, from persons who receive on-going support that is not time-limited. Both are classified as holding supported jobs in our analysis even though persons in transitional employment programs at study entry will presumably be classified as holding unsupported jobs at a later point in the study.

† The only statistically significant difference in demographic characteristics and employment status for the 118 consumers who were excluded due to missing symptom information compared to the 1643 consumers who were included in the analysis was that he excluded consumers were significantly less likely to be African-American. The two groups had no statistically significant differences for age, educational attainment, employment status, gender or age at onset of symptoms. Comparisons of the 132 consumers excluded due to missing information for individual characteristics with the 1643 consumers in the final sample showed four statistically significant differences in symptoms and employment status between the two groups. Mean PANSS Negative and PANSS Positive scores were significantly greater (i.e., more severe symptom levels) among the 132 excluded consumers and rates of employment in sheltered/supported jobs and in non-supported jobs were significantly lower. However, mean Simpson-Angus scores were slightly greater among the excluded group while mean MADRS scores were lower. Therefore, to the extent that PANSS Negative or PANSS Positive symptom severity is predictive of employment status, we may underestimate the marginal effects of PANSS symptom reductions.

Table 1. Percentage of consumers employed, by type of employment and location

Location	Number of Consumers	Percent Employed	Percent In Sheltered or Supported Jobs	Percent In Non-Supported Jobs
All	1643	21.8	10.2	11.6
Orlando, FL	292	16.8	6.9	9.9
West Haven, CT	324	22.9	10.2	12.7
North Carolina	286	24.4	11.5	12.9
Colorado	143	28.7	18.2	10.5
San Diego, CA	317	18.3	6.6	11.7
Baltimore, MD	281	23.5	12.5	11.0

Table 2. Distribution of symptom scores, by employment status

Symptom Scale/Quartile	Not Employed	Sheltered/Supported Employment	Not Supported Employment
Negative Symptoms:			
Minimum	6	7	7
25th Percentile	14	13	11
50th Percentile	18	18	15
75th Percentile	23	22	20
Maximum	41	32	34
Positive Symptoms:			
Minimum	7	7	7
25th Percentile	12	11	11
50th Percentile	16	16	15
75th Percentile	20	19	19
Maximum	37	34	33
Depressive Symptoms:			
Minimum	0	0	0
25th Percentile	6	5	4
50th Percentile	13	11	11
75th Percentile	22	19	19
Maximum	49	45	40
Extrapyramidal Side-Effects:			
Minimum	0	0	0
25th Percentile	1	1	0
50th Percentile	3	3	2
75th Percentile	6	6	4
Maximum	20	21	14

Results

Table 1 shows rates of employment among SCAP consumers. The overall rate of employment (21.8 percent) is similar to rates found previously in severely mentally ill populations*.[1,2] There is considerable variation across study sites in employment rates, and the differences for sheltered or supported jobs appear to be greater than differences for non-supported jobs. It is also noteworthy that there is no obvious association between the rate of sheltered or supported employment and the rate of non-supported employment within particular sites.

Table 2 shows the distribution of symptom scores by employment category. For each symptom category a higher score indicates a greater number and greater severity of symptoms. The distributions suggest that symptom levels in general are lowest for consumers who are employed in non-supported jobs. However, symptom quartiles are remarkably similar across employment categories, and some consumers with high levels of symptoms are employed in non-supported jobs while others with low levels of symptoms are not employed. For example, consumers in the not-employed group as well as consumers in the sheltered/supported group had a median negative symptoms score of 18, while consumers in the non-supported, employed group had a slightly lower median score of 15. Also, the maximum negative symptoms score among consumers in the non-supported, employed group actually exceeded the maximum score among

* Previous estimates are derived from data on self-reported employment status as of the date of interview, rather than during a four-week recall period, and are for a severely mentally ill population that includes persons with schizophrenia as well as persons with other mental disorders.

Table 3. Multinomial probit estimates of employment status

Outcome/Independent Variable	Coefficient		Standard Error
Non-Supported Employment			
Positive Symptoms	-.011		.011
Negative Symptoms	-.045	**	.012
Depressive Symptoms	-.012	*	.007
Extrapyramidal Side-Effects	-.032		.026
Hispanic	-.301		.397
African-American	-.022		.129
Male	.396	**	.120
Age/10	.123		.424
Age/10 squared	-.051		.054
Less than 12 years of education	-.028		.140
13-15 years of education	.211		.186
16+ years of education	.400	*	.225
Age at onset – 18	.025	*	.013
Indicator for age of onset <18	.182		.183
Location:			
Orlando, FL	-.519	**	.188
North Carolina	.093		.178
Colorado	-.046		.280
San Diego, CA	-.525	**	.213
Baltimore	-.268		.192
Constant	.194		.806
Sheltered or Supported Employment			
Positive Symptoms	-.010		.011
Negative Symptoms	-.041	**	.012
Depressive Symptoms	-.014	**	.007
Extrapyramidal Side-Effects	-.019		.025
Hispanic	-.116		.326
African-American	-.004		.128
Male	.386	**	.123
Age/10	.287		.435
Age/10 squared	-.073		.056
Less than 12 years of education	-.052		.138
13-15 years of education	.128		.206
16+ years of education	.360		.224
Age at onset – 18	.030	**	.013
Indicator for age of onset <18	.260		.186
Location:			
Orlando, FL	-.520	**	.186
North Carolina	.111		.183
Colorado	.060		.268
San Diego, CA	-.589	**	.218
Baltimore	-.231		.200
Constant	-.233		1.248

*Statistically significant at the 10% level
** Statistically significant at the 5% level

consumers in the sheltered/supported employment group. Thus, while symptoms may be related to employment outcomes, having a relatively high level of symptoms does not appear to preclude non-supported employment.

Multinomial probit estimates of employment are presented in **Table 3**. The first set of estimates is for the non-supported employment outcome. Negative symptoms have a statistically significant, negative impact on the likelihood of non-supported employment, and positive symptoms have a negative but statistically insignificant impact. Both depressive symptoms and extrapyramidal side effects have negative effects on the probability of non-supported employment, but only the effect of depressive symptoms is statistically significant. Other significant effects in the equation are positive effects of being African-American, having 16 or more years of education, and having a later age of onset, and two sites, Orlando and San Diego, have negative effects on non-supported employment.

The second set of estimates is for sheltered or supported employment. The estimates suggest that negative symptoms and symptoms of depression adversely affect the probability of sheltered/supported employment, while positive symptoms and side effects do not have significant effects. The age effect

Table 4. Simulated effects of symptom reduction on employment

Simulation	*Multinomial Probit Predictions*			
	(1) % E[a]	(2) Δ % E[b]	(3) % EC[c]	(4) Δ % EC[d]
Reduce All Symptoms				
20%	26.9	5.2	15.5	3.3
30%	30.0	8.3	17.5	5.3
40%	33.5	11.8	19.9	7.7
Reduce Only Negative and Extrapyramidal Side-Effects				
20%	25.3	3.6	14.7	2.5
30%	27.4	5.7	16.2	4.0
40%	29.6	7.9	17.9	5.7

[a] Predicted percent employed.
[b] Difference between predicted and actual percent employed.
[c] Percent employed in non-supported (i.e., neither sheltered nor supported) jobs.
[d] Difference between predicted and actual percent employed in non-supported jobs.

is positive but statistically insignificant, while the estimated coefficients for males and symptom-free years suggest that male consumers and consumers with more symptom-free years are significantly more likely to be employed in sheltered/supported jobs.

The restriction that $\sigma_{12} = 0$ implies the independence of irrelevant alternatives assumption. Our point estimate of σ_{12} is .98 and the hypothesis of no covariance between the errors, i.e., $\sigma_{12} = 0$, is rejected (p-value<.001). This result suggests that the multinomial probit estimates is more appropriate for these data than the multinomial logit model.*

Employment Simulations

Next, we use the multinomial probit model estimates to predict changes in rates of employment that might result from reductions in symptom levels. The simulations represent three scenarios for symptom reduction: a 20 percent reduction, a 30 percent reduction, and a 40 percent reduction in symptom levels. In the clinical research literature on schizophrenia a 20 percent improvement in symptom levels is used as a minimum standard of substantial improvement or remission.[24,29] The simulations for 30 percent and 40 percent improvements represent large effects and are presented for comparison.

For each scenario we conduct two simulations - a reduction in all four symptom measures and a reduction in negative symptoms and extrapyramidal side-effects only.† The effects of reductions in negative symptoms and extrapyramidal side effects are reported separately, since several new antipsychotic medications, such as olanzapine, risperidone, and quetiapine, are at least as effective as conventional antipsychotic medications in controlling negative symptoms and have been shown to be more effective in controlling and extrapyramidal side effects as compared to typical antipsychotic medications.[30-35] Values for all other variables in each model are held constant.

The simulation results are presented in **Table 4**. The first three rows of **Table 4** show the estimated impacts on employment of simultaneous reductions in all symptom levels. For example, columns 1 and 2 show that a 20 percent reduction in all symptom measures is predicted to result in a 5.2 percentage point increase in the employment, from 21.7 percent to 26.9 percent. This implies a 25 percent increase employment. Greater reductions in symptom levels are predicted to have proportionally greater impacts on employment. Columns 3 and 4 represent the effects of reductions in symptoms on non-supported employment. Reductions in all symptoms are predicted to increase employment in non-supported jobs by between 3.3 percentage points and 7.7 percentage points depending on the magnitude of the symptom reduction.

The next set of simulations in the table shows the estimated impacts of simultaneous reductions in negative symptoms and extrapyramidal side-effects only. Here the predicted effects of symptom reduction on employment range from 3.6 percentage points to 7.9 percentage points and the predicted effects on employment in non-supported jobs range from 2.5 percentage points to 5.7 percentage points.

Discussion

Of the four symptom categories, we find that negative symptoms of schizophrenia have the most substantial adverse effect on employment, whether employment opportunities are

* A multinomial model was also estimated. For most variables there is little quantitative difference between the two sets of coefficient estimates, though multinomial probit estimates of symptom effects tended to be slightly smaller in absolute value.

† Although three of the four symptom measures are not statistically significant in one or more employment equations, their coefficients point estimates are not zero (see **Table 3**) and are consistent, so we include the impact of all four symptom scores in our employment simulations.

for sheltered/supported jobs or are for non-supported jobs.* For example, the estimates in **Table 3** imply that a 20 percent reduction in negative symptoms from the median would increase the mean rate of unsupported employment by 2 percentage points to 11.6 percent, compared to a .26 percentage point increase for symptoms of depression, a .4 percent increase for positive symptoms, and a .27 percentage point increase for extrapyramidal side effects. The simulation results (**Table 4**) suggest that modest improvements in employment participation by persons with schizophrenia are possible through more effective treatment of symptoms. Based on inspection of the differences between overall employment effects and effects on non-supported employment only, symptoms appear to have a greater impact on non-supported employment than on sheltered or supported employment.

However, even with improvements in treatment and large (i.e., 40 percent) reductions in all categories of symptoms, these results indicate that the rate of non-supported employment among persons with schizophrenia would remain quite low and only one-third of consumers would work for pay.

Moreover, improved treatment regimens, adherence to best practice guidelines, and greater use of atypical antipsychotic medications are unlikely to cause such a very large improvement in symptoms. Reviews of the literature on conventional and atypical antipsychotic medications, for example, suggests that the improvement in symptoms from switching to an atypical antipsychotic is most pronounced for extrapyramidal side-effects, which have a relatively small impact on employment outcomes, and is marginal for negative symptoms[34,35]. Also, among consumers in our sample approximately half already had a current prescription for an atypical antipsychotic medication while most others had a current prescription for a conventional antipsychotic medication.† Less than 10 percent of consumers had no current prescription for any antipsychotic medication. Thus, these results suggest that universal appropriate and effective medication management would not, by itself, greatly improve employment outcomes for persons with schizophrenia.

On the other hand, improving the quality of medication management is an important part of a strategy to implement "outcome oriented" care.[36] For example, there is evidence that switching from treatment with conventional antipsychotic medication to treatment with atypical antipsychotics may improve medication continuation,[37] reduce hospitalization,[38] and increase verbal memory and executive function.[39] Gains in level of functioning due to improvements in medication or medication management might improve the effectiveness of supported employment and other vocational interventions that facilitate participation in competitive employment, if such interventions are available and are integrated with care delivery.

Several other factors may have contributed to conclusions or may affect their interpretation. First, symptoms may have been measured inaccurately, leading to a weakening of the statistical relationship between symptoms and employment outcomes. Second, the strong work disincentives of public income-support and health insurance programs[40] will tend to constrain the positive employment effects of symptom reductions. Third, because the availability of sheltered and supported work opportunities varies widely across sites, the employment impacts of various symptoms may also vary across sites. While our data do not have the power to accurately measure these interactions, it is possible that future research will report more substantial symptom-employment links in localities where the supply of vocational services and opportunities is plentiful.

The limitations of our dependent variable data are also worth noting. Since employment is self-reported, and since the terms "work for pay", "sheltered workshop", and "job coach" may be misinterpreted by some consumers, it is possible that employment status was misclassified in some cases. If the likelihood of misclassification is a function of the level of symptoms or other characteristics, then the results of this study are biased. For example, if consumers experiencing a higher level of negative symptoms are more likely to misclassify themselves as not working for pay, then the effect of negative symptoms on employment are overestimated.

Statistical power and collinearity concerns may also be relevant for interpreting the negative but insignificant coefficients for positive symptoms and Simpson-Angus variables. Scores on the four different symptom assessment measures are positively correlated with one another, with typical correlation coefficients in the 0 to 0.3 range. This level of correlation presumably contributed to relatively large standard errors for the symptom variables.*

There are several broader issues of estimation strategy that are worthy of comment and consideration. We have argued that a detailed structural approach that involves the use of multiple symptom and impairment measures may be preferable to a more aggregated or reduced-form approach. Perhaps the strongest arguments for this approach are in terms of clarity of interpretation of the results and the ability to relate these results to evidence from clinical trials or other treatment "outcomes" studies on the relationship between treatment patterns and specific symptom or impairment levels. A detailed structural framework can also accommodate results from utilization studies on the determinants of treatment patterns, there by allowing us to

* The impacts of negative symptoms may be underestimated due to the exclusion of consumers with missing demographic information, since these consumers have significantly greater negative symptom scores and lower employment rates than consumers included in the analyses.

† In addition to the issue of which antipsychotic medication is being prescribed, there is an issue of dosage levels. Evidence from the only large-scale evaluation of treatment patterns suggests that more than one-third of consumers being treated with schizophrenia receive dosages of antipsychotic medications that are outside the recommended range, and approximately half of patients experiencing extrapyramidal side-effects do not receive an antiparkinsonian agent.[17]

* Note, however, that results for the significant symptom coefficients were robust to the inclusion or exclusion of symptom measures that were not themselves significant. Moreover, the fact that estimated marginal effects of statistically insignificant symptom measures are relatively small suggests that collinearity among symptom measures does not substantially affect the policy implications of our findings.

ultimately measure the connection between policy interventions (e.g., improvements in financial access to care) and labor market outcomes. A further advantage of this approach, and more generally of the use of measures of mental health status measures that are not dependent on service use, is that bias caused by unobservables common to both service use models and employment models should be minimal[41].

Potential problems with this approach should also be noted. First, it may be difficult to find data that provide a fairly complete representation of all relevant symptom and impairment dimensions that we would like to include in our analysis. The present study illustrates this problem in that some important impairment dimensions (such as cognitive impairment), and some consequential side effects of treatment (such as obesity), are not captured in our data. Another potential problem is that we do not account in our framework for the labor market effects of stigma. It is possible that the presence of mental disorder per se may have a negative impact on labor market outcomes because of stigma and the resultant discrimination regardless of the level of symptoms and impairments experienced by the individual patient.

Third, the empirical model specification does not allow for the effects of interactions between the availability of opportunities to participate in vocational intervention programs, such as supported employment, and symptoms. Greater availability of such programs may help consumers, whose symptoms would otherwise have prevented them from finding an unsupported job, find jobs regardless of their symptoms. Therefore, the observed difference in symptom levels between those who are employed in unsupported jobs and those who are not may be less extreme when opportunities to participate in supported employment programs and other vocational interventions are available. While interaction effects of vocational interventions are likely to be important, measures of the local availability of various opportunities for vocational support are not available in our data.*

Finally, it could be argued that feedback effects of employment status on symptoms will create simultaneity bias in our estimates, leading us to overstate the negative impacts of symptoms on employment. Several recent studies[29,42] reported finding these feedback effects though only one[43] identified the direction of causality (from employment to symptoms) by applying a randomized design. It is also interesting to note that study's finding that significant feedback effects were only observed for the PANSS positive and emotional discomfort scores. In contrast, the PANSS negative score, which is the strongest employment predictor in our analysis, showed no evidence of a feedback effect. Thus, based on available evidence, it is doubtful that simultaneity bias strongly affected our results. It will, nevertheless, be important to examine possible feedback effects in subsequent work, which extends our model to a multi-period framework.

* Opportunities for participation in vocational intervention programs may vary by treatment site, but interpretation of the effects of interactions between treatment site indicators and symptoms would not be meaningful given the potential confounding effects of unmeasured site differences.

Conclusion

In this study, we have estimated relationships between detailed symptom measures and employment outcomes that can be cast in the framework of a detailed structural model of labor market impacts due to mental disorders. Our results indicate that the employment impact of treatment for schizophrenia depends on which manifestations of the disease are affected by treatment. Negative symptoms are particularly important for role functioning and employment. The marginal effect on employment of a reduction in negative symptoms is several times greater than the effect of a comparable reduction in positive symptoms. Symptoms of depression and extrapyramidal side effects also have relatively modest effects on employment outcomes. Moreover, the effect of an improvement in symptoms on employment is stronger for non-supported employment than for working in sheltered or supported employment. These results imply that work outcomes for persons with schizophrenia could be significantly improved through more extensive and appropriate use of treatments that are effective in controlling symptoms.

Although commonly measured symptoms of schizophrenia impact employment, greater control of symptoms through improvements in medication efficacy alone is unlikely to lead to large increases in employment for persons with schizophrenia in the near term. Expansions of supported employment opportunities and removal of work disincentives in public income-support programs are two additional measures that may help to increase employment participation.

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