Compensating Differentials for Shift Work

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A model analyzing the choice of shift is developed and estimated using data from two supplements to the Current Population Survey. The findings show a positive wage premium for shift work that varies with personal characteristics, and there is strong evidence showing the importance of self-selection, as workers with low potential daytime earnings are more likely to choose night work and supplement their earnings. The findings demonstrate that cross-section estimates of wage premiums for union membership and firm size are biased upward because they pick up some of the compensating differential for shift work.

Introduction

Economists have long believed that workers receive compensating wage differentials for onerous working conditions, although attempts to demonstrate this empirically have met with mixed success. Brown (1980) found little effect of job characteristics on wages. Duncan and Holmlund (1983), using longitudinal data, estimated significant wage differentials for some working conditions, and Duncan and Stafford (1980) found that some of the union-nonunion wage differential could be explained by differences in working conditions. Other studies cited in Rosen (1986) show a variety of findings. One reason that efforts to estimate significant wage differentials have been inconsistent is that the problem is strongly affected by issues of self-selection as well as data deficiencies. In this paper, I investigate the role of

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equalizing wage differences for a common, though surprisingly little-studied, characteristic of work: shift work, or nonstandard working hours. Shift work is particularly well suited for investigating compensatory wages because it is less subject to personal differences in evaluating working conditions, such as the burden of heavy lifting or job accident rates, which are nearly impossible to measure objectively for an individual worker.

Although Rosen states that it is well known that shift work receives compensating wages, there has not been much empirical work estimating the magnitude of these differentials. In fact, most studies that include variables for shift work find little or no wage differential. Published estimates by the Bureau of Labor Statistics (BLS) also provide little evidence of a sizable difference, with most estimates showing that night workers receive about a 5 percent wage increase. The BLS studies summarized by Foss (1981, 1984) indicate that reported shift differentials, as a percentage of the daytime wage, have declined over time, although they never exceeded 6 percent on average. O'Connor (1970), using data from the 1960s, found shift differentials for both the second and third shifts to be under 10 percent. However, these estimates are either comparisons of average earnings, with personal characteristics not controlled for, or shift premiums reported in contracts, which also have the problem of not controlling for productive traits.

The finding of a small shift premium is surprising since one would expect that, for the majority of workers, some incentive would be required to elicit their labor supply for night work. As discussed in Rosen (1986), the issue is greatly complicated by the distribution of tastes and opportunities in the population, and it may well be the case that there is an adequate supply of workers who are indifferent to, or even prefer, night work and therefore make wage premiums unnecessary. In this paper, however, I argue that for manufacturing workers there is a sizable wage premium associated with shift work, and previous studies underestimate the wage differential because of a failure to correct properly for the presence of self-selection.

It is probable that the explicit treatment of self-selection into shift work will have a significant impact on estimates of wage equations since the choice of shift is likely to be affected by many variables that are typically included in earnings regressions. Union membership, for example, has a strong positive effect on wages, but unionized workers are also much more likely to work night shifts than nonunion workers. So it is possible that some of the union wage differential

1 Shift differentials are usually tabulated in the Area Wage Surveys and can also be calculated from special supplements of the Current Population Survey.
found in wage studies is actually a compensation for shift work. Women are less likely to work nights, as are married workers. Each of these variables has significant effects on earnings, but if they are systematically related to the choice of working conditions, previous estimates are misleading since they confound the equalizing wage effects with personal differences. Similarly, as noted by Oi (1983), large firms utilize shift work more intensely, making it possible that the positive firm size differentials often found in empirical studies may be partly a compensation for the undesirable work schedules.

As further motivation for this study, it is not always appreciated that shift work is a common phenomenon. In May 1985, about 16 percent of full-time wage and salary workers did not work a regular daytime schedule, and within some sectors the proportion is much greater. This percentage is only slightly less than the proportion of the work force that is unionized. If for no other reason, the pervasiveness of shift work and its well-documented detrimental effects on health indicate that it deserves more attention than it has yet received.

Estimation

The theoretical framework of the analysis can be easily sketched out. To begin, assume that preferences can be represented by the utility function \( U(C, S) \), where \( C \) is consumption and \( S \) is a 0-1 indicator of working hours, with \( S = 1 \) if the individual works nonstandard hours. For a given \( C \), assume that \( S = 1 \) is not preferred to \( S = 0 \), so that \( U(C, 0) \geq U(C, 1) \). The compensating income differential needed to provide equal utility to a worker on \( S = 0 \) and \( S = 1 \) jobs is \( \Delta = C_1 - C_0 \), where \( U(C_0, 0) = U(C_1, 1) \).

These ideas can be made operational in the following manner. Let \( W_{Si} \) be the wage for worker \( i \) if he or she is employed on shift work and \( W_{Di} \) be the wage for a regular daytime schedule. An individual chooses shift work if

\[
\frac{W_{Si} - W_{Di}}{W_{Di}} > \rho_i, \tag{1}
\]

where \( \rho_i \) can be interpreted as the reservation wage for shift work.\(^4\)

\(^2\) Mellor (1986) presents a good summary of the frequency of shift work in the U.S. work force, along with differences across industries, occupations, and demographic groups.

\(^3\) See Finn (1981) for a summary of research findings on the impact of shift work on employee health and other problems. Stories describing other complications from working nights are available from the author on request.

\(^4\) This framework is identical to that used by many researchers investigating migration and similar phenomena. Lee (1978) and Robinson and Tomes (1984) provide examples in the context of unionization.
Specify

\[ \rho_i = \mathbf{Z}_i \theta + \mu_i, \]

(2)

where \( \mathbf{Z}_i \) is a vector of exogenous variables affecting the costs and benefits of shift work and \( \mu_i \) is an unobserved random error. Possible \( \mathbf{Z} \) variables would be personal characteristics such as marital status and frequency of shift work within the occupation or industry.

Following standard practice, express the shift differential as

\[ \frac{W_{Si} - W_{Di}}{W_{Di}} = \log W_{Si} - \log W_{Di} \]

(3)

and the structural wage equations as

\[ \log W_{Si} = X_{Si} \beta_S + \epsilon_{Si} \]

(4)

and

\[ \log W_{Di} = X_{Di} \beta_D + \epsilon_{Di}. \]

(5)

With this specification, we shall observe an individual on shift work if

\[ \epsilon_{Di} + \mu_i - \epsilon_{Si} < (\beta_S X_{Si} - \beta_D X_{Di}) - \mathbf{Z}_i \theta. \]

(6)

The complete model contains three equations: the choice equation (6) and the two structural wage equations (4) and (5). The choice equation (6) defines the condition that for individuals to choose shift work the wage premium must exceed the measured and unmeasured costs of shift work. Note also that in this general formulation the structural wage equations are allowed to differ in the two regimes. It is possible to constrain them to be the same, differing only by a constant shift differential. This would be an appropriate model if shift work differed from daytime work only in the hours worked and did not require a different package of skills, or if employers of night workers did not value some characteristics more highly. For example, the higher accident rates frequently found on night shifts might induce employers to pay a premium for characteristics that are correlated with lower accidents, such as education or experience. It is possible to test for equality of the coefficients in the two equations, and if the coefficients differ only by a constant, the appropriate specification is the treatment effects model.

In the case in which the errors in equations (4)–(6) are distributed as multivariate normal, statistical methods for estimating the model are well known and are described in detail in Lee (1978) and Maddala (1983). Define

\[ S_i = X_i \pi + \eta_i, \]

(7)

where \( X_i \) consists of all the variables in \( X_{Si}, X_{Di}, \) and \( \mathbf{Z}_i \), and \( S_i \) is a 0-1
indicator for shift work. Equation (7) is a reduced-form version of (6), and probit estimates of equation (7) can be used to construct the inverse Mills ratios, which are then used as instruments to obtain unbiased estimates of the wage equation parameters by estimating

$$\log W_{Si} = X_{Si} \beta_S + \sigma_{S\eta} \frac{\phi(X_i\bar{\pi})}{\Phi(X_i\bar{\pi})}$$

(8)

and

$$\log W_{Di} = X_{Di} \beta_D + \sigma_{D\eta} \frac{-\phi(X_i\bar{\pi})}{1 - \Phi(X_i\bar{\pi})}.$$  

(9)

The coefficients $\sigma_{S\eta}$ and $\sigma_{D\eta}$ are the covariances between the reduced-form shift work status equation (7) and the wage equation errors, and $\phi(X_i\bar{\pi})$ and $\Phi(X_i\bar{\pi})$ are the standard normal density and distribution functions. Estimation of (8) and (9) gives unbiased estimates of $\beta_S$ and $\beta_D$, which can then be used to calculate the predicted shift differential for each worker and used to estimate the structural choice equation (6). Estimates of $\sigma_{S\eta}$ and $\sigma_{D\eta}$ indicate the nature of self-selection into each sector. Positive selection into each sector implies a positive $\sigma_{S\eta}$ and negative $\sigma_{D\eta}$.

Although the assumption of a multivariate normal distribution is convenient, this may be unduly restrictive in that there is no evidence to indicate that preferences and unobservable wage factors are generated from a normal distribution. Another problem may be the smaller sample sizes after the observations are divided into shift and day workers. These problems are examined by estimating single-equation specifications that constrain both sectors to have identical coefficients, using both the selection model based on the normal distribution and a standard instrumental variable approach to control for the endogeneity of shift work.

**Findings**

Two special supplements to the Current Population Survey (CPS) are used to estimate the effects of shift work on wages. Both the May 1985 CPS Supplement on Work Schedules and the May 1979 Supplement provide data on shift work, but they are analyzed separately since the questions regarding hours of work differ and data on plant size are not included in the 1985 survey. The supplements contain information on the time of day worked, in addition to the standard CPS questions pertaining to earnings and demographic characteristics. The analysis is restricted to male manufacturing workers in order to focus on the choice of working conditions without the added complications of examining the assignment of workers to economic sector
and controlling for gender differences in wages. The sample was restricted to those workers who usually worked at least 30 hours a week and whose earnings were not imputed by the Census Bureau.\(^5\)

Table 1 lists the sample statistics for the two surveys, with shift workers and others shown separately. The 1985 survey asked respondents to state which shift they usually worked, and individuals are assigned to a shift category on the basis of their response. The possible responses are daytime, evening, night, rotating, split, and other. For this analysis, all workers who reported anything other than a regular daytime schedule are considered shift workers.\(^6\) About 22 percent of the May 1985 workers are on shifts in this sample, which is slightly above the national average for male manufacturing workers. Average earnings for the two groups differ only slightly, but the two samples vary significantly in their characteristics. Forty-eight percent of the shift workers are unionized, whereas only 23 percent of the regular daytime workers are union members; shift workers tend to be younger and less educated. The percentage of union members is higher in the 1979 sample, although shift workers are still much more likely to belong to a union. In both samples the average log wage for day workers exceeds that for shift workers by 0.04. But day workers also have more education and experience, so a comparison of mean wages for the two groups is not very meaningful. Of particular interest in the 1979 survey is the fact that shift workers are more likely to be employed in larger plants.\(^7\)

**May 1985 CPS Results**

Table 2 presents estimates for the shift and day work wage equations for the May 1985 sample. Columns 2 and 4 contain ordinary least squares (OLS) estimates, with the selectivity-corrected parameters in

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\(^5\) The May 1979 sample is larger since the data tape provided by the BLS contains earnings data collected in the June 1979 survey in addition to the usual quarter sample in May. Dropping the records with June earnings does not affect the qualitative results very much, but does reduce the sample size by about half, with a corresponding decrease in precision. For that reason, the reported results are based on the larger sample, although estimates based solely on the May data are available on request.

\(^6\) Of those workers on a shift, 47 percent work the evening shift, 19 percent the night shift, 28 percent a rotating shift, 1 percent split shifts, and 4 percent other.

\(^7\) In the estimates that follow in the next subsection, one of the variables used to estimate the choice of shift is the percentage of shift workers in an industry. This serves two purposes. First, it provides a method for incorporating industry differences in the frequency of shift work and presumably also indicates something about individual preferences. (For example, workers with a strong distaste for night work would be less likely to choose to work in a steel mill.) Second, it helps to identify the parameter estimates in the switching regression model. The variable is constructed using the entire CPS sample, not just those observations with valid wage data, so that any individual observation has only a minuscule impact on the industry shift rate.
TABLE 1
SAMPLE STATISTICS

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DEFINITION</th>
<th>MAY 1985</th>
<th>MAY 1979</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Day</td>
<td>Shift</td>
</tr>
<tr>
<td>Log wage</td>
<td>Logarithm of hourly wage</td>
<td>2.28</td>
<td>2.24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(.47)</td>
<td>(.38)</td>
</tr>
<tr>
<td>Yrsed</td>
<td>Years of completed schooling</td>
<td>12.6</td>
<td>11.89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.9)</td>
<td>(2.1)</td>
</tr>
<tr>
<td>Exp</td>
<td>Age − yrsed − 6</td>
<td>17.85</td>
<td>16.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(12.3)</td>
<td>(11.5)</td>
</tr>
<tr>
<td>Tenure</td>
<td>Years with the firm</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shift rate</td>
<td>Percentage of workers on</td>
<td>17.4</td>
<td>23.0</td>
</tr>
<tr>
<td></td>
<td>shifts in three-digit SIC</td>
<td>(9.5)</td>
<td>(10.9)</td>
</tr>
<tr>
<td>Union</td>
<td>= 1 if union member</td>
<td>.23</td>
<td>.48</td>
</tr>
<tr>
<td>SMSA</td>
<td>= 1 if resident of SMSA</td>
<td>.60</td>
<td>.55</td>
</tr>
<tr>
<td>City</td>
<td>= 1 if resident of central city</td>
<td>.19</td>
<td>.16</td>
</tr>
<tr>
<td>Married</td>
<td>= 1 if married</td>
<td>.72</td>
<td>.75</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>= 1 if nonwhite</td>
<td>.11</td>
<td>.10</td>
</tr>
<tr>
<td>Veteran</td>
<td>= 1 if a veteran</td>
<td>.35</td>
<td>.37</td>
</tr>
<tr>
<td>Flextime</td>
<td>= 1 if flexible work hours</td>
<td>.13</td>
<td>.06</td>
</tr>
<tr>
<td>Two jobs</td>
<td>= 1 if working two jobs</td>
<td>.05</td>
<td>.08</td>
</tr>
<tr>
<td>Size 100</td>
<td>100–499 employees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size 500</td>
<td>500–999 employees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size 1,000</td>
<td>1,000+ employees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td></td>
<td>952</td>
<td>264</td>
</tr>
</tbody>
</table>

Note.—Standard deviations are in parentheses.

columns 3 and 5. For comparison, OLS estimates on the full sample without any control for shift are shown in column 1. There is evidence of positive selection into day work since the significant negative coefficient on the inverse Mills ratio implies that those less likely to work nights are those workers with high unmeasured components of daytime wages. However, there is no evidence of selection of any sort into shift work. One possible reason for the lack of selectivity into shift work may be that the error in the reduced-form probit equation (7) is a composite of the wage equation error terms and the structural choice residual. Large covariances between these structural errors could result in an insignificant coefficient on the selectivity term even if the true correlation between $\mu_i$ and $\epsilon_{Si}$ is large. The findings in table 2 are consistent with a more straightforward interpretation that workers with unexpectedly low potential daytime earnings choose night work to supplement their incomes, even though they have no

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8 This possibility is discussed by Duncan and Leigh (1985) in an analysis of selection in union membership.
comparative advantage in shift work. Those choosing day work, on the other hand, have a sizable advantage during the daytime hours.

There are some notable differences in the determinants of earnings in the two sectors. The most important effect is the reduced wage differential on union status for day workers. Moreover, controlling for the endogeneity of shift work reduces the union premium for day workers by about one-third. The coefficient on union membership in the OLS estimate for the full-sample wage equation is 0.203, whereas the weighted average of the union coefficients in columns 3 and 5 in table 2 is 0.146, showing a large upward bias in the cross-section

### Table 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>All Workers (1)</th>
<th>Shift Workers (2)</th>
<th>Day Workers (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3.50)</td>
<td>(3.71)</td>
<td>(3.85)</td>
<td>(2.53)</td>
</tr>
<tr>
<td>Yrsed$^2$</td>
<td>.0003</td>
<td>-.0068</td>
<td>-.0070</td>
</tr>
<tr>
<td>(.48)</td>
<td>(2.87)</td>
<td>(2.99)</td>
<td>(1.38)</td>
</tr>
<tr>
<td>Exp</td>
<td>.0482</td>
<td>.0509</td>
<td>.0517</td>
</tr>
<tr>
<td>(7.51)</td>
<td>(3.48)</td>
<td>(3.62)</td>
<td>(6.64)</td>
</tr>
<tr>
<td>Exp$^2$</td>
<td>-.0016</td>
<td>-.0022</td>
<td>-.0022</td>
</tr>
<tr>
<td>(5.20)</td>
<td>(2.84)</td>
<td>(2.95)</td>
<td>(4.18)</td>
</tr>
<tr>
<td>Exp$^3$/100</td>
<td>.0018</td>
<td>.0028</td>
<td>.0028</td>
</tr>
<tr>
<td>(4.14)</td>
<td>(2.42)</td>
<td>(2.53)</td>
<td>(3.15)</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>-.1058</td>
<td>-.0868</td>
<td>-.0899</td>
</tr>
<tr>
<td>(3.52)</td>
<td>(1.31)</td>
<td>(1.40)</td>
<td>(3.08)</td>
</tr>
<tr>
<td>Married</td>
<td>.0723</td>
<td>.1373</td>
<td>.1399</td>
</tr>
<tr>
<td>(3.25)</td>
<td>(2.82)</td>
<td>(2.96)</td>
<td>(2.18)</td>
</tr>
<tr>
<td>Veteran</td>
<td>.0193</td>
<td>-.0420</td>
<td>-.0404</td>
</tr>
<tr>
<td>(0.89)</td>
<td>(.93)</td>
<td>(.92)</td>
<td>(1.36)</td>
</tr>
<tr>
<td>Union</td>
<td>.2030</td>
<td>.2225</td>
<td>.2326</td>
</tr>
<tr>
<td>(9.10)</td>
<td>(5.16)</td>
<td>(4.37)</td>
<td>(6.91)</td>
</tr>
<tr>
<td>East</td>
<td>-.0220</td>
<td>-.0897</td>
<td>-.0917</td>
</tr>
<tr>
<td>(.87)</td>
<td>(1.69)</td>
<td>(1.79)</td>
<td>(.34)</td>
</tr>
<tr>
<td>South</td>
<td>-.0511</td>
<td>-.0311</td>
<td>-.0302</td>
</tr>
<tr>
<td>(2.05)</td>
<td>(.61)</td>
<td>(.62)</td>
<td>(2.22)</td>
</tr>
<tr>
<td>West</td>
<td>.1045</td>
<td>.1402</td>
<td>.1388</td>
</tr>
<tr>
<td>(3.79)</td>
<td>(2.37)</td>
<td>(2.44)</td>
<td>(3.12)</td>
</tr>
<tr>
<td>SMSA</td>
<td>.1165</td>
<td>.1071</td>
<td>.1075</td>
</tr>
<tr>
<td>(5.60)</td>
<td>(2.54)</td>
<td>(2.66)</td>
<td>(4.79)</td>
</tr>
<tr>
<td>City</td>
<td>-.0781</td>
<td>-.0650</td>
<td>-.0669</td>
</tr>
<tr>
<td>(3.01)</td>
<td>(1.14)</td>
<td>(1.22)</td>
<td>(2.82)</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>.0274</td>
<td>.0274</td>
<td>.0274</td>
</tr>
<tr>
<td></td>
<td>(.30)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>1.2375</td>
<td>.7928</td>
<td>.7237</td>
</tr>
<tr>
<td>(11.08)</td>
<td>(2.52)</td>
<td>(1.91)</td>
<td>(10.97)</td>
</tr>
<tr>
<td>Observations</td>
<td>1,216</td>
<td>264</td>
<td>264</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.5253</td>
<td>.4228</td>
<td>.4230</td>
</tr>
</tbody>
</table>

**Note.**—Six occupational dummies were also included. Absolute values of t-statistics are in parentheses.
TABLE 3  
MAY 1985 CPS: ESTIMATED SHIFT DIFFERENTIALS

<table>
<thead>
<tr>
<th></th>
<th>Union</th>
<th>Nonunion</th>
<th>All Workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>18.14</td>
<td>4.29</td>
<td>8.21</td>
</tr>
<tr>
<td>White</td>
<td>18.03</td>
<td>3.69</td>
<td>7.69</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>18.97</td>
<td>9.33</td>
<td>12.33</td>
</tr>
<tr>
<td>High school graduate</td>
<td>19.70</td>
<td>3.72</td>
<td>8.08</td>
</tr>
<tr>
<td>Non–high school graduate</td>
<td>12.14</td>
<td>7.18</td>
<td>8.83</td>
</tr>
</tbody>
</table>

Note.—The shift differential is estimated as $100 \times [(\hat{e}^{X_{b}^{U}} - \hat{e}^{X_{b}^{D}})/\hat{e}^{X_{b}^{D}}]$. The differentials in the table are the predicted shift premiums averaged over all workers with those characteristics. High school graduates are all those with at least 12 years of completed schooling.

To estimate when choice of shift is ignored. It is interesting to note, however, that the returns to union membership are larger for shift workers and are unaffected by correcting for selection bias. The coefficients on race are similar in the two regimes, although insignificant in the shift work equation. Evaluated at 12 years of schooling, the marginal effect of education is twice as large for day workers, but the cumulative impact is greater for shift workers. The returns to potential job experience are also higher for daytime workers. These findings do not provide much support for the hypothesis that firms prefer more experienced, better-educated workers on night shifts in order to minimize accident rates and other problems common to shift work. However, the distribution of day and night jobs is likely to differ, so it is possible that within a more homogeneous group such as a firm or industry the hypothesis might still hold.

Table 3 presents the estimated wage differentials for selected characteristics as calculated from the estimates contained in Table 2. The differential is calculated as $100 \times [(\hat{e}^{X_{b}^{U}} - \hat{e}^{X_{b}^{D}})/\hat{e}^{X_{b}^{D}}]$. The average shift premium for the full sample is 8.2 percent, with substantial variation among personal characteristics. In comparison, OLS estimates of the shift differential, with no adjustment for selection bias, indicate a wage differential of 5.3 percent. The primary sources of difference in the shift premium are associated with union status. The differential for union workers is about 14 percentage points higher than that for nonunion workers, with an average premium of 18.1 percent for all union workers versus 4.3 percent for nonunion employees. Within the union sample, the differential is about the same for most of the categories calculated, with the exception of non–high school graduates, who receive smaller shift differentials. For nonunion workers,

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9 This estimate is based on the coefficient on a shift work dummy in OLS estimates using the entire sample. The estimates for the single-equation model are provided in the Appendix. The single-equation estimates are shown in the Appendix.
the shift differential is greater for nonwhites and those with less than a high school diploma.

Many of these results are intriguing. Among nonunion workers, for instance, the estimates consistently show larger shift premiums for workers who are paid less in the labor market, such as nonwhites and those with less education. At least in the case of education, the larger shift premium occurs through the narrowing of the usual wage differential across years of schooling and is an effect similar to the pay compression found among union workers. One of the side effects of shift work and its associated compensating differential appears to be a reduction in the variance of wages due to the smaller pay changes for personal characteristics. It would be interesting to examine whether this is attributable to the different organization of shift jobs or unmeasured industry effects, but such an analysis is not possible with the data available in this sample.

The larger shift premium for union workers is of particular interest because it is so much larger than the one for nonunion workers and is by far the most significant factor. Since union status, unlike race or sex, is a choice variable, this may be an indication that the model presented here may not be detailed enough to capture the true nature of the underlying decision process. The presence of such a large premium associated with an endogenous choice variable raises the possibility that the choice of shift work and union status should be considered jointly. This possibility will be investigated later.

Since the sample sizes, especially in the shift work equation, are not very large, a treatment effects model was estimated in which the coefficients of the day and shift wage equations are constrained to be the same. This approach also constrains the shift premium to be identical for all workers. In addition to estimates based on the normal distribution, an instrumental variable approach was estimated to account for the endogeneity of shift work. The results, shown in Appendix tables A1 and A2, indicate that constraining the wage equations to be the same raises the shift premium by a significant amount, with considerably larger shift differentials of 37 percent in the normal model and 22 percent in the instrumental variable specification. The treatment effects estimates are expected to be higher since they constrain the compensating differential to be the same for all workers. With estimates calculated from table 2, the average premium is 16 percent for those workers who are actually working shifts, which is still less than the single-equation estimates. The other principal findings from the switching regression results of table 2 still hold for the single-equation estimates, with a significant correlation between the errors in the wage and choice equations. Workers with positive unmeasured components of daytime earnings are less likely to work
Table 4
May 1985 CPS: Probit Estimates

<table>
<thead>
<tr>
<th>Variable</th>
<th>Reduced-Form Probit</th>
<th>Structural Probit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yrsed</td>
<td>0.1366 (1.49)</td>
<td>-0.0068 (0.28)</td>
</tr>
<tr>
<td>Yrsed$^2$</td>
<td>-0.0073 (1.81)</td>
<td></td>
</tr>
<tr>
<td>Exp</td>
<td>0.0130 (0.44)</td>
<td>-0.0110 (1.86)</td>
</tr>
<tr>
<td>Exp$^2$</td>
<td>-0.0016 (1.09)</td>
<td></td>
</tr>
<tr>
<td>Exp$^3$</td>
<td>0.0023 (1.06)</td>
<td></td>
</tr>
<tr>
<td>Nonwhite</td>
<td>-0.1134 (0.76)</td>
<td>-0.1389 (0.97)</td>
</tr>
<tr>
<td>Married</td>
<td>0.1051 (0.98)</td>
<td>0.0431 (0.38)</td>
</tr>
<tr>
<td>Veteran</td>
<td>0.1644 (1.60)</td>
<td>0.2205 (2.16)</td>
</tr>
<tr>
<td>Union</td>
<td>0.4684 (4.58)</td>
<td>0.3781 (3.48)</td>
</tr>
<tr>
<td>East</td>
<td>-0.0694 (0.57)</td>
<td></td>
</tr>
<tr>
<td>South</td>
<td>0.0255 (0.22)</td>
<td></td>
</tr>
<tr>
<td>West</td>
<td>-0.0397 (0.30)</td>
<td></td>
</tr>
<tr>
<td>SMSA</td>
<td>0.0754 (0.76)</td>
<td></td>
</tr>
<tr>
<td>City</td>
<td>-0.1612 (1.27)</td>
<td></td>
</tr>
<tr>
<td>Shift rate</td>
<td>0.0258 (6.00)</td>
<td>0.0256 (5.99)</td>
</tr>
<tr>
<td>Flextime</td>
<td>-0.2112 (1.27)</td>
<td>-0.2102 (1.28)</td>
</tr>
<tr>
<td>Two jobs</td>
<td>0.3105 (1.67)</td>
<td>0.3083 (1.67)</td>
</tr>
<tr>
<td>Wage differential</td>
<td>0.8725 (2.10)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-2.3602 (3.92)</td>
<td>-1.8080 (4.33)</td>
</tr>
<tr>
<td>Observations</td>
<td>1,216</td>
<td>1,216</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-542.62</td>
<td>-543.86</td>
</tr>
</tbody>
</table>

Note.—Six occupational dummies were also included in the estimation but are not reported in the table. Absolute values of t-statistics are in parentheses.

Table 4 presents the estimates for the reduced-form probit equation (7) and the structural probit equation (6). Variables that enter only the wage equations are not included in the structural probit. Higher-order terms for experience and education were assumed not to affect the choice of shift other than through their effect on wages, and the location variables were dropped for the same reason. Experiments with different specifications showed the results to be robust to changes in the selection of variables. As expected, those variables that

shifts. There is also a large decrease in the estimated union-nonunion wage differential. The union wage premium is overstated by 39 percent in the OLS estimates as compared to the selectivity-adjusted estimate. Therefore, while the single-equation estimates generate larger shift premiums, the basic conclusions of table 2 are confirmed: self-selection is important in the choice of shift, and accounting for the endogeneity of shift work reduces the union wage differential by a large amount. While the single-equation results are consistent with the two-sector model, their validity is rejected by a likelihood ratio test.\(^{10}\)

\(^{10}\) The likelihood ratio test statistic for equality of coefficients in the two sectors is 55.8, which is distributed as $\chi^2_{24}$ and is therefore significant.
affect only the choice process are the same in both probits, as would be expected if the model is specified properly. The shift differential has a positive coefficient as expected, but after the expected wage gain is controlled for, most personal characteristics have little impact. Although the impact of union membership in the structural equation is smaller than in the reduced form, the union effect is still large and it is unclear why this is the case. The larger shift premium associated with union status may induce some bias if the unobserved factors affecting union status also affect the choice of shift work. In that case, it is likely that including an indicator for a union in the structural probit makes it difficult to disentangle the effects of the wage differential and the pure effect of unions. In fact, union status should be in the structural probit only if there is some reason to believe that it has some added effect on the costs of or preferences for shift work. This would be the case if, for example, night workers are more likely to be unionized in order to facilitate communication with management or other workers. But this by itself would not lead to a higher shift differential for unionized workers.

Table 5 shows the impact of alternative treatments of union status in the structural probit. Column 1 estimates a single-equation probit comparable to that shown in table 4 but with union status omitted, while column 2 shows the coefficients in the shift work probit when it is estimated jointly with a probit on union status. The single-equation probit without union status has a much larger coefficient on the estimated shift differential. The impact of the shift differential on choice of shift is reduced when it is estimated jointly with union status, but it is still larger than the coefficient estimated in table 4. The correlation in the bivariate probit is .22 and is significant, demonstrating that the choices of shift and union membership are related.

It is not clear how to interpret these results. There is strong evidence that the predicted shift differential affects the choice of shift work, but because of the joint selection of shift and union status, it is difficult to distinguish between wage premium and union effects in the structural choice equation. These results do demonstrate clearly that the interaction between wages and working conditions, of which shift work and unionization are but two components, is much more complex than is commonly acknowledged. The findings are consis-

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11 An alternative way to account for the endogeneity of both union status and shift work is to use the approach developed by Lee (1983). This involves estimating a multinomial logit choice equation with four options defined by union status and shift. The appropriate selectivity corrections can then be used to estimate four wage equations and to impute wage differentials for each alternative. Estimates derived using this approach are implausible, presumably because of the small sample sizes when the observations are subdivided into four categories. For example, union members work-
### TABLE 5
**May 1985 CPS: Alternative Probit Estimates**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Single Probit</th>
<th>Bivariate Probit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.1551</td>
<td>-1.9540</td>
</tr>
<tr>
<td></td>
<td>(5.16)</td>
<td>(4.56)</td>
</tr>
<tr>
<td>Yrsed</td>
<td>.0111</td>
<td>.0005</td>
</tr>
<tr>
<td></td>
<td>(.45)</td>
<td>(.02)</td>
</tr>
<tr>
<td>Exp</td>
<td>-.0024</td>
<td>-.0071</td>
</tr>
<tr>
<td></td>
<td>(.44)</td>
<td>(1.23)</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>-.1518</td>
<td>-.1300</td>
</tr>
<tr>
<td></td>
<td>(1.07)</td>
<td>(.90)</td>
</tr>
<tr>
<td>Married</td>
<td>-.0206</td>
<td>.0458</td>
</tr>
<tr>
<td></td>
<td>(.19)</td>
<td>(.39)</td>
</tr>
<tr>
<td>Veteran</td>
<td>.2458</td>
<td>.2233</td>
</tr>
<tr>
<td></td>
<td>(2.42)</td>
<td>(2.15)</td>
</tr>
<tr>
<td>Shift rate</td>
<td>.0274</td>
<td>.0252</td>
</tr>
<tr>
<td></td>
<td>(6.52)</td>
<td>(5.81)</td>
</tr>
<tr>
<td>Flextime</td>
<td>-2.618</td>
<td>-.2948</td>
</tr>
<tr>
<td></td>
<td>(1.61)</td>
<td>(1.16)</td>
</tr>
<tr>
<td>Two jobs</td>
<td>.2913</td>
<td>.3051</td>
</tr>
<tr>
<td></td>
<td>(1.59)</td>
<td>(1.57)</td>
</tr>
<tr>
<td>Wage differential</td>
<td>1.527</td>
<td>.9542</td>
</tr>
<tr>
<td></td>
<td>(3.90)</td>
<td>(2.13)</td>
</tr>
<tr>
<td>(\rho)</td>
<td></td>
<td>.2225</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-549.88</td>
<td>-1,135.1</td>
</tr>
</tbody>
</table>

**Note.**—Six occupational dummies were also included in the estimation but are not reported in the table. Absolute values of \(t\)-statistics are in parentheses. \(\rho\) is the estimated correlation between the errors in a bivariate probit on shift work and union status.

Consistent with those of Duncan and Stafford (1980), who found that some of the union wage differential could be explained by differences in working conditions.

Although the findings of a large wage premium for shift work and the importance of self-selection may seem obvious to some, the magnitude of the estimates indicates an important role for shift work in the labor market. The combination of a sizable wage premium for shift work and its frequency in the manufacturing sector means that shift work has a measurable impact on the distribution of wages. Since there is strong evidence of positive selection into day work, the existence of a second sector paying a premium wage to less productive workers not only raises their wages but also reduces the overall varying shifts make 69 percent more than nonunion day workers, nonunion shift workers make 40 percent less than nonunion day workers, and unionized day workers make 38 percent more than their nonunion counterparts. Although unreliable, these estimates lend some support to the hypothesis that the shift premium is not just part of the union premium but that shift work and union status interact in such a way as to increase earnings by a substantial amount.
ance of wages. For those individuals choosing shift work, the increase in earning power is substantial. The difference between the expected day and night wages for those choosing shift work in May 1985 is

$$\log W_S - \log W_D = (X\beta_S - X\beta_D) + (\sigma_{S\eta} - \sigma_{D\eta}) \frac{\phi(X\pi)}{\Phi(X\pi)}$$

(10)

The first term on the right-hand side averages 0.141 for all shift workers, and the second term averages 0.307, for an expected net gain of 0.448. The first term was discussed previously and refers to the difference in the relative prices placed on characteristics in the two sectors. The second term incorporates the effect of unobserved individual differences in earnings. With positive selection into day work, those with unusually low daytime earnings reap large gains by finding employment on shifts in which they no longer have a comparative disadvantage. In contrast, day workers would actually lose income if they moved to night work: the average decrease in wages would be about 5 percent. This occurs because the loss in the unobserved component of daytime earnings more than offsets the increase attributable to the predicted shift differential.

Another way to determine the impact of shift premiums and self-selection on the distribution of wages is to compare observed wages to what they would be if workers were randomly assigned to shift and day jobs. The variance of the logarithm of predicted wages for the actual assignment of workers is 0.112, versus 0.130 if workers were randomly assigned to shifts, thereby making wages more evenly distributed. Average wages are also higher by about 9 percent. These results come directly from the operation of the choice mechanism and the presence of comparative advantage in day work. The combination of shift premiums and worker choice provides an important mechanism for raising the pay of low-wage workers and reducing the inequality of wages.

**May 1979 CPS**

The May 1979 CPS Supplement also contains information on shift work, but it differs from the 1985 survey in that it asks respondents to report what time they started and ended work during the survey week. From those responses it is possible to determine which workers were on a shift, but the answers are not necessarily the same as those given when the respondent is asked to select which shift is usually worked. For our purposes, the latter question, which was asked on the 1985 survey, is likely to be more accurate since it reflects the worker's own perspective and matches up more directly with the data on usual
weekly earnings and usual hours worked. Another problem with the May 1979 survey is that the data on union membership are suspect, with a much higher percentage than usual reporting that they belong to a union. As shown in the analysis of the 1985 survey, union status has a critical impact on the shift differential. Despite these problems, it is still useful to analyze the 1979 survey because of its data on firm size and tenure and as a check on the conclusions based on the 1985 survey. In particular, explicit treatment of the choice of shift work is likely to affect the firm size coefficients in the wage equations because of the greater frequency of night shifts in larger firms, which was shown in table 1.

The model estimated is the same as before, with the addition of variables indicating plant size and employee tenure, and the omission of data on flexible working hours and dual jobs. The wage equations, with and without selectivity corrections, are shown in table 6. Personal characteristics generally have the same relative impact, although the magnitudes may vary from the 1985 survey. The principal differences are the absence of any schooling effect in the shift work equation and the smaller union wage differential for all workers. Even so, the estimated union effect is reduced substantially in the day work equation when selection bias is taken into account, just as in the 1985 sample. The correction for selectivity also reduces the differentials associated with firm size by a large amount in the day work equation. In the full-sample OLS estimates shown in table 6 (col. 1), the coefficients on the two largest firm size categories are 0.063 and 0.138, whereas the weighted averages of the coefficients in the selectivity-adjusted equations are −0.001 and 0.063, showing a large upward bias in the estimates unadjusted for selection. In fact, once shift work and self-selection are taken into account, the coefficients on plant size are insignificant for daytime workers (who constitute 79 percent of the sample). The findings on self-selection are consistent with those found in the 1985 sample, with positive selection into day work and no selection for shift work.

The estimated shift differentials shown in table 7 are lower than those calculated from the 1985 sample, with the reason most likely being the imprecise data on union membership and the less appropri-

---

12 Both forms of the question were asked in the 1985 survey, and Mellor (1986) presents some tabulations that show that the responses do vary, although for regular daytime workers the agreement is 97 percent.

13 A likely reason for the higher percentage reporting union membership is that the question about union status was more inclusive in May 1979. The actual survey question was, "Does . . . belong to a Labor Union or Emp. Assoc. similar to a union?" The May 1985 survey just asked if the respondent was a member of a union.

14 Oi (1983) presents a theoretical analysis of why large firms utilize shifts more frequently and supplements his discussion with some data.
<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>ALL WORKERS</th>
<th>SHIFT WORKERS</th>
<th>DAY WORKERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Yrsed</td>
<td>.0193</td>
<td>.0147</td>
<td>.0218</td>
</tr>
<tr>
<td></td>
<td>(1.93)</td>
<td>(.54)</td>
<td>(.78)</td>
</tr>
<tr>
<td>Yrsed²</td>
<td>.0012</td>
<td>.0009</td>
<td>.0005</td>
</tr>
<tr>
<td></td>
<td>(2.81)</td>
<td>(.73)</td>
<td>(.38)</td>
</tr>
<tr>
<td>Exp</td>
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<td>.0261</td>
<td>.0248</td>
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<tr>
<td></td>
<td>(5.06)</td>
<td>(3.36)</td>
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</tr>
<tr>
<td>Exp²</td>
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<td>-.0009</td>
<td>-.0009</td>
</tr>
<tr>
<td></td>
<td>(3.08)</td>
<td>(2.39)</td>
<td>(2.26)</td>
</tr>
<tr>
<td>Exp³/100</td>
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<td>.0010</td>
<td>.0009</td>
</tr>
<tr>
<td></td>
<td>(1.97)</td>
<td>(1.73)</td>
<td>(1.59)</td>
</tr>
<tr>
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<td>-.0657</td>
<td>-.0646</td>
</tr>
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<td>(4.51)</td>
<td>(1.66)</td>
<td>(1.68)</td>
</tr>
<tr>
<td>Married</td>
<td>.0732</td>
<td>.0410</td>
<td>.0385</td>
</tr>
<tr>
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<td>(4.68)</td>
<td>(1.42)</td>
<td>(1.36)</td>
</tr>
<tr>
<td>Veteran</td>
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<td>.0680</td>
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<td>(1.26)</td>
<td>(2.67)</td>
<td>(2.79)</td>
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<td>Union</td>
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<td>.0524</td>
<td>.0638</td>
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<td>(6.70)</td>
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<td>(2.37)</td>
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</tr>
<tr>
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<td>(4.66)</td>
<td>(2.67)</td>
<td>(2.85)</td>
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</tr>
<tr>
<td></td>
<td>(5.89)</td>
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<td>(3.89)</td>
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<td>West</td>
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<td>.0515</td>
<td>.0454</td>
</tr>
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<td></td>
<td>(2.58)</td>
<td>(1.44)</td>
<td>(1.27)</td>
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<td>SMSA</td>
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<td>.0651</td>
<td>.0671</td>
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<td>(6.50)</td>
<td>(2.59)</td>
<td>(2.72)</td>
</tr>
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<td>-.0325</td>
<td>-.0313</td>
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<td>(1.06)</td>
<td>(1.05)</td>
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<td>.0124</td>
<td>.0104</td>
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<tr>
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<td>(7.25)</td>
<td>(3.07)</td>
<td>(2.25)</td>
</tr>
<tr>
<td>Tenure²</td>
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<td>-.0002</td>
<td>-.0001</td>
</tr>
<tr>
<td></td>
<td>(4.55)</td>
<td>(1.45)</td>
<td>(1.93)</td>
</tr>
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<td>-.1074</td>
<td>-.0772</td>
</tr>
<tr>
<td></td>
<td>(.88)</td>
<td>(1.46)</td>
<td>(.96)</td>
</tr>
<tr>
<td>Size 100</td>
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<td>-.0093</td>
<td>.0341</td>
</tr>
<tr>
<td></td>
<td>(1.15)</td>
<td>(.13)</td>
<td>(.40)</td>
</tr>
<tr>
<td>Size 500</td>
<td>.0630</td>
<td>-.0013</td>
<td>.0478</td>
</tr>
<tr>
<td></td>
<td>(2.57)</td>
<td>(.02)</td>
<td>(.52)</td>
</tr>
<tr>
<td>Size 1,000</td>
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<td>.1201</td>
<td>.1717</td>
</tr>
<tr>
<td></td>
<td>(6.50)</td>
<td>(1.72)</td>
<td>(1.85)</td>
</tr>
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<td>λ</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
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<td>1.3890</td>
<td>1.2324</td>
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<td>(4.73)</td>
</tr>
<tr>
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<td>596</td>
</tr>
<tr>
<td>R²</td>
<td>.4886</td>
<td>.4405</td>
<td>.4411</td>
</tr>
</tbody>
</table>

Note.—Eight occupational dummies were also included. Absolute values of t-statistics are in parentheses.
ate information on shift work.\textsuperscript{15} The relative rankings of the differentials by characteristics are the same, however, with union members and minority workers receiving larger premiums. As with the 1985 sample, the union-nonunion wage differential falls when shift work is treated endogenously. For the 1979 sample, the union differential is 0.089 in the simple OLS equation but is a weighted average of 0.063 for the switching regression model. The single-equation estimates, shown in the Appendix, once again show a larger shift differential than the two-equation model and also show a large reduction in the effects of union status and plant size when choice of shift is analyzed.

The structural probit estimates shown in table 8 are consistent with the conclusions of the 1985 sample and show that the predicted shift differential has a significant positive effect on the probability of shift work, although the coefficient on the shift differential is now much larger and is estimated more precisely. Consistent with the 1985 sample, the coefficient on union membership drops only slightly in the structural probit. The coefficient on veterans has, curiously, about the same magnitude but is opposite in sign in the two samples. When we control for the shift premium, increased tenure reduces the probability of shift work. Firm size still has a strong positive impact on the probability of shift work, although the structural probit estimates are quite a bit smaller than the reduced-form estimates.

As with the 1985 sample, we can calculate the expected gains from working nights. The difference in the expected log wage between day and night work for those choosing shift work in May 1979 is 0.442, which is almost the same as the net gain estimated for the 1985 sample. It is also the case for the 1979 sample that day workers would receive reduced wages if they were to switch to night work, with an average reduction of about 7 percent. We also see a similar change in the distribution of wages when there is self-selection, in comparisons with a counterfactual world with random assignment of workers to

\textsuperscript{15} Recall that shift status is defined from hours worked last week, whereas the wage is calculated from the responses to the questions on usual weekly earnings and usual hours worked. The discrepancy in the time periods could be very important for analyses of compensating differentials for working conditions.
TABLE 8
MAY 1979 CPS: PROBIT ESTIMATES

<table>
<thead>
<tr>
<th>Variable</th>
<th>Reduced-Form Probit</th>
<th>Structural Probit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yrsed</td>
<td>.2013 (3.17)</td>
<td>.0360 (1.75)</td>
</tr>
<tr>
<td>Yrsed²</td>
<td>-.0107 (3.75)</td>
<td>.0048 (1.01)</td>
</tr>
<tr>
<td>Exp</td>
<td>-.0286 (1.35)</td>
<td>.0012 (1.18)</td>
</tr>
<tr>
<td>Exp²</td>
<td>.0012 (1.75)</td>
<td>-.1419 (1.34)</td>
</tr>
<tr>
<td>Exp³</td>
<td>-.0017 (1.17)</td>
<td>.0704 (1.82)</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>-.0254 (.24)</td>
<td>.2302 (2.50)</td>
</tr>
<tr>
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Note.—Eight occupational dummies were also included in the estimation but are not reported in the table. Absolute values of t-statistics are in parentheses.

shifts. With self-selection, the average log wage is higher by 0.08, and there is a reduction from 0.103 to 0.086 in its variance.\(^{16}\)

Conclusions

A model incorporating self-selection and choice of shift work was developed and estimated on two samples from the CPS. For the May 1985 sample, there is a sizable shift premium that varies substantially with union membership, race, and education. The estimated shift differential has a positive and significant effect on the choice of shift work, but there is also evidence to indicate that the choice of shift is intimately related to the choice of union status. One finding of particular interest is that cross-section estimates of the union wage differential are biased upward, and explicit treatment of the endogeneity of

\(^{16}\) When the polychotomous choice model of Lee (1983) is estimated with the May 1979 sample, the results are qualitatively similar to the 1985 results described in n. 11. Compared with nonunion day workers, nonunion shift workers make 14 percent less, unionized day workers earn 1 percent more, and unionized shift workers make 45 percent more. Although the numbers are substantially different, both samples show a sizable increase for the combination of union membership and shift work over what either trait is worth alone.
shift work reduces the union premium by almost one-third, from 23 percent to 16 percent. At the very least, these findings demonstrate that the impact of working conditions on wages is more complex than is commonly treated. In the presence of heterogeneous preferences and choice of working conditions, of which shift work is only one component, including dummy variables is not only insufficient but misleading. Various personal characteristics were shown to be correlated with choice of shift, inducing a bias in OLS estimates of those traits on potential earnings. There is also strong evidence for self-selection, as workers with low potential daytime earnings choose to work nights to increase their earnings.

Analysis of the May 1979 CPS survey confirmed that shift differentials have a significant impact on choice of shift, although the estimated premiums were slightly smaller. The 1979 sample also showed that the shift premium was larger for unionized workers and non-high school graduates. Allowing for the endogeneity of shift work reduces the wage premiums associated with union membership by a substantial amount and virtually eliminates the wage differentials associated with firm size. For both samples, the effects of shift work were estimated in several ways, and in all cases there was strong evidence of self-selection and sizable reductions in the wage premiums for union membership and plant size.

The findings of this analysis are consistent with a growing body of evidence that shows conclusively that individual heterogeneity and self-selection play important roles in the labor market. In addition to the work on union membership by Lee (1978), Robinson and Tomes (1984), and Duncan and Leigh (1985), Killingsworth (1986) and Ga-ren (1988) have recently shown that explicit treatment of self-selection is required to obtain reasonable estimates of the impact of working conditions on wages.

The sample used in this study was limited to manufacturing workers in order to minimize the problem of modeling more completely the occupational choice process. For a number of reasons, the role of shift work in the nonmanufacturing sector probably differs significantly. The relevance of the distinction between day and night work in the restaurant business, for instance, is probably much less important than it is in a steel mill. In many service industries, night work is an attraction to workers and can be used to provide flexibility in coordinating employment and household responsibilities. There is no obvious reason why the impact of shift work should operate differently in the manufacturing sector, but an initial examination of the data indicates that it does. This issue simply highlights how little we know about the organization of work and its impact on both workers and firms. Further research into the effects of shift work in the nonmanufacturing sector would be useful, but it will probably require
more detailed information on individuals and firms than that used in this study.

Much more work could be done on the supply of labor in response to working conditions, but important work remains to be conducted on the demand side as well. Betancourt and Clague (1981) have done a large amount of research on shift work and capital utilization, and Shiells and Wright (1983) analyze an interesting historical example. Attempts by Foss (1984) to estimate a supply and demand schedule for shift labor were unsuccessful because of inadequate data, but it may be feasible using more recent micro data such as those used in this study.

### TABLE A1

**May 1985 CPS: Treatment Effects Model Estimates**

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<th>(3)</th>
<th>(4)</th>
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**Note.**—Six occupational dummies were also included. Absolute values of t-statistics are in parentheses. Col. 3 lists the instrumental variable estimates and col. 4 the normal selection model.
TABLE A2
MAY 1979 CPS: TREATMENT EFFECTS MODEL ESTIMATES

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Note.—Eight occupational dummies were also included. Absolute values of t-statistics are in parentheses. Col. 3 lists the instrumental variable estimates and col. 4 the normal selection model.

References


Differentials for Shift Work