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Marjorie L. Baldwin

ESTIMATING WAGE DISCRIMINATION AGAINST WORKERS WITH DISABILITIES

Marjorie L. Baldwin†

INTRODUCTION

To combat the first wave stereotype that persons with disabilities were unemployable, disability advocates formulated a second wave message which emphasized that workers with disabilities could be just as productive as non-disabled workers given appropriate accommodations. The low wages and low employment rates of workers with disabilities, therefore, were caused by employer discrimination, not by the limiting effects of workers' disabilities.

When economists measured the extent of discrimination against workers with disabilities, however, they took account of the limiting effects of disabilities on worker productivity. These economic models assumed that there was at least some decrease in worker productivity caused by the disabilities. Many disability advocates, in defense of the second wave message, criticized these models, arguing that economists should not take disabilities into account when measuring discrimination.

A third wave message is needed to reconcile the advocates' position promoting the employability of persons with disabilities with the economists' position that the limiting effect of disability is a relevant factor which must be included in wage equations that measure discrimination. The third wave message should emphasize that, while disability can impact productivity and this effect must be measured in order to obtain meaningful estimates of discrimination, there is still evidence that employer discrimination reduces the wages and employment prospects of persons with disabilities.

This essay applies a standard decomposition technique for measuring wage discrimination to a sample of disabled and non-disabled adults. Estimates of discrimination are derived with and without controls for the limiting effects of disabilities. The results suggest that, even in the more stringent model that includes controls for limitations, there is evidence of wage discrimination against workers with disabilities. Evidence of

† Assistant Professor of Economics, East Carolina University, Greenville, North Carolina. Ph.D., Syracuse University, 1988.

discrimination based on models that exclude controls for limitations — the results of which thus may be biased — is easily rebutted with the argument that, had the variables been included in the model, the evidence of discrimination would disappear. Therefore, the strongest evidence of employer discrimination against workers with disabilities comes from models that control for the limiting effects of disability on worker productivity.

I. BACKGROUND

Recent decisions in cases of labor market discrimination against blacks and women have relied more heavily on econometric methods to determine whether there is evidence of discrimination.[1] The econometric technique used to estimate the extent of wage discrimination against a particular minority group was first set forth by Professor Ronald Oaxaca (pronounced "Wa-ha-ka").[2] Numerous empirical studies of wage discrimination using variations of Oaxaca's technique have appeared in scholarly journals and in cases arising under Title VII of the Civil Rights Act of 1964.[3]

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[1] Orley Ashenfelter & Ronald Oaxaca, *The Economics of Discrimination: Economists Enter the Courtroom*, 77 AM. ECON. REV. 321 (1987).

[2] Ronald Oaxaca, *Male-Female Wage Differentials in Urban Labor Markets*, 14 INT'L ECON. REV. 693 (1973). In studies of labor market discrimination, a minority group refers to a demographic group that is relatively disadvantaged in employment, earnings, or occupational distribution. The majority group is the relevant comparison group. Specific minority groups that have been the focus of government policies to eliminate discrimination in the labor market include Blacks, Hispanics, women, and persons with disabilities.

[3] 42 U.S.C. §§ 2000e to 2000e-17 (Supp. IV 1992). The Oaxaca method has been applied in sociology. *See, e.g.*, Otis D. Duncan, *Inheritance of Poverty or Inheritance of Race?*, *in* ON UNDERSTANDING POVERTY 85-105 (Daniel P. Moynihan & James L. Sundquist eds., 1968). The Oaxaca model has also been applied in the field of economics. *See, e.g.*, Oaxaca, *supra* note 2; Allen S. Blinder, *Wage Discrimination: Reduced Form and Structural Estimates*, 8 J. HUM. RESOURCES 436 (1973)

Variations of the Oaxaca method have been used to estimate discriminatory wage differentials against blacks. *See, e.g.*, Richard J. Butler, *Estimating Wage Discrimination in the Labor Market*, 70 J. HUM. RESOURCES 606 (1982); Jeremiah Cotton, *On the Decomposition of Wage Differentials*, 70 REV. ECON. & STAT. 236 (1988); James D. Gwartney & James E. Long, *The Relative Earnings of Blacks and Other Minorities*, 31 INDUS. & LAB. REL. REV. 336 (1978); Nicholas M. Kiefer & Sharon P. Smith, *Union Impact and Wage Discrimination By Region*, 12 J. HUM. RESOURCES 521 (1977); Stanley H. Masters, *The Effect of Educational Differences and Labor Market Discrimi-*

The basis of the Oaxaca technique is to separate observed minority-majority wage differentials into two parts: a part that is explained by differences in the average productivity-related characteristics of the two groups, and an unexplained part that is attributed to employer discrimination. One important criticism of the method is that unmeasured differences in productivity also appear in the unexplained part of the wage differential, producing estimates of wage discrimination that are too large. In other words, if important variables measuring differences in the average productivity of minority and majority workers — such as differences in the average quality of schooling — are not included in the wage equation, then wage differences that could be explained by differences in productivity are instead attributed to discrimination.

The problem is even more troublesome when the Oaxaca technique is applied to workers with disabilities. In the case of disabled workers, the issue of eliminating wage differences that reflect differences in productivity becomes particularly sensitive because the very characteristic that identifies a worker as disabled — a limitation that affects the ability to perform basic life tasks — also reduces the worker's productivity in some jobs.

The Americans with Disabilities Act (ADA),[4] which prohibits private employers from discriminating on the basis of disability, has opened a new arena for litigation of discrimination claims and is likely to increase the demand for statistical evidence of discrimination against workers with disabilities.[5]

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nation on the Relative Earnings of Black Men, 9 J. HUM. RESOURCES 342 (1974).

Similarly, variations of the Oaxaca technique have been used to estimate wage discrimination against Hispanics. *See, e.g.*, Cordelia W. Reimers, *Labor Market Discrimination Against Hispanic and Black Men*, 65 REV. ECON. & STAT. 570 (1983).

The Oaxaca technique has been used to estimate wage discrimination against women. Farrell E. Bloch & Sharon P. Smith, *Human Capital and Labor Market Employment*, 12 J. HUM. RESOURCES 550 (1977); Mary Corcoran & Greg J. Duncan, *Work History, Labor Force Attachment, and Earnings Differences Between Races and Sexes*, 14 J. HUM. RESOURCES 3 (1979); *see, e.g.*, Burton G. Malkiel & Judith A. Malkiel, *Male-Female Pay Differentials in Professional Employment*, 63 AM. ECON. REV. 693 (1973); David Neumark, *Employers' Discriminatory Behavior and the Estimation of Wage Discrimination*, 23 J. HUM. RESOURCES 279 (1988).

[4] 42 U.S.C. §§ 12101-12213 (Supp. III 1991).

[5] It is not necessary that a disabled plaintiff provide statistical evidence of discrimination against disabled workers to prove the plaintiff's case under

Several studies have already used the Oaxaca technique to estimate discriminatory wage differentials between workers with disabilities and non-disabled workers.[6]

Non-economists, however, disagree regarding whether it is appropriate to include controls for the limiting effects of disabilities in a model designed to estimate wage discrimination against workers with disabilities. Disability advocates and members of the disabled community have promoted the civil rights of workers with disabilities by emphasizing their abilities rather than their limitations — this is the essence of the second wave message. Some advocates contend that a model that associates disabilities with productivity losses is contrary to the premises of the disability movement. On the other hand, meaningful estimates of wage discrimination cannot include the effects of real differences in productivity. Economists would not accept a study of discrimination against workers with disabilities that ignored the limiting effects of disabilities on productivity.

The following sections describe in greater detail the Oaxaca technique for measuring wage discrimination, and present an application to demonstrate how controlling for the limiting effects of disabilities can change estimates of wage discrimination against workers with disabilities.

ADA Title I. Under the ADA an employer cannot discriminate against an individual because of that individual's disability. Thus, "[i]t is not necessary to make statistical comparisons between a group of people with disabilities and people who are not disabled to show that a person with a disability is screened out by a selection standard." EQUAL EMPLOYMENT OPPORTUNITY COMM'N, A TECHNICAL ASSISTANCE MANUAL ON EMPLOYMENT PROVISIONS (TITLE I) OF THE AMERICANS WITH DISABILITIES ACT IV-3 (1992). Nevertheless, in some cases a plaintiff may choose to prove his or her case by using statistical evidence. Further, presumably, statistical evidence of discrimination against persons with disabilities will be utilized to show the efficacy — or lack thereof — of ADA Title I.

[6] *See, e.g.*, Marjorie L. Baldwin & William G. Johnson, *Labor Market Discrimination Against Men With Disabilities*, 29 J. HUM. RESOURCES 1 (1994); MARJORIE L. BALDWIN & WILLIAM G. JOHNSON, LABOR MARKET DISCRIMINATION AGAINST WOMEN WITH DISABILITIES (East Carolina University Working Paper, 1993); William G. Johnson & James Lambrinos, *Wage Discrimination Against Handicapped Men and Women*, 20 J. HUM. RESOURCES 264 (1985).

II. THE ECONOMETRIC METHOD OF ESTIMATING WAGE DISCRIMINATION

A. INTRODUCTION TO ECONOMETRIC REGRESSION

Economists say that wage discrimination occurs when differences in the average wages of two groups of workers are unexplained by differences in their average productivity. As noted above, Oaxaca's technique estimates the size of discriminatory wage differentials by separating observed wage differentials into two parts.

One part of the wage differential is "explained" by differences in the productivity-related characteristics of majority and minority workers. For example, majority workers may have more education, on average, than minority workers. Wage differences associated with the differences in education are included in the explained part of the wage differential.

A second part of the wage differential, associated with differences in returns to the characteristics of minority and majority workers, is "unexplained" and attributed to discrimination. For example, majority workers may be paid more, on average, per year of education than minority workers. Wage differences associated with this difference in returns to education are included in the unexplained part of the wage differential.

Thus, the Oaxaca technique is said to "decompose" the minority-majority wage differential into an explained, or nondiscriminatory, component and an unexplained component that is attributed to discrimination.[7]

B. A SIMPLIFIED EXAMPLE

To see how the Oaxaca technique might be applied to wage differentials between disabled and non-disabled workers, consider the following simplified example. Suppose a firm employs laborers to sort and move crates in its warehouse, where the only job requirements are strength and speed. On average, non-disabled workers are able to move 20 crates per hour, while workers with disabilities are only able to move 15 crates per hour. The workers' disabilities have caused functional limitations — less strength and speed — that reduce their productivi-

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[7] *See* Oaxaca, *supra* note 2, at 695-97.

ty. As a result, the average wage for non-disabled workers is $8.00 per hour and for workers with disabilities $5.50 per hour.

The $2.50 hourly wage differential between disabled and non-disabled warehouse workers can be decomposed as follows. Non-disabled workers are paid $.40 per crate moved. Since workers with disabilities move five fewer crates per hour, we would expect their wages to be $2.00 less than the wages of non-disabled workers. This part of the wage differential is explained by differences in the average productivity of disabled and non-disabled workers. The remaining $.50 wage differential is not explained by differences in the productivity-related characteristics — strength and speed — of the two groups of workers. This unexplained, or "residual," difference is attributed to employer discrimination against workers with disabilities.

In the example, the workers' functional limitations are losses of strength and speed. More generally, a functional limitation is any restriction of sensory, mental, or physical capacities. Other examples include inability to see or hear, inability to climb a flight of stairs or walk a short distance, mental illness, emotional problems, or drug addiction.

Typically, studies of discrimination use regression techniques to estimate the relationship between the characteristics of minority and majority workers and their wages. Wage equations are estimated separately for each group.[8] The dependent variable in the equation is a measure of earnings and the independent variables measure productivity-related characteristics of workers — in our example, strength and speed. The regression estimates of the coefficients of the independent variables measure the wage returns to each characteristic. The minority-majority wage differential can then be decomposed into

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[8] In general, the wage equations are estimated in loglinear form,

$$\ln W_i = \beta X_i + c\lambda_i + \varepsilon_i\lambda_i.$$

where the dependent variable is the natural log of the hourly wage rate of the ith worker, X_i is a vector of variables that represent workers' productivity, and ε_i is a mean-zero, random disturbance term. The variable λ_i corrects for sample selection bias, that is, the bias that results because we cannot observe the wages that would be offered to non-workers. The sample selection correction is generated from the coefficients of a participation equation estimated for workers and non-workers. *See* James J. Heckman, *The Common Structure of Statistical Models of Truncation, Sample Selection and Limited Dependent Variables and a Simple Estimator for Such Models*, 5 ANNALS ECON. & SOC. MEASUREMENT 475 (1976).

a part that can be explained by differences in the average productivity-related characteristics of the two groups of workers — measured by differences in the means of the independent variables — and the residual — measured by differences in the coefficients.[9] In our example, eighty percent of the wage differential is explained by differences in the strength and speed of disabled and non-disabled workers, the remaining twenty percent residual — which arises because workers with disabilities are paid only $.37 per crate moved — is attributed to discrimination. One of the main problems with measuring discrimination in this manner is the bias associated with omitted variables.[10] If variables which measure worker productivity are excluded from the wage equations and these variables are correlated with other variables in the equations, then the coefficient estimates may be biased. For example, suppose that in our warehouse example we include a variable for — "control

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[9] Assuming that in the absence of discrimination the wage structure for non-disabled workers would also apply to disabled workers, then the wage differential between disabled (D) and non-disabled (ND) workers can be decomposed as:

$$\overline{\ln W_{ND}} - \overline{\ln W_{D}} - (\hat{c}\bar{\lambda}_{ND} - \hat{c}_{D}\bar{\lambda}_{D}) = (\bar{X}_{ND} - \bar{X}_{D})\,\hat{\beta}_{ND} + \bar{X}_{D}\,(\hat{\beta}_{ND} - \hat{\beta}_{D}).$$

The left-hand side of the decomposition formula represents the offer wage differential, the observed difference in log wages corrected for sample selection bias. The first term on the right-hand side represents the part of the offer wage differential that is explained by differences in the means of the explanatory variables; the second term represents the part of the differential that is attributed to discrimination.

Oaxaca, *supra* note 2, at 696-97, presents two sets of results, alternatively letting the non-discriminatory wage structure be the observed wage structure for the majority and the minority groups. Reimers, *supra* note 3, at 573, suggests that the non-discriminatory wage structure lies midway between the majority and minority wage structures. More recently, several economists suggest that the relationship between the non-discriminatory wage structure and the observed wage structures is determined by the proportion of minority workers in the work force. *See, e.g.*, Cotton, *supra* note 3, at 238-40; Neumark, *supra* note 3, at 283-89; Marjorie L. Baldwin & William G. Johnson, *A Test of the Measures of Non-Discriminatory Wages Used to Study Wage Discrimination*, 59 ECON. LETTERS 223, 223-27 (1992).

[10] The multivariate regression method produces unbiased estimates of the coefficients only if the error term has a zero mean and a constant variance, with no correlation across observations. That is, $E[\varepsilon]=0$ and $E[\varepsilon\varepsilon']=\sigma^2 I$, where I is the identity matrix. When important variables are omitted from the regression, these assumptions are violated and the coefficient estimates may be biased.

for" — the strength of workers but leave out a variable for their speed. If stronger workers also tend to work faster, then the regression estimates of the returns to strength will be biased upward because some of the returns to speed will be captured by the coefficient of the strength variable. Since discrimination is estimated by between-group differences in coefficients, the biased coefficient estimates will produce biased estimates of discrimination.

Omitted variables create a second problem in studies of wage discrimination. If important variables that determine worker productivity are omitted from the wage equations, and if those variables are correlated with membership in the minority group, then the residual is not a valid measure of discrimination. We know, for example, that functional limitations — restrictions to sensory, mental, or physical capacities — can reduce productivity in some jobs, and, by definition, workers with disabilities have more limitations than do non-disabled workers. If measures of functional limitations are omitted from a model of discrimination against workers with disabilities, then wage differences associated with the productivity effects of those limitations will appear in the residual term and be incorrectly attributed to discrimination. In this case, the estimate of discrimination will be too high simply because we have failed to control for the effects of functional limitations on productivity.

III. AN APPLICATION OF THE OAXACA TECHNIQUE: ESTIMATING DISCRIMINATION AGAINST DISABLED WORKERS

To see how omitting functional limitation variables can change estimates of wage discrimination against workers with disabilities, consider the following application. The data come from a sample of 19,182 working men and women who participated in the 1984 panel of the Survey of Income and Program Participation (SIPP).[11] Five percent of the workers (N=1,036)

[11] UNITED STATES CENSUS BUREAU, SURVEY OF INCOME AND PROGRAM PARTICIPATION (SIPP) WAVE III RECTANGULAR CORE AND TOPICAL MODULE MICRODATA FILE (1986) (Machine-Readable Datafile) [hereinafter SIPP]. The data refer to a four month reference period between January and June 1984. The sample is restricted to persons age 16 to 64 and excludes full-time students, members of the armed forces, self-employed persons, and persons who received any of the following kinds of transfer payments throughout the reference period: social security, welfare, disability, or unemployment

are disabled; that is, they respond that a health condition limits their ability to perform basic life tasks.[12] Two different estimates of discrimination are computed by applying the Oaxaca decomposition technique to two specifications of the wage equation. These different specifications of the wage equation are called "models."

The first model does not control for the loss of productivity associated with functional limitations, while the second model does. Estimates of wage discrimination from the first model are expected to be larger than estimates from the model that includes measures of functional limitations. Explanatory variables in both models control for the effect on wages of workers' productivity-related characteristics — corresponding to the strength and speed variables in our earlier example — and the demand for labor. The variables include education level, race, union membership, experience in the current job and other jobs, missing experience (potential labor force years not working and not in school), and occupation.[13] The functional limitation variables added to the second model are constructed from twelve measures of respondents' sensory and mobility restrictions included in the SIPP questionnaire.[14] For the most part, the functional limitation questions are distinct from the questions that identify the disabled sample; thus, we obtain measures of

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insurance.

[12] A worker is considered disabled if he responds yes to one of the following questions: Do you need the help of another person in order to get around? Are you unable to do housework or prepare meals? Does a health condition limit the kind or amount of work you can do?

[13] The occupation variables identify workers in professional/managerial or laborer occupations.

[14] The twelve questions describing mobility and sensory restrictions are: (1) Do you have any difficulty seeing words and letters in ordinary newspaper print even when wearing glasses or contact lenses? (2) Do you have any difficulty hearing what is said in a normal conversation with another person? (3) Do you have any difficulty having your speech understood? (4) Do you generally use an aid to help you get around? (5) Do you have any difficulty lifting and carrying something as heavy as 10 pounds? (6) Do you have any difficulty walking for a quarter of a mile? (7) Do you have any difficulty walking up a flight of stairs? (8) Do you have any difficulty getting around outside the house by yourself? (9) Do you have any difficulty getting around inside the house by yourself? (10) Do you have any difficulty getting in and out of bed by yourself? (11) Because of your health, do you need help to do light housework? (12) Do you need help to prepare meals for yourself? SIPP, *supra* note 11.

functional limitations for both disabled and non-disabled persons. The measures of functional limitations increase with additional restrictions to the worker's mobility or sensory capacities.

In the SIPP sample, mean hourly wages are $9.38 for non-disabled men, $8.80 for men with disabilities, $6.56 for non-disabled women, and $5.93 for women with disabilities. Thus, the observed wage differentials are $.58 per hour between disabled and non-disabled men and $.63 per hour between disabled and non-disabled women.[15] The observed wage differentials, however, provide an incomplete picture of differences in the labor market returns to workers with and without disabilities, because important differences in the productivity-related characteristics of the two groups are ignored.

Workers with disabilities have less education, on average, than non-disabled workers, and are less likely to be employed in professional or managerial occupations.[16] The most striking difference between the two groups, however, is in years of work experience. The average man with a disability has eight more years of work experience, but has more missing experience (0.5 years), than the average non-disabled man. The average woman with a disability has five more years of work experience and three more years of missing experience than the average non-disabled woman. Differences in work experience are probably associated with the age difference between the two groups: in this sample, workers with disabilities are an average of nine years older than non-disabled workers. There is little difference in the racial distribution of the two groups or in the percent of each group that are union members. As expected, average values of the functional limitation variables are higher for workers with disabilities than for non-disabled workers.

Estimates of wage discrimination from the model that does not control for functional limitations are presented in Table 1.[17] The first row reports observed wage differentials between disabled and non-disabled workers (corresponding to the $2.50 wage gap between disabled and non-disabled warehouse workers in our warehouse example). In the second row, the differen-

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[15] *See* SIPP, *supra* note 11.

[16] The education differential is one year for disabled and non-disabled men, and 0.8 year for disabled and non-disabled women.

[17] The coefficient estimates and means on which the estimates of discrimination are based are available from the author.

tial is expressed in log form and corrected for sample selection bias, that is, the bias that results because we cannot observe the wages that might have been offered to non-workers. The next section of the table reports the wage differences associated with differences in the average characteristics of the disabled and non-disabled groups. The sum of these components is the explained part of the wage differential (in our warehouse example, $2.00). The residual, attributed to discrimination, is the wage difference associated with differences in the coefficients of the wage equations for disabled and non-disabled workers. It equals the difference between the offer wage differential and the explained differential (in our warehouse example, $.50).

TABLE 1
Decomposition of Wage Differentials Between Disabled and Non-disabled Workers: No Controls for Functional Limitation[18]

	Men	Women
Wage Differential	0.58	0.63
Offer Wage Differential (Log)	0.064	0.037
Components of the Differential		
Education	0.047	0.044
Race	-0.002	-0.000
Union	-0.005	-0.003
Experience	-0.114	-0.031
Occupation	0.008	0.007
Explained differential	-0.066	0.017
Discriminatory differential	0.130	0.019

Turning first to the results for men, the most important factor explaining the offer wage differential between men with disabilities and non-disabled men is the difference in their average levels of education. Differences in work experience, on the other hand, reduce the explained part of the wage differential. The experience component is negative because men with disabilities have more work experience, on average, than non-disabled men and would, therefore, be expected to earn higher wages. The negative experience component overshadows the other factors in the decomposition so that the explained part of the wage differential is also negative, indicating that — control-

[18] SIPP, *supra* note 11.

ling for education, experience, race, unionization, and occupation — men with disabilities would be offered higher wages than non-disabled men in the absence of discrimination. Thus, the discriminatory wage differential is larger than the offer wage differential.

To interpret the results for men, recall our warehouse example. Suppose that, by virtue of greater experience, workers with disabilities were able to compensate for their lack of strength and speed and load twenty-two crates per hour, on average. In the absence of discrimination, their wages would be $8.80 per hour or $.40 per crate moved. If they are paid $5.50 instead, then the unexplained wage differential attributed to discrimination ($3.30) exceeds the observed wage differential ($2.50).

The observed wage differential between women with disabilities and non-disabled women is larger than the differential for men, but the offer wage differential is smaller after controlling for sample selection bias. Again, education is the largest positive factor contributing to the explained part of the differential, and the experience component is negative. Overall, the variables in the model explain slightly less than half the offer wage differential between disabled and non-disabled women; the remaining fifty-one percent of the differential is attributed to discrimination.

TABLE 2
Decomposition of Wage Differentials Between Disabled and Non-disabled Workers: Including Controls for Functional Limitation[19]

	Men	Women
Wage Differential	0.58	0.63
Offer Wage Differential (Log)	0.067	0.078
Components of the Differential		
Functional Limitation	0.043	0.013
Education	0.047	0.044
Race	-0.002	-0.000
Union	-0.005	-0.003
Experience	-0.115	-0.032
Occupation	0.008	0.007
Explained differential	-0.024	0.029
Discriminatory differential	0.092	0.049

Table 2 presents decomposition results for the model that includes controls for functional limitations.[20] For men, the wage model is stable; that is, the addition of functional limitation variables does not change the coefficients of other variables appreciably. The functional limitation variables are an important factor explaining disabled/non-disabled wage differences — including these variables in the model increases the explained part of the wage differential. Nevertheless, the explained differential is still negative, and there is still evidence of wage discrimination against men with disabilities in excess of observed wage differences.

The wage equation for women is also fairly stable across specifications, with the notable exception of the sample selection variable. When functional limitation variables are added to the model, the coefficient of the sample selection variable changes signs: as a result, the estimated offer wage differential doubles. As was the case with men, differences in physical or mental restrictions are an important factor explaining the wage differential between disabled and non-disabled women, and their inclusion in the model increases the explained part of the wage differential. Yet, because the estimated offer wage differential

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[19] SIPP, *supra* note 11.

[20] The characteristics controlled for are those queried by the SIPP questionnaire. *See supra* note 14; SIPP, *supra* note 11.

is twice as large as in the previous model, the variables in the wage equation now explain only thirty-seven percent of the offer wage differential, and the remaining sixty-three percent is attributed to discrimination. In this case, the estimate of wage discrimination is larger when functional limitation variables are included in the model because the estimated offer wage differential is biased downward in the model that excludes the variables.

CONCLUSION

To enforce the employment provisions of the ADA, it is necessary to estimate wage discrimination against workers with disabilities using the same econometric techniques that are applied to study discrimination against other minority groups. In the disability context, the most difficult issue is how to control for the effects of functional limitations on worker productivity, and whether it is appropriate to include such controls in the equations that are used to measure wage discrimination.

The few studies that have applied a residual measure of discrimination to workers with disabilities have included functional limitation variables in the wage equation.[21] Although the variables explain part of the wage differential between disabled and non-disabled workers, there is still a large unexplained residual attributed to discrimination.

The application presented in this article finds similar results. Estimates of wage discrimination against men with disabilities are smaller when the wage equation controls for physical or mental restrictions, but still imply that the discriminatory wage differential exceeds the observed wage differential. The results for women are even more striking. Controlling for physical or mental restrictions actually increases the estimate of wage discrimination, because the model without functional controls is mis-specified and the coefficient estimate for the sample selection variable is biased.

The application demonstrates that persons who argue against including functional limitation variables in the wage equation weaken the support for findings of discrimination against workers with disabilities. Estimates of wage discrimi-

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[21] Baldwin & Johnson, *supra* note 6; *see generally* Johnson & Lambrinos, *supra* note 6 (discussing studies of wage discrimination between workers with disabilities and non-disabled workers).

nation against workers with disabilities may, in some instances, be larger in models that include the variables.

There are other problems associated with controlling for the effects of functional limitations on productivity that have not been discussed here. One, it is often difficult to obtain labor market data and data on physical or mental restrictions for the same sample of workers. The SIPP data, for example, has no information on workers' cognitive limitations. This variable is omitted from the wage equations and, as discussed above, may bias the estimates of discrimination if cognitive functions are correlated with disability status and productivity. Two, it is not clear how to construct summary measures of functional limitations that capture all the important differences between disabled and non-disabled workers and still yield models of manageable size. Finally, the effects of physical or mental restrictions on productivity are highly correlated with job characteristics and, ideally, the wage equation should control for interactions between workers' limitations and job requirements. Except for very broad measures of occupation, this has not been accomplished.

Despite the difficulties associated with controlling for the effects of functional limitations on worker productivity, the evidence cited here demonstrates that economists' models of wage discrimination can be applied to workers with disabilities. Discriminatory wage differentials do not disappear when functional controls are included in the wage equation. The better we control for differences in productivity associated with physical or mental restrictions, the more convincing the evidence that workers with disabilities are subject to wage discrimination and deserve the protection of civil rights laws.