Racial Inequality and the Probability of Occupation-related Injury or Illness

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RACIAL INEQUALITY IS AN IMPORTANT AND enduring characteristic of United States society, and both earnings and health status measures indicate that black Americans hold a position decidedly worse than that of their white counterparts (Reich 1981; American Public Health Association 1982; U.S. Department of Health, Education and Welfare 1979). Given the prominence of racial differences and the considerable amount of interest they have generated among labor economists and health professionals, one might have expected a substantial body of research on racial inequality and occupation-related injuries and illnesses. Yet a review of the literature reveals both a paucity in the number of studies and an even more severe deficit in the kind of overviews that could aid and direct the formulation of public policy.

This paper seeks to improve the quality of the discussion in three ways. It begins with a consideration of the common issues at stake for public policy in the areas of public health and affirmative action, stressing the counterproductive consequences of the traditional distinction between the two arenas of governmental intervention in the economy. In this section, several basic research questions are raised and the types of data needed to guide public programs are pointed out. In

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the second section of the paper a more in-depth evaluation of the measures of occupational hazard currently available is given, the strengths and weaknesses of each are described, and it is emphasized that a variety of different indexes should be employed in any empirical treatment of racial discrimination with respect to job hazards. In the third section three occupational hazard measures and three data sets are utilized to investigate the concentration of black workers in the more hazardous positions in the economy. The average black worker is found to be in an occupation 37 to 52 percent more likely to result in a serious injury or illness than the occupation of the average white worker, and this overrepresentation in hazardous jobs holds strong even after controlling for differences in education and on-the-job experience. The implications of the empirical analysis for policy are discussed in the concluding section.

Policy Issues, Research Questions, and Data Needs

There exists at present a clear division between governmental programs aimed at reducing the incidence of occupation-related injuries and illnesses and governmental programs aimed at reducing racial discrimination on the job. The Occupational Safety and Health Administration and related agencies conduct research on job hazards and promulgate standards limiting exposures to toxic materials in jobs, without direct concern for which particular worker occupies which particular job. The Equal Employment Opportunity Commission and related agencies, on the other hand, investigate the allocation of black and white workers across jobs with different wage rates and bring pressure upon employers that appear to be discriminating, but do not give special attention to differences in working conditions between jobs. While some division of labor is certainly needed for purposes of administrative efficiency, the separation of occupational health from affirmative-action programs places important limitations on the effectiveness of each. The simultaneous consideration of occupational health and equal opportunity programs raises several important policy issues, which in turn generate new research questions and the need for new and better sources of data.

If there exists discrimination against black workers with respect to allocation between jobs with different levels of wages, as governmental affirmative-action policies presume, then there is likely to exist similar

discrimination with respect to allocation of workers between jobs with different levels of hazard. Measures of discrimination within a particular firm and measures of inequality across society as a whole will underestimate the true extent of racial differences if they rely solely on income to the exclusion of exposure to health and safety hazards.

Attention to safety-related discrimination may, ironically enough, become increasingly important as equal opportunity policies directed at wage rates become more effective. Firms whose ability to discriminate is frustrated with respect to wage policy may begin to discriminate even more heavily with respect to working conditions. Lazear (1979) has argued that this is happening with respect to worker access to on-the-job training.

Evidence of overrepresentation of black workers in the more hazardous jobs within firms would not by itself be proof of discrimination any more than evidence of overrepresentation in the low-paying jobs would be. If hazardous jobs were unskilled jobs, and if black workers had less access to education and on-the-job training, then one would expect to find black workers in the hazardous jobs even though blacks and whites that did obtain the same level of education and training might be treated identically by employers. The observed concentration of blacks in the more hazardous jobs would be due to general inequality in access to education and training but not to racial discrimination on the job. The policy implications would be that equal opportunity to obtain schooling should be guaranteed, but that affirmative-action programs aimed at lessening the assignment of black workers to the more hazardous jobs within firms would be unnecessary and possibly counterproductive. However, if the observed overrepresentation of blacks in the hazardous jobs persisted after differences in education and experience had been accounted for, there would be reasonable evidence of discrimination.

The interrelatedness of wage and hazard levels makes the search for evidence of discrimination particularly difficult. Workers care about the overall quality of jobs, not just the levels of risk to health and safety. If some hazardous jobs tend, for whatever reason, to be exceptionally high paying, then one might find them filled by white workers who desire them for that reason. In evaluating the extent of discrimination, therefore, it is important to consider several dimensions of job quality.

The policy issues at stake produce a new research agenda. First and

foremost is the question of the extent of overrepresentation of black workers in the more hazardous jobs in the economy. Trends over time in the extent of overrepresentation will be interesting for an evaluation of progress made toward society's goal of reducing racial inequality. It will be necessary to control for differences in levels of education and experience in order to distinguish between the effects of general social inequality and those of racial discrimination with respect to working conditions. Finally, since some types of hazardous jobs may be higher paying or otherwise attractive to white workers, evaluations of occupational discrimination will need to consider more than one type of occupational hazard.

These research questions in turn demand certain types of data on jobs and the workers who occupy them. Most important will be information on the type and extent of hazards present in particular jobs. Information on long-term health effects would be especially desirable but also especially difficult to obtain. These data on job characteristics will then need to be matched with information on the workers employed in the jobs, including their race but also their levels of education and on-the-job experience. Series of data consistent over time are needed to evaluate trends in exposure differences. While many types of desirable data are at present unavailable, there do exist a variety of hazard measures and survey data sets on individuals that could be used to obtain preliminary answers to most of the important research questions identified here.

Approaching the Problem: Data on Jobs and Workers

Attempts to analyze racial differences in exposure to risk of injury and illness on the job must combine information on workers, including racial background, with information on jobs, including level of hazard. Special surveys of restricted numbers of worksites obtain both sorts of information at once, but suffer from an inherent lack of generalizability. This study thus focuses on data that can claim to be representative of the economy as a whole.

Measures of Occupational Hazard

The ideal study of racial differences in on-the-job exposures to risk of injury and illness would start with a large and randomly selected

sample of black and white workers, with information on the types of hazards present in their jobs as evaluated by safety engineers, industrial hygienists, and other experts. The cost of obtaining such data is so great, however, that no such studies exist or are likely to exist in the forseeable future. Public policy must, therefore, be based on decidedly less than perfect information.

There are several approaches to the question of extent of risk on a particular job in the absence of a full-blown investigation by qualified professionals. The first begins at the level of the job, asking the incumbent worker about associated risks. Such hazard measures depend upon the subjective evaluation of the workers and, hence, a given job might obtain a different value when evaluated by different workers or by workers and health professionals. Nevertheless, subjective hazard evaluations can be useful both as a first approximation to the true level of hazard on a particular job and as a good measure of worker perceptions that will influence decisions to quit, organize a union, call in a government inspector, etc. Furthermore, it is not certain that workers systematically underestimate the level of hazard exposure. In the 1977 Quality of Employment Survey (to be discussed later), for example, 38 percent of the respondents reported "significant" or "great" levels of exposure to at least one job hazard. Most important for present purposes, subjective hazard indexes will produce a biased measure of racial differences in exposure only if race itself causes workers systematically to over- or underestimate job risks. Cultural differences related to race might indeed produce such effects, but the nature and distribution of risk-related cultural values are not clearly enough researched to help with the present analysis. The one study on the topic suggests that blacks may be less likely than whites to report as hazardous a given level of exposure (Davis 1980).

The second major approach to measuring risk begins with categories of jobs (i.e., occupations or industries), examines rates of associated health problems for a sample of workers within the category, and then assigns to each job within the category the average level of risk for the category as a whole.

Exposure risks for occupations have been developed by the Department of Labor for the *Dictionary of Occupational Titles* (DOT), a compendium of characteristics of 13,778 occupations designed to improve choice of training and occupation for workers. Job evaluators, who are not trained in safety engineering or industrial hygiene, evaluate jobs as

to their skill requirements and as to the presence of noise, extremes of heat, wet conditions, safety hazards, and noxious fumes. The 13,778 DOT classifications were used as a basis for the creation of exposure probabilities for each of the several hundred three-digit census-occupation classifications by Lucas (1974) in order to be comparable with information on race and other characteristics of the workers in each census occupation. Lucas employed the 1967 Survey of Economic Opportunity, with information on each worker's race, sex, and census occupation, to analyze race and sex differences in exposure, making the necessary assumption that all workers in an occupation have the same probability of exposure. Lucas found that, among workers, black men had a 25 percent greater chance of being exposed to at least one hazard than did white men, while black women had a 93 percent greater chance of being exposed to at least one hazard than did white women.

Another occupation measure attempts to use mortality data by occupation of deceased as the basis for a measure of occupational risk. Thaler and Rosen (1975), in a much-cited study, employ actuarial data on mortality in 36 high-mortality occupations as the basis for an excess risk-of-death measure. This procedure is exceptionally flawed, however, in that it necessarily assumes both that the excess deaths observed in the occupation are due to the conditions of work within the occupation, and that the occupation listed on death records is the occupation within which the deceased spent the larger portion of his or her working life. While occupation certainly influences health status, health status very strongly influences choice of occupation, and thus one would expect to find the most arduous and dangerous jobs being done by exceptionally healthy and hence long-lived workers. The effect of working conditions on mortality might be overwhelmed by the effect of health on choice of working conditions. This has long been recognized in epidemiology, where it goes under the name of the "healthy worker effect," but recognition of it has been slow to percolate through to the economists interested in such topics as racial inequality. The strength of these limitations is evidenced in the Thaler and Rosen measure, where taxicab drivers and bartenders are ascribed risks of job-related fatality ninety times that of servicemen and linemen, elevator operators are ascribed a risk twice that of electricians, and waiters are ascribed a risk over three times that of firemen.

An occupational risk measure has recently been developed by the Bureau of Labor Statistics (Root and Sebastian 1981) using information

on successful Workers' Compensation claims. The measure is the percentage of total compensated injury and illness cases accounted for by the occupation, divided by the percentage of total employment accounted for by the occupation. An occupation with an average proportion of injuries to employment is ascribed a value of 100, while safer occupations obtain values less than 100 and more hazardous occupations obtain values greater than 100. As an illustration using major occupational groupings, professional and technical workers are assigned a value of 21, managers and administrators a value of 28, salesworkers a value also of 28, clerical workers a value of 24, craft workers a value of 140, nontransport operatives a value of 179, transport equipment operatives a value of 209, laborers a value of 370, and service workers a value of 92.

The Workers' Compensation–based measure is likely to focus on truly job-related events (in distinction to the Thaler and Rosen measure), but will systematically undercount diseases not usually identified as occupation-related or not compensable as such under state laws. Once again, it will provide an adequate evaluation of racial differences unless black and white workers have different chances of being compensated for similar health problems. Differences of this sort may well occur, but are likely to work to the disadvantage of black rather than white workers. The Workers' Compensation–based risk measure will thus provide a conservative test of racial differences in occupational injuries and illnesses.

Jobs may also be grouped into industries as distinct from occupations. The most frequently used general measure of job-related risk is based on mandatory injury-reporting forms collected by the Bureau of Labor Statistics (BLS) (U.S. Department of Labor 1978) and published annually by industry at the one-through-four-digit Standard Industrial Classification (SIC) level. An example of a one-digit industry is durable goods manufacturing. It contains two-digit industries such as primary metals industries (SIC 33), which in turn contains three-digit industries such as blast furnaces and basic steel products (SIC 331), which in turn contains four-digit industries such as steel pipe and tools (SIC 3317).

The advantage of the BLS measure is that it is based on a large and representative sample of firms within each industry, and that the uniform reporting requirements allow for valid comparisons between industries and across years. The measure excludes, however, job-related

diseases which are not immediately recognized and reported as such by employers. The single greatest limitation of the measure is that, when used as a measure of the risk faced by particular workers within an industry, it requires the heroic assumption that the ratio of risk between industries is the same for all jobs and occupations within the industry. Nevertheless, the industry injury rates do provide direct insights into the significant differences in working conditions for large numbers of workers in different industries. In 1977, for example, the rate of injuries and illnesses resulting in at least one day lost from work was 51 per 1,000 employees in agriculture, forestry, and fisheries, 60 per 1,000 employees in mining, 59 per 1,000 in construction, 54 per 1,000 in durable goods manufacturing, 47 per 1,000 in nondurable goods manufacturing, 53 per 1,000 in transportation and public utilities, 29 per 1,000 in wholesale and retail trade, 8 per 1,000 in finance, insurance, and real estate, and 22 per 1,000 in the service sector.

Kotelchuck (1978) used the industry injury rate to obtain a broad measure of racial differences in job exposures. Assuming that white-collar workers in every industry face the same risk of injury as do all workers in the finance industry (where 95 percent of all employees are white-collar), he used data on the distribution of blacks and whites between blue- and white-collar occupations to estimate that blacks face a 37 percent greater risk of injury and 24 percent greater risk of death on the job than do whites. The more precise occupational-hazard measure used in this study indicates that Kotelchuck's estimates provide a lower bound for the true extent of racial risk differences.

Epidemiological studies may also be used to obtain insights into racial differences in hazard exposures and disease probabilities for workers. Surveys of the medical and epidemiological literatures by Davis and Rowland (1980) and Davis (1980) find the most unhealthy industries to be those in which black and other minority workers are disproportionately represented. For example, studies by the National Institute for Occupational Safety and Health indicate that black workers are one and one-half times more likely than whites to be severely disabled from job injuries and illnesses. Studies of the tire and steel industries found that black workers were both more heavily concentrated in the hazardous sections of those industries and experienced up to eight times the rates of cancer faced by white workers in the same plants. These studies are invaluable for providing in-depth investigations

of particular occupations and industries. They cannot, however, claim to provide a representative picture of the level of racial exposure and illness differences for the economy as a whole. Moreover, if the choice of firms and jobs for study is done on the basis of prior information about racial differences rather than at random, the epidemiological studies could overstate the overall extent of racial differences in the economy.

In conclusion, each of the available job-hazard measures contains important limitations, and, thus, no one source should be used as the sole basis for public policy directed at either the particular problem of racial inequality in job exposures or at the more general issue of measuring the extent of job hazards in the economy. Taken together, however, several of the available measures can be used to form a composite picture of the nature of the problem, as taken from different angles. If the various hazard measures tell a consistent story, then one may feel more confident in making assertions about the current distribution of jobs and workers as a basis for analyzing public choices. In the empirical section of this paper three measures will be used: the subjective hazard assessments reported by workers, the occupational risk measure based on state Workers' Compensation cases, and the rate of injuries by industry.

Information on Workers: Race, Education, and Experience

In seeking to understand patterns of job choice and discrimination, one needs information on the workers in the various jobs, occupations, and industries whose level of hazard has been measured in some way. Most obviously, one needs to know the race of the worker, but information on gender, years of education, and acquired skills will also be necessary to distinguish the effects of workplace discrimination from those of general social inequality. Survey data on individuals provide a rich source of information on a randomly selected sample of the working population that can be used directly to measure whether individual black workers are more often exposed to job dangers than are individual white workers. Unfortunately, most survey data sets do not distinguish between Hispanic and non-Hispanic Caucasians, or, if they do, include too few Hispanics to allow any meaningful statistical analysis of such ethnic differences in hazard exposure. This study thus focuses on differences between black and white workers.

Inclusion of Hispanic workers with the white sample may lead to underestimates of the full extent of ethnic differences in occupational exposures in the United States.

In deciding upon which survey data set to use, one inevitably confronts the tradeoff between the number of questions and the number of respondents. Surveys aimed at large numbers of people cannot for economy's sake ask each person many questions. Data sets that ask a lot of questions about working conditions, therefore, tend to have more restricted sample sizes, whereas large data sets only ask respondents for the name of the occupation and industry in which they are employed, and then code these by conventional census or SIC methods.

In the empirical section of this paper three survey data sets are used, one rich in hazard measures but offering only a modest number of respondents, and two others offering substantially larger sample sizes at the cost of fewer hazard measures.

The first survey data set used is the 1977 Quality of Employment Survey (QES), a random sample of those working 20 hours or more per week in the United States, conducted by the University of Michigan's Survey Research Center (Inter-University Consortium for Political and Social Research 1979). It asks 900 questions of 1,515 workers and is considered the richest source available of information about working conditions. Eight percent of the respondents are black.

Respondents to the Quality of Employment Survey were asked whether they are exposed to any of 13 different occupational hazards and, if so, to what extent. The 13 categories include exposure to hazardous chemicals, fire, fumes and dusts, extremes of temperature, dirty conditions, unsafely stored objects, inclement outdoor weather, loud noise, dangerous tools, risk of disease, risk of traffic accidents, risk of personal attack, or dangerous methods. In this study these questions are used to create 13 binary hazard measures that take the value of 1 if the respondent reports "significant" or "great" exposure to the particular hazard, and 0 otherwise. Two summary job hazard measures are created using these questions. The first is a binary variable that takes the value of 1 if the respondent reports "significant" or "great" exposure to at least 1 of the 13 hazards. The second is a continuous variable giving the number of "significant " and "great" hazards the worker reports (it hence has a range of between 0 and 13).

The QES includes the respondent's three-digit occupation and industry codes and, so, to each worker's job can be ascribed the average risk of its occupation, using the Workers' Compensation measure, and its industry, using the BLS rate of injuries and illnesses resulting in at least one day lost from work. The QES also contains information on the respondent's years of schooling, vocational education, tenure with current employer, and general labor market experience, along with the worker's sex. These variables will be used in the section distinguishing between the effects of general social inequality and those of discrimination.

The second data set is the year 1974 of the Panel Study of Income Dynamics (PSID), an ongoing survey of approximately 6,000 individuals reinterviewed on an annual basis, also by the University of Michigan's Survey Research Center (Institute for Social Research 1974). The PSID is a random sample of the entire adult United States population, not only of the workforce, and so a considerable number of respondents are excluded from the sample for present purposes due to being students, retirees, etc. The available sample size is 4,586, four times that available in the QES. Black workers are systematically oversampled by the PSID, and constitute 37 percent of the data. The PSID data thus provide much more reliable estimates for the black working population than does the QES.

If the PSID is richer than the QES in number of respondents, it is correspondingly poorer in available hazard measures. None of the job-hazard questions are asked, and so only the occupation and industry injury measures can be used (the year 1974 of the PSID was used as it is the last year in which the three-digit occupation code was included). Unfortunately, the respondents' industries are coded only at the two- rather than three-digit level; the industry injury rate is thus an even less precise measure of actual working conditions than it is in the QES. The PSID does contain education, trade school, tenure, experience, and sex variables similar to those in the QES.

The third data set employed is the May 1977 Current Population Survey (CPS), a sample of approximately 130,000 adults conducted by the Bureau of the Census (Inter-University Consortium for Political and Social Research 1982). After exclusion of the unemployed, those out of the labor force, the self-employed, and those in the public sector, the sample used in this study contained 34,388 individuals,

8 percent of whom were black. The CPS includes three-digit occupation and industry codes, and thus is capable of examining the distribution of black and white workers using the Workers' Compensation and industry injury-rate measures at the same level of detail as in the QES. Once again, however, the large sample size is obtained at the price of fewer explanatory variables. The CPS asks no questions about years of trade school, tenure with current employer, or total years of labor force experience. A potential work-experience variable is constructed for this study by subtracting years of education plus five from the respondent's age.

Statistical Evidence: Inequality or Discrimination?

Since blacks are observed to be in a disadvantaged position compared to whites when measures of earnings or general health status are used, one would expect to find them in the less agreeable and more dangerous jobs. Two sets of factors, however, complicate the analysis of racial exposure differences: the importance of other job characteristics besides hazard that influence which worker is hired into any particular job, and the necessity of distinguishing between the effects of general social inequality and those of racial discrimination in assignments to hazardous jobs per se. The first set of factors will be dealt with by examining racial differences in exposure to a wide variety of occupational hazards, and the second by using multivariate statistical techniques that allow one to distinguish between the effects of differences in education and those of discrimination per se in influencing the pattern of employment.

The Combined Effects of Inequality and Discrimination

The first question to be asked when considering racial inequality with respect to occupational safety and health is whether randomly selected samples reveal significantly different average probability and extent of exposure to hazards between black and white workers. To address this issue, the differences in mean values for the two racial groups are considered using the four basic measures of hazard: the presence of at least one "significant" or "great" job hazard, the number of "significant" and "great" job hazards faced, the Workers' Compensation-based measure of occupational risk, and the rate of injuries resulting

in at least one day lost from work for the respondent's industry. The self-identified job-hazard measures are only available on the QES, as discussed earlier. The composite job-hazard measures are then disaggregated to look at the 13 different types of hazard.

Table 1 presents mean values for the black and white samples of the 1977 QES, 1974 PSID, and 1977 CPS for the composite hazard measures, plus the appropriate *p* value for evaluating the statistical significance of the difference between them.

(The term "significant" is used in two ways in this paper. The first, and most directly statistical sense, concerns the probability that one would have observed an estimated statistical difference or coefficient

TABLE 1
Average Hazard Exposure Levels for Blacks and Whites: Analysis of 4 Composite Hazard Measures

Hazard Measures	Blacks	Whites	*p* value
1977 *Quality of Employment Survey*			
Occupational risk (1)	124.28	89.13	.0138
Injury rate (2)	37.47	36.99	.8614
At least 1 hazard (3)	0.470	0.371	.0524
Number of hazards (4)	1.55	1.01	.0168
N	115	1,376	—
1974 *Panel Study of Income Dynamics*			
Occupational risk (1)	150.92	98.33	<.0001
Injury rate (2)	33.65	35.34	.0052
N	1,595	3,278	—
1977 *Current Population Survey*			
Occupational risk (1)	135.46	99.01	<.0001
Injury rate (2)	39.19	38.39	.1096
N	2,817	30,908	—

Note: The third column presents the *p* value relevant for testing the null hypothesis of no difference between the probability or extent of exposure for blacks and whites. Measures of hazard are defined as follows: (1) Ratio of percent of compensated injuries to percent of all employment for the occupation of the average black and white worker; (2) Rate of injuries resulting in at least 1 day lost from work per 1,000 employees per year in the industry of the average black and white worker; (3) Proportion of black and white workers reporting presence of at least 1 "significant" or "great" hazard on the job; (4) Average number of "significant" or "great" hazards reported by black and white workers.

purely by chance, i.e., without there being any true effect of race or other worker characteristic on the probability a worker is exposed to job hazards or suffers a related injury or illness. Following conventional practice, a statistical effect is considered "significant" if there is less than 1 chance in 20 of it being solely due to such random variation, or, in statistical language, if it is significant at the 0.05 confidence level. The p values on tables 1 and 2 yield in a continuous fashion probabilities that the observed difference is due to random variation alone. That is, a p value of less than 0.05 means the observed difference is "significant" at the 0.05 confidence level; one less than 0.01 means the difference is significant at the 0.01 confidence level and thus has less than 1 chance in 100 of being due solely to random variation, etc. The second, and more important sense in which the term "significant" is used refers to the practical importance of the observed difference or coefficient on the real world of health, economics, etc. In this sense, an estimated effect is significant if it implies a substantive influence on health status and/or social status.)

Blacks are shown to face substantially higher risks of suffering from an injury or illness compensable by Workers' Compensation than are whites in all samples, and the differences are statistically significant at the 0.05 confidence level. According to the QES figures, the average black worker is in an occupation with a risk level 39 percent higher than that of the average white worker, whereas in the PSID the occupation of the average black worker is 52 percent more risky than that of the average white worker, and in the CPS it is 37 percent more risky. (Differences between data sets in the average risk levels for both blacks and whites are due to differences in the proportions of women in the samples, as will be discussed later.) A similar picture is obtained when the two summary subjective-hazard measures in the QES are used. Forty-seven percent of the black workers report themselves as exposed to at least one hazard, compared to 37 percent of the whites. The average number of "significant" and "great" hazards reported by blacks is 1.55, compared to 1.01 for whites.

The picture changes markedly, however, when one considers the industry injury-rate measure. The industry of the average black QES worker has an injury rate slightly higher than the industry of the average white QES worker, but the difference is far from meaningful either statistically or in health terms. In the PSID, the industry of the average black worker has an injury rate lower than that of the

average white worker, and that difference is statistically significant at the 0.05 level. In the CPS, blacks are in more dangerous industries, but the difference is not statistically significant.

Table 2 presents the proportions of the black and white QES samples that report "significant" or "great" exposure to each of the 13 particular job hazards. This table records the considerable diversity in exposures behind the overall job-hazard measures. Blacks are observed to be exposed more often than are whites to 10 of the 13 hazards, but the differences are statistically significant at the 0.05 level only in the cases of extreme temperature, dirty conditions, loud noise, and risk of disease. Whites report more often than blacks being exposed to hazardous chemicals, dangerous tools, and risk of traffic accidents, but none of these differences is significant statistically at the 0.05 level.

Taken together, these findings indicate that black workers in general face more hazardous conditions than do their white counterparts, but also that the pattern is more complex than one might have imagined.

TABLE 2
Average Hazard Exposure Levels for Blacks and Whites: Analysis of 13 Particular Hazards

Hazards	Blacks	Whites	*p* value
1977 *Quality of Employment Survey*			
Toxic chemicals	0.052	0.053	.9602
Danger of fire	0.077	0.060	.7948
Fumes, dust, and gas	0.190	0.120	.0872
Inclement weather	0.130	0.096	.2714
High temperature	0.233	0.088	<.0001
Dirty conditions	0.164	0.065	.0014
Unsafe storage	0.061	0.043	.3844
Loud noise	0.224	0.109	.0048
Dangerous tools	0.060	0.086	.0262
Infectious disease	0.146	0.067	.0104
Traffic accidents	0.077	0.104	.2072
Rise of attack	0.070	0.067	.8886
Unsafe methods	0.060	0.057	.8886
N	115	1,376	—

Note: The third column presents the *p* value relevant for testing the null hypothesis of no differences in probability of exposure for blacks and whites.

The greater exposure of whites to several of the job hazards and their higher average industry injury rate in the PSID indicate the importance of skill and earnings factors for the distribution of workers between jobs with different working conditions.

The Separate Effects of Inequality and Discrimination

Since differences between blacks and whites in levels of education and on-the-job training should influence their relative probabilities of facing job hazards, even in the absence of discrimination, it is necessary to examine whether the observed differences in exposure persist after controlling for education and training differences. Tables 3 through 5 present estimated coefficients and standard errors from the regression of the four basic hazard measures used in the QES and the two measures

TABLE 3
Racial Discrimination and Job Hazards: The Workers' Compensation Measure of Occupational Risk

	Quality of Employment Survey	Panel Study of Income Dynamics	Current Population Survey
Black	28.245	30.56	23.67
	(10.64)	(3.78)	(1.95)
Female	−56.596	−56.71	−54.87
	(6.26)	(4.47)	(1.07)
Education	−15.094	−14.58	−14.15
	(1.17)	(0.61)	(0.21)
Experience	−0.961	−0.75	−0.90
	(0.28)	(0.16)	(0.04)
Trade school	10.921	−3.97	—
	(3.37)	(3.90)	
Tenure	−0.580	0.07	—
	(0.47)	(0.25)	
Intercept	326.146	299.62	312.00
	(17.07)	(9.59)	(3.08)
R^2	0.19	0.20	0.19
N	1,196	4,265	31,150

Note: The dependent variable is the ratio of the percent of total injuries accounted for by the worker's occupation to the percent of total economy employment accounted for by the occupation (Root and Sebastian 1981).

TABLE 4
Racial Discrimination and Job Hazards: Two Self-reported Measures of Job Risk in the 1977 Quality of Employment Survey

	Presence of At Least 1 Hazard	Number of Hazards Reported
Black	0.499	0.542
	(0.21)	(0.19)
Female	−0.631	−0.734
	(0.13)	(0.11)
Education	−0.081	−0.110
	(0.02)	(0.02)
Experience	−0.015	−0.019
	(0.01)	(0.01)
Trade school	0.029	0.125
	(0.07)	(0.06)
Tenure	0.013	0.013
	(0.01)	(0.01)
Intercept	0.903	2.926
	(0.35)	(0.31)
R^2	—	0.07
−2 log L	1,651	—
N	1,276	1,276

Note: The dependent variable in the first column is a dichotomous variable taking the value of 1 if the worker reports the presence of at least one "significant" or "great" hazard on the job, and 0 otherwise. The dependent variable in the second column is the number of "significant" and "great" hazards the worker reports.

available in the PSID and CPS on a number of variables likely to influence probability of exposure. In addition to years of schooling, vocational training, tenure with current employer, and general experience in the labor market, the analysis includes a gender variable which equals 1 if the respondent is female (0 otherwise) and a race variable that takes the value 1 if the respondent is black (0 otherwise). The vocational training and tenure variables are not available for the CPS. The gender variable is employed to account for the strong influence of sex-roles on assignment of workers to different jobs which would conceal racial differences, since there are unequal proportions of men and women in the different surveys. Once education, experience, and gender differences between the black and white samples are accounted for, the residual influence of race per se (the estimated coefficient on

TABLE 5
Racial Discrimination and Job Hazards: The Industry Injury Rate

	Quality of Employment Survey	Panel Study of Income Dynamics	Current Population Survey
Black	0.95	−3.06	0.29
	(2.18)	(0.62)	(0.48)
Female	−17.85	−15.40	−15.28
	(1.30)	(0.70)	(0.26)
Education	−2.33	−1.91	−1.83
	(0.24)	(0.10)	(0.05)
Experience	−0.13	−0.17	−0.03
	(0.06)	(0.03)	(0.01)
Trade school	−0.44	−0.54	—
	(0.70)	(0.64)	
Tenure	−0.28	0.12	—
	(0.10)	(0.04)	
Intercept	74.30	63.35	67.51
	(3.56)	(1.52)	(0.76
R^2	0.19	0.18	0.13
N	1,196	4,586	31,150

Note: The dependent variable is the rate of injuries resulting in at least 1 day lost from work per 1,000 employees per year in the worker's industry (U.S. Department of Labor 1978).

race) is taken as illustrative of the effects of racial discrimination in assignment of workers to jobs with different hazard levels.

Since the variable measuring presence of at least one hazard is in binary form, the linear model is inappropriate, and the variable was fit to the logistic distribution, whose parameters were then estimated by a maximum likelihood technique. While the coefficient in the ordinary least squares (OLS) regression technique used for the regressions with the other risk measures directly yields the impact on the dependent variable of a 1 unit change in the independent variable, for the logistic distribution the appropriate formula is

$$dH/dX = bH(1-H)$$

where H is the hazard measure, X is the independent variable under consideration, b is the estimated logistic coefficient on X, and $H(1-H)$ is evaluated at the sample mean of the risk variable. Thus, in order to be compared with the OLS coefficients in the other column

of table 4, those in the first column need to be divided by 4, since the average probability of exposure to at least one hazard on the job is 0.38, and, thus, $H(1-H)$ is 0.24.

The coefficient on race in the occupational injury and illness regression in table 2 reveals the continuing strong influence of race on the likelihood a black worker is in a dangerous occupation. The effect of race, after controlling for gender, education, and work experience differences, is to increase the relative injury ratio of the average worker's occupation by 28 points in the QES, 31 points in the PSID, and 24 points in the CPS, figures quite significant in health as well as statistical terms. Taking into account the determinants of occupational choice reduces the impact of race by substantially less than half from the differences in means observed in table 1. The coefficients on race in the three regressions are very similar, lending added confidence to their interpretation as measures of the extra risk faced by black workers in the entire population. Thus, while inequality in access to education and on-the-job experience leads to the greater presence of black workers in hazardous occupations, it cannot explain the greater part of the observed differences, suggesting that on-the-job discrimination also plays an important role.

The coefficients on the other independent variables in the occupational risk regressions are generally consistent with the studies of restriction of women to the relatively safe, though low-paying, white- and pink-collar occupations, and of the effects of skill on the probability of workers facing hazards on the job. Women are found in significantly less hazardous occupations than men, with occupational risk values being 54 to 56 points less than those of men with similar ethnic, education, and experience characteristics. Greater years of formal education and general labor-market experience give workers access to safer jobs, with an additional year of education reducing occupational risk levels faced by 15 points and an additional year of labor force experience reducing them by slightly less than 1 point. The coefficients on gender, education, and experience are almost identical in the QES, PSID, and CPS regressions. The coefficients in the QES and PSID on years of trade school and tenure with current employer are ambiguous. Greater years of trade school increase the probability of employment in a high-hazard occupation in the QES sample but decrease it in the PSID, while greater years of tenure decrease that probability in the QES while increasing it in the PSID. Most of these coefficients are

not significantly different from 0, however, indicating that the effects of schooling and on-the-job skill acquisition are mainly caught by the education and experience variables.

The coefficient on race in the dichotomous job-hazard equation, presented in the first column of table 4, is positive and statistically significant. According to this estimate, the separate effect of race is on average to raise the probability that a black worker will face at least one hazardous condition on the job by 12 percentage points. Controlling for gender, education, and experience increases rather than decreases the observed effect of race. This counterintuitive result is explained by the greater percentage of women in the black as compared to the white QES samples, which artificially depresses the impact of race on hazard in the comparison of means reported in table 1. The coefficients on the other independent variables are consistent with those in the occupational risk regressions.

Race has a strong effect on the number of hazards workers report facing on their jobs. In the second column of table 4, blacks are observed to face 0.54 more hazards than whites, a figure statistically significant. Controlling for gender, education, and experience has no appreciable impact on the effect of race, since the difference in means of the number of hazards variable for blacks and whites is reported in table 1 as precisely 0.54. The coefficients on the other independent variables are consistent with those in the first column.

The coefficients on race in the industry injury rate regressions, presented in table 5, are similar to the estimated differences in mean values for blacks and whites discussed earlier. The QES and CPS coefficients are positive but not statistically significant at the 0.05 level, while that in the PSID (where injury rates are measured only at the two-digit level) is negative and significant. Taking account of differences in gender, education, and experience does not appear to affect racial differences in choice of industry.

The regression results are thus consistent with the comparison of means in finding that black workers are overrepresented in the more hazardous jobs and occupations in the economy, and extend the comparison of means by finding that the observed differences cannot be explained solely by differences in access to education and experience. The results continue, moreover, to find that the pattern of inequality does not extend to choice of industry. Depending on which data set is used, the results suggest that blacks and whites are evenly distributed

between safe and hazardous industries or, in fact, that whites may be somewhat more commonly found in hazardous industries. The job and occupation results indicate that whites are not in the more hazardous employments within those industries, however.

Other research conducted by the author (Robinson 1984) indicates that this lack of overrepresentation by industry is due both to the heterogeneity of industry jobs with respect to working conditions and to other aspects of hazardous industries that make some of their jobs desirable to white workers. While the two-digit PSID data show blacks to be in safer industries than whites, and the three-digit QES and CPS data show them to be in slightly more hazardous industries than whites (without the difference being statistically significant), aggregate data at the detailed four-digit level within the manufacturing sector show that black workers are significantly overrepresented in the more hazardous industries. While workers in more hazardous occupations are found to earn less than those in safer occupations, even holding constant race, education, and other relevant variables, workers in more hazardous industries earn more than workers in safer industries. When the percentage of the industry that is unionized is held constant, however, this positive wage effect is substantially reduced. These results indicate that white workers accept jobs in more hazardous industries because unions have organized those industries and raised the wages, but that black workers are still found in the most hazardous and lowest paid occupations within those industries.

Summary and Policy Implications

Differential exposure to risk of injury and illness on the job is an important component of racial inequality in the United States. The statistical evidence presented in this paper indicates that the average black worker is in an occupation 37 to 52 percent more likely to produce a serious accident or illness than the occupation of the average white worker. To the extent that safe and healthy working conditions are considered part of the wages of labor, measures based solely on differences in monetary earnings will thus underestimate the full extent of social inequality. These findings also provide insights into one of the pathways by which differences in social and economic status translate themselves into differences in health status.

As the continuing strong effects of race in the multivariate analyses

indicate, however, the concentration of black workers in the more hazardous jobs and occupations in the economy is not solely the result of general patterns of racial inequality that limit the access of blacks to education and good on-the-job training programs. The findings suggest that black workers with the same levels of education and experience as whites will, on average, find themselves in substantially more dangerous occupations. If society is seriously committed to reducing racial differences in health status, then it must consider active policies to reduce existing patterns of discrimination in the workplace.

A precedent exists in the 1974 consent decree between the federal government, the steelworkers union, and nine steel companies mandating various changes in training and promotion policies that operated to the detriment of black workers in the basic steel industry. Ichniowski (1983) describes how the restriction of seniority systems governing promotion and thereby training possibilities to the department level prevented black workers from rising out of the more menial and hazardous occupations to other job progressions offering better wages and working conditions. In order to make such a transfer, the worker would have to renounce accumulated seniority and begin again at the bottom-level job in the new department. Black workers would thus rise to the top of job progressions in certain departments but be successfully prevented from obtaining further improvements via transfer to departments offering continued chances for training and promotion. Consistent with the more general statistical findings of this paper, black and white workers with the same number of years of education and job experience could therefore face substantially different working conditions depending on the job progression to which they were originally assigned. The 1974 consent decree required, among other things, that seniority accumulate on a plant-wide rather than a department-wide basis, thereby allowing transfers between job progressions without total loss of accumulated privileges.

Davis (1980) advocates two legal strategies utilizing existing governmental agencies which have heretofore not been very involved in occupational health and safety. Equal Employment Opportunity Commission Title VII complaints could be issued against employers for injuries or illnesses caused by discriminatory employment practices. National Labor Relations Act "unfair labor practice" charges could

be initiated against employers who promote or acquiesce in discriminatory practices which result in injury or disease.

In conclusion, the findings presented in this paper suggest that, in the area of occupational safety and health at least, problems of health policy and of industrial-relations policy are closely interrelated. Governmental efforts to reduce racial inequality need to pay attention to discrimination related to working conditions as well as that related to wages, and equal opportunity policies should be coordinated with occupational health and safety programs. Affirmative-action plans should be examined to ensure that they do not allow the assignment of minority workers in disproportionate numbers to the more hazardous jobs and occupations within the firm. Time series data on racial differences in exposure to hazards on the job could be developed as a means of evaluating the success of governmental and private-sector efforts to reduce employment discrimination. Finally, if enforcers of the Occupational Safety and Health Act seek to target its efforts on those workers most likely to suffer a preventable job-related injury or disease, they might pay particular attention to those occupations in which black workers are especially likely to be found.

References

American Public Health Association. 1982. *Health of Minorities and Women.* Pub. no. 072. Washington.

Davis, M. 1980. The Impact of Workplace Health and Safety on Black Workers: Assessment and Prognosis. *Labor Law Journal* 31(12):723-32. Reprinted in *Occupational Safety and Health,* ed. F. Goldsmith and L. Kerr, 199–212. New York: Human Sciences Press, 1982.

Davis, M., and A. Rowland. 1980. Occupational Disease among Black Workers: An Annotated Bibliography. Berkeley: University of California, Labor Occupational Health Program.

Ichniowski, C. 1983. Have Angels Done More? The Steel Industry Consent Decree. *Industrial and Labor Relations Review* 36(2):182–98.

Institute for Social Research. 1974. *A Panel Study of Income Dynamics: Procedures and Tape Codes.* Ann Arbor: University of Michigan Press.

Inter-University Consortium for Political and Social Research. 1979.

Quality of Employment Survey, 1977, Cross-Section. Pub. no. 7689. Ann Arbor: University of Michigan Press.

———. 1982. *Current Population Survey. May 1977.* Pub. no. 7967. Ann Arbor: University of Michigan Press.

Kotelchuck, D. 1978. Occupational Injuries and Illness among Black Workers. *Health PAC Bulletin* 81–82 (April):33–34.

Lazear, E. 1979. The Narrowing of Black-White Wage Differentials Is Illusory. *American Economic Review* 69(4):553–64.

Lucas, R. 1974. The Distribution of Job Characteristics. *Review of Economics and Statistics* 56(4):530–40.

Reich, M. 1981. *Racial Inequality.* Princeton: Princeton University Press.

Robinson, J. 1984. Work and Health: An Economic and Policy Analysis. Ph.D. diss, University of California, Berkeley.

Root, N., and D. Sebastian. 1981. BLS Develops Measure of Job Risk. *Monthly Labor Review* 102(1):26–30.

Thaler, R., and S. Rosen. 1975. The Value of Saving a Life: Evidence from the Labor Market. In *Household Production and Consumption,* ed. N. Terleckyj, 265–302. New York: National Bureau of Economic Research.

U.S. Department of Health, Education, and Welfare. 1979. *Health Status of Minorities and Low-income Groups.* HRA pub. no. 79-627. Washington.

U.S. Department of Labor. 1978. *Occupational Injuries and Illness by Industry, 1977.* Bulletin no. 2047. Washington: Bureau of Labor Statistics.

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