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Title
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Permalink
https://escholarship.org/uc/item/7k30z0nj

Journal
Industrial Relations, 27(2)

ISSN
0019-8676 1468-232X

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Publication Date
1988-03-01

DOI
10.1111/j.1468-232X.1988.tb01004.x

Peer reviewed

Hazardous Occupations Within the
Job Hierarchy

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Firms using hazardous technologies face strong incentives to reduce job skill and training requirements so as to minimize the level of compensating wage differentials they must pay. This note examines the outcome of this process in terms of the location of hazardous occupations within the overall structure of jobs. Using four independent sources of data for the period 1974 to 1982, hazardous occupations are found to offer significantly less worker autonomy, less on-the-job training, poorer promotion possibilities, greater risk of temporary and permanent layoff, and lower wage levels than safe occupations.

WHEN CONSIDERING ALTERNATIVE JOB POSSIBILITIES, workers will select safe positions over hazardous ones unless offered offsetting desirable features in the hazardous positions. Hazardous occupations therefore might be expected to offer greater autonomy, promotion possibilities, employment security, and earnings levels than safe occupations, controlling for skill requirements. For most jobs, however, skill requirements are not determined solely by technological factors; they also reflect social and organizational features of the employment relation. Firms possess considerable latitude in assigning particular jobs to particular positions within the internal labor market and in deciding which jobs to subcontract to other firms. This note investigates the tendency for firms to minimize the extent of compensating wage and nonwage differentials they must pay to workers in hazardous positions by assigning these occupations to undesirable job ladders or subcontracting them to secondary labor market firms.[1]

A Dual Theory Framework

The theory of compensating differentials, as argued originally by Adam Smith, holds that labor market competition will ensure that jobs viewed as undesirable in one dimension will offer offsetting desirable features in other dimensions. A large econometric literature has developed that seeks to measure the relationship between two particularly important job characteristics, safety hazards and wages, controlling for the characteristics of the workers employed in each position.

Formal models of labor market response to job hazards have emphasized that workers will be sorted among jobs with different levels of hazard according to the workers' levels of skill and wealth. Thaler and Rosen (1975) and Viscusi (1978) argue that each worker's supply price for jobs with hazardous conditions increases with the level of the worker's expected utility, in turn depending on marketable skills and available assets. Socially advantaged workers require higher wage differentials per unit of hazard endured than socially disadvantaged workers, and hence the former are unlikely to be found in hazardous jobs. Empirical studies have found that black workers, young workers, less educated workers, and workers with few assets are substantially overrepresented in hazardous jobs (see Lucas, 1974; Viscusi, 1978; Robinson, 1984). This suggests that the total association between hazardous conditions on the one hand and wage rates and other desirable job characteristics on the other hand will be negative rather than positive.

This focus on the total association between wages and working conditions may be interpreted as a modern extension of John Stuart Mill's theory of noncompeting groups, much as theories of hazard pay are modern extensions of Adam Smith's doctrine of compensating differentials. In *The Principles of Political Economy* (1848), Mill comments directly upon Smith's theory:

> These inequalities of remuneration, which are supposed to compensate for the disagreeable circumstances of particular employments, would, under certain conditions, be natural consequences of perfectly free competition; and as between employments of about the same grade, and filled by nearly the same description of people, they are, no doubt, for the most part, realized in practice. But it is altogether a false view of the state of the facts, to present this as the relation which generally exists between agreeable and disagreeable employments. The really exhausting and the really repulsive labours, instead of being better paid than others, are almost invariably paid the worst of all, because performed by those who have no choice.... The more revolting the occupation, the more certain it is to receive the minimum of remuneration, because it devolves on the most helpless and degraded,

on those who from squalid poverty, or from want of skill and education, are rejected from all other employments.

As Mill argues, the noncompeting groups and compensating differentials theories can both be true. The typical hazardous industry may offer less worker autonomy, promotion possibilities, employment security, and earnings than the typical safe occupation, while simultaneously offering higher earnings than an (untypical) safe occupation that has identical skill requirements. The compensating differentials theory focuses on the way in which competitive markets yield equal overall returns to individuals with equal initial endowments. The noncompeting groups theory focuses on the way in which competitive markets yield unequal overall returns to individuals with unequal initial endowments.

Job Characteristics

Four types of job attributes, in addition to health and safety hazard, are considered here.

Job content and worker autonomy. General education and experience provide some workers with specific skills useful in the production process. Additionally, education and experience may provide workers with more developed decision-making ability and internal motivation. To the extent employers using hazardous technologies seek to reduce their reliance on educated and experienced employees, they will seek to reduce the degree of latitude individual workers possess in completing their tasks. To the extent possible, jobs will be broken into homogenous tasks whose outcomes can be evaluated easily; variety in tasks will be reduced; and worker control over work pace and task sequence will be narrowed. Employer-determined rules rather than employee initiative will govern the work process.

Possibilities for training and promotion. Acquisition of firm-specific skills gives workers enhanced bargaining power, since a separation would cost the firm the value of its training investment. Other things equal, workers with more extensive on-the-job training will be able to command higher wage premiums per unit of hazard faced than will workers with less training. Firms can hold down their expected hazard-related costs by reducing the degree of on-the-job training required in hazardous jobs. This in turn will reduce the incentive to create promotion ladders that conserve training investments.

Job security. Extent of investment in worker training is the central element in microeconomic theories of layoffs and job security (Oi, 1962; Parsons, 1972; Mortenson, 1978). Firms that rely on temporary layoffs in adjusting to product demand fluctuations run the risk of losing their laid off employees to competitors. The cost to the firm of losing an employee who does not return when recalled varies directly with the extent of on-the-job training that worker has received. Hazardous occupations are thus predicted to manifest a more volatile employment pattern than are safe ones. To the extent hazardous occupations are concentrated in secondary labor market firms where bankruptcy is a common occurrence, they will be subject to higher rates of permanent as well as temporary layoffs than will safe occupations.

Earnings. The existing econometric literature focuses on the partial correlation between hazard and wages, after controlling for worker education, age, job tenure, and other characteristics that measure the level of general and firm-specific skill needed to perform the job (Smith, 1979; Brown, 1980). The foregoing discussion suggests that economic forces play as important a role in determining the total association between wages and working conditions as they do in determining the partial association.[2] The lower levels of general and firm-specific human capital required in hazardous occupations will guarantee that these positions pay generally low rather than high wages.

Data and Methods

Four independent sources of statistical data were used to measure the association between health and safety hazard and the other job characteristics. The best source of information on job attributes is the 1977 Quality of Employment Survey (QES), a cross-sectional survey of workers (N = 1,380) that includes workers' perceptions of specific job characteristics. A second source was achieved by pooling the samples (N = 5,174) from the 1978 Young Men's National Longitudinal Survey (NLS) and the 1980 Young Women's National Longitudinal Survey, both of which contain questions concerning working conditions, but neither of which alone provides a representative mix of jobs and occupations.[3] A third source of data was obtained from the 1974 year of the Panel Study of Income Dynamics (PSID;

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[2] The existing economic literature on occupational safety and health includes only one study (Thaler and Rosen, 1975) that reports the total association between hazard and wages.

[3] Each survey asked the identical set of questions, was conducted within two years of the other, and had a similar age mix (26–37 for men in 1978; 26–39 for women in 1980).

N = 4,452). The year 1974 was chosen because, at the time this study was conducted, it was the only year available that contained three-digit census occupation codes. (The PSID has resumed using three-digit occupation codes in recent years.) Finally, a data set composed of 420 four-digit manufacturing industries was created based on published figures for 1977.[4]

Method. This study uses two types of variables to control for the fact that different workers may consider the same job attribute to be either attractive or unattractive. For those job characteristics where no major differences in worker valuation are to be expected (health and safety hazard, layoff probabilities, earnings) quantitative measures of the level of the characteristic are used. Other characteristics are measured using dichotomous variables that take the value of one if the worker currently in the job views the characteristic as undesirable, and zero otherwise. This approach ensures that no job attribute will be misclassified.

The econometric literature on compensating differentials employs multivariate regression estimators that assign one characteristic the role of left-hand variable and all the other measurable job (and worker) characteristics the role of right-hand variables. Here, the method is much simpler. Jobs (industries in the case of the manufacturing data) were sorted according to their values on the hazard to health and safety job characteristic. Employments were classified as either high hazard or low hazard. Mean values for each of the other job characteristics were then calculated for the high and low hazard samples separately, and conventional comparison of means tests were performed. This procedure yields the same essential information as univariate regressions that exploit differences in hazard levels within the high and low hazard samples.

Variables

Hazard. The measure of health and safety hazard is derived from 1978 Workers' Compensation claims data for 25 states that participate in the Supplementary Data System of the Bureau of Labor Statistics (see Root and Sebastian, 1981). Three-digit census occupation codes are assigned index

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[4] Since the three worker-level data sets query respondents concerning their occupation, individual observations can be assigned directly to the hazardous and safe samples. Manufacturing industries were assigned to the hazardous and safe categories based on their occupational mix. Occupational mix was measured using data on 22,525 manufacturing workers responding to the May 1977 and May 1978 Current Population Surveys (CPS). As the CPS codes industry information according to three-digit census industry codes, a crosswalk was employed to match the SIC industry data to these categories. Four-digit SIC industries were defined as hazardous or safe based on the occupational mix of the three-digit industry that contains them.

values, representing the ratio of claims volume to employment volume accounted for by the occupation. Occupations are defined here as hazardous if the fraction of total compensation claims for which they account is greater than or equal to their share of total employment. Conversely, if they account for a smaller fraction of claims than of employment, they are defined as safe occupations.[5]

Job content and worker autonomy. The QES contains questions that elicit the worker's perceptions of the extent of intrinsic satisfaction to be obtained from the work process itself and the extent of control he or she may exert over various dimensions of the workplace environment. Dichotomous variables were constructed that take the value one if the respondent emphatically describes the job as (1) uncreative, (2) monotonous, or (3) meaningless; if the worker has no significant control over: (4) job duties, (5) work pace, or (6) hours of work; and, finally, (7) if the job involves "rules and regulations governing everything I might do or say." Negative or only mildly affirmative answers to these questions are coded as zeros.

Location within the job hierarchy. Possibilities for on-the-job training and promotion within the firm are defining characteristics of jobs located in well-functioning internal labor markets (Doeringer and Piore, 1971). The QES and NLS contain two questions that shed light on the position of a particular job within the internal labor market. These questions are coded as dichotomous variables indicating whether the worker strongly feels that (1) no valuable skills are being learned and (2) promotion possibilities are poor.

Job security. Each of the four data sets provides information on the degree of employment security. The QES and NLS permit the construction of dichotomous variables indicating whether or not the worker perceives overall job security to be especially poor. The NLS and PSID longitudinal data sets permit the calculation of probabilities of permanent layoff, using information on actual job loss between consecutive interviews. The QES asks respondents whether they expect to be permanently laid off over the next several years. The manufacturing industry data set allows calculation of annual rates of temporary layoffs and permanent layoffs.[6]

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[5] This "objective" measure of hazard, not dependent on worker valuations, eliminates problems potentially plaguing studies that compare job characteristics where all valuations are subjective. In practice, however, similar results were obtained for the QES and NLS data sets when jobs were classified according to whether or not the incumbent workers viewed them as hazardous (worker-perceived hazard measures were not available in the PSID and manufacturing data sets).

[6] Temporary layoffs are defined in this study as those resulting in a recall within the same year, while permanent layoffs are defined as those not resulting in a recall within the same year. Rates of layoffs and recalls were obtained from *Employment and Earnings* for 1977.

Earnings. Average hourly earnings were obtained from the NLS and PSID data sets. The QES does not allow calculation of average hourly earnings for those workers not paid on an hourly basis. In order to obtain a representative earnings measure for this data set, annual earnings were employed. Two wage measures were obtained for the manufacturing industry data. Average hourly earnings for all workers in each of the manufacturing industries were calculated from the May 1977 and 1978 CPS tapes. Average hourly earnings for production and nonsupervisory workers in each industry were obtained from *Employment and Earnings* for 1977.

Results of Comparison of Means Tests

Table 1 presents the percentages of QES workers in hazardous and safe occupations, respectively, who describe their jobs as providing few possibilities for worker creativity or autonomy. Occupations that account for a greater fraction of injuries than of employment are perceived as worse than occupations responsible for relatively few injuries, using each of the seven measures. The strength of the association varies considerably, however. Workers in hazardous occupations are over one-and-one-half times as likely as workers in safe occupations to describe their jobs as uncreative, monotonous, meaningless, and as providing no worker control over work pace. They are 10–20 per cent more likely than are workers in safe positions to report no control over job duties and to describe work rules as pervasive. They are only 8 per cent more likely to report no control over work hours; this difference is not statistically significant.

TABLE 1
JOB CONTENT AND WORKER AUTONOMY IN HAZARDOUS AND SAFE OCCUPATIONS (1977 QES)

	Hazardous occupations	Safe occupations	T[a]
Uncreative work	52.6%	27.7%	10.4
Monotonous work	23.5%	8.2%	9.6
Meaningless work	12.0%	6.9%	3.5
No control over work duties	58.0%	49.7%	3.2
No control over work place	23.1%	15.1%	4.1
No control over work hours	24.8%	22.9%	0.8
Rules governing everything	50.6%	46.2%	1.7

[a] T statistics are derived from comparison of means tests of the null hypothesis: no difference between hazardous and safe occupations in possibilities for task variety or worker autonomy.

Differences between hazardous and safe occupations in terms of on-the-job training and promotion possibilities are indicated in Table 2. QES and NLS workers in hazardous occupations are considerably less likely to receive on-the-job training than are workers in safe occupations. They less often report the availability of promotion possibilities, although the differences are smaller than in the case of on-the-job training and are not statistically significant for the NLS. Interestingly, substantially more workers in both surveys report opportunities for on-the-job training than for meaningful promotions.

TABLE 2

POSSIBILITIES FOR ON-THE-JOB TRAINING AND PROMOTION IN HAZARDOUS AND SAFE OCCUPATIONS

	Hazardous occupations	Safe occupations	T[a]
No valuable skills are learned			
1978–1980 NLS	36.4%	24.6%	11.2
1977 QES	26.4%	10.0%	9.4
Promotion chances are poor			
1978–1980 NLS	51.6%	49.6%	1.3
1977 QES	62.8%	52.9%	3.6

[a] T statistics are derived from comparisons of means tests of the null hypothesis: no difference between hazardous and safe occupations in possibilities for training or promotion.

Table 3 uses all four data sets to describe the extent of employment security in hazardous and in safe occupations. QES and NLS workers in hazardous occupations are 20 to 50 per cent more likely to describe their jobs as generally insecure than are workers in safe occupations. Rates of permanent layoffs range from 70 to 180 per cent higher in hazardous than in safe occupations. The rate of temporary layoffs in manufacturing industries in 1977 was over twice as high in those containing a disproportionate fraction of employment in hazardous occupations than in those containing a disproportionate share of employment in safe occupations.

Table 4 presents mean hourly wages and annual earnings for hazardous and safe occupations. Consistent with the hypothesis that general and firm-specific skill requirements are kept low in dangerous jobs, rates of wages and annual earnings are 5 to 25 per cent lower in hazardous than in safe occupations. Competitive pressures do generate compensating wage differentials among jobs with relatively similar skill requirements, as Adam Smith argued, but in hazardous occupations, the general tendency is for firms to structure skill requirements so as to be able to pay low rather than high wages.

TABLE 3
JOB SECURITY AND LAYOFFS IN HAZARDOUS AND SAFE OCCUPATIONS

	Hazardous occupations	Safe occupations	T[a]
Job security is poor			
1978–1980 NLS	24.4%	20.6%	3.0
1977 QES	30.9%	21.5%	4.2
Per cent permanently laid off			
1978–1980 NLS	10.3%	3.7%	8.2
1974 PSID	6.2%	2.9%	5.7
1977 Manufacturing	3.2%	1.9%	7.4
Per cent expecting permanent layoff			
1977 QES	17.9%	13.4%	2.5
Per cent temporarily laid off			
1977 Manufacturing	11.1%	4.7%	13.6

[a] T statistics are derived from comparisons of means tests of the null hypothesis: no difference between hazardous and safe occupations in job security or layoff probabilities.

TABLE 4
HOURLY WAGES AND ANNUAL EARNINGS IN HAZARDOUS AND SAFE OCCUPATIONS

	Hazardous occupations	Safe occupations	T[a]
Hourly wage			
1978–1980 NLS	$ 6.11	$ 6.40	2.2
1974 PSID	$ 4.68	$ 5.86	9.9
1977 Manufacturing (all workers)	$ 5.32	$ 6.69	8.7
1977 Manufacturing (production workers)	$ 5.30	$ 5.97	6.4
Annual earnings			
1977 QES	$12,583	$14,669	2.0

[a] T statistics are derived from comparison of means tests of the null hypothesis: no difference between hazardous and safe occupations in hourly wages or annual earnings.

Conclusions

The theory of compensating differentials states that labor market competition will equalize the value of jobs throughout the economy. Other things equal, hazardous jobs must pay higher wages, offer better employment security, and provide other superior characteristics relative to safe jobs in order to attract workers. Other things are not equal, however. In particular, workers differ markedly in their levels of work-related skill and social status. The labor market responds to this heterogeneity in worker "values" by

producing a corresponding heterogeneity in job values. As documented in this note, hazardous jobs tend to be uncreative, rigid, insecure, and low-paid positions that offer few training and/or promotion possibilities compared to safe jobs. It is unlikely that this clustering of undesirable job characteristics stems only from technological factors. Rather, it is at least partly attributable to the influence of general labor market factors on the structuring of job hierarchies within individual firms and on the decisions firms make regarding which jobs to subcontract.

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