The relation of age to workplace injuries

Job risk patterns do not vary with age for temporary disabilities, but workers 65 and older are more likely to suffer permanent disabilities and fatalities; age effects are robust to controls for industry and occupation

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Do work-related illness and injury (job risk) rates differ significantly by age? If so, are the patterns dependent on the job-related risk in question? Are age and job risk profiles invariant to controls for workers' occupations and industries?

To answer these questions, we combined 1981 illness and injury incidence data from workers' compensation reports with exposure data from the 1980 U.S. census. These data contain detail on workers' health problems and the jobs on which they experienced the problems, thus permitting us to investigate how occupational risk varies by age, industry, and occupation. According to our research, age is positively and significantly correlated with some forms of workplace risk; job-related temporary disabilities do not vary with age, but employees age 65 and over are more likely to suffer permanent disabilities and fatalities on the job; and age effects are not simply the result of job differences between older and younger workers, because the findings prove robust to the inclusion of controls for industry, occupation, and other variables.

Illness and injury risk

Some studies hold that older workers have a lower incidence of job injuries, compared with younger workers, but tend to sustain more severe impairments when injuries do occur.[1] However, analysts have encountered several problems in proving this claim statistically.

One problem in assessing the age-job risk relationship is the difficulty of measuring "poor health."[2] Because reports of health problems severe enough to warrant medical attention are often regarded as the most reliable indicators, this study uses data on reported illnesses and injuries, rather than workers' self assessments, to estimate the age-job risk relationship.

Another problem is that most previous studies do not test whether age and risk patterns covary statistically.[3] We rectify this drawback by testing for such variances.

Also, many studies do only a cursory job of holding other factors constant. This implies that observed negative relationships between age and the incidence of job-related health problems may be robust to the inclusion of other variables correlated with age.[4] We evaluate the link between age and workplace injury and illness, controlling for occupation, industry, and several other factors.

The data

Most analysts would agree that job risk measures of most interest include incidence (frequency of cases per unit of exposure) and severity (the extent to which health and safety problems are disabling, and for how long). However, nationally representative data on occupational risk are unavailable. Therefore, we use State workers' compensation files to obtain information on the prevalence and severity of workplace illness and injury risks.[5] Our analysis goes beyond previous studies of age-job risk relationship, in that it asks if the patterns vary systematically with workers' age, and if the patterns hold when controlled for occupation and industry.

Some of the statistics required for our analysis are collected under the Supplementary Data System, a

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Federal-State cooperative venture established by the Occupational Safety and Health Act.[6] The Supplementary Data System reports incidents by type but not by exposure, so other sources must be used for exposure data. State files from the 5-percent sample of the 1980 Census of Population are employed to generate the necessary statistics on hours of work per year by age, occupation, and industry. Combined, these two data sources produce illness and injury rates per million employee hours for 6 age categories, 12 occupational groups, and 11 industry groups. Exhibit 1 shows the age, industry, and occupational variables used in this study, as well as the States from which data were obtained.

In 1981, 29 States provided data to the Supplementary Data System. However, only nine of them reported all the required information on workers' age, occupation, industry, and extent of disability.[7] (See exhibit 1.) "Extent of disability" indicates whether the case is a fatality, a permanent or temporary disability, or some other type (for example, illness). Job risks which are probably more costly to employers would be indicated by higher rates of fatalities and permanent injuries, while temporary disabilities are likely to be considered less of a problem.[8] Illness cases are so rare in the data that they are included in the total injury rate analysis, but are not considered separately.[9]

The fact that job risk data are derived from workers' compensation files requires us to be sensitive to the fact that workers' compensation systems vary among States. States differ regarding what they report as a "case," the kind of information recorded about an affected worker and his or her job, how claims are adjudicated and compensated, and the types of claims eligible for compensation payments. Only illnesses and injuries defined as compensable under each State's workers' compensation rules appear in the data files, but States vary in the way they determine which cases may be properly submitted for compensation claims. Waiting periods before benefits are paid vary among States, and the definition of a "closed" case likewise varies.[10] For these reasons, it is necessary to test for significant State-specific effects in the context of the empirical models detailed below. In addition, because the nine States utilized span the country geographically, it is also asked whether variability in the data can be properly represented by regional variables. Because some States exclude domestic and agricultural occupations from coverage, while others exclude government workers, this analysis excludes employees in the farm sector, private household workers, and those in public administration.

Despite the evident limitations of workers' compensation statistics, there is no better data source on the extent of job risk by age, occupation, and industry in the United States.[11] Initial tabulations of workers' compensation data for individual States generally agree with the results reported by previous researchers.[12]

Exhibit 1. Variable definitions

Age groups

Younger than age 25	Age 45–54
Age 25–34	Age 55–64
Age 35–44	Age 65 and older

Industry groups

1. Mining (reference category)
2. Construction
3. Nondurable manufacturing
4. Durable manufacturing
5. Transportation, communications, and utilities
6. Retail trade
7. Finance, insurance, and real estate
8. Business and repair services
9. Personal services
10. Entertainment and recreation services
11. Professional and related services

Occupational groups

1. Executive, administrative, and managerial (reference category)
2. Professional specialty
3. Technicians and related workers
4. Sales
5. Administrative support, including clerical
6. Private household
7. Protective services
8. Service, excluding private household and protective
9. Precision production, craft and repair
10. Machine operators, assemblers, and inspectors
11. Transport and material moving
12. Handlers, cleaners, helpers, and laborers

States

***West*:**	New York (NY)
Colorado (CO)	North Carolina (NC)
Montana (MT)	
Idaho (ID)	***Central*:**
	Arkansas (AK)
***East*:**	Iowa (IO)
Delaware (DE)	Wisconsin (WI)

Analysis of variance models

One method of determining the age-job risk link is to conduct an analysis of variance. This procedure produces an assessment of the systematic age patterns in the data, as well as an estimate of the relative contribution of occupation and industry in explaining differences in the dependent variables. The empirical model employed is:

$$R = \beta + \pi \text{ Age} + \Delta' X + e$$

where *R* is the dependent variable and represents one of four values indicating the extent of disability: the total illness and injury incidence rate, the temporary disability rate, the permanent disability rate, or the fatality rate.[13] *Age* consists of a vector of six age brackets. (See exhibit 1.) Particular attention is devoted to the 55–64 and 65 and older groups, in keeping with our special interest in older workers.[14] X is a vector of occupation, industry, State, and interaction variables. β, π, and Δ' are coefficients to be estimated. The final term, e, represents independent disturbance terms omitted from the model.

The following tabulation shows the percentage of total variance in illness and injury incidence rates that is explained by the contribution of age, industry, and occupation:

Independent variable	*Dependent variable*			
	Total injury incidence rate	*Temporary disability rate*	*Permanent disability rate*	*Fatality rate*
Age	0.8	0.5	1.2	2.1
Age and industry	1.4	.9	1.5	2.3
Age and occupation	6.7	4.6	2.8	2.4
Age, industry, and occupation	7.2	5.0	3.0	2.7

Age differences account for between 0.5 percent to 2 percent of the overall explained variation in the data when no other variables are controlled. When controls for industry are added in addition to age, the proportion of explained variation is little improved for all dependent variables. In contrast, when controls for occupation are added, the explained variance is greatly increased for temporary disabilities, and hence, for total injuries as well, because most job injuries involve temporary disabilities. In the permanent disability analysis of variance, occupation variables are more powerful than are industry variables, even though the overall change in explanatory power is smaller. Only in the case of fatalities do occupation controls rival industry controls in terms of explained variance.

The following tabulation shows the percent of explained variance attributable to age, industry, and occupation:

	Independent variable		
	Age	*Industry*	*Occupation*
Total injury incidence rate	11.4	8.6	80.3
Temporary disability rate	10.7	7.9	81.3
Permanent disability rate	39.6	9.0	51.4
Fatality rate	79.5	8.4	12.9

The data reinforce the conclusion that occupational patterns are most important for the least severe job risks—temporary disabilities—accounting for about 80 percent of explained variance. For fatalities, on the contrary, age, and not occupation or industry, plays the crucial role.

In general, then, occupation appears to be three to four times more important a determinant of temporary disabilities than does industry. The more severe the incident, however, the more similar the explanatory influence of occupation and industry. Thus, the conventional wisdom that occupation is important in predicting job risk patterns, but industry is not, is valid only for total job injury data, because such data mainly reflect temporary disability patterns. This conclusion is incorrect when the more severe job risks are considered.

Multivariate regression models

A second statistical method of examining the data uses multivariate linear regression of job risks on the variables. (See table 1.) In column 1, the data are evaluated by age only to determine if risks vary significantly as workers age. Column 2 expands the set of explanatory variables to include occupation, industry, and State. Column 3 allows age interactions with each occupation, industry, and State. If the direct and interactive age effects become statistically insignificant after adding the control variables, we would conclude that age differences in job risks can be attributed to differences in jobs held by the older and younger groups. It is also possible to use F-tests to determine if occupation, industry, and State are important in explaining variation in the dependent variables.[15]

Age effects. Data in column 1 suggest that job risk is greatest for the very young, rather than the old. Indeed, employees under age 25 (the reference group) are more prone to on-the-job risk than are their more senior counterparts, given that all age coefficients are significantly negative.[16] This "under 25" effect is associated with high rates of temporary injuries (probably because of inexperience on the job),[17] but not with either of the more serious risk measures—permanent injuries and fatalities—given that no age coefficient is significantly less than zero for these two measures.

In contrast to the findings for younger workers, older employees appear to suffer significantly more serious job-related risks. Indeed, permanent disabilities are 1.1 percent higher and fatalities are 1.6 percent higher for workers age 65 and older, than for the sample average.[18] On the contrary, age-job risk profiles are virtually flat between ages 25 and 64. This finding, coupled with the fact that most workers retire before age 65, casts doubt on the hypothesis that aging leads to declining productivity and rising risk for most workers.[19]

A comparison of columns 1 and 2 for each dependent variable in table 1 highlights a second important conclusion: Whenever age coefficients are significant on their own, they remain significant after the inclusion of industry, occupation, and State workers' compensation variables. In other words, observed age effects do not simply reflect the fact that old and young workers hold

Table 1. Multivariate regression analysis of the relationship between job risk and age

[t-statistics in parentheses]

Explanatory variables[1]	Total injury incidence rate (mean = 2.55)			Temporary injury rate (mean = 1.66)			Permanent injury rate (mean = 0.48)			Fatality rate (mean = 0.18)		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Intercept	4.53 (11.62)	0.09 (0.09)	1.05 (0.45)	3.07 (9.09)	–0.30 (0.33)	0.56 (0.27)	0.39 (3.10)	–0.16 (0.45)	0.28 (0.35)	0.01 (0.06)	–0.29 (0.87)	–0.10 (0.14)
Age:												
25–34	–1.82 (3.33)	–1.74 (3.03)	–.28 (.22)	–1.44 (3.04)	–1.34 (2.91)	–.20 (.32)	–.09 (.50)	.08 (.48)	–.07 (.15)	–.001 (.004)	.01 (.08)	–.01 (.01)
35–44	–2.12 (3.82)	–1.93 (3.52)	–.48 (.37)	–1.57 (3.25)	–1.40 (2.97)	–.38 (.32)	–.04 (.22)	–.01 (.05)	–.07 (.15)	.01 (.08)	.02 (.15)	.00 (.01)
45–54	–2.65 (4.71)	–2.33 (4.34)	–.38 (.29)	–2.06 (4.22)	–1.81 (3.80)	–.42 (.36)	–.05 (.31)	.01 (.05)	.05 (.12)	–.0002 (.001)	.03 (.16)	.01 (.02)
55–64	–3.00 (5.23)	–2.65 (4.84)	–.52 (.40)	–2.17 (4.36)	–1.89 (3.91)	–.55 (.47)	–.10 (.52)	–.04 (.22)	.05 (.12)	.001 (.01)	.03 (.15)	–.00 (.01)
65 and older	–2.87 (4.44)	–2.10 (3.38)	–.58 (.44)	–1.41 (2.57)	–0.93 (1.69)	–.07 (.06)	1.27 (6.06)	1.40 (6.68)	.54 (1.15)	1.65 (8.45)	1.71 (8.65)	.99 (2.20)
Industry	....	>0 5	*	....	>0 5, 11	*	....	*	*	....	*	*
Occupation	....	>0 8, 10–13	>0 13	....	>0 10–13	*	....	>0 10–13	*	....	>0 11–13	*
State	....	>0 WI, ID, AK	*	....	>0 WI, AK	*	....	>0 ID, AK	*	....	>0 ID	*
Age–State interactions	....	....	<0 WI: all ages ID: 35–44 55–64 AK: 25–34 45–54 55–64	....	....	<0 WI: all ages AK: 25–34 45–54 55–64 >0 ID: 65 and older	....	....	>0 ID: 65 and older	....	....	>0 ID: 65 and older
Industry–State interactions	....	....	>0 WI: 11, 13 AK, ID: 4, 5	....	....	>0 WI: 11–13 AK: 4, 5	....	....	>0 ID: 11 AK: 5	....	....	>0 ID: 11
Occupation–State interactions	....	....	>0 WI: 13 ID: 10, 11, 13 AK: 11–13	....	....	>0 WI: 13 ID: 11 AK: 11–13	....	....	>0 ID: 11 AK: 11	....	....	*
R^2	.01	.10	.23	.01	.06	.18	.01	.04	.14	.02	.03	.11

[1] Variable definitions are shown in exhibit 1.

NOTE: Signs of industry, occupation, State, and their interactions are indicated only if coefficient estimates are statistically significant at p = 0.05 (>0 = positive trend; <0 = negative trend). Asterisk (*) indicates no coefficient is statistically significant at p = 0.05.

different types of jobs or live in different regions of the country. Rather, they indicate that the very young and those 65 and older suffer more job-related health problems and, hence, are less productive than all other age groups, even when other factors are held constant.

Occupation effects. Occupation coefficients are statistically significant in all four extent of disability risk models, substantiating our inferences from the analyses of variance models. The entire vector of occupational terms contributes significantly to explained variance, according to *F*-tests comparing the sum of squared errors from models which include and then omit these terms. In the models of total incidence rates, service workers as well as workers in the four blue-collar groups (craftworkers, operatives, transportation operators, and handlers and laborers) suffer significantly more health and safety problems. The "blue-collar" effect remains significant and positive for all three measures of risk, even when controlled for age, industry, and State of residence.

Industry effects. Industry findings are less robust across equations, varying by job risk measure. The overall equation indicates significantly more problems in durable manufacturing, controlling for other things. This is mainly because of the higher rate for temporary disability in that sector, and not because of discernably different fatality or permanent disability job-risk patterns. Tests for the significance of the entire vector of industry variables indicate that industry does not contribute to explaining fatality rates or permanent and temporary disability rates. However, the hypothesis that industry variation in total incidence rates is zero is rejected, suggesting that industry matters for the small number of "other" categories which are primarily occupational illnesses.

The finding that industry differentials are not as significant as are occupational patterns reiterates our analyses of variances conclusions, and confirms speculation by earlier analysts—job risk varies more by occupation than by industry, other things equal.

State effects. Because State workers' compensation systems differ, it is useful to determine if reported injury and illness patterns vary according to the State in which the data were collected and if controlling for any State effect alters conclusions regarding age, industry, and occupational effects. The evidence shows that Arkansas, Wisconsin, and Idaho appear to have significantly higher job injury incidence rates than do the other States in the sample. Models incorporating State interactions also emphasize that these States have especially high incidence rates in durable manufacturing and services, particularly for blue-collar occupations. Whether these differences are real, or merely a reflection of State workers' compensation reporting requirements, cannot be determined from the data. However, the effects are sufficiently different among the three States, and from those of other States, that we must reject the hypothesis that regional variables contain the same information as the individual State dummies in the regression models.[20]

It might be surmised that at least some portion of the State-specific effects reflects differences in localities' interpretations of what constitutes permanent disability. This is because many permanent disabilities resulting in workers' compensation claims involve medical conditions which are intrinsically difficult to measure and quantify in terms of degree of disability (for example, lower back injuries). Interestingly, however, the analysis demonstrates that the State coefficients are less statistically significant for more serious job risks.

Controlling for State level and interaction differences does not alter one of our earlier conclusions: increased risk of job-related fatalities remains concentrated among workers older than age 65. However, a second conclusion is weakened somewhat because the age effect for permanent disabilities appears to be mainly due to the Idaho data. Indeed, there remains no additional age effect for that dependent variable after the State interaction is controlled.

Conclusions

Summarizing the results, we find that:

- Prime-age workers and older workers do not seem to have different patterns of job-related temporary disabilities. However, those age 65 and older appear more likely to suffer work-related permanent disabilities and fatalities on the job.
- Age effects are robust to controls for industry and occupation, implying that they are not simply reflecting life-cycle differences in workers' jobs.
- Occupation proves to be more important than industry in explaining job-risk patterns. The observed patterns are not surprising: craftworkers, transportation operators, operatives, and handlers and laborers appear especially prone to job risk. Durable manufacturing industries also have higher than average injury rates.
- State-specific differences in job-risk data persist even if age, industry, and occupational dispersion in jobs are controlled, a result not previously noted in studies using workers' compensation data. Interestingly, however, the analysis demonstrates that State effects are much less important for both the permanent disability and the fatality equations than for the temporary disability equations. □

———*FOOTNOTES*———

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[1] Several studies are reviewed in O.S. Mitchell, P.B. Levine, and S. Pozzebon, "Retirement Differences by Occupation and Industry", *The Gerontologist*, forthcoming.

[2] K. H. Anderson and R. V. Burkhauser, *The Effect of Actual Mortality Experience Within a Retirement Decision Model* (Vanderbilt University, Department of Economics and Business Administration, 1983), Working Paper No. 83-W08; G. G. Fillenbaum and G. Maddox, *Assessing the Functional Status of LRHS Participants* (Duke University, Center for the Study of Aging and Human Development, 1977), Technical Report No. 2; O. S. Mitchell, "Aging, Job Satisfaction, and Job Performance," in I. Bluestone, R. Montgomery, and J. Owen, eds., *An Aging Workforce* (Detroit, Wayne State University Press, forthcoming); and D. O. Parsons, "The Male Labor Force Participation Decision: Health, Reported Health, and Economic Incentives," *Economica 49*, February 1982, pp. 81-91.

[3] M. D. Kossoris argues that older workers are relatively less accident prone in his data, but the tabular analysis does not test the conclusion formally. See M. D. Kossoris, "Relation of Age to Industrial Injuries," *Monthly Labor Review*, October 1940, pp. 789-804. Norman Root discusses, but does not statistically assess, the importance of age effects. See Norman Root, "Injuries at work are fewer among older employees,"

Monthly Labor Review, March 1981, pp. 30–34. Of course, because these studies are descriptive in intent, they should not be faulted for the fact that they are limited to presentations of simple two-way tables. A. Dillingham does include a simple linear age term in a multivariate risk model, but does not allow for nonlinear age effects which may be important. See A. Dillingham. "The Injury Risk Structure of Occupations and Wages" (Ph.D. dissertation, Cornell University, 1979). R. S. Smith includes an age variable which proves statistically insignificant; however, he focuses only on the proportion of young workers (age 25 or younger), and does not disaggregate other age groups. See R. S. Smith, "The Feasibility of an Injury Tax Approach to Occupational Safety," *Law and Contemporary Problems*, Summer 1974.

[4]M.D. Kossoris ("Relation of Age") indicates that older workers are less frequently injured than the young, but the nonrepresentativeness of the data used preclude the author from investigating whether these patterns might be due to different occupational and industrial job-holding distributions by age. Both N. Root and S. Dorsey find age differences in risk paterns when they control for industry, but they do not simultaneously hold occupation constant. See Root, "Injuries at work"; and S. Dorsey, "Employment Hazards and Fringe Benefits: Further Tests for Compensating Differentials," in John Worrall, ed., *Safety and the Workforce* (Ithaca, ILR Press, 1983). Dillingham ("The Injury Risk Structure") argues that occupation matters more than industry in explaining job-related health problems, and so incorporates occupation but not industry variables.

[5]R. G. Ehrenberg reviews recent studies in workers' compensation area. See R. G. Ehrenberg, *Workers' Compensation, Wages, and Risk of Injury* (New York, National Bureau of Economic Research, 1985), Working Paper No. 1538. N. Root and D. McCaffrey discuss differences in State workers' compensation programs. See N. Root and D. McCaffrey, "Providing more information on work injuries and illnesses, *Monthly Labor Review*, April 1978, pp. 16–28. Extensive analysis of New York State was carried out by Dillingham ("The Injury Risk Structure") who uses data from the early 1970's; Root ("Injuries at work") uses 1977 workers' compensation files to review data from 26 States.

[6]"Injury and Illness Data Available from 1981 Workers' Compensation Records," USDL release 83–2 (Bureau of Labor Statistics, December 1983); and *Supplementary Data System, Microdata Files Users' Guide, 1980 Edition* (Washington, National Technical Information System, September 1982) PB83–133553.

[7]There are actually three separate files in the 1981 Supplementary Data System data set. File 1 contains reports from nine States on cases involving medical treatment, while File 2 contains records from 16 States on cases involving days of disability. These two files on the micro data tapes are characterized by significant missing data on age, occupation, and industry, and do not contain usable statistics on the extent of workers' injuries or illnesses. File 3, employed in the analysis in this report, contains virtually complete data on age, occupation, and industry, plus the extent of job-related illnesses and injuries for almost 318,000 separate cases in nine States. Unlike Files 1 and 2, File 3 includes cases only if they were closed or final determination was reached during 1981. The precise definition of such a case may vary among States. See footnote 10.

[8]A. Dillingham, "Demographic and Economic Changes and the Costs of Workers' Compensation," in John Worrall, ed., *Safety and Workforce* (Ithaca, ILR Press, 1983).

[9]Because it is difficult to identify the link between illness and employees' work environments, we expect that data on job-related injuries are more complete than are those on occupational illnesses. See N. A. Ashford, *Crisis in the Workplace: Occupational Disease and Injury* (Cambridge, MIT Press, 1976).

[10]In some States, a "closed" case may mean that the worker has been removed from the workers' compensation rolls altogether, while in others, a case closes when an individual begins to receive benefits.

[11]Ideally, when an injury rate is calculated, the year in which the injury occurs should coincide with that for which the worker's exposure data are collected. In the construction of injury rates from the two data sources used here, however, the figures are not derived from the identical period. Census figures are available only for 1980, while the Supplementary Data System data file contains closed cases for 1981. While a great many of the workers' compensation cases closed in 1981 were probably initiated in 1980, some were not. In steady state, cases closing each year will be replaced with new and similar cases at a steady rate, so no bias should result from the construction method employed in this report. On the contrary, if the workers' compensation system experienced above-average (or below-average) rates of case closings during 1981, the incidence rates reported may be over- (or under-) stated. There is little direct evidence on the likely direction of bias, if any.

[12]For example, 1980–81 industry and occupation rates per million employee hours for New York compare closely with those prepared for that State by Dillingham ("The Injury Risk Structure").

[13]Some States provide data on permanent partial and permanent total disabilities, but because these are not consistently available, we collapse the disability reports into just two variables—permanent and temporary.

[14]Age is missing in a tiny minority of cases in File 3 of the Supplementary Data System—about 1 percent of all cases. Where possible, cases with missing ages are allocated randomly to age brackets using available industry and occupation data and proportions of workers in each age group using the nonmissing cases. A few remaining cases, about 0.9 percent, are eliminated altogether from the sample because of missing industry and occupation data.

[15]P. Kennedy, *A Guide to Econometrics* (Cambridge, MIT Press, 1985).

[16]Statistical significance levels of $p = 0.05$ are used throughout this article.

[17]Root, "Injuries at work"; and R. S. Smith, "The Feasibility of an Injury Tax Approach to Occupational Safety," *Law and Contemporary Problems*, Summer, 1974.

[18]These figures are derived according to the procedure described by D. B. Suits, using the age 65 and older coefficients in column 1 (permanent injury and fatality rates), table 1. They indicate "the extent to which behavior in the respective (age groups) deviates from the (sample) average." D. B. Suits, "Dummy Variables: Mechanics v. Interpretation," *Review of Economics and Statistics*, February 1984, pp. 177–80.

[19]Those familiar with selection problems may query whether risk data might be biased downward, to the extent that affected workers retire early and thus leave the data sample. This possibility is particularly likely for those age 62 and older, because retirement is socially acceptable and economically feasible under Social Security and many private pensions. Unfortunately, existing survey questionnaires do not ascertain from retirees which industry and occupation they had worked in, and the conditions leading to retirement; thus, the degree of bias cannot be assessed. The effect is probably very small for those in the 45–54 age range because relatively few of these workers would be likely to retire from the sample. The fact that no age effects are discerned for that group reinforces our overall conclusions.

[20]Additional regression results, available from the author, provide evidence by region (as defined in exhibit 1).