

Lott Jr., John R.; Manning, Richard L.

Working Paper

Have Changing Liability Rules Compensated Workers Twice for Occupational Hazards?: Earnings Premiums and Cancer Risks

Working Paper, No. 112

Provided in Cooperation with:

George J. Stigler Center for the Study of the Economy and the State, The University of Chicago Booth School of Business

Suggested Citation: Lott Jr., John R.; Manning, Richard L. (1995) : Have Changing Liability Rules Compensated Workers Twice for Occupational Hazards?: Earnings Premiums and Cancer Risks, Working Paper, No. 112, The University of Chicago, Center for the Study of the Economy and the State, Chicago, IL

This Version is available at:

<https://hdl.handle.net/10419/262514>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Working Paper No. 112

**Have Changing Liability Rules Compensated
Workers Twice for Occupational
Hazards?: Earnings Premiums
and Cancer Risks**

John R. Lott, Jr.

Richard L. Manning

Center for the Study of
the Economy and the State

The University of Chicago

WORKING PAPER SERIES NO. 112

**Have Changing Liability Rules Compensated
Workers Twice for Occupational
Hazards?: Earnings Premiums
and Cancer Risks**

John R. Lott, Jr.

and

Richard Manning

April 23, 1995

Center for the Study of the Economy and the State
The University of Chicago
1101 East 58th Street
Chicago, Illinois 60637

Center papers are distributed in limited numbers
for comments only and should not be
quoted without written permission.

Have Changing Liability Rules Compensated Workers Twice for Occupational Hazards?: Earnings Premiums and Cancer Risks

John R. Lott, Jr.

Graduate School of Business
University of Chicago

and

The Wharton School
University of Pennsylvania

and

Richard L Manning

Department of Economics
Brigham Young University

April 23, 1995

* We would like to thank Barry Adler, Frank Easterbrook, Richard Epstein, John Hause, Jeff Parker, Richard Posner, Alan Sykes, George Tolley, Richard J. Butler, Gertrud Fremling, and the seminar participants at the University of Chicago Law School and Economics Department for their helpful comments. Lott would like to thank to the Center for the Study of the Economy and the State for his funding as the John M. Olin Visiting Assistant Professor. Manning's research is funded in part by a grant from the College of Family, Home and Social Sciences at Brigham Young University.

Have Changing Liability Rules Compensated Workers Twice for Occupational Hazards?: Earnings Premiums and Cancer Risks

Abstract

During the last couple of decades courts have intervened in employment relationships by allowing employees to circumvent the workers' compensation liability restrictions. Recent papers point to firms divesting themselves of operations whose employees handled dangerous substances as firms protecting themselves from these new liabilities. Supposedly, these actions prevent their workers from being justly compensated. We show that the central legal premise behind this argument is wrong. Firms cannot expose workers to hazards and then eliminate this liability by divesting or shutting down the hazardous operation. This paper also shows that workers were already being well compensated for carcinogenic exposures even before the courts started allowing workers to collect large damages for occupational illnesses. Instituting the new liability rules also coincided with a large drop in earnings premiums. The compensation for carcinogenic exposures implies values of life that are comparable to studies examining other occupational risks. Our best estimate is \$6 million in 1984 dollars, with a range of \$1.2 to \$12 million. The large premiums imply that workers who were employed prior to the legal changes received court awards which essentially compensated them a second time for their misfortune.

JEL: D61, I 18, G33

Key Words: Corporate Liability
Workers' Compensation
Latent Cancer Risks

I. Introduction

Many occupations expose workers to significant probabilities of death or injury. In some, the relationship between the occupation and potential hazards is direct and immediate. In others, it may take years, maybe even decades, before the harm done to the workers becomes evident. Many famous cases involving asbestos and other carcinogenic substances come to mind for this second category of occupational injuries. Studies claim that anywhere between less than 1 percent to 40 percent of lung cancers and between 0 and 24 percent of bladder cancers are attributable to occupational exposures, though most studies appear to fall in the bottom half of these ranges (see Vines and Simonato (1991, p. 6) for a literature review).¹ For example, the 120,000 lung and 9,000 bladder cancer deaths in the United States in 1984 implies that perhaps as few as 960, but certainly no more than 50,160, were job related.^{2,3} Others claim that as many as 10 to 20 percent of all cancer deaths are occupationally related, which given 450,000 cancer deaths in 1984 would account for up to 90,000 deaths (Wolfe, 1994).^{4,5}

While these hazards obviously make such jobs less attractive, there is some rate of pay that effectively compensates workers for the expected damage they face. If workers are properly informed about the risks, this wage premium should adequately compensate the worker for the

¹ Vines and Simonato's (1991) literature survey describes the vastly different findings as resulting from either different samples (e.g., whether the hospital or survey based) or how the researchers defined whether an exposure had occurred. The highest numbers for occupationally caused lung cancers frequently arise from "small areas where a large fraction of the population is employed in hazardous activities such as asbestos mining" (p. 6). There was only one study from Italy that found that as high as 24 percent of bladder cancer rates were occupationally related, the next highest rate found by a study was 20 percent.

² Multiplying the number of new cancers by 40 percent is surely an overestimate. As Simonato, Vineis, and Fletcher (1988) write: "the proportion of lung cancers attributable to occupational exposure can be very elevated (up to 40 %) among selected populations resident in specific areas. . . . Estimates from smaller and more homogeneous communities are likely to be higher than estimates from larger populations, given these communities were chosen because of a presumed high risk for lung cancer."

³ Breyer (1993, pp. 6) surveys the evidence on this question and concludes that expert estimates for cancer caused by pollution and industrial products ranges from 2 to 10 percent of cancer deaths each year. Other useful surveys of particular industries include (Wen et. al. (1985) who examine oil refinery workers and Shannon et. al. (1984) who examine nickel workers). The National Academy of Science's Committee on the Biological Effects of Ionizing Radiation (1989) claimed that cancer mortality among radiation workers was indistinguishable from the normal cancer rate. Kneale and Stewart have found a higher rate and claimed that 200 out of 35,000 workers at the Government bomb plant in Washington State "have lost or will lose years of their lives because of radiation induced exposure" (Wald, December 8, 1992, p. A1). (See also Siemiatycki (1991, p. 13 and 298-308) for a survey of this literature.)

⁴ Landrigan (1992) estimates that between 50,000 and 70,000 cancer deaths a year in 1990 were occupationally related.

⁵ 99.5 percent of all the United States's cancer deaths in 1990 occurred for individuals 20 years old or older (Miller, May 4, 1994, p. 659).

risks that he is undertaking. In fact, many economists' faith in this relationship can be seen in their frequent use of these wage premiums to assess the value that individuals attach to their lives when their deaths occur under other more direct circumstances (e.g., Mishan, 1988 and Viscusi, 1992).⁶

During the last couple of decades, however, courts have intervened in this employment relationship by allowing employees to circumvent the workers' compensation liability restrictions. Ringleb and Wiggins (1990, p. 579) claim that letting workers directly sue their employers has altered the organization of firms in hazardous industries, with one major effect being that those operations whose employees handle dangerous substances have been spun off into separate units. Their paper argues that firms divest their hazardous operations in order to protect themselves from these potential liabilities, thus preventing their workers from being justly compensated. By spinning off the operations, the rest of the firm is supposedly able to protect its assets from future legal action.⁷

Some argue that firms not only evade legal liabilities, but that firms also are presumably able to undercompensate their workers by avoiding paying a wage premium for the expected losses incurred by the workers. Wiggins and Ringleb (1992) believe that this occurs because of an adverse sorting problem that exists in labor markets. For any given wage, those workers who do not properly anticipate the hazards of employment are the ones most likely to accept these risky jobs. Thus, even if employees are correctly informed on average, it is the distribution of mistakes which is relevant for whether workers are being properly compensated.⁸

While it is theoretically possible that such adverse sorting exists in labor markets involving hazardous occupations, there are many institutional arrangements that may arise to mitigate or even completely avoid this problem.⁹ For example, competing firms could inform workers that they are

⁶ For a comparison see Tolley et. al.'s (1994) discussion of contingent valuation surveys.

⁷ There is a larger literature that recognizes the effect of tort litigation on firm size. For example, Zucker, Darby, and Brewer (1994, p. 15) discuss how this threatened liability causes new biotech ventures to be started as new independent firms.

⁸ For discussions and evidence on the question of worker responses to job risks see Viscusi (1979) and Viscusi and O'Connor (1984) (See also Viscusi (1992)). Other relevant studies that deal with the question of how individuals respond to risk include Peltzman (1973, 1975, 1987), Schneider, Klein, and Murphy (1981), and Viscusi (1990).

⁹ This adverse sorting story is really not different from the traditional adverse sorting stories that have been shown to be theoretically possible in other markets like those for used cars. If buyers are unable to differentiate "lemons" from other types of used cars, these "lemons" will tend to be sold into the used car market. In the extreme, it is predicted that the used car market will cease to exist since even though the average price of used cars will decline to

not receiving as high a real wage from their competitors as the workers might have been led to believe once these health risks are taken into account. Worker associations or unions can internalize the benefits from investigating potential health effects from working conditions. Third parties, like health alert bulletins, can also provide workers or firms with this information. It is not necessary for the workers to understand the science or the legal arguments involved, but only that they are able to rely on organizations which develop trustworthy reputations. Ultimately, it is an empirical question how important these adverse sorting effects are.

Unfortunately, the existing evidence on firms divesting those operations where the risks are the greatest bears no relationship to whether workers in a particular market are making mistakes [Ringleb and Wiggins (1990) and Wiggins and Ringleb (1992)]. Nor do experimental studies that provide evidence of a winner's curse (which contain their own sets of problems) indicate whether workers in a particular market are making mistakes.¹⁰ Even if divestiture were to provide firms with the claimed legal protection, the alternative hypothesis is that firms that already compensated their workers for expected job related health risks are now being forced to compensate their workers a second time through the legal system. Spinning off operations would then protect firms from doubly compensating those workers who were employed prior to the rule change. Divestiture might also allow the firms to more properly compensate new workers who do not desire this court imposed insurance as much as it costs these workers in terms of reduced current wages. Even if the courts have better information than workers about the health risks, it is unlikely that the courts have better information than the workers concerning their own preferences.

In addition, if workers understand the potential health risks, changing the legal rules seems likely to lower worker welfare. While it is true that workers under these new liability rules could theoretically insist on higher wages from firms with few assets, the question is why previous

reflect the low quality of cars being sold, only those whose cars are valued below this lower price will be willing to place their used cars up for sale. The price and quality of used cars could theoretically decline to the point where no one tries to sell used cars anymore. However, casual observation indicates that the used car market indeed operates quite well and that these predictions seem to be of primarily theoretical, and not empirical, importance. Used car markets presumably persist because they have developed arrangements to overcome these information problems. Some of the more obvious mechanisms involve reputations and warranties.

¹⁰ Hansen and Lott (1991) provide a critical review of some of the recent experimental results upon which these claims are based.

arrangements implicitly made the worker responsible for insuring against future health problems. Workers and firms could presumably have voluntarily made this arrangement, but they did not. Besides the obvious inefficiencies which could arise if the government insurance was so high that workers' wage would have to be reduced below their value marginal product, one possibility is that moral hazard problems on the part of workers might make it more costly for firms than for individuals to insure against future long term health risks. Another interesting motivation for not voluntarily adopting such compensation is that the length of time that a worker receives the wage premium is more closely related to the extent of his exposure and the probability that this particular source did produce the illness.¹¹

Several testable implications arise from our analysis. If workers on average were being compensated for employment hazards, wage premiums should have been paid to workers prior to when courts began to require formal compensation of workers, and those wage premiums should have declined after that point. If the courts overcompensate the workers, the wage premium could even be negative. To the extent that mandated legal compensation does not fully compensate workers, we should still observe a relatively smaller wage premium after the legal rules changed to require formal compensation. It is thus important not only to identify the existence of wage premiums, but to determine whether those premiums were sufficiently large to compensate workers for the risks they bore. In addition, if firms are really able to reduce legal liabilities by divesting themselves of assets, those spin-offs should exhibit higher wage premiums, though, as we will discuss, there may be other bankruptcy related explanations for these higher wages.

The next section discusses how Ringleb and Wiggins (1990) have misunderstood the law over whether divestitures or shutting down operations can shield parent companies from already incurred liabilities and whether these changes can prevent employees from suing their former employers. Section III describes how we will test for whether wage premiums compensate

¹¹ Even though Wiggins and Ringleb claim that the liability rule changes are useful to ensure that workers are properly compensated, they acknowledge (1992, p. 211) that holding firms liable imposes certain inefficiencies. It is not clear however how they reach their conclusion (p. 211) that the liability rule changes necessarily "weakly" lowered the cost of labor. They appear to have confused changes in the wage rates with changes in the total cost of using labor.

workers for exposure to carcinogens. In addition, that section also discusses how the change in liability rules during the 1970's eliminates (or at least bounds) a vexing potential bias facing value of life studies: the concern that measures of industry or firm risk may be positively correlated with other undesirable attributes of firms. Section IV shows how we measure the level the carcinogenic exposures and describes the data that we will use. Finally, Section V provides the first estimates of the wage premium workers receive for carcinogenic exposure.

II. Issues Concerning the Legal Rules

Ringleb and Wiggins' interpretations of the legal rules are incorrect on three points. First, by far the most important is their (1990, p. 578) claim that:

The long delay between exposure and injury means that agents can engage in risky activities and reap the associated returns, while remaining confident that potential damage awards lie many years in the future. Hence firms can often produce for substantial periods with relative impunity. Then before liability obligations appear, such agents can simply go out of business and enter entirely separate lines of work. . . . A primary way firms implement such a strategy is by shutting down or divesting their interest in hazardous portions of their production process

This claim is simply inaccurate. Ringleb and Wiggins have ignored the legal rules on piercing the corporate veil (e.g., Posner, 1992, pp. 406-409 and Ribstein, 1990, pp. 67-71) and more particularly on successor corporations (Ribstein, 1990, pp. 1147 and the cases listed there).¹² Selling or shutting down an operation only offers the original parent company protection from liability under the most extreme circumstances, and even then it is more a matter of convenience than legally providing a shield from liability.¹³ The only case where the owners of the original parent company are shielded appears to be where the parent company has been dissolved, and it is simply too costly to track down the parent company's original individual shareholders. Short of this extreme case, however, the practical gains from shielding assets against existing claims

¹² We would like to thank Barry Adler, Frank Easterbrook, Richard Posner and Larry Ribstein for their comments on this point.

¹³ If a subsidiary commits a tort, the ability to pierce the corporate veil is not altered by whether the subsidiary is later sold off. If the courts would have allowed the corporate veil to be pierced while the subsidiary is owned by the parent company, the courts would still have allowed the veil to be pierced after the subsidiary has been sold off.

through eliminating the operation do not exist. Changing the liability rules should thus reduce the wage premium those originally employed by the parent company receive for carcinogenic exposures regardless of whether the firms are divested from their parent companies.¹⁴

Even though divestitures do not allow firms to shield themselves from existing liabilities, divestitures are still likely to be associated with a larger wage premium, though for a different reason. Operations dealing with hazardous materials may face other product liability suits which, without the assets of a larger organization to draw on, increases the probability of bankruptcies.¹⁵ If these new firms face a higher probability of bankruptcy because of liability suits, workers may receive higher wages to compensate them for a higher probability of bankruptcy which could result in either lower expected pension benefits or simply a higher risk of having to change jobs again.

Secondly, with few exceptions (e.g., *Beauchamp v Dow Chemical* 140 Mich.App. 699, 364 N.W.2d 286 and 427 Mich. 1, 398 N. W.2d 2), the case law focuses almost exclusively on asbestos litigation (e.g., *Borel v. Fireboard Products Corp.* 493 F. 2d 1076 [5th Cir. 1973], cert. denied, 419 U.S. 869 [1974]), though these rulings were not inherently limited to only asbestos production. According to Epstein (1982, pp. 15-17 and 44), *Borel* represented a major change in worker compensation by retroactively converting these cases, with their strict limitations on liabilities, into tort suits that allowed the product liability laws to be used against suppliers. If empirical evidence is to measure any industry wage differences over time, it is necessary that firms and workers believe that these legal precedents alter the probability that their own occupations will be effected. Given the later publicity surrounding the Johns-Manville bankruptcy case (Epstein, 1982, p. 14), it at least seems plausible that many firms recognized the possibility that these rules could apply to other industries by the late 1970's.

¹⁴ While divestitures are not be motivated by avoiding already incurred liabilities, one might think that divestitures can still have implications for how wages change for workers first employed before and after the change in liability rules if workers are able to sue their employers as Ringleb and Wiggins argue (p. 579). For example, changing the liability rules will differentially effect the wages paid to new workers depending upon whether they are working for the original parent company or a spin-off with fewer assets. Those who work for divested operations with few assets will expect higher wages than new workers who join operations that remain connected to the original parent companies. However, as we will shortly discuss in this section, the ability of workers to directly sue their own employers is extremely limited, and these liability suits are really only directed against the firm's input suppliers.

¹⁵ We thank Richard Posner for bringing this point to our attention.

Finally, Ringleb and Wiggins (p. 579) wrongly claim that these large liabilities “generally fall on the firm whose workers are exposed to the hazardous process” and also “the specialized firm will be liable for injuries to workers in those firms using the product as an input.”¹⁶ While discussing worker compensation statutes (pp. 581-2, italics added), Ringleb and Wiggins argue that *Borel* made “inroads . . . in third-party liability *and* against the workers’ compensation exclusivity clause.” The last portion of this statement is also incorrect. Workers’ compensation allows workers to sue their own employers only under very limited circumstances, specifically where a firm intentionally injures a worker (e.g., *Beauchamp v Dow Chemical*), and the rules determining when workers could sue their employers did not change over the period studied by Ringleb and Wiggins.^{17,18} The importance of cases like *Borel v. Fireboard Products Corp.* was that they provided a way around these strict limits on worker liability claims (e.g., *Boeing Company v. Shipman*, 5 Cir. 1969, 411 F.2d 365, 374) *only* because it allowed workers to sue input suppliers.¹⁹

Practically, however, firms employing the harmed workers still face potential liability risks because the firms selling the hazardous inputs can then sue the workers’ firm for contributory negligence. Even while the employees’ firm is frequently also protected from these suits by state workers’ compensation, the employees’ firms can still bear the liability because they might provide indemnification to the firms that supply them with hazardous inputs.²⁰ Thus, while it was

¹⁶ We greatly benefited from Jeff Parker’s discussions on the issues raised here.

¹⁷ Some other cases in which intentional tort is ruled an exception to the exclusive remedy of workers compensation include: *Seals v. Henry Ford Hospital*, 123 Mich.App. 329, 333 n.w.2d 272 (1983); *Kissinger v. Mannor*, 92 Mich.App. 572, 285 n.w.2d 214 (1979); *Broadus v. Ferndale Fastener Division Ring Screw Works*, 84 Mich.App. 593, 269 n.w.2d 689 (1978).

¹⁸ *Beauchamp v Dow Chemical* was one of the first cases that expanded the notion of what constituted an intentional injury. Prior to that case, an intentional injury involved the conscious act of the employer physically harming the worker (e.g., hitting him). After 1983 in the state of Michigan, this case expanded the definition to include an employer knowingly placing a worker in a hazardous environment where he would be injured.

¹⁹ The district court case was filed in *Borel* in October 20, 1969 and both the district court decision was made and the Appeals court brief was filed in 1972. Wiggins and Ringleb (1992, pp. 206-8) point to some examples of firms divesting themselves of a subsidiary so as to shield themselves from future liability. One example takes place in 1973 when Allied Chemical Company shifted its production of Kepone to a much smaller company with very little assets name Life Science Products.

²⁰ Yet, even with indemnification, bankruptcy by the employee’s firm will not prevent the employees from being compensated. Since the input supplier must sue the employee’s firm to recover some portion of its payments to the employee, bankruptcy by the employee’s firm will instead only alter the share of the liability borne by the input supplier.

incorrect to assume that workers can directly sue their employers, the legal system still can place employers at risk from such suits. However, the bottom line is that regardless of whether the suits are limited to the employees' firm or to firms that supply inputs to the employee's firm, allowing the ability to sue reduces the wage premium necessary to induce workers into the industry.

III. The Empirical Test

The principal issue is to investigate the wage premium, if any, paid to workers in jobs exposing them to long term health hazards. As a proxy for all long term hazards, we take cancers associated with occupational exposure to carcinogens. The estimation of wage premia paid for undesirable employment conditions involves an extensive literature (see Smith (1979) for a review, also Brown (1980) and Duncan and Holmlund (1983)). Following the general approach used in those models, this paper proceeds under the assumption that equilibrium earnings can be expressed as:

$$W_{ij} = f(\Omega_i, R_j, L) \quad (1)$$

where W_{ij} are the earnings of worker i in job j , assumed to be determined principally by three effects. These are, first, a vector of worker specific characteristics, Ω_i , including such things as age, education, gender, etc.; second, a vector, R_j , of job characteristics which are independent of the individual's own characteristics; and third, the changing liability rules (L), which will be our central focus.

Ringleb and Wiggins (1990) present evidence that downsizing in industries characterized by long term latent health hazards is widespread. By examining data from industries in the manufacturing sector in 1967 and 1980, they find entry by relatively small corporations in the later year to be significantly and positively related to the Hickey and Kearney (1977) estimates of worker exposure to carcinogens by industry, measured at the level of two digit SIC codes. They date the change in liability rules as occurring "primarily in the first half of the 1970's" (page 583) with cases like *Borel v. Fireboard Products Corp.* (493 F. 2d 1076 [5th Cir. 1973], cert. denied, 419 U.S. 869 [1974]). This finding is taken as evidence that corporations in these industries

downsized as a result of the change in liability rules, in order to limit their exposure to ex-post worker liability claims.

As discussed above, liability rules determine the method under which workers are compensated for job-related exposure to long term health hazards. Under what can be called a no liability rule, firms face no liabilities in the event of an injury or illness suffered in the course of ordinary employment activities. Under a rule of no liability, to the extent that workers properly perceive and evaluate these risks, wages will include premiums sufficient to compensate the marginal worker ex-ante for subjecting himself to various employment risks. Of particular interest here is the risk associated with latent health hazards, or injuries that typically manifest only after a delay of many years.

So were workers systematically undercompensated for carcinogenic exposures, as claimed by Ringleb and Wiggins? To answer this, we will measure the net effect of liability rules changes and any downsizing on individual earnings. Making firms liable for ex-post payments to injured or ill workers essentially grants workers a claim on the firm's assets as part (or all) of their compensation for job related risks. All else the same, granting workers a right to ex-post compensation reduces the desirability for ex-ante wage premia. If, however, the courts provide excess compensation, it is possible that the wages will fall by more than the wage premium previously being received. If workers were already fully compensated for the risks, introducing ex-post liability diminishes the wage premium for exposure to hazards.

If it is possible to protect parent firms from liabilities, smaller firms specializing in risky activities ought to pay more for workers since workers have fewer assets to claim as compensation through the courts. While the legal difficulties in protecting firms from these liabilities make this unlikely, we still control for the extent of divestitures since (as we mentioned earlier) that may affect the risk of bankruptcy, thus imposing other expected costs on workers ranging from lost pension funds to a higher probability of job turnover. Although in theory it is possible to differentiate the increase in wages due to the threatened loss of pensions, this cannot be done since data are not available prior to 1978. Thus while we will attempt to control for divestitures, it will

not be possible to use that particular variable to differentiate between Ringleb and Wiggins' explanation as opposed to alternative hypotheses.

The change in the legal regime also allows us to address the disturbing problem of whether previous measures of risk overestimated the value of life because those measures were positively correlated with other unmeasured undesirable characteristics of occupation quality. In our case, for unmeasured undesirable characteristics to create a wage premium that exists in 1970 but then disappears in 1984, these unobserved characteristics must be both positively correlated with measures of carcinogenic exposures before the change in liability rules and then are uncorrelated after the change.

IV. Data

In estimating equation (1), data on earnings, individual, and certain job characteristics are taken from the March Demographic Files of the Current Population Survey (CPS) for the years 1971 and 1985. These surveys correspond to worker experience in the years 1970 and 1984, years which span the change in liability rules and shed light on changing wage premia in response to the change in legal structure. The initial year of 1970 was chosen since it preceded both the *Borel v. Fireboard Products Corp.* case's district and appeals court verdicts and yet was still relatively close in time to when the primary data was gathered that we will be using to measure exposures to carcinogenic material. The final year 1984 was chosen since it was safely after the major changes in the liability laws had occurred, and it also represents the middle of a study that we use which identifies occupational cancers rates. Different measures of worker risk are used in the estimation as will be explained below. All, however, are done in the context of a single basic regression model as in equation (1).

The dependent variable in each of the regressions is the individual's reported wages or salary for the year 1970 or 1984 (all values are in 1984 dollars). The data contains not only the normal censoring problems encountered as income approaches zero, but also because the data only reports

incomes of up to \$50,000 in 1970 (\$133,880 in 1984 dollars) and \$99,999 in 1984.²¹ 192 observations were assigned these maximum values and the 11 observations that equalled zero had 0.01 added to them before we took the log of the income variable. While the Weibull distribution is the more typical approach to handling problems where observations are artificially truncated from above due to sample design, truncated values can be estimated for the log of wages using either Tobit or Weibull regressions. Since we have no strong prior beliefs on how to weight these truncated values, we will report both methods in addition to the OLS estimates.²²

Given that there exists no single source of data on worker exposure to carcinogens that is specific or complete enough to provide a certain measure of this risk, we rely on three separate sources, summaries of which are reported in Table 1. The first of these is a study done by Hickey and Kearney (1977), who analyzed site survey data gathered in National Occupational Hazard Survey (NOHS) conducted in the early 1970's by the National Institute for Occupational Safety and Health (NIOSH). This is the same study used by Ringleb and Wiggins. In this survey, trained observers visited a sample of establishments and recorded the number of worker exposures to known or suspected occupational carcinogens. Hickey and Kearney adjust the reported exposures for their carcinogenic potential and calculate an index of worker exposures by industry of employment measured for two digit SIC codes. This index is reported in table 1 as the Hickey-Kearney Carcinogen Exposure variable.

Ringleb and Wiggins (1990) findings on small firm entry rates suggests a systematic relationship between divestiture activity and risk of long term latent hazards. There apparently exists no complete series on divestitures by industry that covers the entire period under study here. Mergers and Acquisitions magazine published information regarding all divestitures over a 15 month period (the summer of 1972 through the summer of 1973). They published a complete roster of corporate sell-offs, providing sufficient information to identify sales of entire units or

²¹ Two such adjustments were made, one with the Consumer Price Index (CPI) and the other with the GNP Price Deflator, each reported by the Commerce Department. Here, we will report only the results obtained from the CPI weighting, but as would be expected, weighting by the GNP Price Deflator makes no substantial difference to any of the results.

²² One typical example of this involves problems like unemployment spells where the length of some of the spells are artificially truncated when an end period to the sample is chosen.

product lines by industry. While the reported sell-offs proxy for the sell-off pattern due to long term latent liabilities, as mentioned earlier, they are also likely to indicate those industries that find it difficult to avoid bankruptcy for other reasons. Within each SIC category, the number of firms divested was divided by the number of firms (DIVESTITURES). Consistent with Ringleb and Wiggins' results, we find a high and significant Pearson correlation coefficient between the Hickey-Kearney measure of cancer risks and DIVESTITURES across industries of .74 (significant at the .0001 level) and the Spearman correlation coefficient is .32 (significant at the .01 level).

While the quality of the Hickey-Kearney measure is relatively high as a measure of worker exposure in the early 1970's, changing occupational and production processes over time may diminish its usefulness as an indicator of risk in the mid 1980's. From 1981 through 1983, NIOSH conducted a follow-up to the NOHS, known as the National Occupational Exposure Survey (NOES). This new study has the advantage of measuring a wider set of known or suspected carcinogens, but it surveyed fewer industries. Unfortunately, unlike the Hickey and Kearney study, the NOES data does not weight each exposure by the associated risk, and thus this data provide a much less precise measure of risks. Again, all data are reported by two digit SIC codes. In contrast to the previous correlations, the Pearson correlation between industry measures of DIVESTITURES and either the unweighted NOES measure of total exposures per employee (-.156, significant at the .34 level) or the unweighted total exposures (.056, significant at the .73 level) implies no real relationship between exposures and changing industry structure. The respective Spearman correlation coefficients are -.203 (significant at the .21 level) and .306 (significant at the .05 level). However, the lack of weighting risks suggests some caution when we use of this measure later on.

We also investigate wage premiums by examining variations in exposures across occupations within an industry. The only data we know on occupation specific cancer risk can be obtained from Siemiatycki (1991), though this reduces our sample size by almost 30 percent. His study took place in Montreal from 1978 to 1990. By employing standard epidemiological methods, his study estimates odds ratios for acquiring various cancers in 83 specific occupations or occupation

groups. Transforming the estimated odds ratios yields estimates of the probability that a worker spending his entire career in a specific occupation will contract a specific cancer.

Unfortunately, however, this study reports all the different cancers one might have upon death rather than an individual's initial type of cancer. A cancer that starts in the lungs may spread to many other parts of the body and thus technically result in multiple types of cancers. In this case, while the crucial cancer for our current study would be the initial lung cancer, Siemiatycki's work does not distinguish which cancer constituted the initial one. Failing to make this distinction between primary and secondary cancers produces measured cancer rates that greatly exceed one hundred percent of the total population. We attempted to solve this problem by only using the rate at which the most prevalent type of cancer appears in a particular occupation. Yet, even this change produces unrealistically high estimated cancer rates (e.g., in personal service industry the average probability of obtaining cancer is reportedly 62.5 percent and the maximum occupation rate is 93.9 percent). The anomaly arises because the sample was not randomly drawn from the general population, but instead over represented those who already had contracted cancer, thus preventing us from using any estimates to calculate implied values of life. Yet, we hope that this index is correlated with the true measure of occupational cancer rates.

Despite these concerns, this measure of occupational cancer risk again provides evidence of a positive correlation between activities with cancer risk and divestitures. While the relationship is not as strong as that shown with the Hickey-Kearney index, the Pearson correlation coefficient between the occupation probability of cancer risks and DIVESTITURES for the entire sample is .09 (significant at the .0001 level) and for just the 1984 period it is .11 (significant at the .0001 level).

The individual characteristics used in the earning regressions are: age and age squared, gender, marital status, race, education level, place of residence, and the number of weeks worked during the year. Each variable is also interacted with a dummy variable, which takes the value zero for the year 1970 and one for 1984. The education level dummies measured whether a person had less than a high school degree (the omitted variable), high school degree, some college, a college degree, and graduate education. We control for where people live using eight regional dummies

and whether they live in an SMSA or what portion of the SMSA (e.g., central city or not).²³ As primary variables, each of these would be expected to have a significant effect on earnings; the interaction terms should be significant only when the relationship between earnings and these characteristics changed over the period in question.

As proxies for job characteristics, dummy variables are included for white and blue collar occupations, farm workers, and service workers (the omitted category), and for each of the Current Population Survey's thirteen major industry classifications.²⁴ Again, each of these is interacted with the year dummy to allow for changes in earnings by job class or industry over the time period. We initially control for industry unionization rates in 1970 and 1984, and later specifications use a subset of the Current Population Survey data which contains individual level data on union membership. Finally, we reestimate several of our specifications by controlling for occupational illness and injury rates by industry for 1970 and 1984 in addition to our carcinogenic exposure rates.²⁵ Table 1 provides a list of the variables which control for job and individual characteristics, together with the mean value and standard deviation of each variable in the broadest of the samples used. Also included in this table are the means and standard deviations of the variables used to capture the effects of carcinogenic exposure.

²³ These categories were: Pacific Coast states (Alaska, California, Hawaii, Oregon, Washington), Mountain states (Arizona, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, Wyoming), Northwest central states (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota), Northeast central states (Illinois, Indiana, Michigan, Ohio, Wisconsin), Southwest central states (Arkansas, Louisiana, Oklahoma, Texas), Southeast central states (Alabama, Kentucky, Mississippi, Tennessee), South Atlantic Coast states (Florida, Georgia, South Carolina, North Carolina, Virginia, West Virginia, Maryland, Delaware), MidAtlantic Coast states (New Jersey, New York, Pennsylvania), and the omitted area is New England (Connecticut, Maine, Massachusetts, Rhode Island, Vermont).

²⁴ Our sample is limited to these thirteen industries because we were unable to obtain the unionization rate for all industry categories. The thirteen categories were: agriculture, forestry, and fishing; mining; construction; durable manufacturing; transportation, communication, and utilities industries; wholesale trade; professional services; retail trade; finance, insurance, and real estate; business and repair services; personal services; and the omitted category is nondurable manufacturing. A fourteenth industry, public service, is eliminated from the data set because we consider people employed in the private sector only. The 1984 unionization data was obtained from *Employment and Earnings*, Vol. 33, No. 1, p. 214, Bureau of Labor Statistics, U.S. Department of Labor (January 1986). The 1970 data was obtained from the *Statistical Abstract of the United States 1972*.

²⁵ The 1970 and 1984 data for occupational injury and illness rates was obtained from the *Statistical Abstract of the United States 1972 and 1987*.

V. Estimation and Results

Does a wage premium exist that reflects the cancer risks associated with different types of employment? Did workers recognize these risks prior to the court decisions during the first half of the 1970's? When the liability rules changed, did this wage premium disappear for workers that could now be compensated through legal action against their former employers?

Tables 2 through 7 report the results of various specifications of the Weibull, Tobit, and least squares estimates of cancer risk premia. In each table, these three different types of regressions are again divided upon the basis of whether we have controlled for the different individual and job characteristics discussed in the previous section.²⁶ To economize on space, only the parameter estimates corresponding to the risk premia are reported in these tables. Complete regression output for one of the regressions is included in the appendix. Across specifications, all the primary control parameter estimates have strong statistical significance, though some of the interactions with the 1984 year dummy are not significant. All the control parameters are of the expected sign, and their values remain very stable across specifications.

Tables 2 and 3 use the Hickey-Kearney exposure index and its interaction with a 1984 year dummy to estimate the wage premium for cancer risk. While Table 2 examines the entire data set, Table 3 separates out the sample for only Blue Collar workers.²⁷ These estimates include all occupations in all industries for which the Hickey-Kearney index is reported. All the coefficients are consistent with the notion that workers received a significant premium for the risks that they faced in 1970, and that for industries without divestitures this premium fell by between 43 and 108 percent in 1984. In addition, all the regressions imply that the 1984 wage premium increases as the extent of divestitures rises. In all but two cases, the results are statistically significant at least at the .05 percent level.

²⁶ Including a year dummy for the regressions in the sections entitled "not controlling for other factors" does not perceptively alter the results.

²⁷ Separating out the White Collar workers instead of the Blue Collar workers produces somewhat larger and even more statistically significant results. Using the White Collar workers for the specifications shown in Table 3 results in all the coefficients staying the same sign and all being statistically significant at least at the .05 level. One possible explanation is that White Collar workers were even better informed about the hazards of carcinogenic exposures than were Blue Collar workers.

For example, the first specification in Table 2 implies that a worker facing the average exposures to carcinogens earned an additional \$1,465 in 1970, measured in 1984 dollars. Workers in industries with exposure that are one standard deviation greater than the mean earned an estimated annual premium of about \$3,980. Assuming a real interest rate of 3 percent and 40 years of work, these two levels of exposure produce present values of \$33,842 and \$91,938.²⁸ By 1984, assuming a divestiture rate of zero and the average exposure rate, the estimated premium falls by 70 percent (or \$1,033), a result consistent with the change in liability laws. Divestitures also have the predicted effect. Workers facing both the average divestiture and carcinogenic exposure rates in 1984 earn approximately a 7 percent lower premium than they did in 1970.

Given that Ringleb and Wiggins (1990) examined only divestitures in manufacturing industries, we reran the regressions in Tables 2 and 3 using only workers in those occupations. The results are very similar to those already reported. For Table 2, the other major change is that the regressions controlling for other factors the interactions between the Hickey-Kearney Exposure Index and the 1984 dummy are now between 73 and 100 percent as large as the Hickey-Kearney Exposure Index by itself. We also reestimated the regressions in Table 2 including variables for occupational injury and illness rates in 1970 and 1984, with the results for the Hickey-Kearney Index and the divestiture variables remaining largely unchanged.²⁹ The 1984 drop in premiums now eliminates between 78 and 80 percent of the premium that existed in 1970, though the Tobit and OLS exposure coefficients for the 1984 interaction are no longer statistically significant. For the exposure and 1984 interaction, the OLS estimate is only significant at the .10 level for a single-tailed t-test and the Chi Square statistic for the Tobit is only significant at the .18 level.

A skeptical reader will undoubtedly be concerned by the inherent measurement error for the cancer indexes and firm divestitures. The model is thus under-identified since the set of maximum-likelihood solutions contains more than one point. However, as long as the reverse

²⁸ Obviously, we could theoretically adjust these present values by explicitly controlling for the increased probability of deaths at different ages that result from exposure to dangerous chemicals. An alternative method is to simply pick a higher interest rate to discount this flow of earnings by. Increasing the real interest rate to 4 percent lowers the present values shown above to: \$29,007 and \$78,804.

²⁹ There is actually a very low correlation between the Hickey-Kearney carcinogenic exposure index and occupational injury and illness rates of -0.01788 (p-value = .8912).

regressions for those variables measured with error all yield estimates of the same sign for each variable as in the direct regression, the interval between the maximum and minimum values for a coefficient from this set of estimates will contain the true coefficient (Koopmans (1937) and Leamer (1978, pp. 237–45)).³⁰ Using this procedure we can show that the minimum and maximum values for the three risk coefficients in Table 2 are bounded. For example, specification 4 implies that maximum-likelihood estimates for the Hickey-Kearney index's coefficient range from $3.6075E-4$ to $3.7687E-8$, the Hickey-Kearney index times the 1984 dummy from $-1.779E-3$ to $-2.2928E-8$, and the divestiture rate times the 1984 dummy from .0433 to 530. For each variable, the estimates shown in Table 2 are at the lower end of these ranges and they indicate that the true wage premiums worker receive as compensation for carcinogenic exposures may be larger.

Table 4 uses the coefficients from Table 2's specifications 1 and 4 to show the premiums paid in 1970 for the two digit manufacturing industries. Results using specification 4 assume a 38 year old, white, married (with spouse present), male, college graduate who is working 50 weeks per year in a white collar job and who lives in the Mid-Atlantic census district and within an SMSA (though not within the central city area). The yearly exposure premium ranges all the way from only \$6.85 for educational services (SIC 82) to \$15,850 for instruments (SIC 38).³¹ The Tobit and OLS estimates imply even larger wage premiums. Again assuming a 3 percent real interest rate and a 40 year career, three of the estimated present values exceeded \$100,000 in 1984 dollars, and the instrument industry's estimate exceeds four hundred thousand dollars. Once all the other possible control variables are taken into account, the premium's size, while still positive, declines by slightly over 50 percent.³²

³⁰ See also Klepper and Leamer (1984).

³¹ We are puzzled by the very high Hickey-Kearney index that is shown for the legal services industry (SIC Code 81) in Table 4. The industry is defined as containing attorneys, legal aid services, counselors at law, legal services, Law offices' staff, Patent solicitors' offices staff, Lawyers, and referees in bankruptcy. Eliminating this one industry from the sample increases the statistical significance of the three risk variables that we are focusing on. The instruments industry involves intensive exposure to heavy metals and other carcinogens in the manufacturing process, though once the instrument is completed there is no danger in handling it (Hickey-Kearney, 1977).

³² Given that we have no strong prior beliefs on the exact functional form in which age enters into determining earnings, we also reran the regressions in Table 2 by including age to the third, fourth, fifth, and sixth powers in addition to age and age squared. This slightly increased the significance level of the three risk variables, but did not otherwise appreciably alter the results.

Interestingly, Table 4 implies that even after the change in liability rules, workers still received some wage premium to compensate for exposures. This indicates that while workers expect a significant court award, the expected value of the award does not exceed the premium that they were previously getting.

We can provide a rough estimate of how much these workers value their lives if we make two assumptions: 1) 10 to 20 percent of cancer deaths arise from occupational exposures (Wolfe, 1994) and 2) changing the Hickey-Kearney index from zero to its mean value is equivalent to changing the probability of getting occupationally caused cancer from zero to its mean value. The number of workers in 1970 was 82,519,000 and the number of cancer deaths was 330,700.³³ If 10 or 20 percent of the cancer deaths are from occupational exposure (admittedly the very highest end of the estimated range), the probability that a worker will get cancer in any given year ranges from .04 to .08 percent. When we multiply these probabilities by the wage premium in column 7 in Table 4 for, say, a worker in the tobacco manufacturer industry (the industry whose Hickey-Kearney Index is the closest to the industry average), we get a value of life of between \$1,202,150 and \$2,404,300.

Most other estimates claim, however, that occupational causes of cancer are less important and thus imply even greater estimates. Using Doll and Peto's (1981, p. 1256) claim that 4 percent represents the best estimate of cancer rates resulting from occupational sources suggests a value of life of \$6,010,750. Given their range of "acceptable probability estimates" of 2 to 8 percent, the values of life are between \$3,005,375 and \$12,021,500. Viscusi's (1992, pp. 52-4) survey of twenty-three value of life studies using industry death risks show estimates ranging from \$560 thousand to \$12.9 million in 1984 dollars, with an average estimate of \$4.7 million, which are comparable to our numbers.³⁴

There is at least one reason to believe that our value of life estimates are biased downward. To the extent that in 1970 workers or employers already anticipated changes in liability rules, wage

³³ An almost identical ratio can be found for 1984, where there were 106,841,000 workers and 450,000 cancer deaths (Statistical Abstract of the United States, 1987).

³⁴ The articles Viscusi (1992, pp. 52-4) surveys include estimates of risk which are both objective and subjective. See also Tolley et. al. (1994, pp. 323-344).

premiums would already have been reduced in 1970 to offset future expected liability awards. Since our value of life estimates include only wage premiums and ignore expected legal awards, the higher the expected future liability awards in 1970, the more we are underestimating the true compensation workers received.

Turning from the assumption that the Hickey-Kearney index is the best measure of exposure risk in 1984, the regressions of tables 5 and 6 use the measures of exposure from the later survey, the NOES, with essentially the same results. Because the NOES data exist for substantially fewer industries, the sample size for these regressions shrinks by about 33 percent. Unfortunately, since the NOES data and the Hickey-Kearney index are given in different units and are weighted differently, they are not directly comparable. Because of this we can not calculate the net wage premium change that results from the legal regime change. Yet, the regressions still allow us to qualitatively compare the direction of the changes before and after the regime changes. In these tables, the 1970 premium is estimated with the Hickey-Kearney index and the 1984 premium by the NOES total worker exposure variable.

The 1970 premium estimate is very close to that obtained in tables 2 and 3. However, despite the different measure of carcinogenic risk, the effect of the changing liability rules is still quite similar to those shown earlier. For example, using specification 1 in Table 5 and assuming the mean values of the Hickey-Kearney and the NOES indexes and no divestitures, a one standard deviation increase in the Hickey-Kearney index raises the wage premium by \$1,174, while a one standard deviation increase in the NOES index lowers the premium by \$732 (or 63 percent). In Table 6, the liability rule changes tend to produce relatively greater percentage drops in the wage premiums for the first three specifications which do not control for other factors. For both Tables 5 and 6, the coefficients for the divestiture rates remain quite similar to those shown in tables 2 and 3. The results continue to imply that workers received a sizable premium for carcinogenic exposures and that these premiums fell after the change in liability rulings.

Using the Current Population Survey data, we also tried replacing the industry unionization rates with a variable controlling for whether individual employees belonged to a union, though this

variable was only available for 40 percent of our sample.³⁵ All the regressions in Tables 2, 3, 5, and 6 were rerun by replacing the industry unionization rates with a union membership dummy and a union membership dummy interacted with the 1984 dummy variable. The results largely confirm our earlier findings. The primary exception is the Hickey-Kearney Exposure index with the 1984 interaction. For that variable, it now switched signs in three of the 24 specifications (though none was statistically significant), and it is now negative and statistically significant at least at the .10 level for a two-tailed t-test in eleven specifications. On the other hand, all the Hickey-Kearney Exposure Index variables are positive, statistically significant, and their sizes are consistent with our earlier value of life estimates. Even though there is now one of the 24 specifications where the divestiture rate interacted with the 1984 dummy is no longer statistically significant at the .10 level for a two-tailed t-test, it continues to always be positive.

Table 7 attempts to isolate occupation specific effects. Siemitycki's (1991) study provides estimates for about 70 percent of our entire sample, and sample size is reduced accordingly. Keeping in mind the difficulties with this measure discussed in Section III, the results are generally similar to those already presented. The coefficients for the Hickey-Kearney exposure indexes and the divestiture rate continue to have similar signs, sizes, and significance to those reported earlier. The most surprising results are that while the occupational cancer probability interacted with the 1984 dummy is always significant and of the expected sign, the occupational cancer probability by itself is negative and significant for 8 of all 12 specifications. While rerunning the these regressions over just the blue collar occupations provides the expected statistically significant signs for all 6 of the specifications which do not contain the other control variables, the results reported for 8 of the specifications in Table 7 are inconsistent with the hypothesis that workers were being compensated for the risks taken in 1970. Yet, the occupational cancer probability multiplied by the 1984 dummy variable is between 1.4 to 7.95 times larger than the occupational cancer probability by itself, and the large decline in earnings for risky occupations after the changes in legal

³⁵ Robinson (1990) finds a positive though insignificant relationship between the likelihood of unionization and occupational cancer risks as measured by the unadjusted National Occupational Hazard Survey (NOHS) index.

interpretations during the 1970's is consistent workers substituting court imposed compensation for wages.

In summary, the income premium for carcinogenic exposure in 1970 is both economically and statistically significant in every specification. Depending upon what assumption is made about the proportion of cancers that are job related, the value of life estimates range from just over \$1.2 million to \$12 million, with the most plausible estimate being about \$6 million. These are, as far as we know, the first estimates that measure the wage premium for carcinogenic exposures. With the exception of one specification (where the coefficient was not statistically significant), the firm divestitures are slightly smaller economically than for the exposure variable. The coefficient on the interaction between the exposure indexes and the 1984 dummy variable is statistically significant and negative in 68 percent of our regressions and it is positive (though insignificant) in 3 percent of the specifications. This interaction's coefficient consistently remains between 40 and 108 percent, averaging 64 percent, as large as the coefficient for the Hickey-Kearney index by itself.

While the divestiture coefficients are consistent with Ringleb and Wiggin's previous findings and with their interpretation that firms are avoiding liability through spinning off units where workers are exposed hazardous materials, the coefficients also imply that if this were indeed what was happening workers are not being deceived by the practice. Increased divestitures consistently result in higher wages being paid to workers. The law, however, is clearly inconsistent with this interpretation. Parent firms gain no additional protection from already incurred torts through divesting or shutting down the offending operation. If divested units are more likely to go bankrupt, the interpretation is that workers are being compensated for other costs associated with bankruptcy.

VI. Conclusion

The existing view in the economics literature has been that firms are exposing workers to carcinogenic hazards and then spinning off or shutting down the dangerous activities before it was possible for ill workers to be compensated. The claim is then that prior to the early 1970's the

firms were “avoiding liabilities” and that they continued to do so after the changes in legal rules by reorganizing their companies. We have attempted to show that there are two central problems with this argument. First, firms can not expose workers to hazards and then eliminate this liability by divesting or shutting down the hazardous operation. The change in legal rules during the early 1970’s thus can not explain the trends in divestitures and creation of other small firms that Ringleb and Wiggins have pointed to.

Secondly, workers were indeed already being compensated for carcinogenic exposures even before the courts started allowing workers to collect large damages for occupational illnesses. This first attempt at measuring the compensation for carcinogenic exposures implies that the values of life associated with avoiding these risks are comparable to other studies examining occupational risks. In addition, allowing workers compensation through the courts reduced this premium by between 43 to 108 percent. The fact that this premium was almost never entirely eliminated, implies that at least the average worker did not expect court awards that exceeded the compensation that the workers had previously been demanding through their wage premiums. However, instead of viewing divestitures as leaving workers uncompensated for carcinogenic exposures, the large premium implies that workers who were employed prior to the legal change received court awards which essentially compensated them a second time for their misfortune.

Bibliography

- Breyer, Stephen G., Breaking the Vicious Circle: Towards Effective Risk Regulation, Harvard University Press: Cambridge, Massachusetts (1993).
- Brown, Charles, "Equalizing Differences in the Labor Market," Quarterly Journal of Economics Vol. 94 (February 1980): 131-34.
- Doll, Richard and Richard Peto, The Causes of Cancer: Quantitative Estimates of Avoidable Risks of Cancer in the United States Today, Oxford University Press: Oxford, United Kingdom (1981).
- Duncan, Greg and Bertil Holmlund, "Was Adam Smith Right After All?: Another Test of Compensating Wage Differentials," Journal of Labor Economics Vol. 1 (October 1983): 366-79.
- Epstein, Richard A., "Manville: The Bankruptcy of Product Liability Law," Regulation Vol. 6 (September/October 1982).
- Hansen, Robert G. and John R. Lott, Jr., "The Winner's Curse and Public Information in Common Value Auctions: Comment," American Economic Review Vol. 81, no. 1 (1991): 347-361.
- Klepper, Steven and Edward E. Leamer (1984). "Consistent Sets of Estimates for Regressions with Errors in All Variables," Econometrica, Vol. 52, no. 1 (January), 163-83.
- Koopmans, T.C. (1937). *Linear Regression Analysis of Economic Time Series* (Amsterdam: Econometric Institute Itaarlem-de Erwin F. Bohn N.V.).
- Landrigan, Philip J., "Commentary: Environmental Disease — A Preventable Epidemic," American Journal of Public Health Vol. 82 (1992): 941-5.
- Leamer, Edward E. (1978). *Specification Searches: Ad Hoc Inferences with Nonexperimental Data* (New York: John Wiley & Sons).
- Miller, Barry, "Cancer Incidence by Age," Journal of the National Cancer Institute Vol. 86, no. 3 (February 2, 1994): 169.
- _____, "Cancer Mortality by Age," Journal of the National Cancer Institute Vol. 86, no. 4 (February 16, 1994): 257.
- _____, "Cancer as a Percent of All Causes of Death," Journal of the National Cancer Institute Vol. 86, no. 9 (May 4, 1994): 659.
- Mishan, E.J., Cost-Benefit Analysis, fourth edition, Unwin Hyman Publishers: London (1988).
- Peltzman, Sam, "Evaluation of Consumer Protection Legislation: The 1962 Drug Amendments," Journal of Political Economy Vol. 81, no. 5 (September/October 1973): 1049-91.
- _____, "The Effects of Automobile Safety Regulation," Journal of Political Economy Vol. 83, no. 4 (August 1975): 677-725.
- _____, "The Health Effects of Mandatory Prescriptions," Journal of Law and Economics Vol. 30 (October 1987): 207-238.

- Ringleb, Al H. and Steven N. Wiggins, "Liability and Large-Scale, Long-Term Hazards," Journal of Political Economy Vol. 98, no. 3 (June 1990): 574-595.
- Robinson, James C., "Worker Response to Occupational Risk of Cancer," Review of Economics and Statistics Vol. 72 (August 1990): 536-541.
- Rosen, Sherwin, "The Quantity and Quality of Life: A Conceptual Framework," in Tolley et. al. (1994): 221-248.
- Siemiatycki, Jack, editor, Risk Factors for Cancer in the Workplace, CRC Press: Boston, Massachusetts (1991).
- Simonato, Lorenzo; Paolo Vineis; and AC Fletcher, "Estimates of the Proportion of Lung Cancer Attributable to Occupational Exposure," Carcinogenesis Vol. 9 (1988): 1159-1165.
- Smith, Robert S., "Compensating Wage Differentials and Public Policy: A Review," Industrial Labor Relations Review Vol. 32, no. 3 (April 1979): 339-352.
- Schneider, Lynne; Benjamin Klein; and Kevin M. Murphy, "Governmental Regulation of Cigarette Health Information," Journal of Law and Economics Vol. 24 (December 1981): 575-612.
- Tolley, George; Donald Kenkel; and Robert Fabian, eds., *Valuing Health for Policy: An Economic Approach*, University of Chicago Press: Chicago, Illinois (1994).
- Vineis, Paolo and Lorenzo Simonato, "Proportion of Lung and Bladder Cancers in Males Resulting From Occupation: A Systematic Approach," Archives of Environmental Health Vol. 46, no. 1 (January/February 1991): 6-15.
- Viscusi, W. Kip, *Employment Hazards: An Investigation of Market Performance*, Harvard University Press: Cambridge, Massachusetts (1979).
- _____, "Do Smokers Underestimate Risks?" Journal of Political Economy Vol. 98, no. 6 (December 1990): 1253-1269.
- _____, *Reforming Products Liability*, Harvard University Press: Cambridge, Massachusetts (1991).
- _____, *Fatal Tradeoffs: Public and Private Responsibilities for Risk*, Oxford University Press: New York, N.Y. (1992).
- Viscusi, W. Kip and Charles J. O'Connor, "Adaptive Responses to Chemical Labeling: Are Workers Bayesian Decision Makers?" American Economic Review Vol. 74, no. 5 (December, 1984): 942-956.
- Wald, Mathew L., "Pioneer in Radiation Sees Risk Even in Small Doses," The New York Times (Tuesday, December 8, 1992): A1 and A8.
- Wen, C.P.; Shan P. Tsai; Nancy S. Weiss; Roy L. Gibson; Otto Wong; and William A. McClellan; "Long-term Mortality Study of Oil Refinery Workers. IV. Exposure to the Lubricating-Dewaxing Process," Journal of the National Cancer Institute Vol. 74, no. 1 (January, 1985): 11-18.

Wiggins, Stevens N. and Al H. Ringleb, "Adverse Selection and Long-Term Hazards: The Choice between Contract and Mandatory Liability Rules," Journal of Legal Studies Vol. 21, no. 1 (January 1992): 189-215.

Wolfe, Sidney M., Senate Judiciary Testimony Supreme Court Nomination: Confirmation Hearings on Judge Stephen Breyer, Federal Document Clearing House Congressional Testimony (July 15, 1994).

Zucker, Lynne G.; Michael R. Darby; and Marilyn B. Brewer, "Intellectual Capital and the Birth of U.S. Biotechnology Enterprises," National Bureau of Economic Research Working Paper No. 4653.

Table 1

Sample Means and Standard Deviations for Variables Contained in the Entire Sample

Variable Descriptions	Mean	Standard Deviation
Real Wage or salary income (in 1984 dollars) Observation is for 1984 (from 1985 CPS)	18249.08 0.5519352	13860.62 0.4972984
Personal Characteristics Dummies		
Male	0.5898247	0.4918683
Age in years	37.7567795	13.5570419
Age squared	1609.37	1123.92
Race is black	0.0807084	0.2723884
Race is other than white or black	0.0207278	0.1424726
Hispanic ethnicity	0.0684275	0.2524795
Married, spouse present	0.6583739	0.4742578
Married, spouse absent	0.0079722	0.0889314
Separated or divorced	0.0895083	0.2854777
Widowed	0.0285297	0.1664815
Education Level Dummies		
Years of education equals 12	0.4240871	0.4942066
Years of education between 12 and 16	0.1754503	0.3803542
Years of education equals 16	0.0938413	0.2916096
Years of education greater than 16	0.0472858	0.2122508
Employment Classification Dummies		
White collar occupation	0.5009250	0.5000022
Blue collar occupation	0.3803554	0.4854771
Worked full-time from 40 to 47 weeks	0.0635224	0.2439017
Worked full-time 48 or 49 weeks	0.0300998	0.1708630
Worked full-time from 50 to 52 weeks	0.6888997	0.4629466
Worked part-time from 27 to 39 weeks	0.0310979	0.1735833
Worked part-time from 40 to 47 weeks	0.0204479	0.1415275
Worked part-time 48 or 49 weeks	0.0084834	0.0917147
Worked part-time from 50 to 52 weeks	0.0877799	0.2829763
Percent of Industry workforce unionized by 2 digit SIC code 1970	27.601025	21.910080
Percent of Industry workforce unionized by 2 digit SIC code 1984	15.986020	11.020602
Carcinogen Exposure Variables		
Hickey-Kearney carcinogen exposure (NOHS)	391694.00	609665.03
Hickey-Kearney carcinogen exposure * 1984 Dummy	362390.03	598319.89
NOES carcinogen exposure per employee * 1984 Dummy	0.1208343	0.1290160
Total NOES carcinogen exposures * 1984 Dummy	338716.73	273774.06
Estimated occupational cancer probability	0.5789254	0.1554558
Estimated occupational cancer probability * 1984 Dummy	0.5764472	0.1595715

Divestiture variables

Divestitures per firm within 2 digit SIC code	0.1015900	0.1791809
Divestitures per firm within 2 digit SIC code * 1984 Dummy	0.0959080	0.1788924

Union Membership by Industry

Percent Union Membership in 1970	26.7287714	22.2646115
Percent Union Membership in 1984	16.6250609	10.9830796

Individual Union Membership Dummy

Union Membership in 1970	0.2427403	0.4287452
Union Membership in 1984	0.1583950	0.3651293

Occupational Illness and Injury Rates per 100 Full Time Employees

Occupational Illness and Injury Rate	12.9983133	7.9321938
Occupational Illness and Injury Rate in 1984	8.1731664	4.2488376

Location of residence

Central city, inside SMSA	0.2715433	0.4447583
Not central city, but within SMSA	0.3692064	0.4825929
SMSA information not coded	0.0863681	0.2809085
Pacific census division	0.1335443	0.3401641
Mountain census division	0.0636806	0.2441846
West North Central census division	0.0839094	0.2772536
East North Central census division	0.1826436	0.3863764
West South Central census division	0.0877434	0.2829231
East South Central census division	0.0497201	0.2173673
South Atlantic census division	0.1487585	0.3558524
Mid-Atlantic census division	0.1674294	0.3733611

Major industry group of principal employment

Agriculture, forestry or fishing	0.0053189	0.0727369
Mining	0.0087390	0.0930741
Construction	0.0637171	0.2442499
Durable goods manufacturing	0.1908958	0.3930095
Transportation, communication or utilities	0.0728822	0.2599446
Wholesale trade	0.0383033	0.1919287
Entertainment and recreation services	0.0106865	0.1028221
Professional services	0.1309883	0.3373896
Finance, insurance or real estate	0.0757059	0.2645286
Retail trade	0.1959104	0.3969023
Business and repair services	0.0444377	0.2060667
Personal services	0.0296616	0.1696531

Table 2

Earnings Regressions, All Occupations, NOHS Industries
 (ChiSquares for the Weibull and Tobit specifications and absolute t-statistics for the OLS specifications are in Parentheses)

Dependent Variable: Natural Log of Total Wage or Salary Income in 1984 dollars

	Not Controlling for Other Factors		Controlling for Other Factors	
	Weibull	Tobit	Weibull	Tobit
Hickey-Kearney Exposure Index	1.94399E-7 (1116.46)*	3.17494E-7 (2309)*	4.881E-8 (44.39)*	6.1866E-8 (82.83)*
Hickey-Kearney Exposure Index * 1984 Dummy	-1.3548E-7 (192.3)*	-2.0164E-7 (274.85)*	-2.2928E-8 (4.004)*	-2.6403E-8 (6.4244)*
Divestiture Rate * 1984 Dummy	0.47202 (259.46)*	0.6314 (300.3)*	0.0433 (3.611)*	0.1781 (50.15)*
Intercept	9.8266 (9538830)*	9.39707 (6732106)*	7.6297 (73268)*	7.0857 (49464)*
Adj-R2			0.0431	0.5643
F-statistic			1235.2	1386.1
Log Likelihood	-99172.5	-105317	-64325	-71886
Observations	82160	82160	82160	82160
OLS	3.18E-7 (48.165)*	-2.02E-7 (16.639)*	4.881E-8 (44.39)*	6.1743E-8 (9.098)*
OLS				-2.6274E-8 (2.527)*
OLS				0.1780 (7.088)*
OLS				7.0865 (222.8)*
OLS				0.5643
OLS				1386.1
OLS				-71886
OLS				82160
OLS				82160

* Significant at least at the .05 percent level, for t-statistics it is for a two-tailed t-test.

** Significant at least at the .10 percent level, for t-statistics it is for a two-tailed t-test.

Table 3

Earnings Regressions, Blue Collar Occupations, NOHS Industries
 (ChiSquares for the Weibull and Tobit specifications and absolute t-statistics for the OLS specifications are in Parentheses)

Dependent Variable: Natural Log of Total Wage or Salary Income in 1984 dollars

	Not Controlling for Other Factors		Controlling for Other Factors	
	Weibull	Tobit	Weibull	Tobit
Hickey-Kearney Exposure Index	6.01266E-8 (100.6)*	1.64033E-7 (475.3)*	4.1399E-8 (25.98)*	4.5405E-8 (36.22)*
Hickey-Kearney Exposure Index * 1984 Dummy	-6.513E-8 (41.5)*	-1.2807E-7 (88.043)*	-3.2305E-8 (6.371)*	-2.0332E-8 (2.89)*
Divestiture Rate * 1984 Dummy	0.25667 (64.397)*	.32454 (56.937)*	0.1510 (30.70)*	0.1737 (30.44)*
Intercept	9.87897 (5204817)*	9.5187 (3140815)*	7.7312 (18164)*	7.2236 (25973)*
Adj-R2		.0190		0.5076
F-statistic		280		453.1
Log Likelihood	-30419.3	-34521.7	-20494	-23532
Observations	31250	31250	31250	31250

* Significant at least at the .05 percent level, for t-statistics it is for a two-tailed t-test.

** Significant at least at the .10 percent level, for t-statistics it is for a two-tailed t-test.

Table 4

Risk Premium as a Function of the Hickey-Kearney Exposure Index for Two-digit Industries: Using Regressions
 Provided in Table 3 (All Values in 1984 Dollars)

SIC Code	Industry	Hickey-Kearney Index	Predicted 1970 Premium from working in a firm with the average index: Table 2 Specification 1	Present Value of preceding premium with 3% real interest rate over 40 years	Predicted Percentage drop in premium that had occurred by 1984 using Specification 1	Predicted 1970 Premium from working in a firm with the average index: Table 2 Specification 4	Present Value of preceding premium with 3% real interest rate over 40 years	Predicted Percentage drop in premium that had occurred by 1984 using Specification 4
7	Agriculture Services and Hunting	41960	\$ 151.68	\$ 3,003.36	0.698	\$ 89.80	\$ 1,777.98	0.470
8	Forestry	16234	\$ 58.54	\$ 1,159.07	0.697	\$ 34.72	\$ 687.45	0.470
9	Fisheries	3874	\$ 13.95	\$ 276.26	0.697	\$ 8.28	\$ 164.00	0.470
13	Oil and Gas Extraction	18902	\$ 68.18	\$ 1,349.91	0.697	\$ 52.77	\$ 1,044.84	0.470
14	Nonmetallic Minerals	2670	\$ 9.62	\$ 190.38	0.697	\$ 7.45	\$ 147.53	0.470
15	General Building Contractors	143367	\$ 523.42	\$ 10,363.70	0.700	\$ 453.57	\$ 8,980.68	0.471
16	Heavy Construction Contrac	266632	\$ 985.26	\$ 19,508.14	0.702	\$ 846.09	\$ 16,752.55	0.471
17	Special Trade Contractors	248777	\$ 917.67	\$ 18,169.96	0.702	\$ 789.09	\$ 15,623.90	0.471
20	Food and Kindred Products	98695	\$ 358.76	\$ 7,103.42	0.699	\$ 244.60	\$ 4,843.08	0.470
21	tobacco manufacturers	385340	\$ 1,440.61	\$ 28,524.09	0.705	\$ 961.72	\$ 19,042.12	0.472
22	Textile Mills	70372	\$ 255.10	\$ 5,050.96	0.698	\$ 174.29	\$ 3,450.85	0.470
23	Apparel	193053	\$ 708.25	\$ 14,023.33	0.701	\$ 479.56	\$ 9,495.21	0.471
24	Lumber and Wood products	178634	\$ 654.43	\$ 12,957.65	0.701	\$ 436.28	\$ 8,638.25	0.471
25	Furniture and Fixtures	142591	\$ 520.55	\$ 10,306.82	0.700	\$ 347.94	\$ 6,889.24	0.471
26	Paper and allied Products	431437	\$ 1,620.29	\$ 32,081.65	0.706	\$ 1,077.99	\$ 21,344.14	0.472
27	Printing and publishing	553130	\$ 2,102.42	\$ 41,628.00	0.708	\$ 1,386.18	\$ 27,446.29	0.473
28	chemical and allied products	687149	\$ 2,646.76	\$ 52,405.91	0.711	\$ 1,727.71	\$ 34,208.58	0.474
29	Petroleum and coal products	1028957	\$ 4,101.01	\$ 81,200.07	0.718	\$ 2,608.94	\$ 51,657.07	0.476
30	Rubber and Plastics	436076	\$ 1,638.46	\$ 32,441.44	0.706	\$ 1,089.70	\$ 21,576.10	0.472
31	Leather and leather products	963615	\$ 3,815.49	\$ 75,546.69	0.717	\$ 2,439.34	\$ 48,298.97	0.476
32	Stone, Clay, and glass	273689	\$ 1,012.04	\$ 20,038.33	0.703	\$ 669.98	\$ 13,265.65	0.471
33	Primary metals	740103	\$ 2,865.78	\$ 56,742.51	0.712	\$ 1,832.58	\$ 36,285.04	0.474
34	Fabricated Metals	2295337	\$ 10,415.30	\$ 206,223.00	0.743	\$ 5,906.16	\$ 116,941.98	0.484
35	Machinery (except electrical)	1319442	\$ 5,415.18	\$ 107,220.53	0.724	\$ 3,314.00	\$ 65,617.24	0.478
36	Electrical Machinery	2057065	\$ 9,105.59	\$ 180,290.68	0.738	\$ 5,261.83	\$ 104,184.15	0.482
37	Transportation Equipment	1314978	\$ 5,394.42	\$ 106,809.45	0.724	\$ 3,302.43	\$ 65,388.04	0.478
38	Instruments	3180810	\$ 15,850.47	\$ 313,839.26	0.759	\$ 8,367.41	\$ 165,674.81	0.489
39	Misc Manufacturing Ind	668896	\$ 2,571.79	\$ 50,921.42	0.711	\$ 1,653.37	\$ 32,736.70	0.474
41	Local and Interurban Passenger Trans	377159	\$ 1,408.89	\$ 27,896.04	0.705	\$ 1,056.57	\$ 20,920.05	0.472
42	Trucking and dWarehousing	73782	\$ 267.55	\$ 5,297.47	0.699	\$ 205.16	\$ 4,062.25	0.470
44	Water Transportation	179241	\$ 656.69	\$ 13,002.45	0.701	\$ 499.70	\$ 9,894.03	0.471
45	Transportation by Air	273742	\$ 1,012.24	\$ 20,042.31	0.703	\$ 764.92	\$ 15,145.40	0.471
46	Pipe Line Transportation	780722	\$ 3,035.32	\$ 60,099.34	0.713	\$ 2,208.86	\$ 43,735.34	0.474
49	Electric, Gas, and Sanitary Service	304512	\$ 1,129.42	\$ 22,362.58	0.703	\$ 851.54	\$ 16,860.50	0.472
50	Wholesale Trade	406533	\$ 1,523.02	\$ 30,155.71	0.705	\$ 1,024.78	\$ 20,290.69	0.472
52	Building Materials and Farm Eq	161209	\$ 589.59	\$ 11,673.79	0.700	\$ 364.94	\$ 7,225.84	0.471
53	General Merchandise	30357	\$ 109.62	\$ 2,170.40	0.698	\$ 68.50	\$ 1,356.34	0.470
54	Food Stores	176224	\$ 645.45	\$ 12,779.83	0.701	\$ 399.08	\$ 7,901.76	0.471
55	Automotive Dealers and Service	34220	\$ 123.61	\$ 2,447.51	0.698	\$ 77.23	\$ 1,529.09	0.470
56	Apparel and Accessory Stores	118631	\$ 432.07	\$ 8,554.91	0.699	\$ 268.28	\$ 5,311.85	0.470
57	Furniture and Home Furnishings	33740	\$ 121.87	\$ 2,413.07	0.698	\$ 76.14	\$ 1,507.62	0.470
58	Eating and Drinking Places	13632	\$ 49.14	\$ 973.05	0.697	\$ 30.75	\$ 608.83	0.470
59	Misc Retail Stores	77361	\$ 280.62	\$ 5,556.37	0.699	\$ 174.77	\$ 3,460.44	0.470
60	Banking	49941	\$ 180.68	\$ 3,577.39	0.698	\$ 128.01	\$ 2,534.63	0.470
61	Credit Agencies other than Banks	9297	\$ 33.50	\$ 663.34	0.697	\$ 23.81	\$ 471.38	0.470
62	Security, Commodity Brokers	5797	\$ 20.88	\$ 413.47	0.697	\$ 14.84	\$ 293.90	0.470
63	Insurance Carriers	5854	\$ 21.09	\$ 417.54	0.697	\$ 14.99	\$ 296.79	0.470
65	Real Estate	14328	\$ 51.66	\$ 1,022.80	0.697	\$ 36.69	\$ 726.55	0.470
70	Hotels and Other Lodging Places	5526	\$ 19.91	\$ 394.13	0.697	\$ 12.15	\$ 240.52	0.470
72	Personal Services	12285	\$ 44.28	\$ 876.79	0.697	\$ 27.01	\$ 534.79	0.470
73	Misc Business Services	30202	\$ 109.06	\$ 2,159.29	0.698	\$ 75.27	\$ 1,490.28	0.470
75	Auto Repair, Services & Garages	77629	\$ 281.60	\$ 5,575.77	0.699	\$ 193.68	\$ 3,834.95	0.470
76	Misc Repair Serv	27575	\$ 99.54	\$ 1,970.97	0.698	\$ 68.72	\$ 1,360.57	0.470
80	Medical and Other Health Serv	134838	\$ 491.87	\$ 9,739.04	0.700	\$ 320.98	\$ 6,355.41	0.471
81	Legal Services	751623	\$ 2,913.73	\$ 57,691.86	0.712	\$ 1,816.47	\$ 35,966.03	0.474
82	Educational Services	1902	\$ 6.85	\$ 135.61	0.697	\$ 4.51	\$ 89.36	0.470
86	Nonprofit Membership Org	18011	\$ 64.96	\$ 1,286.17	0.697	\$ 42.75	\$ 846.51	0.470
89	Misc Services	27540	\$ 99.42	\$ 1,968.46	0.698	\$ 65.39	\$ 1,294.66	0.470

Table 5

Earnings Regressions, All Occupations, NOES Industries
 (ChiSquares for the Weibull and Tobit specifications and absolute t-statistics for the OLS specifications are in Parentheses)

Dependent Variable: Natural Log of Total Wage or Salary Income in 1984 dollars

	Not Controlling for Other Factors		Controlling for Other Factors	
	Weibull	Tobit	Weibull	Tobit
Hickey-Kearney Exposure Index * 1970 Dummy	8.3071E-8 (198.2)*	1.5465E-7 (504.2)*	1.55E-7 (22.493)*	4.2414E-8 (10.549)*
Exposures per Employee * 1984 Dummy	-0.3476 (202.22)*	-0.406696 (190.69)*	-0.40778 (13.875)*	-0.1342 (8.724)*
Divestiture Rate * 1984 Dummy	0.4526 (613.14)*	0.63425 (957.7)*	0.6333 (30.968)*	0.1092 (25.73)*
Intercept	9.9936 (3931996)*	9.6252 (2669505)*	9.6249 (1637.2)*	7.1310 (36381)*
Adj-R ²			0.0307	0.5272
F-statistic			578.2	803.5
Log Likelihood	-59910.5	-64000.6	-39240	-44361
Observations	54706	54706	54706	54706
				4.2443E-8 (3.237)*
				-0.1351 (2.602)*
				0.1091 (5.073)*
				7.132 (98.7)*
				0.5272
				803.5
				-44361
				54706
				54706

* Significant at least at the .05 percent level, for t-statistics it is for a two-tailed t-test.

** Significant at least at the .10 percent level, for t-statistics it is for a two-tailed t-test.

Table 6

Earnings Regressions, Blue Collar Occupations, NOES Industries
(ChiSquares for the Weibull and Tobit specifications and absolute t-statistics for the OLS specifications are in Parentheses)

Dependent Variable: Natural Log of Total Wage or Salary Income in 1984 dollars

	Not Controlling for Other Factors		Controlling for Other Factors	
	Weibull	Tobit	Weibull	Tobit
Hickey-Kearney Exposure Index * 1970 Dummy	2.23047E-8 (12.233)*	9.8015E-8 (149.33)*	3.047E-8 (24.15)*	3.887E-8 (38.89)*
Exposures per Employee * 1984 Dummy	-0.16104 (36.48)*	-0.26753 (58.58)*	-0.0339 (6.398)*	-0.0828 (2.203)
Divestiture Rate * 1984 Dummy	0.1942 (85.839)*	0.33618 (170.6)*	0.1214 (23.89)*	0.1382 (25.21)*
Intercept	9.93656 (3006670)*	9.6142 (1769470)*	7.7216 (13091)*	7.241 (23485.6)*
Adj-R ²			0.0146	.4732
F-statistic			140.0	358.2
Log Likelihood	-26320.9	-29847.3	-17938	-20976
Observations	28232	28232	28232	28232
OLS	1.55E-7 (22.493)*	-0.40778 (13.875)*	3.887E-8 (6.230)*	0.1381 (5.014)*

* Significant at least at the .05 percent level, for t-statistics it is for a two-tailed t-test.

** Significant at least at the .10 percent level, for t-statistics it is for a two-tailed t-test.

Table 7

Earnings Regressions, All Occupations, Occupational Cancer Probabilities
(ChiSquares for the Weibull and Tobit specifications and absolute t-statistics for the OLS specifications are in Parentheses)

Dependent Variable: Natural Log of Total Wage or Salary Income in 1984 dollars

	Not Controlling for Other Factors				Controlling for Other Factors			
	Weibull	Tobit	Tobit	OLS	Weibull	Tobit	Tobit	OLS
Hickey-Kearney Exposure Index * 1970 Dummy	1.775E-7 (379.6)*	2.995E-7 (839.7)*	2.995E-7 (839.7)*	2.99E-7 (29.027)*	4.601E-8 (19.666)*	6.655E-8 (47.46)*	6.6295E-8 (6.877)*	6.6295E-8 (6.877)*
Hickey-Kearney Exposure Index * 1984 Dummy	-7.41E-8 (23.75)*	-1.635E-7 (78.1)*	-1.635E-7 (78.1)*	-1.64E-7 (8.861)*	-2.1639E-8 (3.9694)*	-3.310E-8 (4.954)*	-3.273E-8 (2.205)*	-3.273E-8 (2.205)*
Occupational Cancer Prob	-0.108 (25.72)*	-0.0514 (4.261)*	-0.154 (37.69)*	-0.1528 (6.109)*	-0.0182 (0.536)	0.0694 (4.212)*	0.0823 (2.97)*	0.0696 (2.504)*
Occup. Cancer Prob*1984	-3.4768 (1006.5)*	-0.4087 (970.2)*	-0.2623 (333)*	-0.2627 (18.321)*	-0.1084 (10.944)*	-0.0219 (0.3614)	-0.0297 (0.815)	-0.0216 (0.594)
Divestiture Rate * 1984 Dummy	1.0419 (984.6)*	1.2904 (1347)*	0.9531 (338)*	1.286 (36.69)*	0.1055 (14.07)*	0.2905 (63.74)*	0.3391 (11.37)*	.2892 (7.964)*
Intercept	9.999 (672224)*	9.5753 (447003)*	9.536 (445489)*	9.535 (669)*	7.579 (35145)*	6.9702 (24326)*	6.9601 (156.1)*	6.9712 (156.3)*
Adj-R ²				0.0303			0.5611	0.5609
F-statistic				621.5			989.6	965.8
Log Likelihood	-74391	-78741	-78286		-49045	-54409		
Observations	59,596	59,596	59,596	59,596	59,596	59,596	59,596	59,596

* Significant at least at the .05 percent level, for t-statistics it is for a two-tailed t-test.

** Significant at least at the .10 percent level, for t-statistics it is for a two-tailed t-test.

** Significant at least at the .15 percent level, for t-statistics it is for a two-tailed t-test.

**Appendix: The Complete Set of Regression Coefficients for Table 2
Specification 4**

Variable	Estimate	ChiSquare	Pr>Chi
INTERCPT	7.62969891	73267.71	0.0001
DUMMY 1984	-0.2176402	31.21331	0.0001
MALE	0.50166579	6097.61	0.0001
AGE	0.04890882	1641.102	0.0001
AGESQ	-0.000497	1254.518	0.0001
MALE84	-0.1053999	153.4282	0.0001
AGE84	0.00703295	17.92349	0.0001
AGESQ84	-0.0000718	13.93681	0.0002
BLACK	-0.1231535	151.1621	0.0001
HISPANIC	-0.1248623	81.65036	0.0001
OTHER RACE	-0.0760578	8.083544	0.0045
BLACK84	0.0039497	0.084617	0.7711
HISPANIC84	-0.0016289	0.010035	0.9202
OTHER RACE84	0.01733745	0.32841	0.5666
MARRIED SPOUSE PRESENT	0.15371623	354.0035	0.0001
MARRIED SPOUSE ABSENT	0.22491468	58.98224	0.0001
SEPARATED OR DIVORCED	0.07327447	32.56426	0.0001
WIDOWED	0.03189365	3.728326	0.0535
MARRIED SPOUSE PRESENT84	-0.0309218	8.551984	0.0035
MARRIED SPOUSE ABSENT84	-0.157018	15.63603	0.0001
SEPARATED OR DIVORCED 84	0.02421483	2.364175	0.1241
WIDOWED84	0.02120199	0.784645	0.3757
HIGH SCHOOL GRAD	0.11827704	342.8611	0.0001
SOME COLLEGE	0.22017413	595.6503	0.0001
COLLEGE GRAD	0.37084118	952.1601	0.0001
POST COLLEGE GRAD	0.4788408	877.6636	0.0001
HIGH SCHOOL 84	0.07284802	61.17391	0.0001
SOME COLLEGE84	0.0357535	8.648905	0.0033
COLLEGE GRAD84	0.09731108	38.95941	0.0001
POST COLLEGE GRD84	0.16116322	62.68326	0.0001
WHITE COLLAR OCCUPATION	0.31672416	983.3358	0.0001
BLUE COLLAR OCCUPATION	0.10283997	94.12791	0.0001
WHITE COLLAR OCCUPATION84	-0.0365254	7.767408	0.0053
FARM OCCUPATION84	0.01371173	0.103699	0.7474
BLUE COLLAR OCCUPATION84	0.03532622	6.342186	0.0118
FULL TIME 40 TO 47 WEEKS	0.1784684	178.2323	0.0001
FULL TIME 48 TO 49 WEEKS	0.21968005	173.639	0.0001
FULL TIME 50 TO 52 WEEKS	0.38352148	1513.771	0.0001
PART TIME 27 TO 39 WEEKS	-0.5687438	1014.582	0.0001
PART TIME 40 TO 47 WEEKS	-0.4410509	407.6708	0.0001
PART TIME 48 TO 49 WEEKS	-0.4419071	213.1004	0.0001
PART TIME 50 TO 52 WEEKS	-0.2830999	434.4436	0.0001
FULL TIME 40 TO 47 WEEKS84	0.00359872	0.036058	0.8494
FULL TIME 48 TO 49 WEEKS84	0.0627981	6.965916	0.0083
FULL TIME 50 TO 52 WEEKS84	0.08328365	35.03753	0.0001
PART TIME 27 TO 39 WEEKS84	-0.0576371	5.660946	0.0173

PART TIME 40 TO 47 WEEKS84	0.04994275	3.060749	0.0802
PART TIME 48 TO 49 WEEKS84	0.08745297	4.708692	0.0300
PART TIME 50 TO 52 WEEKS84	0.11194759	37.49241	0.0001
AGRICULTURE, FORESTRY, FISHING	-0.0938202	5.826003	0.0158
MINING	0.10331696	8.999199	0.0027
CONSTRUCTION	0.16500279	77.33193	0.0001
MANUFACTURING DURABLE	0.00342513	0.090506	0.7635
TRANSPORTATION, COMMUNICATION, UTILITIES	0.08981638	31.52575	0.0001
WHOLESALE TRADE	0.05147433	12.17011	0.0005
RETAIL TRADE	-0.0500592	23.15718	0.0001
FINANCE, INSURANCE, REAL ESTATE	0.08777411	35.38439	0.0001
BUSINESS & REPAIR SERVICE	0.04838011	8.496636	0.0036
PERSONAL SERVICE	-0.0765006	19.25887	0.0001
AGRICULTURE, FORESTRY, FISHING84	0.13662529	5.504702	0.0190
MINING84	0.17648407	18.94257	0.0001
CONSTRUCTION 84	-0.0717879	17.41775	0.0001
MANUFACTURING DURABLE 84	0.02964378	3.001723	0.0832
TRANSPORTATION, COMMUNICATION, UTILITIES84	0.01158626	0.209245	0.6474
WHOLESALE TRADE84	-0.0121951	0.331992	0.5645
RETAIL TRADE84	-0.0310368	5.728001	0.0167
FINANCE, INSURANCE, REAL ESTATE 84	-0.0089	0.219013	0.6398
BUSINESS & REPAIR SERVICE84	-0.0091647	0.200863	0.6540
PERSONAL SERVICES84	0.06207155	7.292823	0.0069
CENTER CITY SMSA	0.10505757	222.4806	0.0001
NOT CENTRAL CITY SMSA	0.11461969	309.1125	0.0001
NOT IN SMSA	-0.0147943	3.254101	0.0712
CENTER CITY SMSA84	-0.0325245	10.65377	0.0011
NOT CENTRAL CITY SMSA84	-0.0367229	16.32392	0.0001
PACIFIC STATES	0.07559784	37.1848	0.0001
MOUNTAIN STATES	-0.0258103	2.246426	0.1339
WEST NORTH CENTRAL STATES	-0.0104375	0.577064	0.4475
EAST NORTH CENTRAL STATES	0.05371153	22.84203	0.0001
WEST SOUTH CENTRAL STATES	-0.0946974	49.22991	0.0001
EAST SOUTH CENTRAL STATES	-0.1467342	99.02354	0.0001
SOUTH ATLANTIC STATES	-0.0186586	2.383377	0.1226
MID ATLANTIC STATES	0.0517173	20.3643	0.0001
PACIFIC STATES84	0.02901167	3.255193	0.0712
MOUNTAIN STATES84	0.05681036	7.582879	0.0059
WEST NORTH CENTRAL STATES84	-0.0537902	9.484653	0.0021
EAST NORTH CENTRAL STATES84	-0.0654154	18.89001	0.0001
WEST SOUTH CENTRAL STATES84	0.06403304	13.39047	0.0003
EAST SOUTH CENTRAL STATES84	0.01997478	0.989484	0.3199
SOUTH ATLANTIC84	-0.0266531	2.913966	0.0878
MID ATLANTIC84	-0.0640322	17.60516	0.0001
UNION PERCENT 70	0.00122161	12.79684	0.0003
UNION PERCENT 84	0.00159695	2.846458	0.0910
HICKEY-KEARNEY CARCINOGENIC EXPOSURE	4.88135E-8	44.39114	0.0001
HICKEY-KEARNEY CARCINOGENIC EXPOSURE 84	-2.928E-8	4.003502	0.0454
DIVESTITUTERS PER FIRM WITHIN 2 DIGIT SIC CODE	0.04330781	3.610936	0.0574