MANAGEMENT OF OCCUPATIONAL INJURY COSTS FOR THE COLORADO UNDERGROUND COAL INDUSTRY

by

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ABSTRACT

Public concern over the health and safety of workers has prompted important changes in workers' compensation laws over the past fifteen years. These changes in laws and in worker attitudes have in turn contributed to increased insurance costs, increased complexity of insurance structures and greater uncertainty in estimating a firm's future liability for occupational injuries. Workers' compensation law amendments and the creation of a federal program for black lung risks have especially aggravated problems of high costs and injury risks that are difficult to insure for the underground coal industry.

This thesis examines three insurance-related aspects for occupational injury risks in the Colorado underground coal industry. These are 1) a history of issues and trends in insurance costs; 2) an overview of structures to insure federal and state occupational injury risks; and 3) the data and analytical methods available to estimate future liability.

The conclusions reached are first, insurance costs as measured by manual rates in the Colorado underground coal industry (private insurers) have increased by approximately 36% over the past twelve years. The increase is made more

significant because rates developed for black lung risks cannot be adjusted by a firm's accident experience as can rates for state occupational injury risks. Second, the structures to insure both state and federal occupational injury risks favor the largest coal-producing companies. Small and mid-sized firms, on the other hand, must pay higher insurance premiums and have less flexibility in managing costs. These inequities are apparent in state and federal regulations for insurance of work injury risks, in private industry practices, and in the development of manual rates for state and federal occupational injury risks. Finally, available cost data indicate that work injury risks per claim are climbing. At the same time, accident statistics point to shifts in the nature of occupational injury risks. However, predictive methods have not been developed that adequately evaluate these changing risks. Employers and their insurers therefore face greater uncertainty in assessing and preparing for their future liability under workers' compensation laws.

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LIST OF ACRONYMS

COIM	Cost of Injury Model
CSIF	Colorado State Insurance Fund
MSHA	Mine Safety and Health Administration
NCCI	National Council on Compensation Insurance
NIOSH	National Institute for Occupational Safety and Health
SDS	Supplementary Data System

This list of acronyms has been used consistently throughout this thesis and is provided for the convenience of the reader.

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CHAPTER I

INTRODUCTION

Federal legislation which had as a shared purpose mitigation of the impact of industrial hazards on various segments of society was enacted in the late 1960s and early 1970s. These laws and their counterparts at the state level were in turn a response to investigations into industrial hazards and to an apparent public sentiment that those hazards should be curbed by regulatory measures with industry bearing the costs. Health and safety in the workplace, particularly in the coal-mining industry, was one of the issues targeted in two pieces of federal legislation--the Coal Mine Safety and Health Act of 1969 and the Occupational Health and Safety Act, passed a year later. Both laws, in addition to establishing federally mandated safeguards in the workplace, addressed compensation to be paid to injured workers. The controversial Black Lung Benefits Act, as part of the Coal Mine Safety and Health Act, authorized benefits to be paid to underground coal miners in the case of disability due to coal workers' pneumoconiosis. The Occupational Health and Safety Act did not contain any legislation that directly affected the payment of benefits to injured employees. However, the act did establish the National Commission on State Workers' Compensation Programs, which was directed to study workers' compensation programs in the states. The Commission proposed over 80 recommendations which it felt were necessary to upgrade and standardize state workers' compensation programs. Nineteen of these recommendations were termed essential to ensure adequate coverage and benefit levels. A proposal to codify the 19 essential recommendations and thereby establish minimum federal standards for state workers' compensation programs was considered several times during the 1970's by the Senate Human Resources Subcommittee on Labor under several bill numbers but has yet to become law. The proposal and the threat of its passage have spurred legislation at the state level, however, and in the period from 1970 to 1975 the states have enacted over 1300 amendments. As a result of these amendments, the most dramatic increases in benefit levels and types of coverage since the inception of the workers' compensation program in the early 1900s have taken place.[1] For example, benefit levels rose from 53% of wage loss replacement in 1969 to two-thirds replacement of the injured worker's average weekly wage by 1977.[2,3] Initial estimates to support the rise in benefits and broadened coverage predicted a 69% increase in costs to employers if the minimum standards recommended by the federal bills were met. Actual compensation costs as measured by insurance premiums averaged over all industries rose from $1.00 per

$100 of payroll in 1969 to $1.85 per $100 of payroll in 1978.[4,5]

In the coal industry, where disabling injury rates can be as much as four times the national average and coal miners under liberal eligibility requirements can receive benefits under a federal program, the cost burden and the increases in costs are much greater.[6] In two western coal-mining states--New Mexico and Utah--insurance rates rose from approximately $6 per $100 of payroll to a high of over $30 per $100 of payroll by 1973 before falling to present rates of $22-26 per $100 of payroll.[7] In Colorado, 1970 rates were substantially higher than rates in neighboring states--$17 per $100 of payroll--and increases during the early 1970's were less dramatic. Insurance rates for Colorado reached a high of $26 per $100 of payroll and subsequently fell to the present rates of $23.39 per $100 of payroll.[8] (Table I, Table II)

These cost increases for the coal industry were due almost entirely to the liability created by the Federal Black Lung Program. In 1969 estimates showed that annual costs for the program would be $40 to $60 million, but in reality, first-year costs were $330 million. Black lung program costs later rose to one billion dollars.[9,10] Projections made in 1970 for increases in insurance premiums

TABLE I. MANUAL RATES FOR UNDERGROUND COAL MINE RISKS FOR THREE WESTERN STATES, 1970-1980, NATIONAL COUNCIL ON COMPENSATION INSURANCE RATES (PER $100 PAYROLL)

A. Colorado

Effect. Date	Traumatic Rate	Disease Rate	Total Rate
9/1/69			17.05
10/1/71			18.17
1/1/74			27.41
5/1/76	8.58	17.33	25.91
3/1/77	7.05	16.15	23.20
3/1/79	7.24	16.15	23.39

B. New Mexico

Effect. Date	Traumatic Rate	Disease Rate	Total Rate
12/1/67			7.57
7/1/73	6.81	25.02	31.83
1/1/80	6.81	17.65	24.46

C. Utah

Effect. Date	Traumatic Rate	Disease Rate	Total Rate
7/1/65			5.86
10/1/71			6.70
7/1/73	5.03	28.60	33.63
1/1/80	5.03	19.49	24.52

TABLE II. MANUAL RATES FOR UNDERGROUND COAL MINE RISKS, 1970-1980, COLORADO STATE INSURANCE FUND (EXCLUDES FEDERAL BLACK LUNG RISKS) (PER $100 PAYROLL)

Effect. Date	Traumatic Rate	Disease Rate	Total Rate
1/1/70			12.97
10/1/71			11.17
7/1/72			12.97
8/1/73			13.83
9/1/74			21.41
10/1/75	12.91	11.33	24.29
7/1/78	14.24	11.33	25.57
2/1/79	7.05	16.15	23.20
12/1/79	7.24	10.14	17.38
1/1/80	6.99	10.14	17.13

as a result of the black lung program were 7% for surface operations and 11% for underground mining.[11] However, by 1980, the premium rate developed by the National Council on Compensation Insurance (NCCI) for third-party insurers in Colorado had increased by approximately 35%. It should be noted that although total premiums increased dramatically during this evolutionary period, that part of the premiums which applied to traumatic injuries remained relatively constant.[12] In contrast, the manual rates developed by the Colorado State Insurance Fund (CSIF), which provide coverage equivalent to coverage provided by NCCI traumatic injury insurance rates, increased by approximately 40%.[13]

In addition to high insurance rates, the coal industry faced special problems in obtaining insurance to cover occupational injury risks.* In general, small firms engaged in what are considered hazardous occupations are regarded by private insurance firms as undesirable risks that will ultimately be subsidized by other industries. Other options such as self-insurance or captive insurance companies are available only to large firms because of state regulations that call for a minimum number of employees (300 in Colorado) and evidence of financial stability before a firm can self-insure. State insurance funds or assigned

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*Occupational injury is to be understood to include traumatic injuries and occupational diseases.

risk pools are the only insurance method available to many employers in the underground coal industry. The alternative that these employers have, not a legal one, is to "self-insure" workers' compensation risks by not purchasing any form of insurance. In Colorado, Gil Valdez of the Colorado State Fund estimates 20% of Colorado employers in all industries do not have workers' compensation insurance; according to the U. S. Department of Labor, 23% of all coal operators did not have insurance for black lung risks as of 1978.[14,15]

The existence of a federal black lung program to cover a portion of the occupational disease risks for the coal industry creates higher total insurance costs and increases the difficulty of obtaining insurance at all. For insuring federal black lung risks there are again two options before the employer--private insurance and self-insurance regulated by the U. S. Department of Labor. The problem before the coal operator is not to choose the least expensive insurance method but to dovetail insuring methods for state and federal programs while working within the constraints of costs, state and federal regulations, and private insurance practices. Private insurance firms can insure both state and federal injury risks but that is more true in theory than in practice. In the western region, private insurers are reluctant to insure state compensation risks for underground coal operators and insure black lung risks only because they are required to do so. The coal operator is often not able to consolidate traumatic risks and black lung risks under any single insuring method.

Estimation of the financial consequences of a future injury is significantly different for occupational injuries as traditionally defined than for the broadened risks that have been evolving over the past decade. The problems that accompanied changing definitions of occupational injury are dramatized by the experience of the black lung program. In attempting to resolve issues the states had not addressed, Congress took significantly different approaches to determining eligibility for benefits of a claimant and in the amount of benefits awarded. The most important of these approaches were as follows:

1) presumptions of disability under circumstances not related to medical criteria were used to determine eligibility for benefits;

2) awards were made for total disability rather than partial disability as was usual under state programs; and

3) benefits paid were tied to the pay scale of civil service employees rather than a fixed wage, ensuring cost-of-living increases not present under state laws.

Added to these changes in eligibility requirements and benefit levels was the number of claims that had accumulated over twenty or more years before the enactment of the federal program in 1969. The net result was that many more claims were awarded and at significantly higher benefit levels than through state compensation programs. The total cost to the coal industry, even with sizable subsidies from general tax revenues, has been staggering: insurance premiums are now $15 to $20 per $100 of payroll for black lung risks in western states (insurance premiums for eastern states are even higher) and a per ton tax of $1.00 for underground and $.50 for surface operations is levied on coal production.

There is reason to doubt whether the experience and costs associated with the black lung program can be used to predict the costs of occupational disease hazards or other special risks. The enactment of the program was complicated by political and economic issues in addition to issues of compensation for black lung victims. Other occupational hazards that capture public attention are also raising issues that go beyond the question of compensation for a work injury through traditional mechanisms, and the political ramifications are impossible to avoid. Public and corporate concern over asbestosis claims is one example. Health and safety experts worry about unidentified hazards in the workplace, but probably more potent in increasing the risk and costs for an employer are worker and public awareness of occupational hazards and the inclination to seek legal remedies rather than compensation through state programs. The expense and confusion associated with the black lung program will probably make Congress much more cautious about enacting a federal program for a single occupational disease (it has already shown its reluctance with respect to asbestosis), but the issues surrounding broadened definitions of workplace hazards and the associated costs have not been laid to rest as the recent storm in the asbestos industry confirms.

The problem that emerges from this background is that compensation insurance costs for all industries have evolved due to changes in the law and in insurance structures. (Details of these changes appear in other chapters.)[16] For the coal industry, costs and risks faced by an employer for black lung also appear to have peaked following the 1981 amendments and the 10 years of experience in rate development or cost assessment for black lung risks. However, work injury risks faced by a single firm or by an entire industry are no longer adequately defined by historical costs; claims costs continue to rise due to inflation and legislative changes affecting benefits paid out. In addition, more claims are being approved due to

Risks have traditionally been divided into two broad categories: 1) traumatic injuries, where time and place of occurrence and the condition that results are easily identifiable; and 2) occupational diseases, which under the most widely accepted definition develop as a result of prolonged or repeated exposure to hazardous conditions. Definitions of what constitutes an occupational disease vary widely among agencies recording injury statistics. For risk assessment or rate development, however, work injuries have fallen into a classification different from the usual division into traumatic injuries and occupational diseases. For the majority of work injuries, past loss experience continues to be a good predictor of future losses with only minor modifications necessary for inflationary increases in benefits and medical costs. For those injuries or conditions where loss experience is distorted by a number of other factors (e.g., law amendments, legal action on the part of the claimant, unidentified hazards) alternatives for prediction of future losses are being sought. For this latter category of risks, no widely accepted method of assessing risks has been developed and little published material is available to predict costs for a given risk. Although risk management experts recommend more sophisticated efforts, three alternatives usually practiced are

1) using loss experience inflated by a safety or "catastrophe" factor; 2) using loss experience in combination with more sophisticated predictive techniques to assess risks for serious injuries; and 3) developing projections based on assumptions and available data in place of loss experience.

The aim of this paper is to look at those factors that indicate a change in the cost and frequency of work injury risks as a result of changes in workers' compensation programs over the past decade. The indicators of any change in work injury risks are cost and accident data. Cost data are derived from three sources in this paper--the NCCI, the Colorado Division of Labor's Supplementary Data System (SDS), and the Cost of Injury Model (COIM) developed by FMC and maintained by the U. S. Bureau of Mines. Accident statistics are supplied by the U. S. Department of the Interior's Information Circulars, the Mine Enforcement and Safety Administration (MESA) and the Mine Safety and Health Administration (MSHA). This paper will also examine and critique the methods, assumptions and calculations used to assess risks and costs for occupational injuries not adequately defined by historical costs or loss experience.

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CHAPTER II

HISTORY OF OCCUPATIONAL INJURY RISKS IN THE UNDERGROUND COAL INDUSTRY

Employer concern with safety in the underground coal industry has historically been influenced by three factors. These include a sense of responsibility by the employer, often reinforced by industry associations committed to safety; state and federal regulations of safety conditions; and the costs of accidents. A commitment to workers' safety by the employer has always been to some degree a reflection of public attitudes. For example, the pressures to enact safety legislation, child labor laws, and other legislation concerned with social welfare were paralleled by development of industrial organizations concerned with safety, such as the National Safety Council, during the same period.[1] Most states have had statutes regulating safety in coal mines since the 1870s with stricter regulations enacted from time to time as the need was perceived. The introduction of economic motives for safety came with the enactment of workers' compensation laws in the early 1900s. These laws, by requiring compensation to be paid for injuries that occurred at work, regardless of fault, transferred a portion of the costs formerly born by the injured employee to the employer, to be internalized as a production cost and ultimately passed on to the consumer. The laws were passed not only to alleviate the misery caused to an injured miner and the family in lost wages and medical costs but also implied that the employer should be financially responsible for safety conditions within the firm.[2]

Prior to the enactment of workers' compensation laws, economic conditions in the coal industry acted as a disincentive to safety in underground mines. The coal industry was fiercely competitive because of the large number of mines. Accordingly, the industry as a whole suffered from low profits, excess capacity, and fluctuations in seasonal demand.[3] Although demand for coal increased rapidly from 1840 to 1910, competition within the industry also increased as more regions began to produce coal. In an industry so competitive, small differences in production costs could price coal produced by marginal firms out of the market, especially if the firm were also at a disadvantage because of distance from mine to market. Coal producers therefore resisted enactment of safety laws and workers' compensation laws at the state level because they feared the loss of competitive advantage over firms in other states.[4]

Mine workers themselves did not argue strongly for workers' compensation or safety laws. Safety issues were a secondary concern following efforts of the early unions in the mining industry to organize and to increase wages. The same conditions that caused the industry to be so competitive and fragmented also were the source of a precarious livelihood for coal miners with low wages, unsafe conditions, and seasonal work. The United Mine Workers of America and other unions in fact used the principle of assumption of risk (typically employed in common law defense by employers) as an argument for higher wages rather than safer conditions or income maintenance programs for injured workers. Although their capacity to do so was limited, the unions often assumed financial responsiblity for severely injured miners and their families.[5]

After a series of coal mine disasters in 1907 and 1908, many influential coal operators joined, and in fact spearheaded, a drive to create a federal bureau of mines to encourage safety in the mines.[6] Though public opinion can often be persuasive, operators had as a stronger motive the desire for uniform safety legislation that would allow stricter safety laws but also dull the competitive edge offered to some firms because of difference in state safety laws. Similar motives focused a desire for a federal program to supersede state laws passed during the same period. As in the debate that preceded the creation of the Bureau of Mines, states' rights and responsibilities and variations in the states' legal codes were points of conflict.[7]

Employers had additional reasons to favor workers' compensation laws. For example, such laws promised to reduce conflicts with labor in litigation over industrial injuries and to make costs for on-the-job injuries more predictable.[8] In addition, court rulings were eroding the defenses allowed employers in legal suits by injured workers. In the legislative arena, Congressman John G. McHenry's version of the bill to establish the Bureau of Mines called for a tax of one cent per ton to compensate miners and familes of miners injured in mine accidents. This would suggest an inclination by Congress to take remedial steps if the states did not. Finally, the American Mining Congress took an official stance in support of state workers' compensation laws in 1911.[9]

Enactment of workers' compensation laws, meant to apply to all industries, often came as a result of incidents or conditions in the coal mines. Montana's first law (1909) to provide compensation for work injuries was for injuries resulting from accidents in the mines.[10] In Wyoming, the Union Pacific Railroad yielded to pressure from public opinion after the Hanna coal mining disaster and provided lump sum payments to widows and children of miners killed in mine explosions. In turn, Wyoming used this as a basis for its first workers' compensation law passed in 1914.[11] A year later, in Colorado, a Republican General Assembly created the Colorado Industrial Commission and passed a workers' compensation law. The Colorado legislation was prompted by the nationwide outrage following an incident in Ludlow in which eleven women and children died as a result of clashes between striking coal miners and the state militia.[12]

Following the surge in accident rates in 1907, the rate and severity of accident rates began to decline dramatically in all industries across the nation. Accident rates in the coal industry remained substantially higher than those of other industries but showed a steady decline that continued into the 1960s. Some potent factors were at work affecting accident rates in all industries and explanations exist with several of the theories specific to the coal industry. The period from 1900 to 1920 produced many changes that could be credited in part for improvement in safety records, besides the reasons most often cited--the enactment of stricter safety regulations and of workers' compensation laws.[13]

The passage of workers' compensation laws added significant operating costs for employers. To control the uncertainty associated with injury costs and minimize the risk of high losses, an insurance industry emerged to pool the risks and costs of job accidents. However, the hazards in underground coal mining in 1915 made effective and affordable insurance programs difficult to achieve. State funds and private insurance companies were reluctant to insure coal mine risks. The insurance industry, in an effort to provide workers' compensation insurance to coal mine operators without any single insurance firm having to assume the entire risk, formed an insurance cooperative for coal mine risks in 1915. The cooperative was among ten stock insurance companies called Associated Companies. In Colorado coal operators formed their own insurance pool--Employers' Mutual Insurance Company--immediately after enactment of the state's workers' compensation laws. The purpose of such agreements was to spread the risk and "to furnish the final answer to the claim that coal mining risks with their large collective hazards (could not) be distributed by some means of stock insurance."[14] The experiment was successful to some degree in that it encouraged safer practices in mines, but even with cooperative agreements, private insurance firms struggled to remain solvent. In 1926, Associated Companies gave notice to Colorado operators that it would no longer insure coal mine risks in the state. As a result, the Colorado State Fund faced the prospect of assuming these risks and indicated it would do so only if allowed to inspect mines every ninety days. Compensation officials felt that even at the high rates charged coal mine risks, other policy holders were likely to subsidize loss payments for coal mine accidents.[15] Employers Mutual continued to take new risks until 1970, but the trend was for coal firms to insure with state funds in those states that offered the service. The coal industry has retained its reputation as a poor insurance risk, and in practice many private insurance firms refuse to insure underground coal operations for state workers' compensation risks. Thus, that task has fallen to state insurance funds, or if no state-run insurance fund exists, undesirable risks can obtain insurance through assigned risk pools.

Although passage of state compensation legislation represented a major step in assigning financial responsibility for workplace injuries, the programs created were far from adequate. Income benefits were low (in Colorado, for instance, average weekly compensation in 1915 was $7.54 while the average weekly wage was $20.87),[16] no payment of medical expenses was included in many state programs, and injuries resulting from disease or prolonged exposure to hazardous conditions were not compensable.[17] This last issue was to provoke the greatest conflict fifty years later with the incidence of black lung in the coal industry. Specifically, black lung became a focal point for public opinion and legislative action much the same as high accident rates and mining disasters in the underground coal industry had been instrumental in the enactment of workers' compensation laws in the 1910-1920 period.

In the western states, the regional trade organization for underground mines in four states, the Rocky Mountain Coal-Mining Institute, viewed the passage of legislation establishing workers' compensation programs on a cautious note. However, at its 1917 meeting the Institute hosted a speaker from Associated Companies. The speaker for Associated Companies, Herbert M. Wilson, described to western coal operators how insurance premiums could be reduced by improving safety measures and programs in their mines to meet a standard set by Associated Companies for each state. He further discussed how such financial incentives worked to improve safety in the mines. "The immediate effect of (workers' compensation) legislation," he states, "is the certainty confronting the mine operator that he must pay out large sums for every accident, regardless of its cause, thus adding materially to the cost of the production of his coal." Premiums in Colorado during the early years of workers' compensation programs were $7.00 per $100 of payroll, but that amount could be reduced by more than a third. The reduction was based on how well a firm met pre-established criteria for a safe mine (in contrast to a reduction in the number of injuries).[18]

Illness arising from employment was not an unknown concept to either industry or the medical field in the early 1900s. However, workers' compensation laws for traumatic injuries were considered a radical reform and in fact the courts declared acts passed in Maryland in 1902 and in New York in 1910 to establish compensation to injured employees unconstitutional.[19] Additionally, coverage for occupational diseases as well presented too many extraordinary issues for state laws to address. The attention of reformers was first directed at injuries resulting from identifiable incidents. Even so, many states did define 'injury' broadly enough to cover occupational diseases. Other states (Colorado included) while recognizing the occurrence of work-related illnesses specifically excluded them from coverage under workers' compensation laws.[20] In any event, for many years following enactment of workers' compensation laws, no significant amendments were enacted to change programs. By contrast, court decisions interpreting standard phrases, such as 'arising out of and in the course of employment,' broadened coverage in the absence of legislative changes.[21]

For the coal industry, evidence existed to suggest that chronic health conditions among miners were related to employment, especially for diseases of the lungs. As early as 1911, South Africa enacted legislation recognizing silicosis as a compensable disease. Medical experts in Great Britain investigated pulmonary diseases in coal miners as early as 1928, and by 1943, recognized coal workers' pneumoconiosis as a condition distinct from silicosis.[22] In the U. S., reference to a lung condition known as 'miners' asthma' is documented in a 1909 legislative conference of coal operators.[23] National attention focused on silicosis in this country as a result of a tunnel drilled during road construction (1930-1932) at Gauley Bridge, West Virginia, where several of the workers died of silicosis. The result was a congressional investigation and national conference on silicosis headed by Frances Perkins, then U. S. Secretary of Labor, in 1937.[24] Other movements during the 1940s emphasized health issues among workers. The 1946 Krug-Lewis agreement between the Department of the Interior and the United Mine Workers' Association addressed issues of health and compensation for occupational diseases for coal miners. This agreement came at a time when the incidence of coal workers' pneumoconiosis was on the increase, apparently due to the increased mechanization in underground mines.[25]

Most states passed occupational disease laws during this same time period. For example, Colorado's Occupational Disease Disability Act passed in 1945; Utah passed a similar act in 1953; and Wyoming, the last state to specifically address coverage of occupational disease, amended its statutes in 1969.[26,27,28] Legislation often specifically addressed compensation for silicosis or anthracosis (black lung) with less stringent statues of limitation for reporting of disability due to these diseases. But technicalities in laws and the fact that occupational diseases arise over a period of time, in fact sometimes after employment has ceased, created special problems for disabled workers. These special problems include statutes of limitations, assignment of financial responsibility if the employee had several employers, which state laws prevailed and which state bore financial responsibility if an employee had worked in more than one state, and what role nonwork factors played in the development of the disease. The deterrent for states to amend their statues was economic both from the standpoint of additional claims that might be generated and, a more difficult problem, how to fairly compensate employees disabled or retired prior to enactment or amendment of occupational disease laws. Most states made coverage effective the date of passage of legislation.

For black lung victims, Pennsylvania was the only state to address the problem of disabled workers not covered under state laws because of these difficulties and to fund payments out of state funds rather than trying to assign employer responsibility for each claim.[29] Other states also amended their laws to recognize coal workers' pneumoconiosis as a compensable disease apart from silicosis during the sixties, in some instances after pressure was exerted by coal mine workers through strikes or threats of strikes.[30]

During the Eisenhower administration, a national commission was created to study state compensation laws and prepare recommendations for improvements in these laws based on standards developed. However, federal legislation recommending state standards was rejected at that time. Subsequently in 1970 as a part of the Occupational Safety and Health Act, the National Commission on State Workers' Compensation Programs proposed eighty-four recommendations it felt necessary to upgrade and standardize state workers' compensation programs. The three goals include

1) improving benefit levels for those eligible;

2) providing coverage for occupational disabilities not recognized by many state laws; and

3) persuading state legislation to adopt laws that would eliminate the variations in benefits, coverage and costs from state to state.[31,32]

Overshadowing the recommendations of the National Commission was the enactment of the Federal Black Lung Act in

1969. This legislation had purposes similar to the National Commission but was directed at a specific industry--coal. The Black Lung Act, however, represented two important departures from traditional approaches to compensation for occupational injuries: 1) the intervention of the federal government in an area of responsibility that since its inception had been assigned to the states; and 2) the introduction of rebuttable and irrebuttable presumptions of disability under certain circumstances to determine a claimant's eligibility for benefits. Both of these innovations were attempts to solve problems the states had been unable to solve.

The issue of the federal government assuming responsibility, financial as well as administrative, had in fact been suggested by the states during the early sixties when state officials predicted a large number of claims for disability from lung diseases caused by radiation exposure in the uranium industry.[33] In a similar circumstance, coal-mining states did not want to shoulder financial responsibility for claims of retired miners, especially when the public health surveys conducted in 1963 showed such an alarming prevalence of respiratory diseases among coal miners. The Federal Black Lung Act was enacted in 1969 as a temporary measure to ease the financial burden on both the states and the coal industry of a large number of claims by retired miners or their survivors; under the Act, individual states and the coal-mining industry would take responsibility for all claims fiiled after 1972. By that time, with federal guidance, Congress expected that states would amend their workers' compensation laws to conform with the Federal Black Lung Act of 1969 to assure that future black lung victims would be fairly and fully compensated for disability from the disease. The states did not substantially amend their laws to include the presumptions in the federal law, but the passage of time and federal amendments in 1972 and 1978 served to make permanent a program very different from state compensation programs.

The presumptions of disability introduced by the Federal Black Lung Act were likewise an attempt to address issues surrounding fair compensation for disability from occupational disease. In amendments to state compensation laws, statutes of limitations have been revised to allow for the latency period for some occupational diseases. Two issues that have not been addressed are:

1) the difficulty in proving that a condition, even one so notorious as black lung, is due primarily to employment and not the result of other non-employment factors; and

2) the extent to which an an employer or insurer is liable for disability and medical payments if an illness is due to a mixture of on-the-job and off-the-job factors.[34]

The Black Lung Act was criticized for relying heavily on x-ray evidence as proof of disability since other respiratory ailments were difficult to distinguish from black lung. Critics perceived that use of x-ray evidence ruled unfairly against miners with legitimate claims.[35] The 1972 and 1978 amendments increased the number of presumptions of disability and modified evidentiary standards, serving to further shift the burden of proof of disability from the claimant to the employer or insurer.

Critics in the coal and insurance industries especially found much to be desired in the program following the 1978 amendments. John F. Burton, author of several studies on costs of workers' compensation, wrote in 1977, "The Black Lung program...is a classic example of pork barrel legislation with benefits going to a limited locale and costs spread widely."[36] These sentiments and the massive cost overruns which threaten the Black Lung Trust Fund have prompted amendments once again to the Black Lung Act. These latest amendments double the tax per ton of coal placed on the coal industry and reverse the trend toward liberal evidentiary requirements and the reliance on rebuttable and irrebuttable presumptions of disability. 'Responsible operator' was also redefined in attempts to ease costs to the employer and/or his insurer and to resolve conflicts between the coal and insurance industries about liability for certain claims. The net result of these amendments is, according to Allan Cooter of CF&I, a program that "industry can live with" and that is fair to both sides.[37]

The development of the black lung program came about through twelve years of conflict and compromise among a diverse set of interests--the coal industry, insurance representatives, state officials, the unions as representatives of miners. The evolution of the program in fact mirrors the similar development of workers' compensation programs with many of the same issues: 1) the perceived need by the public and by the coal industry for a program to compensate injured workers; 2) conditions within the coal industry as impetus for many of the changes that were to be applied to other industries; 3) the initial high costs; and 4) the inadequate insurance options available to cover the risks created by a new program.

Many of the issues raised by the industry's liability for job injuries have not been totally resolved. Costs as represented by manual rates for insurance are very high. Insurance for many coal producers is difficult to obtain, especially for black lung risks. Finally, the differences in insurance rates among states are significant (the eastern coal industry claims a bias in insurance costs that favors western coal-mining states, prompting Kentucky Governor John Brown to draft legislation to curb compensation costs for the coal industry in his state).[38] Two 18-month studies have been commissioned by the 1981 amendments to the Black Lung Act for two other unresolved issues: a study examining the roles of the state and federal programs with respect to black lung and a medical study of evidentiary requirements and diagnostic tools to establish a disabling condition from pneumoconiosis.

These same issues concerned legislators when the program was enacted in 1969.[39] Whether these issues will eventually be put to rest is a matter of doubt, but change and compromise over the last 70 years have slowly brought needed changes in workers' compensation programs and confirm industry's commitment, although sometimes reluctant, to the safety and welfare of their employees.

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CHAPTER III

CURRENT METHODS OF INSURING AGAINST RISKS

Insurance of underground coal mine risks focused from the beginning of workers' compensation programs on two issues. Specifically, these included the difficulty of obtaining adequate insurance and the problem of how to control and estimate costs within the available insurance framework. Insurance for the underground coal industry emerged immediately after enactment of the workers' compensation program with underground coal mine operators joining together to form a cooperative insurance company. Insurance allowed a firm to reduce the uncertainty of financial losses from work injuries by sharing those losses with others facing similar risks, and it protected any member of the group against the possiblity of very serious losses. Insurance thereby standardized financial losses as a result of accidents, translating losses into a dollar amount per $100 of payroll; i.e., the total amount paid in premiums became the measure of exposure to a risk. Mechanisms such as modification of insurance premiums to reflect a firm's accident experience linked accident experience with insurance costs, but still, management of work injury risks became for employers a business, rather than a safety, decision.

Insurance costs as represented by manual rates per $100 of payroll, were for many years a stable part of payroll.

Insuring of work injury risks was a simple choice between purchasing insurance from a third party insurer (either a private insurance company or a state-administered insurance fund) and self-insurance. These approaches, however, have allowed employers a narrow range of choices or actions in controlling accident costs, especially as workers' compensation programs have improved and costs have increased. For the underground coal industry in Colorado, the restricted choices available to a firm are especially important for three fundamental reasons. These include 1) the high costs of workers' compensation insurance; 2) the reluctance of private insurers to insure underground coal mine risks; and 3) the creation of the federal black lung program which imposed a second work injury risk over the risks as defined by state workers' compensation programs. For the coal industry, these factors complicated access to insurance and estimation of costs associated with two distinct work injury risks. The result was that many coal mining firms have no choice but to rely on third party insurers for workers' compensation insurance. A number of approaches offering greater flexibility in insuring work injury risks and greater reliability in assessing costs are developing, however. The underground coal industry and other industries with difficult-to-insure risks are playing important roles in the development of these approaches. Pending further issue delineation and insurance program development, the claim procedures as summarized in Table III govern.

Current insurance options

1) Third Party Insurers

Third party insurance through state funds or private insurance companies is the usual method of insuring work injury risks for many employers. As a result, the manual rate has become a widely accepted indicator of insurance costs. For many industries, private insurance companies provide insurance coverage for work injury risks at a cost of less than 2% of payroll.[1] Additionally, in recent years, as insurance companies have competed for business and as high interest rates have promised high rates of return from investment of premium dollars, premiums have often been less than the combined expenses of administering claims and paying losses.[2] However, the private insurance industry has for many years been reluctant to insure workers' compensation risks for the underground coal industry. In Colorado private carriers were responsible for only 2% of reported claims for underground coal mine operations until the late 1970s. Since 1976, this percentage has increased substantially and reached 42% of reported claims in 1981.[3] It has been suggested that this shift may in part be

TABLE III. CLAIMS PROCEDURES FOR WORK-RELATED DISABILITY, FEDERAL BLACK LUNG PROGRAM AND COLORADO STATE COMPENSATION LAWS

Federal Program	State Program
Claimant must prove: 1. disease--black lung or related condition 2. disability for usual and customary work in coal mines 3. causality	Claimant must prove: 1. disease or injury 2. disability total disability for all work partial disability for usual work 3. causality
Criteria: 1. physical exam 2. x-ray evidence 3. blood-gas test 4. pulmonary function test 5. coal mine employment	Criteria: 1. medical evidence of injury or disease 2. evidence of incident causing injury or of exposure to hazardous conditions.
Presumptions: rebuttable--work-related condition if Claimant with ten years' experience in coal mines has pneumoconiosis. irrebuttable--total disability due to pneumoconiosis if claimant is suffering from a chronic dust disease of the lungs according to prescribed medical standards.	Presumptions: None
Monthly Benefits: 37.5% of monthly wage of GS 2/1 employee increased by 50% for one dependent increased by 75% for two dependents increased by 100% for three or more dependents	Weekly Benefits: Total disability--2/3 of claimant's weekly wage not to exceed 80% of the state's average weekly wage. Partial disability--2/3 of the claimant's loss of earning capacity not to exceed 80% of the state's average weekly wage.

Source: Claims Offices, Colorado State Insurance Fund and U. S. Department of Labor, Office of Coal Workers' Compensation.

due to insurance companies offering coverage for these undesirable risks as a courtesy to large corporate accounts and in part due to the creation of captive insurance companies to cover work injury risks. This latter insurance option will be discussed in greater detail later in this chapter.

Private insurers must insure federal black lung risks. Accordingly, for this risk the NCCI has developed a separate manual rate. This rate, called an occupational disease rate, represents the risk of black lung claims approved under either the state or the federal program. All other occupational injury risks, including occupational diseases other than black lung, are covered by the "traumatic injury" manual rate. The "occupational disease" rate of $16.15 is more than two-thirds of the combined manual rate unadjusted by experience modifications or premium discounts. This rate is not subject to modification of premium. As a consequence, the occupational disease rate assumes an even greater portion of the premium actually paid by the employer after adjustments are made to the traumatic injury premium.

State insurance funds are the second source of third party insurance and a much-used method of insuring workers' compensation risks for small operators. Before 1978, CSIF was the responsible insurer for 82% of reported claims for the underground coal industry and now is responsible for 41% of reported claims.[4] A small operator may in theory have two or three insuring options to choose from, but in practice is often limited to state funds since private insurers avoid these risks and requirements for self-insurance cannot be met by the smaller operators. State laws require these funds to insure all employers requesting insurance coverage and therefore insure more than their share of 'undesirable' risks. The state insurance funds, however, manage to offer insurance rates which are competitive with those of private insurers because administrative costs are low and acquisition costs and profits nonexistent. In addition, state funds are exempt from state taxes and sometimes receive appropriations from the state's general revenues for administrative costs.[5]

Since the late 1920s, the CSIF has insured most underground coal mining firms. This function was assumed after a private insurance company, Associated Companies, made the decision to stop accepting new risks.[6] The state fund accepted the risks reluctantly, choosing to develop its own rates for coal mining risks while all other rates used have been developed by NCCI. Coal mine risks have received special attention from the Colorado fund because of the hazardous nature of the work and because of the extraordinary risks represented by occupational disease. Since 1976, CSIF has separated the manual rate for underground coal mine risks into a traumatic injury rate and an occupational disease rate. However, Colorado laws regarding coverage of occupational disease have contributed to the high manual rates for underground coal mine risks since the 1960s.

Currently, the occupational disease rate developed by CSIF is $10.14 per $100 of payroll but can be modified by a firm's experience and by a 30% premium discount routinely applied to the premium developed from the manual rates. The occupational disease rate covers state black lung risks but does not cover claims approved under the federal black lung program, an important concern for employers insuring workers' compensation risks through CSIF. It should be noted that under the state system, it is not possible to purchase the two types of coverage separately. The rate structures described above are summarized in Table IV.

2) Self-Insurance of State Workers' Compensation Risks

By self-insuring, some employers can also fulfill the obligation to meet state-mandated benefits for job injuries. This alternative most closely reflects the actual costs to the employer for work injury risks but forgoes the advantages of sharing costs and risks in the event of severe injuries or a catastrophic event.

TABLE IV. CATEGORIES OF MANUAL RATES AND COVERAGE PROVIDED, NCCI AND CSIF

Categories of Manual Rates	Coverage Provided	Cost Per $100 of Payroll
NCCI		
Traumatic Injury	All occupational injury risks except black lung risks	$ 7.24
Occupational Disease	Black lung risks	16.15
	Federal black lung risks (if purchased separately)	13.06
	State black lung risks (if purchased separately)	4.68
CSIF		
Occupational Injury	All occupational injury risks except federal black lung risks	17.13

Source: Rate Filing Memorandum, National Council on Compensation Insurance, January, 1979; rates provided by Gil Valdez, Colorado State Insurance Fund, July 1980.

State regulatory agencies, usually the Division of Industrial Relations or the Division of Labor, have the authority to grant or refuse permission to self-insure workers' compensation risks. Such a decision in most states is made on the basis of size and financial stability of the company in question. Criteria for many states are the number of employees, the size of payroll, and the results of an examination of detailed financial statements provided by the applicant. State authorities frequently require deposits of securities or bonds to cover some portion of the expected losses as based on the firm's prior accident experience. The cost of self-insurance under this requirement is increased by the loss of revenue a firm could expect from capital investment of reserve funds. However, in many states, a letter of credit from a bank or lending institution is sufficient to guarantee the firm's timely ability to pay losses due to job injuries. The letter of credit, the carrying cost of which is approximately 1%, assures the state regulatory authority that the bank will extend immediate credit in a sufficient amount to meet workers' compensation losses should the need arise.[7]

The costs of job injuries to the employer under self-insurance are the losses in medical and indemnity payments that occur in a 'policy' year, outstanding claims not covered by reinsurance, the costs of reinsurance, carrying costs of securities, bonds, letters of credit or stop-loss policies, and the costs of administrative time to adjudicate and pay claims. Most states assess a premium tax; in Colorado this is 1.75%.[8] Some firms hire an outside consultant to perform administrative duties. As for any insurer, the administrative costs will include legal costs associated with contested claims, and taxes assessed by the state to support the state workers' compensation office.

There are a number of potential advantages to self-insurance. For example, claims, legal costs of contested claims, and administrative costs can be closely controlled. Also, a firm can enjoy the profits from the investment of reserve funds which in the case of third party insurance are collected by the insurer. Most important, the costs of self-insurance mirror accident costs and are paid out as a direct consequence of job injuries; in turn, this provides an incentive for supervision to avoid accidents. In practice though, these types of benefits are only available to large firms in most states since the exposure base to estimate losses must be large enough to assure accurate predictions and to accommodate all but the most extraordinary losses. However, some states do allow groups of employers or an association of companies to insure risks, and the number of states permitting group self-insurance is increasing. Under this option, employers set up reserve funds, purchase reinsurance, and hire a claims service to administer claims. Proponents contend that employers can save 35-45% in insurance costs through the group method.[9]

To guard against very severe losses, self-insurers can obtain reinsurance. Typically, this is done on a per injury basis so that the reinsurer pays any losses after payments for claims and medical costs exceed a given amount. This limit varies and, as a consequence, costs of reinsurance per $100 of payroll are determined by two factors. The first consideration is the point of "attachment" or limit of the insurer's liability with any excess over this limit to be paid by the reinsurer. The second factor accommodates the company's past loss experience as measured in financial losses for injury claims.

Risk management experts urge more sophisticated techniques for handling occupational disease risks than many firms presently practice. These experts are convinced that the special hazards involved will produce higher claims costs in the future. Typical advice is reflected in the four-point program recommended by Dan R. Anderson in a recent issue of Risk Management. To start, Anderson advocates a review of statistical data provided by state and federal agencies as well as in-house sources. Second, the firm should identify and analyze potential hazards within the business. Establishment of preventive programs is the third consideration and financing of risks and funding of reserves fall into place as the fourth part of the program. Anderson advises that particular attention be paid to 'incurred but not reported' cases, for conditions with long latency periods or that represent as yet unidentified risks.[10] Noticeably absent from this program but much used in practice is the legal affairs department of the company to handle contested claims.

Employers and insurers continue to take conservative views of what is compensable in terms of work-related injuries and in preparing for occupational injury risks. Use of legal counsel is common with as much as two-thirds of all occupational disease claims contested by the insurer and 60% of occupational disease claims denied benefits.[11] Many workers' compensation programs for self-insured firms are handled by attorneys rather than risk management experts. Additionally, firms who self-insure are more likely to contest claims than other insurers. For example, 70% of all claims for serious injuries are contested by self-insurers while private insurers contest 44% and state insurance funds contest 30% of such claims.[12] Finally, it should be noted that some firms who self-insure, even coal mining operations where risks and costs are high, prefer to pay all claims out of general funds, and many of the same firms forgo reinsurance.

3) Captive Insurers

As insurance of risks becomes more difficult and costly, new insurance options are developing. One of these is a captive insurance company, a compromise between third-party insurance and self-insurance for large corporations or an assocation of companies. A captive insurance company insures the risks for a parent company and its subsidiaries or for the companies within an association of companies. The captive typically focuses on risks that are either difficult or very expensive to insure through conventional mechanisms. Because of restrictive state laws, captives can be formed within the U. S. only in two states--Colorado and, since 1978, Tennessee. However, other states are contemplating law changes to allow formation of captives. A number of corporations have established captives outside of the U. S., primarily in Bermuda and the Bahama and the Cayman Islands because of taxation and regulatory policies in those jurisdictions.[13]

The major obstacles to setting up captives to insure risks are the administrative problems involved and the meeting of regulatory standards. Once organized, however, captives are structured to insure a variety of risks. For the underground coal industry, captives can be particularly attractive because all work injury risks can be insured under a single insurance option.

A corporation intending to establish a captive insurance company must generally meet some minimum capitalization requirements and the regulatory requirements of both the Internal Revenue Service and the jurisdiction where the captive is formed. The off-shore jurisdictions have few regulations and often no taxation, making them attractive to many corporations; over 500 firms have established captives in Bermuda alone.[14] Although the off-shore jurisdictions impose no taxes, a premium excise tax of 1% for reinsurance and 4% for casualty insurance is assessed by the Internal Revenue Service.[15]

For many Colorado coal mining firms, off-shore captives present obvious administrative problems. Alternately, captive formation in Colorado is much more feasible, even with more regulatory constraints and higher taxes. To form a captive in Colorado, the corporation or association of firms must demonstrate that adequate U. S. insurance markets are not available to cover the risks encountered or that the cost of such risks is unreasonable.

Further, annual premiums must be $500,000 for a single corporation or $1,000,000 for an association of firms. Finally, an association of firms setting up a captive company must be formed for other reasons than insurance purposes or captive formation and must have been in existence at least one year.[16] One captive has been set up in Colorado representing two coal mining firms to insure black lung risks, but once established, the captive can assume other risks the parent companies face.[17]

Several advantages of captives have been observed:

1) insurance programs can be tailored to the coporation's needs and loss experience in contrast to the payment of premiums based on the industry average for a given risk;

2) the building of incentives to encourage management responsibility for loss experience can be built into insurance plans;

3) access to reinsurance markets not usually available to self-insurers;

4) tax deductions for reserves established for future losses (this is an advantage over self-insurance options, where tax deductions can be taken only for current-year losses); and

5) retention of profits by the captive insurer.[18]

In the past, firms using captives have also been allowed tax deductions for the premiums paid to the captive. However, an IRS ruling in 1977 (IRS Revenue Ruling 77-516) prohibits this practice unless the captive either insures firms outside of the parent corporation or the captive is established by an association of firms. The ruling was challenged in a number of court cases, but the U. S. Tax Court and Ninth Circuit Court of Appeals ruled that if premiums are paid to a subsidiary under control of a single corporation, such premiums are not tax deductible.[19] It should be observed that the IRS position does not apply to captives formed by an association of firms. Accordingly, interest in group and association captives is growing while interest in captives operated by a single corporation is fading.

As a cautionary focus, it is pointed out that while tax benefits of some captive arrangements have been squelched, investment income, especially in off-shore jurisdictions, presents a great attraction to a corporation. W. E. Thompson of the Landmark Insurance Group, a captive insurance consulting firm for corporations, notes that

> "captives are taking advantage of today's high interest rates. Millions upon millions of corporate and association dollars are sitting in off-shore bank accounts or Euro-dollars, drawing interest in such high percentages as to almost dare the captives to lose money overall. The risk is in fact that the administrators of captives will pay more attention to investment income than to management of insurance risks."[20]

4) Self-Insurance of Federal Black Lung Risks

The Federal Black Lung Act and its amendments created a sudden liability for coal operators. Further, the insurance costs to meet the federal requirements as represented by manual rates have been very high, ranging from 10% to 30% of payroll. Throughout the late seventies, legal disputes occurred between the insurance companies and the coal industry. The dispute largely centered on financial responsibility for certain claims, especially those filed from 1970 to 1973 and those which the 1977 amendments made the responsiblity of individual coal operators. Insurance mechanisms have developed in response to the difficulties faced by the coal industry, however. These mechanisms basically modified existing insurance options. The principal benefits to coal mine firms have been in tax treatment of self-insured risks and in regulations allowing pooling of risks among firms.

Under self-insurance regulations administered by the U. S. Department of Labor, coal operators have several options: 1) self-insure as a single entity; 2) through self-insurance pools; or 3) insure black lung risks through a trust fund established by the firm as permitted by the 1977 Black Lung Revenue Act. The U. S. Department of Labor has several minimum criteria (CFR: VI, 726) that must be met before an application to self-insure black lung risks is approved. In many respects, the regulations are similar to those administered by many state offices in that the principal requirements are financial. Specifically, the firm must present financial statements to demonstrate an income ability for honoring future claims against it and an indemnity bond must be deposited to cover default in payment of claims. An important difference under U. S. Department of Labor regulations is that size of firm is not a criterion to determine eligibility to self-insure as it is in many self-insurance regulations with state agencies. However, though the Department of Labor regulations require that the firm employ a minimum of five miners, the financial requirements and the amount of securities to be deposited for the required indemnity bond discourage small firms from applying for self-insurance for black lung risks. The Department of Labor estimates that the net worth of a firm must be $400,000 before an application to self-insure will be approved. In addition, firms with less than $500 million net worth are required to have "a base reserving requirement equal to 10 years of future benefits computed at 100% of the expected federal benefits level for each year. If the net worth is over $500 million, the base is set at only five years of future benefits."[21] Some firms have taken advantage of regulations that allow pooling of risks so that nationwide, 100 approved applications for self-insurance represent 300 firms. The Department of Labor reports, however, that applications approved for self-insurance generally represent the largest coal-producing companies in the nation.[22]

The Black Lung Revenue Act of 1977 allows self-insurance trusts to be set up under supervision of the U. S. Department of Labor and the Internal Revenue Service. With this system of self-insurance, the company funds its expected liability through an irrevocable trust. The trust monies can be used to pay black lung benefits, insurance premiums, and administrative costs. Further, trust funds can be invested in local or federal securities or in time or demand deposits with a bank or federal credit union. Similar to the payment of insurance premiums, the amounts placed in the trust are tax-deductible so that future liability is tax-deductible; this contrasts to other self-insurance programs where only claims actually paid are deductible from taxable income. For many large companies, the tax deductions make this method of self-insurance attractive. Further, trusts are permanent "insurance policies," not subject to cancellations by the insurer, and if properly funded and managed, can produce tax-free income and self-sustaining funds for black lung claims.[23] For smaller firms, the front-end funding necessary is a disadvantage and the tax deductions are not so important. Another drawback for all companies is that the trust is irrevocable and the company, if it overestimates its liability, will lose those monies.[24]

Summary

This chapter examines insurance options for the Colorado underground coal industry. These options are summarized in the decision tree of Table V. The basic conclusion is that coal mine operators have two separate but related work injury risks to insure with limited access to insurance and at high costs for both risks. This situation has been complicated in Colorado because the two risks cannot easily be insured under a single insurance option, given state and federal insurance regulations and insurance industry practices. As a result, many small and mid-sized firms are obliged to insure state work injury risks and black lung risks through the two different insurance options that have the highest costs and fewest administrative advantages. Because the risks must be insured through two insurers, an overlap in coverage results for a part of the occupational disease risks. Specifically, the Colorado State Insurance Fund and private insurers both include in their manual rates the risk that some black lung claims will

TABLE V. INSURANCE OPTIONS FOR WORK INJURY RISKS IN COLORADO

STATE OCCUPATIONAL INJURY RISKS

Colorado State Insurance Fund	Private Insurers	Captive Insurers	Self-Insurers
	subject to: reluctance to insure 'undesirable' risks	subject to: licensing by insurance authority in jurisdiction where captive incorporated	subject to: approval of self-insurance applications by Colorado Industrial Commission minimum 300 employees ability to pay
Advantages: available to all employers Disadvantages: high costs will not insure federal black lung risks	Advantages: single insurer for all work injury risks Disadvantages: high costs	Advantages: tax advantages investment income increased flexibility pooling of risks possible Disadvantages: administrative responsi-ties regulatory constraints	Advantages: lower costs control of administrative costs increased flexibility Disadvantages: administrative responsi-bilities

FEDERAL BLACK LUNG RISKS

Private insurers	Captive Insurers	Self-Insurance
	subject to: licensing by insurance authority in jurisdiction where captive incorporated	subject to: approval of self-insurance appli-cation by U. S. Department of Labor minimum 5 employee/miners ability to pay $400,000 net worth
Advantages: available to all employers Disadvantages: high costs state and federal black lung risks cannot be insured as separate risks	Advantages: tax advantages investment income increased flexibility pooling of risks possible Disadvantages: administrative responsibilities	Advantages: lower costs control of administrative costs increased flexibility self-insurance pools Black Lung Trust Fund tax advantages self-supporting fund Disadvantages administrative responsibilities Black Lung Trust Fund contributions to fund are irrevocable front-end costs

be approved under state workers' compensation programs. Large firms, on the other hand, have much more flexibility in choosing insurance options for its work injury risks.

As work injury risks become more complex and costly, however, other options have been developing to insure risks. These include captive insurance companies, either for a single corporation or for an association of firms and which could be based either in a domestic or foreign jurisdiction. Insurance options have also developed to meet black lung risks; these options include use of self-insurance pools and the establishment of black lung trust funds. These developments could have important ramifications for tax and insurance regulations for governing self-insurance programs under state laws.

In Colorado, a dramatic shift in choice of insurer by underground coal operators has occurred over the past five years. Self-insured firms have for many years been the responsible insurer for 16-17% of all reported claims. This share has not substantially changed. However, a shift has occurred in the share of claims for which private insurers are responsible. These insurers are now the responsible insurers for 42% of reported claims, up from the 2% of reported claims in 1976. The CSIF, on the other hand, is now responsible for a much smaller share of reported claims than in past years. This shift can be attributed to two possible influences. These include 1) the increased competitiveness among private insurers seeking premium dollars to invest at a time when interest rates were high and 2) the seeking out of other insurance options by coal mine operators because of the high costs of insuring two work injury risks. Similarly, developments in insurance could be encouraged by equivalent factors, including self-insurance pools (already allowed in many other states and permitted in Colorado for local and county governments) and changes in regulations concerning the establishment of captives. These types of developments not only allow more flexibility in management of risks to all firms but additionally play an important role in reducing insurance costs. This latter factor would be a hopeful prospect for coal mine operators and other industries needing to insure extra-hazardous risks.

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CHAPTER III

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CHAPTER IV

CURRENT CATEGORIES OF RISK AND METHODS OF ASSESSING THOSE RISKS

Injuries on the job have traditionally been divided into two categories by health and safety professionals. These categories are defined as traumatic injuries and occupational diseases. How injuries are categorized differs considerably according to the agency defining the terms and the purposes for classifying injuries. However, the most widely accepted definitions rely on the time period in which the injury occurred. The definition of traumatic injury from this perspective refers to any injury resulting from a sudden and unexpected occurrence, identifiable as to time and place. Alternatively, occupational disease is defined as a condition resulting from exposure to hazardous conditions over some extended period of time. For purposes of assessing costs that result from work injuries, however, these classifications of injuries have more to do with whether or not loss experience is an adequate predictor of future costs.

The two insurance rating bureaus in Colorado responsible for developing manual rates for underground coal mine injury risks are NCCI and CSIF. Since 1976 these rating bureaus have divided their rates into traumatic injury and occupational disease categories. The terms as applied to the manual rate are, however, ambiguous and misleading. This confusion occurs because the occupational disease rate developed by the NCCI is for black lung risks only and the CSIF occupational disease rate, which is quoted reluctantly, is included in total loss experience, with the breakdown into occupational disease portion an arbitrary one.

Loss experience is the basic unit for estimating future costs and consists of indemnity and medical costs. For insurance rating bureaus, the important costs are total compensation costs compared to payroll; i.e., the costs represent the frequency and severity of injuries and the amount of payroll exposure to the risks. Medical costs are also calculated as a percent of payroll. The percentages for indemnity and medical costs are added together for the pure premium. For managers of risks for a single firm, the per injury cost is the most commonly used unit for estimation of costs and assessment of risks. These per injury costs may include medical costs but often medical costs are calculated separately because they are involved in a larger number of injuries than indemnity costs. If medical costs are included as a part of the per injury costs, a distinction must be made between disabling and nondisabling injuries.

Several techniques are used to supplement or replace loss experience in assessing work injury risks. For purposes of this discussion these techniques can be separated into the following three categories according to the nature of the risk they assess:

1) injuries with low incidence but high costs (serious injuries);

2) injury risks which are changing as workers' compensation laws and worker attitudes change with subsequent changes in costs (changing risks); and

3) a single injury or disease risk which is transformed by particular circumstances and legislative or legal action from a low incidence/low cost risk into a risk with unknown incidence rates and very uncertain costs attached ("occupational disease" risks).

Together with loss experience, these techniques allow rating bureaus to develop manual rates. Self-insurers can use the same techniques to estimate future liability, either to establish reserve funds or as a means of comparing costs among insurance options.

Serious Injuries

The serious injury risk is the claim which on occasion results in very high medical and indemnity costs. This risk is a familiar part of work injury risks or any property casualty risk. Repeated studies of accidents show that of any given number of incidents a pyramid phenomenon emerges. Specifically, these are a large number of incidents at the base that result in little or no damage or injury;

conversely, the tip of the pyramid is represented by incidents that cause higher losses but occur less frequently.[1] NCCI refers to these latter risks as "serious" injuries, usually any claim resulting in losses greater than $10,000. Years of experience by rating bureaus and risk managers establish that serious injuries account for 4% of total claims resulting in lost time from work and 50% of total medical and indemnity costs.[2]

Data averaged over all industries can be expected to have only a general application to a single industry. However, cost data and frequency distributions for the Colorado mining industry show somewhat different characteristics in that average per injury costs are much higher for mine risks. For example, when comparing claims of the approximate age (months from the date of injury to the date of last payment of benefits), average indemnity costs per injury in Colorado industries were $651 while the per injury costs for the mining industry were $887; average per injury medical costs were $422 for all industries and $563 for the mining industry.[3] Equivalent figures are not available for underground coal. However, the Table VI distribution of per injury costs represents indemnity and medical costs in Colorado underground coal. These costs are much more heavily weighted to injuries resulting in costs of $5,000

TABLE VI. COMPARISON OF FREQUENCY DISTRIBUTIONS OF COSTS, TYPICAL DISTRIBUTION OF COSTS, AND COLORADO DIVISION OF LABOR DATA

Size Categories WC Lost-Time Claims (Indemnity and Medical)	Percentage of Total: All-Industry Data Typical Distribution		Colorado Underground Coal Data 1978-1980	
	#	Total Amt. Pd.	#	Total Amt. Pd.
$25,000 and Over	1.5	27.7	1.9	32.2
10,000 to 24,999	2.5	20.0	4.5	21.9
5,000 to 9,999	3.5	14.7	5.9	14.8
1,000 to 4,999	15.6	23.0	27.1	23.3
500 to 999	11.6	6.4	17.0	4.3
0 to 499	65.3	8.2	43.6	3.5
	100.0	100.0	100.0	100.0

Source: W. S. MacSwiney, "Claims Service for Self-Insurers," Risk Management, Vol. 28, December 1981, p. 33. and Computer Printout, Colorado Division of Labor, Supplementary Data System, April 30, 1982.

and up than are industrywide averages. Note that injuries with costs of $10,000 or more account for 6.4% of total injuries and 54% of total costs.

A second characteristic of serious injury risks is that because the cost per injury is so high, total costs vary considerably from one policy year to the next as shown in Tables VII and VIII. In addition, average per injury costs also vary since the definition of a serious injury is by costs. For these reasons, serious injuries are given particular attention in developing estimates of future losses. The most familiar methods used to develop these estimates are credibility or safety factors which adjust loss experience to account for the variations in serious losses. For example, NCCI, the rating bureau for workers' compensation risks in most states, uses a credibility factor of 50% applied to serious injury losses developed over a five-year period. This factor halves the change in pure premium indicated by loss experience. A 100% credibility factor is applied to all other indemnity and medical costs. The net effect is that the credibility factor for serious injuries limits the influence of serious injury costs in the development of manual rates.[4] Traumatic injury rates as developed by the National Council have been stable for underground coal mine risks for several years. Most

TABLE VII. LOSS EXPERIENCE FOR COLORADO UNDERGROUND COAL MINES, 1970-1975, NATIONAL COUNCIL ON COMPENSATION INSURANCE DATA

Year	Serious		Non-Serious		All Claims	
	# of Injuries	Total Costs	# of Injuries	Total Costs	Medical Costs	Total Costs
74-75	7	$335,440	129	$124,520	$111,872	$ 571,832
73-74	1	44,288	129	108,605	90,931	243,824
72-73	5	129,656	89	111,134	99,610	340,400
71-72	3	70,442	55	82,246	61,521	214,209
70-71	5	146,530	23	46,788	65,166	258,484
Total	21	$726,356	425	$473,293	$429,100	$1,628,749
% to Total Injuries:						
	4.7		95.3			
% to Total Costs						
		44.6		29.0	26.4	100.0

Source: Rate Filing Memorandum, National Council of Compensation Insurance, January 1, 1979.

TABLE VIII. LOSS EXPERIENCE FOR COLORADO UNDERGROUND MINES, 1976-1980, COLORADO DIVISION OF LABOR SUPPLLEMENTARY DATA SYSTEM

Year	Serious		Non-Serious		All Claims	
	# of Injuries	Total Costs	# of Injuries	Total Costs	Medical Costs	Total Costs
1980	4	$ 99,340	158	$126,390	$116,271	$ 342,001
1979	4	121,959	172	188,977	160,790	471,726
1978	9	204,458	86	139,067	138,543	482,068
1977	11	219,886	13	43,813	113,548	377,247
1976	5	151,472	11	31,588	71,774	254,834
Total	33	$797,115	440	$529,835	$600,835	$1,927,876
% to Total Injuries						
	7.0		93.0			
% to Total Costs						
		41.3		27.5	31.2	100.0

Source: Computer Printout, Colorado Division of Labor, Supplementary Data System, April 30, 1982.

fluctuations in manual rates occurred during the early seventies. Insurance rates for underground coal mine traumatic injury risks as developed by CSIF have fluctuated more than those developed by NCCI, and only since 1979 have unadjusted traumatic injury rates been comparable to manual rates for private insurers. The reason for these almost annual fluctuations has to do in large part with the methods used by CSIF to assess risks. For example, CSIF uses a factor to inflate loss experience to current benefit levels and adds a catastrophe loading rate of $4.40 to the pure premium (total losses paid compared to total payroll) to cover losses from mining disasters (loosely defined as accidents that result in more than one serious injury) for five years to total payroll for the same period. Since these catastrophic losses can vary significantly from one rating period to the next, a 20% limit is placed on the rate per payroll; i.e., the rate must be within a ±20% range of the previous period's rate.[5]

Many self-insurers and risk counselors also use a safety factor to inflate loss experience, using an estimated percent of loss experience to prepare for the risks as perceived by the risk manager. The selection of a factor often follows no particular rule except the risk manager's experience and assessment of factors that might influence total losses. In select instances, however, analytical tools are used. For example, there are attempts to analyze accident cost data with frequency distributions, comparison of the average costs of claims among certain similar categories of claims, and other equivalent methods to track claims costs and to determine where the most serious losses are taking place. One method for predicting very serious losses involves the use of a Pareto distribution with frequency of claims the dependent variable and loss size marked by increasingly wide intervals as the independent variable. In this technique, regression analysis is used to determine the slope of the line from the midpoints of the loss size intervals to predict very high losses. The authors of this approach indicate that there is a regularity to large losses and that the risk manager can predict both the probability of occurrence and the value of losses.[6] An important virtue of the Pareto technique is its rigorous analysis of data and the exactness in predicting the amount of very high losses. Alternatively, the technique not only allows risk managers to estimate what potential losses might occur but to reasonably compare costs of insurance alternatives.

Medical losses are a part of total losses. Sometimes they are assessed as a distinct category contributing to total losses and in other methods they are lumped together with indemnity costs for purposes of risk assessment. Medical costs include a larger population of injuries than indemnity costs since they are the only compensation cost for injuries where no disability results. Medical costs according to statistics kept by the Social Security Administration have been one-third of total costs.[7] Accident cost statistics for underground coal mine risks in Colorado indicate a similar ratio of medical costs to total costs. National Council loss experience establishes medical costs at 26% of total losses as averaged over five years of experience with ratios in any one year ranging from 20% to 37%, while according to Colorado's Supplementary Data System (SDS) statistics, medical costs are 31% of total costs.[8,9]

Records of losses for different risks are kept by independent agencies. The usual sources for statistical data are rating bureaus which develop insurance rates or provide loss data for a fee. Through its Coal Mine Rating Bureau, NCCI provides data for underground coal mine risks in Colorado. The NCCI data are based on accident losses reported by its subscribers, including CSIF. Two government agencies that provide loss data for the same risks are the Colorado Division of Labor through a computerized data system called the SDS and the U. S. Bureau of Mines through its Cost of Injury Model (COIM). Both agencies collect accident data from employers. However, the claims costs are provided by insurers for the SDS and are generated by a computer model for the COIM. The appendix goes into more detail about how data are collected and costs analyzed for each of these three agencies.

Changing Risks

Reliable and consistent estimates of costs are difficult to obtain even for a risk as well-defined and monitored as traumatic injuries within a given state for the underground coal industry. A single firm will have problems using past loss experience escalated to present levels for evaluation of future risks. Nonetheless, loss experience has proven to be an essential element in predicting losses. For a part of occupational injuries, however, loss experience does not provide enough information for future risks. For example, tools described to estimate either traumatic injury risks or serious injury risks have been effective in predicting losses but useful only for a stable and familiar risk. Much research in recent years indicates that work injury costs are increasing as a percentage of payroll, an increase that was anticipated as states passed legislation to improve benefits and coverage under workers' compensation programs.[10] However, the risks represented by both unidentified hazards and conditions where work hazards are suspected but neither often diagnosed nor reported play a significant part in these changing occupational injury risks. Similarly, there are uncertainties in the consequent increases in manual rates for occupational disease coverage. Costs for these claims can be very high if approved for compensation because of long periods of disability. If a condition consistently occurs among even a small percentage of the work force and if claims go uncompensated, costs for claims mount over time until the employer and his insurer face an overwhelming liability.

Also influencing costs are other factors not usually associated with the actual health hazard encountered in a work situation. For example, as workers become aware of workplace hazards and the remedies open to an injured employee, they are more likely to seek benefits through state compensation programs and, more important, through legal suits against the employer. Also, changes in state laws have broadened coverage and increased benefits and the prospect of federal action to establish programs has created special caution among risk managers and insurance rate-making agencies. Unfortunately, the techniques used to evaluate occupational injury risks do not account for the changes in costs as a result of these changes in laws and attitudes. To compensate, risk managers have, over the past ten years, devised methods to monitor these increases in costs. Briefly they rely primarily on measuring changes in injury costs from year to year. Alternatively, the National Council uses informed judgment to increase or decrease rates to reflect the impact of law amendments made by each state. To supplement the adjustment for law amendments, the National Council has used "trend factors" since 1977 to account for external factors such as the state of the economy, unemployment rates, and other influences not contained in traditional methods of risk assessment. Trend factors adjust manual rates for these amorphous influences by monitoring, using linear regression analysis to changes in net loss and loss adjustment ratios from year to year.[11] These ratios of losses paid out over net premiums collected by the insurers began to climb from the historic 70-72% to 86.5% in 1976 and 87.4% in 1977 despite the use of law amendment type factors to adjust rates for increased benefits under state compensation programs.[12] Using these same types of factors, and due to law amendment changes, Colorado coal mine traumatic injury rates increased by 25.5% in 1976. However, the rates have remained stable since then, an interesting phenomenon when compared to manual rates for all industries.[13] Specifically, manual rates for traumatic risks averaged over all industries have shown gradual but steady increases over the past decade so that the 1978 rates are 85% higher than the 1970 rates.[14]

Analogous to the traumatic injury rates, the $10.14 manual rate for occupational disease risks through the SCIF is modified by premium discounts and experience modifications. The intent is to match insurance premiums to an individual firm's accident and injury experience. Costs for occupational disease are in fact included in loss experience for all occupational injuries and the breakout of an "occupational disease" rate is an arbitrary one, with the risks it is intended to cover undefined.

Methods used by the risk manager to assess changing risks are relatively new and experimental with most resulting advice focusing on careful monitoring of changes in the average cost per claim. Cost and accident statistics are the parameters that indicate changes in the risk are taking place. However, claims need to be classified and analyzed by particular characteristics since an overall average of claims costs or accident statistics may disguise fundamental changes in the risk. Claims need to be subject to frequency distributions, classifications, and comparison over time by factors such as type of injury and age of claim to determine how a risk is changing.

One of these methods can be used with SDS data for underground coal mine risks in Colorado. For example, by comparing costs for claims with less than six months disability, average claims costs are shown to increase by 29% between 1978 and 1979, by 8% between 1979 and 1980, and by 9% between 1980 and 1981. Cost data are inadequate for reliable per injury costs for 1976 and 1977. This deficiency is because of the small number of claims for which cost data are available and the bias in those years for collecting cost data for high cost injuries. For a more complete comparison, see Table IX.

TABLE IX. ANNUAL INCREASES IN PER INJURY INDEMNITY COSTS FOR CLAIMS WITH LESS THAN SIX MONTHS DISABILITY, 1976-1981

Year	No. of Claims	Amount/Injury	Percent Change in Costs from Previous Year
1976	6	$734	
1977	12	987	+34
1978	129	388	-39
1979	224	499	+29
1980	203	537	+ 8
1981	67	583	+ 9

Source: Computer Printout, Colorado Division of Labor, Supplementary Data System, April 30, 1982.

More analysis using closed claims with longer periods of disability is necessary before any conclusions about overall cost increases can be drawn. In the meantime, these increases do indicate that benefits for short-term claims increased at an average rate greater than inflation during the period 1978-1981. The above type of analysis serves to indicate that claims costs are increasing and does not serve to indicate what specific factors are causing cost increases. These descriptive techniques can be useful, particularly if enough claims data over a number of years are available for analysis. This is, however, an obstacle for many firms as they lack sufficient in-house data owing to either their firm size, loosely kept accident and cost records, or lack of experience in assessing costs.

Risk managers are devoting an increasing amount of attention to occupational disease risks as traditionally defined. Specifically, this is in response to a number of studies by health professionals that claim many work-related conditions go unreported and uncompensated. For example, one study claims that workers' compensation programs supply only 5% of income for persons severely disabled by an occupational disease. The remaining sources of income to disabled workers are Social Security (53%), pensions (21%), veteran's benefits (17%), welfare (16%) and private insurance (1%). The study also contends that 75% of such persons receive no income from any source while 33% receive benefits from several programs. For employers, the implication of these statistics is that occupational injury costs have the potential of increasing substantially.[15]

Many health professionals contend that incidence of occupational disease as reported by employers or determined by examining workers' compensation claims do not adequately represent the true impact of occupational illnesses on worker health. Other measures are better for predicting the number of occupational diseases in a population since they include chronic illnesses or illnesses with long latency periods that incidence rates often exclude. Examples of these types of measures include prevalence rates, which measure the number of illnesses or suspected conditions in a given population at a given time, and standardized mortality ratios, which compare observed numbers of deaths to expected number of deaths based on a broader population. Critics of recent studies have pointed out, however, that such rates require extrapolation from a smaller population to a larger one. Researchers have not always been careful to screen out important differences in population make-up, and in some instances, worst case findings have been used to extrapolate to a larger population.[16]

Despite these studies and the increased awareness of occupational disease risks, costs and incidence of occupational disease show little change. SDS data for underground coal mines show that occupational disease claims as defined by the Colorado Division of Labor fluctuated between 2% and 4% of all injuries from 1976 to 1980. The 1978 total claims cost based on four closed cases, two of which were denied benefits, was only $139.[17] But as experience with black lung has shown, changes in the risk and potential liability are possible. For example, broadened definitions of occupational disease, increased medical research, increased awareness of occupational hazards, pursuit of monetary awards through civil courts rather than workers' compensation programs, and the enactment of presumptions by states or federal legislatures could cause incidence and costs of occupational disease to escalate.

In recent experience, sharply increasing costs and risks have been restricted to single work-related conditions, namely, black lung and asbestosis. However, similar increases could in the future result from an increased number of claims filed for conditions where work environment is only a contributing factor. Techniques depending on loss experience or adjustments to loss experience clearly cannot prepare a firm or an industry for such potential liability. Additionally, it is possible that no risk assessment techniques can be devised to describe or reduce the uncertainty of an expanded base of occupational disease risks.

Even in the absence of presumptions added to existing state compensation laws, costs associated with occupational diseases could be unexpectedly high. In a recent instance, for example, claims for asbestos-related lung cancer have caused turmoil in that industry. Paul W. MacAvoy, an economist with Yale University, predicts costs for asbestos disease victims are "likely to total $38.2 billion--and possibly as much as $90 billion over the next 35 years," with some insurers facing financial ruin. In almost all cases, claimants are seeking restitution through legal channels, choosing to bypass the state compensation programs because of low award and benefit levels.[18] Further as legal action against the employer or the insurer instead of or in addition to seeking benefits through a state compensation program "do not preclude plaintiffs...from filing civil suits," legal action may become more frequent.[19]

Occupational Disease Risks

The Federal Black Lung Program illustrates how presumptions of disability under certain circumstances can increase the number of claims and escalate costs. In fiscal year 1982, the Black Lung Trust Fund paid $202 million of the indemnity costs associated with federal black lung claims, responsible operators paid $15 million, and $480 million in annual cost was paid from general tax revenues.[20] These figures were the U. S. Department of Labor obligation only; claims paid by the Social Security Administration (SSA) totaled almost $990 million for the same period.[21] These high costs developed from an occupational disease risk that at an earlier period accounted for less than 1% of all injuries and compensation, and which, if awarded, was for partial disability.

Incidence of coal workers' pneumoconiosis and related conditions reported by the SDS continues at these low rates. To the contrary, the Mine Safety and Health Administration figures show an increase from three to four cases per year before 1978 to 275-300 cases per year in 1978 as a result of new reporting procedures.[22,23] The number of claims filed with the U. S. Department of Labor's Office of Coal Workers' Compensation is much higher, however, For example, 202,000 claims had been filed as of December 31, 1980. In additon, 73,933 claims originally denied by the SSA were filed with the Office of Coal Workers' Compensation following the 1977 amendments. Of these claims, 88,964 were approved for benefits, 144,964 were denied benefits and the remaining 43,010 were unadjudicated. If approval rates of 30% to 45%, depending on the type of claim, hold, approximately 12,400 of the 42,000 unadjudicated claims will be approved by the Black Lung Program in the months since December 31, 1980.[24]

The "occupational disease" rate developed by the NCCI is for black lung risks only and not based on loss experience at all. Rather it is based on assumptions about approval of claims and statistical data provided by the U. S. Department of Labor's Coal Workers' Compensation Program and by NIOSH. This rate, in contrast to the occupational disease rate under CSIF, cannot be adjusted by experience since it does not use loss experience in rate development. For example, the National Council assumes that the typical male claimant is married and that the wife is two years younger. Life expectancy tables are then used to determine expected life span of both the claimant and his wife. Benefit levels under the federal program are tied to the pay scale for federal employees and determined by the number of dependents (37.5% of the monthly wage of the GS 1/2 pay scale for the claimant alone; this basic amount is increased by 50% for one dependent, 75% for two dependents, and by 100% for three or more dependents). These benefit levels are assumed to increase at 6% a year for four years to allow for increases in the federal pay scale. Present value calculations determine the value of benefits paid under a combined state-federal program and a federal program only using a discount factor of 3.5%. The reason for calculating the present value of indemnity benefits under two programs is that the assumption for Colorado is that the state compensation program will approve and fund 50% of all approved claims. For calculating the present value of claims paid under state programs, however, a combined state-federal schedule of payment is used.

Although benefits paid by state programs are initially higher than federal benefits, the cost-of-living increases in federal benefits will eventually make the claimant eligible for benefits under the federal program. A 50% factor is applied to the resulting values to reflect the assumption that half of all claims filed will be approved first under the state compensation programs and half under the federal program; these are added together along with the estimated present value of medical benefits. This latter amount is based on the 1977 estimate that average medical costs per claim are $325 per year, increased at a rate of 6% per year for the life of the claimant and discounted at 3.5%. The sum of these amounts is the total present value of all benefits for a single claim. Expense-loading factors to allow for administrative costs, taxes, acquisition costs, and the like are applied to present value of a claim in a manner similar to the loading of pure premium estimates for traumatic injuries.

Frequency rates for incidence of black lung are developed from NIOSH statistics among miners aged 20-59, from combined NIOSH incidence rates and an assumed rate of 25% for miners aged 60-64, and an assumed rate of 25% for all miners over 70. This rate when applied to the present cost per case (including expense-loading factors) gives a "per capita annual charge"; when compared to estimated annual salary a basic rate as a percentage of payroll results. As a final step a contingency loading factor of 5% is applied (replacing a 40% contingency factor used before 1977). The result is an occupational disease rate of $16.15 per $100 of payroll, $13.06 of which is for federal risks, $4.68 for state risks.[24,25] (See a summary of these calculations in Table X.)

The approach used by the National Council with the attending assumptions and calculations is unique in the development of a workers' compensation insurance rate. However, this was necessary in the light of limited data available on loss experience for black lung risks as defined by federal laws. The nature of the black lung program in fact makes assumptions and calculations used to fund pension

TABLE X. DERIVATION OF OCCUPATIONAL DISEASE RATES FOR COLORADO UNDERGROUND MINES, NATIONAL COUNCIL ON COMPENSATION INSURANCE

Present value of indemnity benefits, combined state and federal programs	$63,848
Present value of indemnity benefits, federal program	61,800
State percentage based on presumptions	50
Federal percentage based on presumptions	50
Average present value of indemnity benefits (63,848 x .5) + (61,800 x .5)	63,824
Present value of medical benefits	7,101
Total present value of all benefits (62,824 + 7,101)	69,925
Portion of premium required for expenses	.165
Expense loading: 1.00 ÷ (1.000 - .165)	1.198
Present cost per case (69,925 x 1.198)	83,770
Frequency	.0257
Per capita annual charge (83,770 x .0257)	2,153
Average annual salary in hundreds	140
Basic rate (2,153 ÷ 140)	15.38
Contingency loading	1.05
Occupational disease rate for underground coal mine risks (per $100 of payroll)	16.15

Source: Rate Filing Memorandum, National Council on Compensation Insurance, February 15, 1977.

plans more appropriate than the traditional rate development methods used for workers' compensation risks. The amendments to the black lung program in 1972, 1977, and 1981 have not made the task of assessing costs and risks any easier. But the ten years of data and recent amendments to restore the program to its original intent of compensating miners disabled by black lung make re-evaluation of the assumptions advisable. On several points--assumptions that states will fund 50% of all claims approved, on discount rates used for present value calculations, on incidence of approved claims among active miners--development of rates needs to be re-examined. Finally, the lack of any mechanism to modify rates according to the risks faced by a particular firm is questioned when ages of the miners employed, length of employment in underground mines, and other similar factors affect the number of claims approved for black lung benefits.

NCCI rates are the most familiar of black lung insurance rates but state insurance funds and self-insurers need to estimate their liability for black lung risks. The rate development process for the occupational disease rate through CSIF has been described in earlier paragraphs. Self-insurers must also estimate future liability either for contributions to a self-insurance trust or to prepare for future claims by other means if the company has not established a trust as set out in the 1977 Black Lung Revenue Act. As for other work injury risks, past experience is a guide for future costs but is an accurate predictor for only a portion of black lung risks. As a consequence, many firms turn risk assessment for black lung over to a firm of actuaries, who in turn rely on data from the U. S. Department of Labor and NIOSH incidence rates for black lung. Adjustments can be made for factors that will affect the number of claims approved for a particular firm.

The black lung program should stabilize in the 1980s, assuming no further legislative action or decreases in compensable claims because of improved respiratory standards over the past ten years. With stabilization, reliable techniques may emerge for assessment of future liability of black lung claims and provide valuable information for similar risks in other industries. The Black Lung Trust Fund is itself an innovation as an insuring option as a result of problems faced by the coal industry in financing black lung claims.[25,26] At present, however, a mixture of past experience and the risk manager's judgment are the bases for predicting future costs of black lung claims.

The preceding pages have outlined the different kinds of "occupational disease" risks and techniques used to anticipate future losses. The analysis chapter to follow will examine each of the techniques--methods for describing and predicting the probability of serious injuries, evaluation of changing risks, and assessment costs for a special risk such as black lung--in light of the experience of underground coal operators in Colorado.

The intent of the analysis chapter is to examine how costs and risks of injuries in underground coal mines are changing and to determine the accuracy of current methods for risk assessment are when estimating future liability for these occupational injury risks.

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CHAPTER V

DATA PRESENTATION AND DISCUSSION

The coal industry has played an important part in the development of programs to compensate injured workers and to finance the cost of occupational injuries. Despite this, the issues and problems described in the previous chapters are common to a number of industries. Many industries face risks that are high cost, difficult to insure, and that are changing as workers' compensation laws change. The asbestos industry, as an example, is already experiencing the extraordinary costs as a result of a single occupational hazard similar to black lung risks for the coal industry. However, and as a focal point, this chapter will concentrate on how well methods to assess risks or develop insurance rates are working for the underground coal industry.

Risk assessment in this thesis refers to techniques and practices used to estimate costs associated with occupational injuries. It will be helpful to remember, though, that goals and requirements for accuracy differ among insurance rating bureaus, risk managers of individual firms, and safety professionals. These noted differences are especially true, given the share of work injury risks that have increased in uncertainty and in cost because of the difficulties experienced in obtaining reliable estimates of costs and in verifying those estimates. Insurance rating bureaus, for example, need to establish a range of costs that will cover losses--collecting premiums equal to or in excess of losses and administrative expenses is the important aim. Risk managers, on the other hand, have two purposes in estimating potential liability. These purposes include preparation for future losses, especially those associated with high cost injuries, and comparison of insurance costs in order to make decisions about how and to what extent risks should be insured. Safety professionals use cost data to pinpoint hazards within the workplace so that relative rather than actual costs are the focus of attention. Each of these three aims is apparent in the three data sources for this paper.

NCCI develops rates for industries in 44 states.[1] Data from this source were supplied by rate filing memoranda for traumatic and occupational disease rates. For traumatic injury rates, total injury costs (indemnity and medical) compared to total payroll in 100s of dollars are available with distinctions made only between "serious" and "nonserious" injuries. Black lung rates, on the other hand, do not use loss experience at all but rely on assumptions and data as described in the previous chapter. The SDS is an information bank for researchers and workers' compensation professionals; it collects data but does not analyze it. Cost data from that source are available on a per injury basis beginning in 1976. SDS includes other information such as what type of insurer is responsible for payment of the claim, the age and years of experience for the injured miner, and data on the severity and nature of the injury. The COIM was programmed with the intent of using costs to identify work hazards and safety problems. It collects accident statistics from employers through MSHA and calculates total, annual and per injury costs using a computer model. The COIM also includes indirect accident costs in the form of production losses for all fatal or permanently and totally disabling injuries.

These differences in purpose and methods of analysis produce markedly different per injury costs--$2,690 for the NCCI, $1,837 for the SDS, and $1,073 for the COIM.[2,3,4] In addition to the above noted differences in data bases, these variations incorporate different reporting periods and different populations. The NCCI uses cost information from years 1970-1975 escalated to 1978 benefit levels and derives its data from private insurers and the CSIF. By contrast, the SDS uses cost data for all underground coal mine risks from 1976 to 1980 adjusted to 1978 benefit levels. The COIM approaches to data collection and analysis were described above. In any event, a representative of all these vagaries can be noted in Table XI.

TABLE XI. INDEMNITY COSTS PER OCCUPATIONAL INJURY FOR COLORADO UNDERGROUND COAL MINES, 1978 BENEFIT LEVELS

	NCCI		SDS*		COIM	
	# of Inj.	Cost/ Inj.	# of Inj.	Cost/ Inj.	# of Inj.	Cost/ Inj.
All Injuries	446	$ 2,690	736	$ 1,837	191	$ 1,073
Serious	21	34,588	33	22,918	6	15,967
Nonserious	425	1,114	703	849	185	590

Source: National Council on Compensation Insurance, Rate Filing Memorandum, January 31, 1979, and Computer Printout, Colorado Division of Labor Supplementary Data System, April 30, 1982, and Computer Printout, U. S. Bureau of Mines, Pittsburgh Research Center, Cost of Injury Model, July 14, 1982.

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*To adjust injury costs for SDS data to 1978 benefit levels, the increases in maximum weekly benefit payments in each of five years is used as an indicator of changes in benefit costs. These maximum benefits were, beginning 1975, $144.13 per week increasing to $152.53, $161.40, $173.60, $222.74 and $244.65 in the years 1976-1980. The parameter of interest to adjust actual cost data to 1978 benefit levels is the ratio of 1978 maximum indemnity payments to the maximum benefit payments for all other years--173.60/152.53 or 113.8% for 1976, 173.60/161.40 or 107.5% for 1977, 173.60/173.60 or 100% for 1978, 176.60/222.74 or 77.9% for 1979 and 173.60/244.65 or 70.9% in 1980. These factors taken times the appropriate year's actual injury costs yield an adjusted cost. From that a weighted average of all years' costs is possible.

The SDS data on per injury costs merit further attention because they come from a single source and the comparison of costs is not affected by collection methodology and analysis differences among agencies. For example, averaged over five years, the per injury costs are $1,830 for self-insurers, $720 for private insurers, and $2,470 for the CSIF.[6] The importance of a firm's loss experience is especially evident in the difference between per injury costs for private insurers and the CSIF. Keep in mind that private insurers are very selective about the risks they accept and the CSIF is required to insure all employers who request coverage. The significance of these differences in costs is that loss experience, even if it must be adjusted by some factor, is a basic unit for assessment of risks. Further, loss experience averaged over an entire industry in a state may not fit a single firm's experience. This clearly gives self-insurers a possible advantage although experience modifications of premiums adjust total insurance costs to a firm's accident experience. Once a firm's loss experience is established, providing it has enough cost data, risk assessment techniques exist to establish potential liability, including that for serious injury risks.

Changing Risks

For the past six years, traumatic injury rates for private insurers have remained stable. During this same time period, the equivalent portion of the CSIF rates has fallen (total CSIF rates have actually doubled even without the inclusion of the federal black lung risk). Hence it can be concluded that traumatic injury rates are essentially a constant percentage of payroll. As benefits have increased, wages have apparently increased proportionately. These average rates may in fact disguise fundamental changes in the nature of occupational injury risks in Colorado underground coal mines. For example, this section examines cost and accident data that indicate important changes have taken place in recent years. Specifically, claims costs on both a per injury and a total basis in relation to payroll have risen for reasons other than inflation.

Important among these indicators is the comparison of per injury costs in years 1976-1981 for claims with less than six months of disability. (Table IX, Chapter IV). These SDS data indicate that benefit costs for short-term injuries rose an average of 16% per year over the period 1978-1981.[6] No conclusions can be immediately drawn about all injuries from these claims, of course, but they can be taken as indicator that claims costs are increasing. More conclusive data will be available only as more complete cost information is added to the SDS; meanwhile, the system currently lacks sustained years of data for higher cost injuries. Increases in claims costs can be attributed to several possible factors such as: increases in weekly benefits, increased awards for some degree of permanent disability, and longer periods of disability, even within a well-defined period. Weekly maximum benefit payments have increased by annual percentages roughly parallel to increases in claims costs described above. For example, there was a 28.3% increase between 1978 and 1979, a 9.8% increase between 1979 and 1980, and a 6.4% increase between 1980 and 1981 (see Table XII).

The maximum benefit is determined as a percentage of the state's average weekly wage--66 2/3% in 1975 and 80% since 1976.[7] Further, as the average weekly wage of an underground coal miner easily exceeds the state's average weekly wage, the indemnity benefits for underground miners can be expected to have increased by percentages parallel to those observed in rising maximum weekly benefits.

A second indicator that work injury risks are changing is accident data. The risk assessment techniques previously described in this paper use cost data exclusively and do not incorporate accident statistics in describing work injury

TABLE XII. COLORADO MAXIMUM WEEKLY BENEFITS UNDER WORKERS' COMPENSATION, 1975-1981

Year	Maximum Weekly Benefit	Percentage Increase
1975	$144.13	
1976	152.53	5.8
1977	161.40	5.8
1978	173.60	7.6
1979	222.74	28.3
1980	244.65	9.8
1981	260.80	6.4

Source: A. S. Hribal, G. M. Minor, "Workers' Compensation--1975 Enactments, Monthly Labor Review, Vol. 99, No. 1, January 1976, p. 30-31; "Workers' Compensation Laws: Major Amendments in 1976," Monthly Labor Review, Vol. 100, No. 2, February 1977, p. 39; "Workers' Compensation Laws--Key State Amendments in 1978," Monthly Labor Review, Vol. 102, No. 1, January, 1979; LaVerne Tinsley, "Workers' Compensation Laws--Key Amendments of 1979," Monthly Labor Review, Vol. 103, No. 2, February 1980; U. S. Chamber of Commerce, Analysis of Workers' Compensation Laws, 1980 and 1981 editions.

risks. By not using this information, risk managers and insurance rating bureaus are neglecting pertinent data about the mix of injuries that make up the total risk. Thus, this chapter examines nationwide 1976, 1970, 1975, and 1980 accident data from MSHA, the U. S. Bureau of Mines and MESA (different agencies had responsibilities for the data at different points in time). Further, there is a review of the Colorado SDS data for 1976 and 1980. Both MSHA and SDS analyze data according to several classifications relating to cause and result of accidents. However, this paper concentrates on two of these classifications--classification

TABLE XIII. MSHA INJURY RATES AT BITUMINOUS COAL MINES, 1965, 1970, 1975, 1980, AND COLORADO SDS ACCIDENT DATA 1976 AND 1980 BY NATURE OF INJURY

Nature of Injury	Year	Distribution As a % of Injuries MSHA		SDS	Frequency or Incidence Non-Fatal Disabling Injuries	Severity Non-Fatal Disabling Injuries
Amputation Enucleation	1965	2.1			1.03	806
	1970	1.6			.85	670
	1975	1.5	1976	.4	.55	255
	1980	.7	1980	.4	.09 (.45)	39 (195)
Asphyxiation	1965	.5			.17	2
	1970	.2			.08	1
	1975	.2	1976	-	.04	1
	1980	.5	1980	-	.02 (.1)	-
Burn, Scald	1965	3.9			1.78	29
	1970	2.5			1.33	37
	1975	.9	1976	.8	.33	9
	1980	1.0	1980	1.7	.12 (.6)	2 (10)
Chemical Burn	1965	.4			.18	3
	1970	.2			.10	2
	1975	.3	1976	.8	.11	2
	1980	.3	1980	-	.03 (15)	-
Concussion Crushing, Contusion	1965	25.0			11.6	382
	1970	27.0			13.78	367
	1975	26.9	1976	15.1	10.07	335
	1980	21.6	1980	14.9	2.59 (12.95)	57 (285)
Radiation	1965	.4			.17	1
	1970	.9			.47	4
	1975	-	1976	-	-	-
	1980	1.2	1980	.4	.14 (.7)	2 (10)
Cut, Laceration, Puncture	1965	10.3			4.99	124
	1970	10.3			5.41	136
	1975	11.4	1976	8.4	4.29	125
	1980	9.5	1980	13.0	1.16 (5.8)	20 (100)
Electric Shock	1965	.2			.11	1
	1970	.3			.10	2
	1975	.4	1976	.4	.10	3
	1980	.3	1980	.2	.03 (.15)	-
Dermatitis	1965	-			-	-
	1970	-			-	-
	1975	.1	1976	-	.05	-
	1980	-	1980	.4	-	-
Foreign Body (Eye Injury)	1965	1.7			.87	20
	1970	2.1			1.12	45
	1975	-	1976	-	-	-
	1980	1.0	1980	-	.12 (.6)	1 (5)
Fracture	1965	15.9			7.6	926
	1970	14.8			7.6	649
	1975	14.5	1976	12.7	5.4	684
	1980	12.2	1980	9.8	1.49 (7.45)	81 (405)
Hernia	1965	1.3			.61	35
	1970	1.0			.56	32
	1975	.8	1976	1.6	.30	16
	1980	1.0	1980	2.0	.13 (.65)	6 (30)
Hearing	1965	-			-	-
	1970	-			.01	-
	1975	-	1976	-	.03	-
	1980	-	1980	-	-	-
Poisoning	1965	.1			.02	-
	1970	-			.02	-
	1975	-	1976	-	.01	-
	1980	-	1980	.8	.01 (.05)	-

TABLE XIII. (Continued)

Nature of Injury	Year	Distribution As a % of Injuries MSHA		SDS	Frequency or Incidence Non-Fatal Disabling Injuries	Severity Non-Fatal Disabling Injuries
Sprain, Strain, Dislocation	1965	19.8			9.62	378
	1970	21.8			10.62	389
	1975	25.7	1976	44.6	9.68	458
	1980	38.4	1980	44.6	4.69 (23.45)	166 (664)
Pneumo., Silicosis	1965	-			.01	11
	1970	-			.05	124
	1975	-	1976	1.2	-	-
	1980	-	1980	-	-	-
Inflammation	1965	-			.02	1
	1970	.3			.18	7
	1975	.2	1976	.8	.05	6
	1980	-	1980	-	-	-
Multiple Injuries	1965	-			-	-
	1970	-			-	-
	1975	4.9	1976	4.4	.31	154
	1980	7.6	1980	6.0	.92 (4.6)	31 (155)
Other NEC	1965	1.5			.7	64
	1970	.4			.25	6
	1975	4.6	1976	1.6	1.75	35
	1980	.9	1980	.8	.11 (.55)	4 (20)
Unclassified	1965	16.7			8.01	322
	1970	15.8			8.04	375
	1975	7.5			2.80	188
	1980	4.0			.49	15 (75)
All Injuries	1965				47.47	3109
	1970				51.62	2865
	1975				37.11	2246
	1980				12.14 (60.70)	425 (2125)
Colorado	1965				50.0	1680
	1970				45.0	1300
	1975				17.24	1233
	1980				16.21 (81.05)	665 (3325)

*Accident rates between the years before 1978 and from 1978 on are not wholly comparable. The most apparent difference is that accident rates before 1978 are computed by comparing number of injuries or number of days lost from work to each 1,000,000 man-hours worked; from 1978 on these numbers are compared to each 200,000 man-hours worked. If this were the only difference, adjustments could be made to make the rates comparable. However, new classifications of injuries were also instituted in 1978 which affect calculation of incidence and severity rates for injuries except fatalities. Comparison of rates between these two periods must therefore be done with caution.

Source: Information Circulars, U. S. Bureau of Mines, 1965 and 1970; Information Reports, Mine Enforcement and Safety Administration, 1975; Informational Report, Mine Safety and Health Administration, 1980, Computer Printout, Colorado Division of Labor, Supplementary Data System, April 30, 1982.

TABLE XIV. MSHA INJURY RATES AT BITUMINOUS COAL MINES, 1965, 1970, 1975, AND 1980, AND COLORADO SDS ACCIDENT DATA, BY PART OF BODY AFFECTED

Part of Body	Year	Distribution As a % of Injuries MSHA		SDS	Frequency or Incidence Non-Fatal Disabling Injuries	Severity Non-Fatal Disabling Injuries
Head, Face, Neck	1965	6.0			2.69	102
	1970	6.8			3.37	173
	1975	7.5	1976	7.2	2.77	166
	1980	7.8	1980	8.6	.96 (4.8)	24 (120)
Eye	1965	4.8			2.33	75
	1970	4.5			2.39	115
	1975	3.9	1976	.2	1.48	34
	1980	2.9	1980	1.3	.35 (1.75)	5 (25)
Trunk	1965	29.9			14.23	955
	1970	29.8			15.47	798
	1975	29.7	1976	37.5	11.13	689
	1980	36.6	1980	40.5	4.48 (22.4)	170 (850)
Arm Above Wrist	1965	3.5			1.72	305
	1970	3.6			1.89	351
	1975	4.7	1976	1.6	1.75	132
	1980	3.7	1980	3.0	.46 (2.3)	22 (110)
Wrist, Hand, Fingers	1965	16.8			8.17	469
	1970	18.2			9.62	399
	1975	19.9	1976	9.8	7.49	353
	1980	18.6	1980	10.0	2.28 (11.4)	64 (320)
Leg	1965	11.7			5.66	516
	1970	11.7			6.16	461
	1975	11.5	1976	16.7	4.33	402
	1980	12.3	1980	14.6	1.52	64 (320)
Ankle, Foot, Toes	1965	10.6			5.14	282
	1970	11.6			6.13	235
	1975	13.0	1976	13.6	4.92	195
	1980	11.3	1980	13.1	1.38 (6.9)	42 (210)
Multiple Injuries	1965	6.5			2.52	204
	1970	6.9			3.65	154
	1975	8.1	1976	9.2	2.8	259
	1980	6.3	1980	7.9	.73 (3.65)	31 (155)
Not Stated	1965	10.3			5.00	204
	1975	6.8			3.62	170
	1975	1.4			.45	14
	1980	.2			.02 (.1)	1 (5)

*Accident rates between the years before 1978 and from 1978 on are not wholly comparable. The most apparent difference is that accident rates before 1978 are computed by comparing number of injuries or number of days lost from work to each 1,000,000 man-hours worked; from 1978 on these numbers are compared to each 200,000 man-hours worked. If this were the only difference, adjustments could be made to make the rates comparable. However, new classifications of injuries were also instituted in 1978 which affect calculation of incidence and severity rates for injuries except fatalities. Comparison of rates between these two periods must therefore be done with caution.

Source: Information Circulars, U. S. Bureau of Mines, 1965 and 1970; Information Reports, Mine Enforcement and Safety Administration, 1975; Informational Report, Mine Safety and Health Administration, 1980, Computer Printout, Colorado Division of Labor, Supplementary Data System, April 30, 1982.

by nature of injury and by part of body affected. These results are summarized in Tables XIII and XIV. These data show several apparent trends but since no analyses have been applied, they should be noted with caution. In any event, the three most notable trends are summarized and presented below.

1. While incidence or frequency rates* both nationwide and in Colorado demonstrate no clear trend, in general severity rates are declining. Further, severity rates for injuries classified by nature of injury are declining for most categories with the exception of sprain and strain injuries. These injuries instead show an increase in severity rates.

2. According to MSHA data, some categories of injuries are changing as a percentage of all injuries. For injuries classified by nature of injury, these are amputations, fractures, sprain and strain injuries, and injuries for which insufficient data are available for classification. For classification of injuries by part of the body affected, categories showing a change as a percentage of all injuries include eye and trunk injuries and injuries where too little information is available. However, by either type of classification, most of these shifts are minor. Only sprain and strain injuries (from 19.8% of total injuries in 1965 to 38.4% in 1980) and injuries to the trunk of the body (from 28.6% of

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*Frequency rates are defined by MSHA as the total number of injuries per 1,000,000 man hours worked while incidence rates, a measure adopted in 1978, are the number of injuries per 200,000 man hours worked. Severity rates are before 1978 defined as the number of days of work missed per 1,000,000 man hours worked due to a work injury while from 1978 the measure is number of days lost per 200,000 hours worked. Average severity rates are days lost per injury.

total injuries in 1965 to 36.6% in 1980) show marked increases. To the contrary, injuries with too little data to classify show marked decreases (from 16.5% of all injuries in 1965 to 4.0% in 1980 for injuries classified by nature of injury; and from 9.6% of all injuries in 1965 to 1.4% for injuries classified by part of body affected).

3. Colorado SDS data show no shifts in distribution of injuries but these data are available only since 1976. Further, SDS data represent different distribution of injuries when compared with MSHA data.

The injury categories that show some discernible trend over the fifteen-year period from 1965 to 1980 are of interest to this paper. Specifically, they support the thesis that injury risks are changing in response to changes in work injury laws and changing attitudes about employer responsibility for many health conditions. Some changes can clearly be explained. For example, the decrease in the number of injuries for which insufficient data are available is certainly because of changes in data collection and analysis methods used by MSHA, i.e., more detailed classification of injuries and better accident reporting by employers. However, changes in workers' compensation laws and in worker (and employer) attitudes are argued to have had some indlurence on other trends. By analogy from an earlier period when enactment of workers' compensation programs were credited with helping to reduce accident and fatality rates in underground coal mines, increased benefits for work injuries can be suspected as a factor in the decreases in severity rates. That workers' compensation law amendments have influenced the dramatic increases as a percent of total injuries for two classifications of injuries in particular (sprain and strain injuries and injuries to the trunk of the body) must be seriously entertained, although other factors as well may be involved. In any case, such shifts should be noted by risk managers as much as the increase in weekly benefits or expansion in coverage. In particular, these shifts affect the potentital liability although a determination of whether costs will increase or decrease and by how much is less certain.

Particular attention is made that categories or occupational injuries labeled occupational diseases show little change in total injuries or as a share of total injuries. With related legislative changes in the 1970s many professionals in the workers' compensation field expected increases in claims filed and approved. However, SDS data show occupational diseases as defined by the Colorado Division of Labor to be only 2-4% of all injuries from 1976 to 1980.

To be useful to risk managers or insurance rating bureaus, two additional aspects of the risks described must be known. First, given that MSHA and SDS data indicate that certain injuries are accounting for an increasing share of injuries, countering other trends that show decreases in severity of injuries, it is relevant to question the future pattern of these trends. An inverted version of this questioning is to assess likely trends for categories of injuries showing no apparent trend from historical accident statistics but that studies and forecasts by researchers indicate may become an increasingly important risk (occupational disease as variously defined is an obvious example.) Second, it is relevant to inquire about the associated costs for these categories of injuries and determine how such can be integrated with accident data in assessing changing risks.

Identifying and describing trends for particular categories of injuries is very difficult to accomplish. In particular, the data used to describe any trend change are only fully available after the risk represented has again become stable. In addition, any one of a number of reasons could account for a sudden change in accident statistics or changes noted could have little correlation with accident costs. Examples of changes in accident statistics are the decreases in severity rates and shifts in distribution of injuries in underground mines as noted previously in this chapter. At some point, these types of changes can be expected to level out but that point is equally difficult to predict as is the change to begin with. Another example of change is noted in the black lung program where liability for claims came as a result of the enactment of a federal law and fluctuated with amendments in 1972, 1978, and 1981. The curve of this liability, either in total costs or number of claims approved, is expected to peak and then fall as respiratory standards improve working conditions and stiffened eligibility requirements reduce the numbers of potential claims. In each case, these trends represent an extended period of uncertainty and their impact on costs has not successfully been assessed in advance of the liability. Other work injury risks have the potential of following similar trends, especially as many issues surrounding compensation of occupational injuries remain unresolved.

Tables XV and XVI show the costs associated with categories of injuries that have either increased as a share of injuries or shown decreases in severity rates. However, there are no conclusions drawn about these effects on total injury cost. Categories of injuries that are decreasing in severity or average severity are relatively serious injuries--amputations, asphyxiations, concussions, and fractures--and could be expected to generally have a high per injury costs. Alternately, the COIM and cost data from the

TABLE XV. INJURY COSTS IN INDEMNITY AND MEDICAL COSTS AND PRODUCTION LOSSES FOR UNDERGROUND COAL MINES BY NATURE OF INJURY FOR SELECTED CATEGORIES OF INJURIES, 1978
(100s of Dollars)

Nature of Injury	No.	Percent of Total Injuries	Amount per Injury	Total Costs	Percent of Total Costs
Amputation	94	.8	$2,675	$251,461	39.0
Asphyxiation	17	.1	442	7,529	1.2
Burn, Scald	96	.8	21	2,016	.3
Concussion, Contusion	3000	25.0	34	101,739	15.8
Fractures	1772	14.8	30	53,260	8.3
Sprain, Strain	3936	32.8	7	28,286	4.4
Illness*	12	.1	5	55	< .1
All Injuries	12007		$5,400	$644,676	

*Illness in the Cost of Injury Model includes "other accidents," disorders due to physical agent, disorder due to repeated trauma.

Source: U. S. Department of Labor, Mine Safety and Health Administration, "Cost of Injury Model at Underground Coal Mines," 1978.

TABLE XVI. INJURY COSTS IN INDEMNITY COSTS FOR UNDERGROUND COAL MINES IN COLORADO, BY NATURE OF INJURY FOR SELECTED CATEGORIES OF INJURIES, 1978

Nature of Injury	No.	Percent of Total Injuries	Amount per Injury	Total Costs	Percent of Total Costs
Amputation	3	1.8	$2,923	$ 8,769	2.3
Asphyxiation	-	-	-	-	-
Burn, Scald	6	3.6	1,183	7,097	1.9
Concussion, Contusion	24	14.3	358	8,581	2.3
Fracture	26	15.5	1,856	48,263	12.7
Sprain, Strain	73	43.5	2,882	210,413	55.3
Occupational Disease*	2	1.2	278	555	.14
All Injuries	168		$2,264	$380,352	

*The Colorado Division of Labor defines occupational disease as an "abnormal condition or disorder which is not caused by an occupational injury, but rather by exposure to environmental factors associated with employment," and includes several broad categories of occupational injuries.

Source: Computer Printout, Colorado Division of Labor, Supplementary Data System, April 30, 1982.

SDS show that amputation and asphyxiation injuries do have higher than average injury costs but that the concussions and fractures categories have lower than average injury costs. The dramatic differences in distributions of total costs and in the estimates of costs per injury when COIM and SDS data are compared is disturbing. The COIM data show that amputations account for 39% of total costs (this includes production losses and medical costs) and sprain and strain injuries account only for 4.5%; SDS cost data (which do not include production losses or medical costs) have these reversed--amputations account for 2.4% of total costs and sprain and strain injuries for 43.5%. The COIM data also indicate sprain and strain injuries to be a minor category of injuries in terms of per injury costs with per injury costs of $700 compared to $5400 for all injuries while SDS cost estimates for the same category of injury are $2,882 compared to $2,264 for all injuries. The conclusions a risk manager can draw about the effect on injury costs from these two bodies of data are very different.

The other category that MSHA data indicate to be increasing as a share of total injuries is injuries to the trunk of the body. In this category, according to SDS data, costs per injury are high compared to average costs per injury--$3,815 per injury for 1978 injuries. Over half of these injuries (60%) are back injuries with a cost of $4,485 per injury (see Table XVIII). Chest injuries are the other high cost injury in this category with average costs of $6,292. Otherwise, injuries to the abdomen are $695 per injury, injuries to the shoulder are $337 and all other injuries to the trunk of the body are $356. The distribution of these injuries by costs is heavily weighted to high cost injuries (see Table XVII), with the frequency distributions of all injuries and sprain and strain injuries.

As noted in Chapter IV, per claim occupational disease costs for 1978 averaged only $278, and $139 if claims denied benefits are included. However, using data averaged over a five-year period and adjusted to 1978 benefit levels, the average per claim costs are higher than average costs for all injuries over the same period, owing to the one high occupational disease claim in 1976, which was for "inflammation or irritation of joints, tendons or muscles" involving the back.[8] Even more so than for the statistics for sprain and strain injuries, repeated analysis with new data is necessary to confirm these estimates because of the small number of injuries (18) on which cost estimates are based. The occupational disease cost data do illustrate the wide range of costs this risk can cover. (See Table XIX.)

TABLE XVII. COMPARISON OF FREQUENCY DISTRIBUTIONS OF COSTS FOR SPRAIN AND STRAIN INJURIES AND INJURIES TO THE TRUNK OF THE BODY, COLORADO UNDERGROUND COAL MINES, 1978-1980

Size Categories WC Lost Time Claims (Indemnity and Med.)	Percentage to Total					
	All Injuries		Sprain and Strain Injuries		Injuries to the Trunk of Body	
	No.	Amt./Inj.	No.	Amt./Inj.	No.	Amt./Inj.
$25,000 and over	1.9	32.2	2.6	31.9	4.3	47.2
10,000 to 24,999	4.5	21.9	6.3	28.7	4.9	20.3
5,000 to 9,999	5.9	14.8	8.3	15.9	3.7	7.9
1,000 to 4,999	27.1	23.3	21.8	16.4	26.2	18.4
500 to 999	17.0	4.3	17.2	3.9	16.4	3.3
0 to 499	43.6	3.5	43.8	3.2	44.5	2.9

Source: Computer Printout, Colorado Division of Labor, Supplementary Data System, April 30, 1982.

TABLE XVIII. INJURY COSTS IN INDEMNITY COSTS FOR UNDERGROUND COAL MINES IN COLORADO, BY INJURIES TO THE TRUNK OF THE BODY, 1978

Part of Body	No.	Percent of Injuries	Amount per Injury	Total Costs	Percent of Total Costs
Abdomen	4	2.4	$ 695	$ 2.780	.7
Back	32	19.0	4,485	143,513	37.7
Chest	9	5.4	6,292	56,630	14.9
Shoulder	6	3.6	337	2,024	.5
Trunk, not otherwise classified	3	1.8	356	1,068	.3
Trunk of the Body	54	32.1	$3,815	$206,020	54.2
All Injuries	168		$2,264	$380,352	

Source: Computer Printout, Colorado Division of Labor, Supplementary Data System, April 30, 1982.

TABLE XIX. INDEMNITY COSTS PER OCCUPATIONAL INJURY FOR YEARS 1976-1980 FOR COLORADO UNDERGROUND COAL WORKERS (ADJUSTED TO 1978 BENEFIT LEVELS)

	1976		1977		1978		1979		1980		Average	
	#	Amt/Inj	#	Amt/Inj	#	Amt/Inj	#	Amt/Inj	#	Amt/Inj	#	Amt/Inj
All Injuries	19	$12,787	39	$6,985	168	$2,264	278	$988	232	$782	736	$1,837
Occ. Disease*	1	29,920	1	4,400	2	278	8	849	6	169	18	2,371

Source: Computer Printout, Colorado Division of Labor, Supplementary Data System, April 30, 1982.

*See footnote, Table XVI.

For COIM cost data, the category of "illnesses" is the least costly of all injuries, involving less than .1% of injuries and total costs. It should be noted, however, that occupational disease as defined by the Colorado Division of Labor and illness as defined by the COIM are not equivalent and that several categories included as occupational disease in the SDS are counted as other injuries in the COIM. In any event, these low costs highlight issues in assessing future costs. Literature on occupational disease risks states that 90% of occupational disease cases go unrecognized and uncompensated. Further, even critics of these studies acknowledge that incidence rates do not adequately represent health hazards faced by workers.[9] For the employer, what the actual risk is in terms of cost is even more uncertain. Not only is the employer in doubt about the number of potential claims but about what directions legislative or legal decisions might take in deciding who should accept financial responsibility for a disability arising from a mixture of on-and-off-the-job factors, with the origins of many conditions in doubt.

The factors in the workplace which have significant bearing on incidence of occupational disease are, most important, age of the work force, and second, length of exposure to known hazardous conditions. Also important is the effort exerted by the employer in controlling the work environment. However, this is of little assistance in assessing risks since the "safe" level is not known for many hazardous materials. The trend toward presumptions of disability based on length of exposure make levels of exposure, even if they could be determined, an unimportant point as illustrated by the black lung program.

What the combined effect of increases in benefit costs and changes in the nature of accident risks will be on occupational injury costs is not clear. This uncertainty stems from both the contradictory information from various sources and decreases in severity rates and changes in distribution of injuries which might serve to counter benefit increases. However, currently the total costs have not shown the steady increases as reflected in insurance rates experienced by other industries. To the contrary, movements in costs and risks have been reflected in slow changes rather than abrupt increases. Further, the threat of occupational disease claims, except for black lung, has not materialized for the coal industry in Colorado. Cost data give grounds for the suspicion, however, that there is an upward push on total injury costs that will eventually be seen in insurance for traumatic injury risks.

Due to the complex trends in costs and accident rates, predictive techniques for these changing risks have not been developed reliably to assess costs. Insurance rate-making bureaus have preferred to adjust total costs and have turned to alternative measures in order to supplement loss experience in rate development. Examples of these measures are the "Catastrophe loading rate" used by CSIF and the law amendment adjustments and trend factors used by NCCI. A more complete discussion of adjustments to loss experience can be found in Chapter IV. As also noted in that chapter, manual rates for traumatic injury rates have not shown increases experienced by other industries. Stable rates may in part be accounted for because current rates are developed on loss experience for a period (1970-1975) when such experience came almost exclusively from employers insuring through the CSIF. As noted earlier in this chapter, employers insuring through private insurers (now being charged rates developed on CSIF experience) have claims costs that are 1/3 to 1/2 of those of employers insuring through the CSIF; hence, the better loss experience of these firms may be countering the trends in increased injury costs.

"Occupational Disease" Risks"

It may well be argued that the techniques employed by rating bureaus and risk managers are useful in describing a present risk. However, they do not take into account the occupational injury risk that due to special circumstances developes from a minor, or almost unnoticed risk, into a major liability for an industry. The federal black lung program is of course an example of this. The most obvious hardship faced by the coal industry was the sudden liability created although most claims have been financed by general tax revenues or from the Black Lung Trust Fund provided for by a tax per ton of coal. A secondary difficulty was assessing the costs that would result for future claims given no loss experience and little statistical data as a guide. The National Council met this challenge in rate development by using a set of assumptions together with known data to develop insurance rates for third-party insurers in coal mining states. The derivation of proposed rates was based on both assumptions and data about expected frequency rates, the claimant's age, number of dependents, expected life span, and expected increases in benefits. By developing a cost per claim first, then applying expected frequency rates, and comparing costs to the annual average salary of a coal miner, the National Council combined techniques using loss experience compared to total payroll and a cost per injury used by risk managers. In doing so, the National Council set up a framework for assessment of black lung risks that can continue to be used with substitution of data and changes in assumptions as information about the risk accumulates. Using data available from several sources, this paper examines some of the assumptions and data used to develop black lung rates for Colorado in 1977. Data on approved rates since the 1981 amendments have not been incorporated, but these amendments can be expected to ultimately both reduce the number of claims approved and lower total costs. Points to be examined are 1) frequency rates using a combination of NIOSH data and an assumed rate of 25%; 2) assumptions used about the average claimant on which a per claim cost is developed: age at the time of disability, the number of dependents and their ages, and life expectancy of all beneficiaries; 3) inflation and discount rates used to calculate the present value of benefits; 4) medical costs over the life of the claim; 5) the percent of claims that the National Council assumes will be approved under state workers' compensation programs; and finally, 6) the average annual wage for an underground coal miner in 1977.

The issues to be examined concentrate on the "pure premium" portion of the manual rate. The expense-loading factors used to estimate administrative and adjudication expenses and the contingency loading factor of five percent are not questioned here. Traditional calculations for expense-loading factors cannot be expected to apply to the black lung program, where claims adjudication is done by the U.S. Department of Labor. However, legal expenses in contesting approved claims might be considerably higher, but these have been incurred by coal mine operators rather than insurance companies. Insurance rates for black lung risks also differ since premium discounts and experience modifications applied to other workers' compensation insurance premiums are not applied to black lung rates. The National Council does use a different expense-loading factor for black lung rates--1.198 as compared to 1.56 used for traumatic injury rates. This essentially means that the National Council estimates that 16.5% of the premiums collected will be used for administrative expenses rather than the 35% estimated for expenses for traumatic injury risks.[10]

The frequency base used for black lung rates is derived from a combination of NIOSH study results involving 9,000 miners from 31 mines in 1971 and 10,785 miners from 44 mines

TABLE XX. FREQUENCY OF SUCCESSFUL CLAIMS AND AVERAGE AGE OF CLAIMANT

Age Interval	Distribution of Miners	Frequency	Distribution of Claimants	Middle Age of Interval
0-19	199	.00000*	0	--
20-24	1,940	.00010*	0	22.5
25-29	2,191	.00013*	0	27.5
30-34	1,765	.00067*	1	32.5
35-39	1,396	.00134*	2	37.5
40-44	1,646	.00607*	10	42.5
45-49	2,464	.01303*	32	47.5
50-54	3,041	.02339*	71	52.5
55-59	2,920	.03462*	101	57.5
60-64	1,571	.12799*!	217	62.5
65-69	213	.25000!	53	65.7
70+	44	.25000!	11	74.0**
Total	19,390		498	
Frequency				.0257
Age of Claimant				59

*Derived from NIOSH study

!Assumed rate

**Weighted average based on distribution of active coal miners.

Source: Rate Filing Memorandum, National Council on Compensation Insurance, February 1977.

in 1975 and an assumed rate of 25% for miners over 60.[11] These rates combined with data on the age distribution of miners gives a frequency rate of .0257 and an average age of 59 for a coal miner at the time of disability. (Table XX.) Though some criticism can be made, this approach is an ingenious solution to the problem of estimating the incidence of black lung risks. Specifically, the incidence represents both the actual risks of black lung disease and the claims that will be approved as a result of legal presumptions used in adjudication. The NCCI uses NIOSH prevalence rates derived from a small population of miners to describe a much larger population which in fact may have different characteristics in age distribution, length of exposure and other key factors. Faced with no alternative for reliable data, the use of NIOSH rates is justifiable. Second, a more serious criticism can be entered by noting that the National Council uses frequency distributions for miners by age using the miners in the NIOSH study. Hence, the distribution by age of Colorado miners is not represented, an important factor in the number of approved claims an employer can expect. This flaw in rates aggravates the already biased distribution of costs of a program which primarily benefits Appalachian coal miners. Specifically, frequency rates developed on nationwide studies are used to determine Colorado rates.

As part of its methodology, the National Council uses the assumption that 50% of approved claims will be approved under the state's workers' compensation program. In fact, according to SDS, no Colorado black lung claims were approved for benefits although in 1976 and 1977 a small number of claims was filed. A review of the calculations of black lung rates (Table IV) shows that the dollar impact of this assumption is to increase benefit estimates by $1,000-- a minor impact contributing some 24¢ to the manual rates. Conceivably, this small amount could be defended by the National Council as necessary to cover the possibility of state programs assuming responsibility for the federal program.

Assumptions about the miner/claimant's age at the time of claim approval are derived from the estimate of frequency discussed above. Additional assumptions are made by NCCI about a miner's marital status and number of dependents per methods calculating pension or life insurance benefits. A complete description of these assumptions can be found in Chapter IV. Several of these assumptions can be questioned, however. For example, Department of Labor statistics for the black lung program indicate, however, that the number of active claims for survivors is higher than NCCI assumptions would support. As of 30 December, 1980, the average number of beneficiaries per claim was 1.7, while 35% of all payments were to claims for survivors as the primary beneficiary.[12] Further, this percentage is increasing according to a 1980 article in the Social Security Bulletin.[13] The 1981 amendments to the Black Lung Program, which are expected to reduce the number of approved claims for the current work force, will accelerate this trend. Since benefits are paid according to the number of beneficiaries up to the total of one primary beneficiary and three dependents, the cost per claim for a 62-year-old miner with a 59-year-old spouse was $248,000 in actual costs with benefits escalated at 7% a year. For a widow 59 years old, the costs per claim were only $180,600.[14]

In evaluating the impact of law amendments on injury costs, the National Council estimated inflationary increases at 6% a year, then discounted the costs at 3.5% in its present value calculations resulting in a constant dollar rate of return of - 2.3%.[15] Critics have contended that inflation rates before 1976 did not support such a high estimate of inflation while the discount rate to estimate net income from premium dollars was unjustifiably low.[16] In developing black lung rates for Colorado, the National Council adjusted these rates by inflating benefits at 6% a year for the first four years of benefit payments and using benefit costs for the fourth year for all remaining years of expected disability.[17] It continued to use the 3.5% discount rate to estimate expected return on investment of premium dollars, however. As a result, escalated dollar rate of return is more favorable for years 5 through 20, at approximately 9.7%. Actual inflation of benefits from 1978 to 1980 averaged 9% a year, proving that the National Council was conservative in choosing a 6% inflation rate. The fact that the first four years of benefit payment has such a low rate of return, however, exaggerates the present value of benefits and will affect the manual rate developed.

For medical costs, these shortcomings are even more pronounced. Annual medical costs per claim in 1977 were estimated at $325, giving a total cost of $7,100. This is in contrast with present value calculations for indemnity benefits where inflationary trends are calculated only for the first four years and the life expectancy of the miner for whom medical costs would apply is only fifteen years. In addition, the comments about the increases in the percent of benefits being paid to survivors would also affect medical cost estimates, since the medical cost per claim would not be incurred in claims for survivors. The Department of Labor data confirm that medical costs should be lower than the National Council estimates. Medical costs in 1978 were only 1.5% of total benefits paid and 2.6% in 1980.[18] By contrast, present value of medical costs according to National Council estimates are 10.1% of total benefits paid.

In NCCI rate development, (1) the present value costs (indemnity plus medical) are added together, 2) the 50% assumption rates applied to the present value estimates for combined state and federal benefits and for federal benefits only, 3) rates are inflated for administrative expenses, and 4) the frequency rate is applied. The resulting amount is then compared to the average annual salary in 100s of dollars for an underground coal miner. (See Table X.) The annual wage used in 1977 calculations was $14,000, the approximate wage of a coal miner in a Grade 1 classification (the lowest of five grades in union mines) according to 1977 wage agreements in Colorado mines. This is a conservative estimate of average annual wages when compared to the $19,000 reported in 1977 Colorado Division of Labor data for all miners in strip and underground coal mines in the state. This estimate includes overtime work and part-time workers.[19]

If these calculations are reassessed at 1977 levels (since the result is a ratio of costs to payroll and can be expected to remain constant) with some adjustments, a reduction in rates results. (Table XXI.) In this recalculation of rates, the following changes are made: 1) all claims are approved through the federal program; 2) no inflation of benefits and medical costs is applied and the discount rate is 3.5%; 3) and average annual salary is estimated at $16,000 instead of $14,000. The benefits at 1977 levels are $2,465 for one beneficiary and $3,697 for two beneficiaries. Medical costs are calculated at $325 per year. A rate of return on premium dollars of 3.5% over inflation can be considered reasonable since net return on investment for any successful business can be expected to outstrip inflation. The resulting rate as shown in Table XXI is $10.20.

Other assumptions and data used by the National Council are unchanged despite the need of further investigation in the frequency rates and age distribution characteristics of underground coal miners in Colorado and on the assumptions about average age of a miner and his spouse. These investigations could affect manual rates even further, as illustrated in Table XXII, where the additional adjustment is made in the average age of the miner and his wife. In these calculations, the miner is assumed to be 62, his wife, 59, and expected life of the claim to be 12 years for benefits paid to the miner and his wife and 5 years for the widow. This implies a change in frequency rates but to assess the impact of changes in assumptions and because no data on age distributions of Colorado miners were available to this paper, the frequency rate is not changed. The manual rate that results is $9.35.

TABLE XXI. DERIVATION OF OCCUPATIONAL DISEASE RATES FOR COLORADO UNDERGROUND COAL MINES WITH ADJUSTMENTS IN PRESENT VALUE ESTIMATES AND IN ANNUAL AVERAGE SALARY

Present value of indemnity benefits for miner and spouse	
3697.20 $(P/A_{3.5,15})$ =	$42,621
Present value of indemnity benefits for widow	
2,464.80 $(P/A_{3.5,3})(P/F_{3.5/15})$ =	4,134
Present value of indemnity benefits	46,755
Present value of medical benefits	
325 $(P/A_{3.5,15})$ =	3,747
Present value of all benefits	50,502
Portion of premium required for expenses	.165
Expense loading: 1.000 (1.000 - .165)	1.198
Present cost per case (50,502 x 1.198)	60,501
Frequency	.0257
Per capita annual charge (60,501.30 x .0257)	1,554
Average annual salary in 100s	160
Basic rate (1554.90 160)	9.72
Contingency loading factor	1.05
Occupational disease rate for underground	
coal mine risks (per $100)	10.20

In any event, for risk managers representing coal mining operations with a large work force, the NCCI structure for estimating future costs can be of value in assigning frequency rates and in developing a per claim cost. The data necessary for calculation of estimates of future liability are readily at hand and can be adapted to meet the firm's own situation. Additionally, changes in basic assumptions can provide the framework for a type of sensitivity analysis.

TABLE XXII. DERIVATION OF OCCUPATIONAL DISEASE RATE FOR COLORADO UNDERGROUND COAL MINES WITH ADJUSTMENTS IN AVERAGE AGE OF BENEFICIARIES, IN PRESENT VALUE ESTIMATES, AND IN ANNUAL AVERAGE SALARY

Present value of indemnity benefits for miner and spouse 3697.20 $(P/A_{3.5,12})$ =	\$35,750
Present value of indemnity benefits for widow 2,464.80 $(P/A_{3.5,12})(P/F_{3.5.12})$	7,379
Present value of indemnity benefits	43,130
Present value of medical benefits 325 ($P/A_{3.5,12}$ =	3,143
Present value of all benefits	46,273
Portion of premium required for expenses	.165
Expense loading: 1.000 (1.000 - .165)	1.198
Present cost per case (46,273 x 1.198)	55,435
Frequency	.0257
Per capita annual charge (55,435 x .0257)	1,424
Average annual salary in 100s	160
Basic rate (1,424.70 160)	8.90
Contingency loading rate	1.05
Occupational Disease rate for underground coal mine risks (per \$100)	9.35

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CHAPTER VI

SUMMARY AND RECOMMENDATIONS

The costs of occupational injuries and how to insure those risks have been familiar issues for the underground coal industry since the inception of workers' compensation programs in the early 1900s. The industry has been the focus for many of the changes in work injury laws and has sought out programs to insure the risks created. Over the 70 years of workers' compensation programs, insuring of most work injury risks has become a routine and predictable business expense. A large portion of work injury losses are expected losses, and the real risk is represented by serious injuries or injuries resulting from unfamiliar hazards. The coal industry's experience with the black lung program in particular has brought to light many issues in insuring a changing and unfamiliar work injury risk. Many of these issues are still unresolved. For example, legal questions about new approaches in awarding compensation benefits and in assigning financial responsibility for the claims are among the most important and difficult of issues to be resolved. Concurrently, risk assessment and insurance for work injuries are important practical considerations.

In this thesis background research found that Colorado underground coal firms can insure occupational injury risks either through third-party insurers (private or state) or by self-insuring risks. However, the CSIF is an important option for covering state workers' compensation risks. The costs of insurance through third-party insurers after adjustments for experience modifications and premium discounts is $7.00 to $15.00 per $100 of payroll (the difference accounted for by accident experience) for state workers' compensation risks and an additional $13.06 for federal black lung risks. The $13.06 for federal black lung risks through third-party insurers is misleading. The true rate for black lung risks through private insurers is $16.15 but in development of black lung rates NCCI assumes $4.68 of the $16.15 will be required to cover claims approved under state workers' compensation programs. This assumption has not been supported by program experience. What results for coal mining firms which insure state risks through the CSIF and black lung risks through private insurers is a kind of double payment in coverage of black lung risks. Specifically, CSIF includes in its occupational disease rate the risk of black lung claims approved under state laws and in addition the risk that the federal black lung program will become a responsibility of state workers' compensation programs.

Self-insurance for both state work injury and black lung risks can be 35-45% less than through third-party insurers. These cost savings are available primarily to large coal mining firms. By Colorado statute, only firms with greater than 300 employees can self-insure work injury risks if other requirements concerning financial stability are met, while the U. S. Department of Labor reports that only the nation's largest corporations have qualified for self-insurance of black lung risks.

Alternatives to insure both work injury and other difficult risks are evolving. Discussed in this paper are captive insurers who insure risks at a cost and tax advantage. Captives can act either as a subsidiary company of a single corporation or for an association of companies. As attractive an option as captive insurers could be for smaller coal mining firms, Colorado laws limit its use. Specifically, Colorado permits the arrangement only for associations formed for purposes other than captive insurance formation and requires the associations to have been in existence for at least one year. There is only one captive insurer in Colorado that represents coal mining firms.

The Black Lung Revenue Act allows a firm to establish a trust fund as a part of a self-insurance program. Contributions to the fund are tax-deductible and investment income from the fund is tax-free. However, the money invested in the fund can be used only for black lung claims, administrative expenses, or insurance premiums, and any excess contributions go into the Black Lung Trust Fund. This innovation could lead to legislative amendments allowing self-insurers to deduct from taxable income an estimated liability for future claims in the same manner insurance premiums (paid for future liabiity) are tax-deductible.

At the state level, many states have amended their laws to allow pooling of risks by firms under self-insurance programs. Colorado allows self-insurance pools for local and county governments but not for private industry. The Colorado Division of Insurance, which has no authority over self-insurance but regulates practices of commercial insurersss snd opposes extending self-insurance pools to private industry. In fact, the Colorado authority urges stiffer regulations for existing self-insurance programs to ensure adequate reserving practices and estimation of potential losses.

Many of these changes in self-insurance regulations are allowing more firms to determine what part of work injury risks they wish to retain. For the coal industry, as a hazardous industry, a large share of work injury costs is expected costs and the real risks are losses for severe (costly) injuries or risks that for other reasons are difficult to assess. Further development in insurance options that allow firms to reinsure special or extraordinary risks but retain a portion of the risk as an expected business expense would most likely benefit the coal industry.

Small underground coal mines in Colorado, however, do not have flexibility in insuring work injury risks. Because of insurance regulations and practices by private insurers, state workers' compensation risk for these firms must be insured through CSIF and black lung risks through private insurers. An additional handicap imposed by these limitations is that there is some overlap in coverage for state black lung risks. Many small coal operators faced with high costs choose not to insure either work injury or black lung risks at all.

The other aspect of insuring work injury risks is estimating losses. For the underground coal industry, losses have characteristics similar to work injury losses of other industries but with higher average and total costs. For all insurers, these are average risks with recognized techniques to evaluate potential liability.

As workers' compensation laws change, industries face an additional risk, not only in increasing costs but also in the expanded coverage of injuries. The traditional division of work injury risks has been into occupational diseases and traumatic injuries. However, for risk assessment, these distinctions do not work. First, definitions of occupational diseases vary significantly. Further, many occupational disease risks behave in terms of costs like traumatic injury risks while traumatic injury risks are changing into a less predictable risk. Injuries associated with repeated trauma are an example where the result is a familiar injury usually associated with a single incident. A more workable division for risk assessment is whether loss experience is an adequate predictor of future costs, or if losses must be inflated by some factor to cover influences that are not easily measured. There is evidence of this kind of risk in the Colorado underground coal industry. This does not occur in occupational disease risks but rather in sprain and strain injuries and in injuries to the trunk of the body, most of which involved the back. These categories of injuries nationwide increased as a percentage of total injuries over a fifteen-year period with costs per injury registering above average costs. Research studies show that these injuries do not replace occupational disease risks, but rather are in addition to them. Many experts claim the health impacts of occupational diseases are still unrecognized and may in future years become an established part of work injury risks with significant costs attached.

Insurance rating bureaus use a number of techniques to inflate losses to prepare for the risks described. Adjustment for law amendments to state workers' compensation programs or trend factors to assure that loss experience remains a constant percent of premiums collected are the most notable examples. These evaluative techniques work for an insurer interested in estimating losses for rate development but are not effective for risk managers wanting to control costs. For risk managers, whether the risks are self-insured or insured through third-party insurers, using total losses alone means forfeiting opportunities for more effective safety and cost control programs. Several evaluative techniques, while not fully developed, do exist to describe essential characteristics of these risks. Whether more reliable techniques to assess these changing risks can be developed is uncertain. The perception, probably a sound one, is that these risks represent a transition stage in upgrading workers' compensation laws and that eventually costs will again be a stable part of payroll. However, the potential for sizable increases in costs exists, especially in compensation of disabilities resulting from a mixture of causes, including natural aging processes, from increases in benefits paid, or from application of cost-of-living increases to claims for long-term disability.

The underground coal industry experience in the black lung program is an example of how special circumstances and changing attitudes can affect occupational injury risks. The laws developed for black lung may in fact serve as a model for future laws to compensate specific conditions at the state or federal level. Use of presumptions of disability are gaining wider acceptance for adjudication of occupational disease claims.

The assessment of black lung risks for insurance rates required a new approach. NCCI, in developing the framework to calculate black lung rates, combined assumptions about the "average" successful claim with known data on the costs of claims, life expectancy of beneficiaries and incidence of black lung. Rates now in effect for Colorado black lung risks were developed in 1977. In the five-plus years that have elapsed, an accumulation of data should allow reassessment of black lung rates, even though significant changes in the program have occurred. Specifically, the 1977 amendments expanded eligibility for benefits and the 1981 amendments that followed removed many of the presumptions of disability as defined by the 1972 and 1977 amendments. Research for this thesis found evidence that certain assumptions used in rate making are not supported by available data and that discount rates used in combination with inflation of benefits lead to high estimates of benefits as compared to payroll. Frequency data for the incidence of black lung relies on nationwide studies and NCCI has not adjusted these statistics to reflect Colorado conditions or experience. Age distribution of Colorado miners is probably the most important factor excluded by NCCI, which instead used the age distribution of miners studied by NIOSH.

Calculations done in this paper with changes in assumptions, use of the same discount rate but without inflation of benefits, and substitutions of data indicated that black lung rates for Colorado could be reduced. Effectively, this would be from $16.15 per $100 of payroll to a rate of $10.20. Further reductions might be possible if more data about age distributions of Colorado miners and average age of claimant were available. Seemingly, this may appear as a criticism of data and assumptions used by NCCI in development of rates. However, the calculations used provide a straightforward approach to assess black lung risk and estimate the potential number of claims. Self-insurers of black lung risks can similarly substitute data and reflect the firm's assumptions about inflation of benefits and discount rates to be used and to apply frequency rates developed on the current work force.

The recommendations made by this paper touch many of the parties involved in insuring work injury risks. These parties include NCCI, the insurance industry, the employer, regulatory agencies such as the U. S. Department of Labor, the Colorado State Industrial Commission and the Colorado Division of Insurance. Changes recommended could have important implications for coal mining firms seeking to reduce work injury costs and especially so for small-to-medium-sized firms.

The first recommendation deals with insurance options offered to coal mine operators in Colorado. As discussed, while a number of options are available to larger firms to insure both state and black lung risks, many small firms have essentially no choice. For example, small firms must accept some overlap in coverage for black lung risks. Captive firms have offered an alternative for firms joined in a recognized association. However, this method of pooling of risks, an attractive alternative to third-party insurers, is not available under state laws and not widely practiced to insure black lung risks. Consequently, this paper recommends that investigations be made into self-insurance pools similar to the arrangements allowed for local and county governments at the state level. Also, further investigation is warranted into the reasons discouraging use of self-insurance pools for black lung risks under the U. S. Department of Labor. The Colorado Division of Insurance opposes self-insurance pools for state risks and their criticisms may be justified. In fact, tighter regulations for self-insurers may make it possible for self-insurance pools to operate effectively and for firms to hire competent firms to manage pooled risks.

This paper's second recommendation is closely related to the suggested investigations into self-insurance regulations. Research for this thesis suggests that self-insurers are lax in evaluation of losses and use of predictive techniques to estimate losses. Given this, mismanagement of work injury risks is a prospect, where a self-insured firm could face severe losses because a risk is underinsured. Also, adequate evaluation of insurance alternatives in terms of relative costs is not possible, and cost data cannot be used to complement safety programs. If tighter regulations for self-insurers are instituted, better underwriting practices would be a natural consequence. The trend toward risk management positions in many large firms is another possible development.

Rating bureaus and risk managers often suffer from lack of consistently used techniques for risk assessment. This is especially true in the areas of occupational disease and expanding work injury risks. There are two basic reasons for this shortcoming. First, changes are often complex and result from a number of factors; second, changes are typically perceived as a temporary stage as workers' compensation programs are improved. These changes have occurred over a ten-year period, however, and are far from resolved. For risk managers, work injury losses during that period represent an on-going risk that needs to be evaluated. To date, NCCI's trend factors and law amendment adjustments appear to be the most successful in assessing losses for rate-making purposes. However, these adjustments are difficult for self-insurers to use. The emphasis for self-insurers is on a cost per claim using in-house data. In contrast, NCCI's adjustments are applied to total losses for a number of firms and over a number of years. Many self-insurers now use a number of techniques or methods to evaluate risks. Included in this approach are computerized programs which evaluate work injuries. In general, managers seek to analyze frequency distributions and compare claims representing similar kinds of injuries. Statistical techniques are employed in varying degrees of application.

The final recommendation of this paper is that reassessment of black lung rates for Colorado is in order. In particular, changes in assumptions and data used in rate development need to be tailored to Colorado risks. The thesis also finds the inflation in combination with a low discount rate of 3.5% leads to an unjustifiably high estimate of benefits; hence, the suggestion of a minimum discount rate of 3.5% used with no inflation of benefits. These changes will result in lower black lung rates, a welcome relief for firms not able to self-insure.

In summary, this paper finds that insurance of work injury risks is particularly costly for small-to-medium-sized firms. However, changes are possible in several areas to offer these firms more choices in effective management of work injury risks. Firms with greater than 300 employees in contrast have a number of options but often do not make effective use of evaluative techniques to compare insurance costs. Effective management of work injury risks offers more than cost benefits, as firms can once again integrate the costs of injuries with safety programs.

APPENDIX

DESCRIPTION AND LIMITATIONS OF DATA

This appendix examines three sets of data used to estimate injury costs for this paper. It describes each set of data according to 1) purpose for collecting and analyzing data; 2) how injuries are defined and categorized; 3) the populations covered; 4) how data are analyzed and injury costs are developed; and 5) the limitations of each data source. In addition, accident data from MSHA are examined according to the same criteria. Two purposes are served by this careful scrutiny of data sources. First, some insight into the reliability of data used in this paper is possible. Second, the data from public sources can be evaluated for their effectiveness as a tool to estimate injury costs when used by an individual firm.

NCCI Data

The NCCI, as a rate-making agency, collects loss data from third-party insurers. In this paper, the data are for Colorado underground coal mine risks for the period from September 1, 1970, to August 30, 1975, escalated to 1978 benefit levels. The NCCI develops the portion of the manual rate representing losses (called the pure premium) by using data from three categories. These categories are serious injury losses (as defined by the cost per claim), nonserious injury losses, and medical costs. Losses from each of these categories are compared to reported payroll and the sum of these ratios equals the pure premium per $100 of payroll. The rate filing memorandum that was used as a source in this paper supplies the number of claims for indemnity costs but not for medical costs. As a consequence, per injury cost estimates are possible only for indemnity costs, not for medical costs.[1]

SDS Data

The most complete set of data used in this paper is from a computer printout provided by the Colorado Division of Labor's Supplementary Data System. The completeness of this source results from its purpose: to provide public administrators, researchers and insurers with a detailed body of data about workers' compensation costs. The printout used here lists all injuries for underground coal operations as reported by employers for the years 1976-1980. Cost data are supplied by the insurer for closed claims only (i.e., claims that are paid off with no benefits due). However, information about injuries, the insurance method used, the injured miner, and the location of the mine are available for all reported injuries. Severity of each injury is defined according to ten categories of injuries. These include denial of benefits, claims for medical costs only, temporary total disability, fatalities and all other categories describing some degree of permanent disability.[2]

Medical costs are available on a per injury basis, in contrast to NCCI data where only the total amount paid amount paid out for medical costs is available. The reason for this is that self-insurers and sometimes third-party insurers do not consistently report medical costs for injuries because medical treatment is provided by company-run facilities.

<u>COIM Data</u>

The U. S. Bureau of Mines Cost of Injury Model uses a computer model to calculate per injury and total costs using data as provided by MSHA. The primary purpose of the COIM is to serve as a safety tool for employers. By pinpointing the kinds of injuries which are causing the highest losses, managers can direct safety efforts accordingly. Although the COIM strives for accurate per injury costs, it is more interested in the accuracy of relative costs; that is, in the accuracy of the costs of one type of injury in comparison to another. Costs for various medical treatment scenarios and for benefit payments based on each state's compensation laws are stored in computer files. These files are then drawn on to assign costs to each injury report entered into the model. The information to be entered into the model includes 1) marital status, age, and number of dependents of the injured miner; 2) the nature, cause, and severity of injury and the period of disability; and 3) the state where the injury occurred. The severity of injuries is broken into seven categories: fatalities, permanent disability, temporary total disability, temporary total disability and restricted duty, restricted duty, no days lost, and illness. COIM data are available on a state-by-state basis and include all underground operations within a state.[3] Data used in this paper are 1978 data for Colorado mines in order that they be comparable to data from other sources.

Limitations of Data

Imperfections exist in each set of data. The most noteworthy deficiency in NCCI data as far as this paper is concerned is the lack of information about individual injuries. The data concentrate on total costs, which are important in developing insurance rates but are inadequate for developing per injury costs or costs for specific kinds of injuries. Further, total costs mask changes in injury risks that may be taking place. Examples of these changes are trends in severity rates or shifts in the kinds of injuries reported. The SDS data, on the other hand, are available on a per claim basis and include other information about the claim besides costs. This detail could prove valuable to an individual firm seeking to integrate safety and insurance functions or desiring more detailed cost information in predicting future costs. However, although the SDS data are more useful to individual firms than are the NCCI data, the flaws are also more apparent. One of these flaws is that costs per injury have been recorded on the SDS only since 1976 and are based on closed claims. As of April 1982, these closed cases accounted for only 50% of reported claims for the period 1976-1980. Cost data for 1976 and 1977 are based on an even smaller percent of reported claims. As a result, a disproportionate share of claims are classified as injuries with some degree of permanent disability. For example, 11 of 19 injuries in 1976 and 18 of 29 in 1977 are classified as causing permanent disability.[4] In contrast, SDS data in more recent years do not include the most costly of claims since those involving long-term disability are not yet closed cases.

The short history of data collection does not provide sufficient cost data to establish trends in yearly costs or to estimate costs for serious injury claims in correct proportion to costs for nonserious injuries. The NCCI surmounts this problem by devloping current rates on cost data that are four to ten years old, updated to current benefit and wage levels. The risk that factors to adjust cost data are inaccurate is offset by the completeness of the data.

The data supplied by the COIM avoid some of the problems encountered in using actual cost data but has imperfections of its own. Since cost data are estimated by a computer model, all costs are generated immediately. As a result, there is no lag in obtaining costs for serious injuries. Computer-generated data also avoid bias in reporting of costs by insurers or employers. The disadvantage is that estimates rely on very complex assumptions in the model about medical costs, benefit payments for each state, and severity of injury to estimate total costs. This paper, in fact, makes one adjustment to COIM data. In 1978, the model estimates that indemnity costs in Colorado for two fatalities are zero, when in fact the minimum payment for any fatality, if there are no dependents as defined by state laws, is $15,000, paid to the state's second injury fund. This payment is not an indemnity payment in the strictest sense of the term, but for the insurer is a cost comparable to true indemnity payments.

MSHA Accident Data

MSHA keeps injury statistics for all states for both underground and surface operations. This task was administered by the U. S. Bureau of Mines until 1970 and by the Mining Enforcement and Safety Administration (MESA) until 1976. The units of measurement for work injuries are incidence and severity rates. Incidence rates measure the number of accidents per 200,000 man-hours of exposure (approximately 100 full-time employees) while severity rates measure the number of days lost per 200,000 man-hours of exposure. Average severity rates are defined as the number of days lost per injury.[5] These measures are roughly comparable to ratios of losses to payroll used by rating bureaus or risk managers. For example, MSHA severity measures are similar to the pure premium of manual rates which compares total losses to total payroll. In a similar manner, average severity rates are comparable to an average cost per claim.

The strengths of MSHA data result from many years of data collection and analysis. The statistics are therefore complete enough to describe trends in injuries. As such, it can be a valuable tool to supplement cost statistics, possibly identifying changes in injury risks that cost data do not. However, methods of defining and measuring accident data have changed during the history of MSHA and its predecessors and comparison of accident statistic among different years must be done with caution. The most important of these changes is the switch from frequency rates, based on 1,000,000 man-hours of exposure, to incidence rates as described above. This switch also affects severity rates. Other changes include the addition of categories of injuries for nondisabling injuries, increased attention paid to collection of occupational disease statistics, and refinement of injury classifications.

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