

INTERNALIZATION OF SOCIAL COSTS
AND THE VALUE OF THE FIRM:
A DESCRIPTIVE EMPIRICAL STUDY

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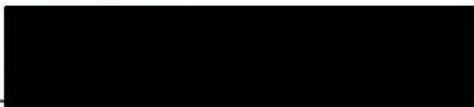
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A DISSERTATION

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and the Graduate School of the University of Oregon
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for the degree of Doctor of Philosophy

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APPROVED:

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Pressures building in the late 1960's and early 1970's led to the enactment of legislation effectively constraining firms to internalize social costs of pollution. The questions addressed in this dissertation are whether: a) investors' responses to these constraints reflected new off-balance-sheet liabilities; and b) investors made significant use of subsequently disseminated information about the liabilities.

The capital asset pricing model was used to analyze the theoretical effect of the pressures. The analysis predicted a decline in the equity values of the firms, viewed as new off-balance-sheet debt equal to the present value of the social costs to be internalized. Also predicted was an increase in systematic risk. Subsequent information about the liability was characterized as potentially having a "disclosure" and/or a "regulatory" effect. Any regulatory effect would be identical in nature to the effect of the pressures leading to the earlier legislation.

An extended market model, controlling for autocorrelation and non-synchronous trading, was used with daily data to observe price and risk changes. The main experimental group consisted of firms included in reports on the firms' "social (environmental) responsibility" published by the Council on Economic Priorities (CEP). Four test periods were identified that contained events (social pressure events) hypothesized to have significantly increased the probability that firms would be effectively constrained.

Test results, showing associations of the social pressure events with increases in systematic risk and decreases in prices, were consistent with the hypothesis that significant off-balance-sheet liabilities resulted from the pressures. Additional tests for associations of the release of the CEP reports with changes in the systematic risk of firms reported on were inconclusive. Results of tests performed for additional experimental groups of firms, not included in the CEP reports, provided limited support for there having been a regulatory effect of the reports.

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dedicated to
The Sweetest Rose
and to my lovely wife
Sharon

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CHAPTER I

INTRODUCTION

The following quote taken from a recent article (January 24, 1982) in the Albuquerque Journal sets the stage for the research that follows.

...the Clean Air Act of 1970 is considered the nation's most important, complex, and far-reaching piece of environmental legislation. . . Because of the Act's scope, industry has resisted its regulations, which it claims have cost billions of dollars. The Environmental Protection Agency has estimated the cost of complying with the Act at \$291.6 billion in 1977 dollars for the period between 1970 and 1986. One industry sponsored report put the cost at \$414 billion.

The passage of the Clean Air Act Amendments, referred to above, on December 31, 1970, marked the culmination of the initial surge of an environmental movement, characterized by social pressures calling for the internalization by firms of the social costs of pollution. The term social cost is used in this dissertation as it was by the 1974 American Accounting Association Committee on Measurement of Social Costs. There, it was defined as the first order (negative) effects of an organization's activities on society, and it was specifically pointed out that the term was not used in the traditional economic sense of pareto optimality.

The interest of the investment community was apparently aroused by this phenomenon of increased pressures on firms to control pollution.

An analysis of the Wall Street Journal Index counted 45 articles dealing with environmental issues in 1968, 94 such articles in 1969, and 323 in 1970. In spite of the energy crisis and two recessions in the last 12 years, public pressures for corporate internalization of social costs of pollution has apparently not waned. Quoting again from the article in the Albuquerque Journal,

Testifying before the House in October, (Lou) Harris said that 80 percent of those surveyed in a mid-summer poll opposed any relaxation of the Clean Air Act. 'This message is one of the most overwhelming and clearest we have ever recorded in our 25 years of surveying public opinion,' Harris said. 'Clean air happens to one of the sacred cows of the American people.'

The general question addressed in this dissertation is whether the economic consequences to investors of phenomena such as the one just described are sufficient to warrant consideration of the classification, measurement, and inclusion of those consequences in financial reports. More specifically, when society recognizes a social cost and then demands the internalization of that cost by firms, is there an effect on the equity values of the firms sufficient to be evident of investor interest? This study will attempt to characterize this effect and assess its significance to investors. In particular, empirical evidence will be provided concerning the issue of whether a measurable off-balance-sheet liability arose for firms in the period of pressures leading to the Clean Air Act Amendments of 1970.

Additionally, there will be an evaluation of the significance to investors of information subsequently disseminated concerning the performance of firms in fulfilling their obligations under the law to inter-

nalize the social costs. This information is contained in seven reports published by the Council on Economic Priorities (CEP), and is the best surrogate available for externally-audited social accounting information. As it is defined in this study, social accounting information evaluates the effects of constraints on firms to internalize social costs, and the abilities of the firms to operate within those constraints. The degree to which they operate within the constraints then defines their social performance. The expressed purpose of the CEP is indicated in the book (CEP [1972]) containing the first CEP report.

The CEP was founded two years ago to research the practices of such decisions (those made by corporations concerning their posture toward pressures to internalize social costs), to develop criteria for evaluating socially responsible performance, and to define in detail which corporations have the most responsible records. With such information available, concerned Americans could evaluate the impact of industries and individual companies on their own lives and provide pressure or encouragement - in their roles as consumers, stockholders, business men and women or students - for a greater degree of social responsibility.

Thus, the CEP was certainly not without bias in their objective, however their reports have been generally regarded with respect for the care taken to present factual material. For example, Time Magazine (December 28, 1970), in a review of the first CEP report, gave the following description of the CEP and their reports.

. . . the CEP report is as dry and statistic laden as a stock prospectus . . . Now, the CEP has about 800 subscribers for its regular research publications - including banks, investment houses, foundations, universities, and more than 40 corporations. . . .Borrowing the methods of securities analysts, the Council's staff of 20 interviews company officials, spot checks the results for accuracy (both in the field and with

outside specialists) and then compiles its surveys. . . It's philosophy is just to present unadorned, hitherto unavailable facts.

The first of eight corporate environmental performance reports published by the CEP was a 400-page study of the 131 mills of the 24 biggest pulp and paper producing companies. The second report covered the 124 fossil-fuel plants of 15 electric utility companies, generating 25 percent of the nation's power. The third report was a follow-up to the first, evaluating the improvement of the pulp and paper companies over the year and a half since the first report's publication. The fourth report covered the 47 mills of the nation's seven largest steel companies. The fifth and sixth reports surveyed the environmental performances at 61 of the 69 refineries of the eight largest oil companies (these were companion studies issued at about the same time - only the first will be used in the analysis that follows). Finally, the seventh and eighth environmental reports of the CEP were follow-ups to the earlier steel and power reports, respectively. Each of these eight reports were widely publicized by summaries in either the Wall Street Journal or New York Times or both at the time of their publication. A question to be addressed is whether the information in these reports was used by investors to reassess off-balance-sheet liabilities (to internalize social costs of pollution) that may have arisen for the firms reported on pursuant to the pressures described earlier in this chapter.

This dissertation is organized as follows. The next chapter provides a review of the subset of the social accounting literature that relates to the potential usefulness to investors of social performance information. In the context of the literature reviewed, research issues

will be raised and the questions to be addressed in this project will be specified. The third chapter will apply a well-known equilibrium theory of capital asset prices to predict and characterize the effects on investment decision parameters of pressures on firms to internalize social costs and of subsequently disseminated and related social performance information. The fourth chapter develops the statistical methodology, using an efficient markets framework, needed to empirically evaluate the significance of the effects predicted in Chapter III. The fifth chapter formally develops hypotheses, specifies the experimental design, and reports empirical results assessing the significance to investors of events hypothesized to have significantly increased the probability that effective constraints for controlling pollution would be institutionalized. The sixth chapter gives the hypotheses, experimental design and results for tests of the significance to investors of the information released in the CEP reports. Finally, the concluding chapter provides a summary of the research with the major implication, presents limitations, and suggests avenues for further research.

CHAPTER II

LITERATURE REVIEW

This chapter reviews the subset of the social accounting literature relevant to this research project. With reference to American Accounting Association committee reports on the subject of social accounting and to normative research in the area, three inter-related research issues are raised in the first section of this chapter. Some of the empirical work on one of the three questions, not specifically addressed here, is also reviewed in the first section. The second and third sections review the empirical work on the usefulness to investors, in the aggregate, of social accounting information produced outside the firm and produced voluntarily by the firm, respectively. Finally the last section summarizes the research questions to be addressed and describes the relationship of this project to the literature reviewed.

The Research Issues

The American Accounting Association (AAA) appointed committees in the years 1973-1976 that studied and reported on the issue of whether accountants should get involved in the external reporting of social costs associated with the activities of a firm and/or the degree to which those costs have been internalized (AAA [1973, 1974, 1975, 1976]).

The 1974 AAA committee explained the concepts of social cost and social accounting as they are used in this dissertation. The committee specifically pointed out that the term, social cost, was not used in the traditional economic sense of pareto optimality. Rather, it was used to mean the first-order (negative) effects of an organization's activities on society (p. 99). In this dissertation social performance will be defined to be the degree to which a firm has internalized social costs. The committee defined social accounting to be concerned with the "social, human, and environmental constraints on organizational behavior." (Note that social accounting has also been used in AAA [1971, 1972] to describe reporting on the effectiveness of government-sponsored social programs.) It was depicted in the 1974 committee report that the goals (e.g. profit maximization) of the firm did not change but the subgoals did, as a result of constraints such as increased pressures to control pollution. If these pressures were strong enough, it might be in the firm's best interests to control pollution. Then, the degree to which the sub-goal of pollution control was met would be an important piece of information much as is any other information concerning the firm's performance in areas that impact on profit maximization (p. 100). The question of whether social and political pressures to control pollution are a strong enough constraint on corporate activity to warrant consideration of reporting a firm's exposure and performance in this area is an important question addressed in this study.

Efforts have been made by researchers to develop a normative model for social reporting. Examples include Churchill [1974] and Estes [1976] who, with reference to traditional generally-accepted accounting

principles, concepts and objectives, propose frameworks for reporting social accounting information. Probably the major work in the development of a normative theory of social accounting was done by Ramanathan [1976]. His research, like Estes' and Churchill's, called for a broader scheme of corporate performance measurements than profit alone. Ramanathan justified his proposal by reference to the notion of a social contract, expressed or implied, that each firm has with society. The notion was previously developed by Shocker and Sethi [1974]. It states that a corporation's survival and growth are dependent upon two factors: 1) the delivery of some socially useful goods and services; and 2) the distribution of economic, social, or political rewards to social groups from which the firm derives its power. Both aspects of this contract are constantly changing in our dynamic society. Ramanathan states that the purpose of social accounting is to help evaluate how well a firm is fulfilling its social contract.

This dissertation takes the position that the "social, human, and environmental" constraints on organizational behavior referred to in the 1974 AAA committee report can be viewed as part of the firm's social contract. With reference, then, to the 1973 AAA committee report, these constraints may be expressed, in the form of legislated environmental standards, or implied, when more stringent standards are anticipated. The 1973 committee (p. 78) raised a question that is a central issue of this dissertation:

. . . whether or not the imposition of environmental standards creates an unrecorded liability . . . Underlying . . . the question . . . is the more fundamental problem of determining the validity of the 'going concern' assumption . . .

The committee noted that increased anticipation of more stringent standards could result in contingent liabilities for affected firms (p. 107). The classification of any liability resulting from such anticipation as contingent is not at issue in this dissertation. The more general description, off-balance-sheet liability, will therefore be used throughout the study to refer to any unreported liability of the firm resulting from either anticipated or formally enacted environmental standards. The events that result in increased anticipation of more stringent standards can be viewed as also resulting in a change in the firm's social contract. Whether the change is significant enough to warrant consideration of a change in the reporting requirements of the firm is the major empirical question of this study.

Regarding the issue of external reporting of environmental information, the 1973 AAA committee stated that ". . . the central starting point . . . is to identify some of the users, and examine some of their needs for such data" (p. 89). The committee felt that a significant segment of the investor population would find environmental information useful. As an example they cited the Dreyfus Fund that held a portfolio of "clean investments." This dissertation will provide empirical evidence assessing the significance of the demand for such information, where significance will be measured statistically by the degree to which the market, as a whole, reacted when: a) events occurred that would have been likely to increase the probability that environmental standards would be imposed and enforced; and b) information was later disseminated concerning the degree to which firms had complied with those standards. Note that (a) above will also provide evidence as to the

significance of any liability associated with increased anticipation of more stringent standards.

In summary, the questions raised above are:

- 1) when more stringent environmental controls were anticipated, did liabilities of significant magnitude arise for affected firms (i.e. were there significant changes in firms' social contracts?);
- 2) who are some of the specific users of environmental information and what are their needs for such data; and
- 3) how significant is the demand for such information?

To this researcher's knowledge, there is nothing in the literature concerning the first question raised above. Schwert [1981] suggests that in an efficient (with respect to publically available information) market ". . . unanticipated changes in regulation result in a current change in security prices, and the price change is an unbiased estimate of the value of the change in future cash flows to the firm" (pp. 191-122). He goes on to note that the changes are rarely unanticipated and their effects are "impounded into prices at the time when they are first anticipated," and the "main difficulty with measuring the effects of regulatory change . . . is identifying when the market first anticipates the effects of the change . . ." (p. 122). More will be said in Chapter V about how this problem is handled.

The second question, above, will not be addressed in this study. Survey research using questionnaires has been done to determine who uses or would use social accounting information with mixed results. For example, Longstreth and Rosenbloom [1973] polled 196 institutional investors of various types (e.g. banks, mutual funds, insurance companies, and churches). Of the 115 respondents, 66 said they considered social

performance information in making their decisions. Of the 66, 39 said they believed the social performance information to be of economic significance. Based on these results the conclusion is reached that there is a widespread view among an influential set of investors that an association exists between a corporation's social performance and its value as an investment. See Spicer [1978a, pp. 96-97] for a fuller explanation. Justification for this conclusion based on the results is not at issue here. Two studies by Buzby and Falk [1978, 1979] focused on the relevance of nine specific types of social information to mutual fund presidents and university chief financial officers, respectively, for making investment decisions. In the first study it was concluded:

. . . it is our personal opinion that the level of interest (of mutual fund presidents) for . . . the three items listed below (is) high enough to prompt further consideration of them as potential candidates for corporate disclosure.

- Item 1: Involvement in improper or illegal business or political practices.
- Item 2: Pollution of the environment.
- Item 3: Sale of products which are potentially hazardous.

In the second referenced Buzby and Falk study (p. 36) it was concluded that:

. . . a substantial majority of our responding (292 out of 500) universities did not consider the degree of a firm's negative involvement in the nine social activities as variables in their investment decision-making processes . . . respondents had a preference for audited versus unaudited information . . . (and) . . . believe that there is a limited availability of information.

Thus, two of the three studies found at least some interest in social performance information for some subset of the users surveyed.

The third research issue raised above differs from the second in that the focus is not on specific users and their needs, but rather on the significance of the demand for social accounting information to users, making investment decisions, in general. The empirical studies addressing themselves to this issue fall into two general categories: 1) those assessing the usefulness of social accounting information produced outside the firm; and 2) those assessing the usefulness of social accounting information included voluntarily in the firms' annual reports. These two categories of studies will be discussed in turn, and a section concluding this chapter will explain the contribution of this dissertation to the literature.

Social Accounting Information Produced Outside the Firm

There is only limited accessibility to social accounting information produced outside the firm. Thus, sample sizes of studies of the usefulness of that type of information have been small. This has inhibited the generalizability of the results and the power of the statistical tests. The advantages, however, over studies of voluntarily reported social accounting information are that unbiased comparisons across firms and industries are possible and, at least from one source, much more detailed information is available than is disclosed in annual reports. Also the externally produced information ". . . can be viewed as a surrogate for mandated disclosure based on specific reporting standards"

[Shane and Spicer, 1982].

There have been several association tests of the correlations between various measures of investment worth and measures of social performance (i.e. the degree to which social costs have been internalized), derived from the information in the external reports. There has also been one event study where the association of the release of the information in external reports of environmental performance and changes in shareholder wealth was assessed.

Associations of Social Performance with Investment Worth

Three studies in this area used different ratings of firms based on their social performances as reported by the Business and Society Review. Three others used much more detailed information produced by the Council on Economic Priorities (CEP) to derive ratings of companies on pollution control performance. The relationship of these ratings with various investment worth measures was assessed in the studies. Significant results in these studies would indicate that social accounting information is useful to investors if: 1) investors use the specified investment worth measures; and 2) the social accounting information would help them predict the values of the investment worth measures. The association tests discussed in this section do not provide evidence on these two points. The implications of the results should be evaluated with this in mind. Of course, even if useful, whether disclosure of this information should be mandated is another issue which depends, in part, on whether the information would be produced

more efficiently and effectively if disclosure was mandated [Shane and Spicer, 1982].

Studies Using Ratings Reported in the Business and Society Review

The first association test was done by Milton Moskowitz [1972], senior editor of the Review. He identified 14 firms that ". . . might well belong in the portfolio of any investor . . . who feels that social responsibility is a relevant factor in the investment decision." This selection was simply based on his own observation "after four years of closely monitoring businesses' social involvement . . ." As reported by Vance [1975], Moskowitz concluded later in 1972 that there was a relationship between social performance and investment worth. His evidence was a 7.28% average rise in the prices of the 14 selected stocks in the first six months of 1972, while the three most popular market indices only rose 4.4, 5.1 and 6.4 percent. Vance took issue with Markowitz's conclusion, as he noted that the median return on the same 14 stocks for the four-year period ended January 1, 1975 was -58%. The national indices dropped only about 33% of their value during the same period. Vance went further and used two other ratings sponsored and published in 1972 by the Review in the analysis. The first [1972a] was a survey of the opinions of 86 corporate staffers in the urban-affairs and public-affairs fields on the relative social responsibility performance of 45 major corporations. The second rating was from a survey of 300 graduate business students' preferences among 50 companies (44 were also in the previous survey) for their social performances. In both polls ratings were on a scale from one to five. Vance regressed

the ratings in each survey against the ratios of January 1, 1975 stock prices to January 1, 1974 stock prices. He noted that in the case of either survey there was a significant negative relationship between social performance and performance of the company's stock in the market. Based on these results he came to the opposite conclusion as Markowitz. Neither Markowitz nor Vance gave any statistical measures of significance, nor did they control for systematic risk.

A more rigorous study, using the same Business and Society Review rankings, was done by Alexander and Buckholz [1978]. First they noted that the rank order correlation coefficient between the corporate staffers' and students' rankings of firms on social responsibility was .66, significant at $\alpha = .05$. The sample was reduced to the 40 companies that were included in the two surveys and had common stock (there were four mutual life insurance companies without common stock). Regressions of the form in (2.1) below were run for each firm for both the five-year period from January 1, 1970 to December 31, 1974 and the three-year period from January 1, 1971 to December 31, 1973.

$$R_{jt} - R_{ft} = \alpha_j + \beta_j [R_{mt} - R_{ft}] + \varepsilon_{jt} \quad (2.1)$$

where R_{jt} is the return on security j in month t ,
 R_{ft} is the return on a 30-day treasury bill for month t , and
 R_{mt} is the return on the S & P 500 Composite Index.

This model follows a method devised by Jensen [1968] for measuring security performance on a risk-adjusted basis. It is based on the Sharpe-Lintner [Sharpe, 1964; Lintner, 1965] capital asset pricing model. In (2.1) α_j and β_j are the regression parameters with random error term ε_{jt} . The intercept, α_j , ". . . can be interpreted as a measure

of stock performance on a risk-adjusted basis. . . . The parameter β_j , . . . beta . . . , can be interpreted as a measure of the risk of security j " (p. 480). Only two α_j 's in the five-year period and three in the three-year period were significantly different from zero. The ranked α_j 's and β_j 's for both the three- and five-year periods were correlated with both the student and corporate-staffer rankings. Only one of the four correlation coefficients for α_j (for the three-year period with the corporate staffer rankings) and one of the four correlation coefficients for β_j (for the five-year period with the student rankings) were significant at $\alpha < .05$. Based on these results the authors conclude (p. 485) that either a) there is no relationship between social responsibility, as measured in the surveys, and stock market performance, or b) the market efficiently impounded the information concerning the degree of these firms' social responsibility before 1970. The studies using the CEP reports, to be discussed next, report stronger associations. The stronger results could be attributed to any of the following factors. First, the CEP data are much more detailed and are derived by much more thorough analysis. Secondly, these studies generally measure investment worth over a period that begins before 1970. And finally, the investment worth variables used in the studies using CEP data are for the most part accounting rather than market measures.

Studies Using CEP Reports

A more detailed externally produced set of social responsibility information in the specific area of pollution control has been published

by the CEP. They have published eight reports from December of 1970 to December of 1977 on the pollution control performance of firms in four different industries. The first such report, a 400-page study published on December 16, 1970, reported on the performances in controlling pollution of 24 companies involved in the production of pulp and paper. Their third report was a follow-up study to the first, reporting again on the pollution control performances of the same 24 companies. It was published on August 27, 1972. Association tests have been done using the first, and both of these two reports.

The first study that used CEP data to assess the association between social (environmental) performance and investment worth was by Bragdon and Marlin [1972]. The CEP data used was from the first study on the pulp- and paper-producing companies. The authors gave reasons why controlling pollution would not necessarily be associated with lower profits. They noted

. . . four ways to reduce pollution, only one of which (the fourth) is . . . a drain on profits: 1) increase the conversion rate (i.e. the efficiency with which inputs are processed during production); 2) sell waste as by-products for input into other production processes; 3) buy or accept free waste of others . . . for use as an input; 4) treat waste before emitting it into the air or water . . .

Additionally, reasons were given why companies with good pollution control records may be likely to have lower labor costs, lower taxes and legal costs, lower financing costs, and lower costs for plant and equipment purchase. In making this argument, the authors fail to explain why, if pollution abatement is cost effective, corporations were not engaging in these activities before there were pressures on them to con-

trol pollution. The authors offer two other possible explanations as to why pollution control and profitability may be "compatible." First, "firms with higher profits are better able, and thus more likely, to invest in cleaner plants. "Secondly, "good managements are likely both to earn higher profits and to be more careful in protecting the environment."

Bragdon and Marlin go on to test their hypothesis that an association exists between pollution control and profitability. They computed three indices of pollution control performance for each of the 17 firms in their sample using the data in the first CEP report. They measured profits (investment worth) in five different ways: 1) earnings per share growth from 1965 to 1970; 2) earnings per share growth from 1970 to 1971; 3) average return on shareholders' equity from 1965 to 1970; 4) average return on capital (shareholders' equity plus long-term debt) from 1965 to 1970; and 5) return to shareholders' equity in 1970. Two sets of correlations were then computed between the rankings of firms on the pollution control indices and the rankings on the profitability indices. The first set included all 17 firms in the sample. The second set excluded five firms that were involved in heavy merger activity during the 1965-70 period. The second set of correlations produced consistently significant results across indices. Based on these results the authors conclude that "some degree of pollution control is likely to increase profits."

Spicer (1978a) performed a more comprehensive study of the same type as Bragdon and Marlin. He added systematic and total risk as additional variables measuring the investment worth of the firms' securities. This

provided a means of testing Bragdon and Marlin's argument that firms with better pollution control records would have lower financing costs (Spicer, 1978a, p. 98). In addition to the risk variables the following were included as variables measuring investment worth: 1) profitability measured by the average annual return on stockholders' equity; 2) size measured by the average of the natural logarithms of yearly total asset size; and 3) price/earnings ratio. Time periods ". . . spanning a number of years were used for the measurement of financial variables to smooth out the year to year changes in the financial data of the sample companies." Computations were all performed over three time periods: 1) a six-year period from 1968 through 1973; 2) the three-year period from 1969 to 1971; and 3) the three-year period from 1971 to 1973. The time periods were chosen to analyze the effects of the two CEP reports on the pulp- and paper-making companies. The first time period was chosen so as to not only encompass the two reports, but also to span ". . . a period of significant growth in public pressure for environmental protection." Pollution control indices derived from the first CEP report ". . . were viewed as . . . surrogates for the average responsiveness (to these pressures) . . . before such pressures were formalized in federal anti-pollution statutes." (The Clean Air Act Amendments of 1970 were passed in December of 1970.) An average of the pollution control indices in the two CEP reports was viewed as reflective of ". . . corporate responsiveness prior to the passage of anti-pollution legislation together with corporate responses to the mandates of this legislation." The second and third time periods above were used to focus attention on each of the CEP studies individually.

Spicer used both the Spearman Rank Correlation Coefficient and the Mann-Whitney U-statistic to test for associations between his measures of environmental performance derived from the CEP reports and investment worth over the three time periods noted above. His results allowed him to conclude:

. . . companies with better pollution-control records tend to have higher profitability, larger size, lower total risk, lower systematic risk and higher price/earnings ratios than companies with poorer pollution-control records. However, as it also was found that there was a marked reduction in these associations over a period of time . . . , these findings must be tempered by an understanding that such associations may be relatively short-lived phenomena under circumstances where public pressure results in legislative mandates . . .

The relationships for the 1971-1973 time period were much weaker but still were in the hypothesized direction. The relationships for both the 1968-1973 and 1969-1971 time periods were generally significant ($\alpha = .10$ or less) except for the two risk variables, where the results were significant in only five out of ten cases.

To provide additional evidence on the relationship between the risk measures and pollution control performance, Spicer performed an additional study (1978b). In this second study the question posed (p. 71) is: "Does information on the pollution control records of companies in pollution-prone industries convey information to investors about the risk attaching to investment in these companies' common stocks?" In this second study, Spicer restricted the analysis to the first CEP report and the 1968-1973 time period. Spicer's risk measures for each company were: 1) total risk as measured by the standard deviation on monthly stock returns over the 1968-1973 time period; and 2) systematic

risk as measured by the beta from the Sharpe (1963) market model computed from monthly return data over the 1968-1973 period.

In order to ". . . evaluate the contribution that knowledge of companies' pollution control records makes towards explaining the observed variation in market measures of the riskiness of companies' common stocks," partial correlations were computed between each measure of risk and the companies' pollution control indices. In this context, contribution toward explained variation in risk of variables previously found empirically to have significant explanatory power were controlled for. Two sets of partial correlations were computed. The first controlled for the effects of earnings variability, average asset growth, and average payout (Beaver, Kettler, and Scholes [1970]) and resulted in partial correlations in the hypothesized direction (the lower the environmental performance rating the higher the risk) and significant at alpha equal to .114 and .023 respectively for total and systematic risk. The second set of partial correlations controlled for the effects of the ability of management to smooth sales, dividends, capital expenditures, earnings, and a dividend payout ratio (Lev and Kunitzky [1974]) and resulted in partial correlations in the hypothesized direction and significant at alpha equal to .047 and .037 respectively for total and systematic risk. In both Spicer studies it was apparent that the pollution control rating given a company was strongly correlated with its size. Spicer (1978a) notes:

One plausible explanation . . . may be that risk is closely related to size which in turn affects the availability of resources to the company and hence its ability to finance the purchase and installation of pollution control equipment.

As noted at the beginning of this section, all of the association tests discussed above are subject to the limitation that while social performance and hypothesized investment worth variables appear to be correlated, it is not clear that there would be information content in the reporting of social performance information. As the Bragdon and Marlin study pointed out, it could be the firm's profitability and ability to replace old equipment with an orientation toward growth that naturally results in more advanced pollution control methods. They also point to exceptions and argue that the cause-effect relationship does not necessarily run in that direction, but it is at least a possible explanation for their results. Spicer, along similar lines, pointed to the possibility that a company's size could be the determinant of its pollution control posture.

Chen and Metcalf [1980] argue these points more vehemently in a comment on Spicer [1978a], concluding that Spicer found only spurious associations between pollution control performance and measures of securities' investment worth. They define a spurious association as one which occurs because an intervening variable has not been properly controlled. In a replication of Spicer [1978a] they note that partial correlations of investment worth measures with pollution control performance are insignificant when size is statistically controlled for in the analysis. They conclude (p. 177) that the "... associations (found by Spicer) are spurious due to at least one common background variable - size."

Spicer's reply [1980] to Chen and Metcalf makes at least two interesting points that have implications for the research to be reviewed

next and for this dissertation. First he notes, with reference to Ellsworth [1977], that the statistical partialling out of the suspected intervening variables (as done by Chen and Metcalf) is less satisfactory than finding settings with more explicit controls. Among the other more preferable approaches to testing rival hypotheses for the results, he lists first (from Ellsworth [p. 613]) the option of choosing a control setting where the suggested intervening variable is absent. This was basically the approach taken by the information content study of Shane and Spicer [1982], which will be discussed next. There, the authors examine the association of the change in stock market prices of firms in the CEP's reports with the release of the information in the reports. Since the reports contained no new information about size or traditional profitability measures for the companies reported on, associations of stock price changes with the release of the reports are more likely to be attributable to information about pollution control performance.

A second point in Spicer's reply supports the approach taken in this dissertation to the question of the relevance of social performance information to investors. He notes that the objective of Spicer [1978a] was only to determine whether the associations between pollution control performance and investment worth measures exist - not to find out why they exist. He suggests that the identification of other more critical (than size) background variables is an important avenue for future research. He suggests further that a likely candidate is the social pressure on firms to control pollution, which was likely to influence both the pollution control performance and the profitability of firms. This dissertation is structured to specifically consider investor

response to this social pressure; and then to analyze the importance of pollution control performance information in the light of the initial investor response to the pressure.

An Information Content (Event) Study

Shane and Spicer (1982) expanded the use of CEP reports to include all eight environmental reports published and addressed, more directly, the issue of whether investors, in the aggregate, found this information useful in assessing investment worth.

In addition to the two reports already mentioned on the pulp and paper industry, the CEP published two studies each of the environmental performances of: 20 electric utility companies (15 in each of two reports) - original report published April 15, 1972, update published December 7, 1977; seven steel producing companies - original report published May 21, 1973, update published September 26, 1977; and eight oil refining companies - these were companion studies published July 21, 1975 and December 15, 1975.

Two problems were encountered by Shane and Spicer in assessing the information content of these studies. The first was the difficulty in separating the disclosure effect of the information in the reports from the regulatory effect of the publications. A regulatory effect would increase the probability that firms would be effectively pressured, through "stricter enforcement and more stringent sanctions," to control pollution. In this sense the regulatory effect is of the same nature as the effect of events referred to earlier which increase the anticipation of more stringent environmental standards. A regulatory effect would

not necessarily imply that the information in the reports was important, but perhaps only that the event of their publication was an important signal to the market that the social contracts of the firms had changed. The authors took the position that even where a regulatory effect was present, the information about specific companies could be useful in assessing both the overall strength of the effect and its impact on individual companies. The second problem encountered by the authors was in hypothesizing the direction of the impact of the specific pollution performance ratings on the firms. No known expectations model was available, so, for example, it was conceivable that a good rating for a firm may not have been good in light of expectations based on prior information that may have been available.

A simple mean-adjusted returns model that controlled for cross-correlation (Brown and Warner, 1980) among the returns of sample firms was used to evaluate the significance of firms' returns during a six-day test period, where the date of newspaper publication reporting the CEP's findings was the fifth day. Thus, specific associations with changes in investor perceptions of firms' systematic risk was not assessed in the study. A detailed analysis of potentially confounding events reported in the Wall Street Journal was performed, and firms were eliminated from the sample on days when it seemed reasonable that their returns may have been significantly affected by these confounding events. Firms reported on by the CEP were also eliminated from the sample if either they were not listed on the CRSP tapes or they were not included in both CEP reports on their industry.

Basically, two tests were performed. The first was an overall evaluation of the change in stock prices of the firms included in the CEP reports and the sample. The second assessed the differential price changes between a group of firms assigned a high pollution control performance index (PCPI) and those assigned a low PCPI. The results prompted the conclusion:

. . . the CEP firms (those in the eight CEP reports that remained in the sample) experienced, on average, relatively large negative abnormal returns on the two days immediately prior to newspaper reports . . . Moreover, returns for those companies revealed to have low pollution control performance rankings were found, on average, to have significantly more negative returns than companies with high rankings on the day the newspaper reports were published . . . Whether these observed associations are due primarily to a disclosure effect or a regulatory effect (or some combination of both) has not been resolved.

This study, then, provided more direct evidence of the usefulness of social accounting information for investment decisions, at least insofar as there was a significant price change associated with the release of the information in the CEP reports. As the authors note, the results concerning the differential price reaction of the high and low PCPI groups ". . . need to be interpreted with care because of the small sample sizes which result when firms are put into high and low PCPI groups."

Voluntarily Reported Social Accounting Information

As noted earlier the studies of the usefulness of social accounting information using voluntarily reported information in corporate annual reports are limited due to the ". . . imprecise, ambiguous, and often

self-serving nature of the voluntary social disclosures investigated" (Shane and Spicer, 1982). However these disclosures are more readily available than externally-produced information and therefore are amenable to larger sample sizes. Bowman and Haire (1975) addressed themselves to this issue in the first study involving voluntarily reported social accounting information. They measured a firm's social responsibility by the proportion of lines of prose in the firm's annual report devoted to social responsibility. They tested this measure, using Moskowitz's (1972) list of 14 outstandingly responsible firms. A matched set of 14 firms was constructed by choosing at random a firm in the same industry and of similar size for each of the Moskowitz firms. They then computed their measure of social performance for each of the 28 firms. At $\alpha < .05$ using a binomial test the Moskowitz group had a greater percentage of their annual reports devoted to social responsibility than did the matched group. The authors used this evidence to support the efficacy of their measure of social responsibility.

Bowman and Haire restricted their attention to 82 firms in the food-processing business. Of these firms, 31 discussed corporate social responsibility in their 1973 annual reports and 51 did not. Of the 31 firms discussing social responsibility, 13 were said to make "high mention" of their responsibility, and 18 made "medium mention" of it. Their results indicated:

. . . medium activity in corporate responsibility is clearly more closely associated with high profitability than is either little or much activity. Further, in this inverted U-shaped curve, the left-hand tail is lower than the right (i.e. the high-mention group had greater profitability than the no-mention group).

The measure of profitability used was average return on shareholders' equity over the most recent five years. Bowman and Haire also replicated the Bragdon and Marlin study, breaking their sample of pulp and paper firms into a high, middle, and low performing group. The results were consistent again with an inverted U-shaped relationship between social responsibility and profitability. The authors went on to argue that a medium posture towards social responsibility was a sign of good management and that it was this good management that was the cause of higher profits for the firms in that group.

Two other studies using voluntarily reported social responsibility information both relied on the data gathered by Beresford (1974) in 1971 and 1972 and updated annually since then by Ernst and Whinney in its Social Responsibility Disclosure publication. The data is a survey of all Fortune 500 companies' social disclosures categorized by type of disclosure (environmental, minority employment, personnel responsibility, community activities, and product improvement). Ingram (1978) used an interesting methodology to examine the associations of these types of information with the cumulative excess return (CER) for the 12-month period from nine months before to three months after the release of the annual report. CER, the dependent variable, was measured using a standard market model technique, where the excess return for each month was summed over each 12-month test period. The independent variables were: industry (food, chemicals, industrial manufacturing, and transportation manufacturing); fiscal year (1971-1975); excess annual accounting earnings (using a model that defined expected earnings with reference to the relationship over a 14-year estimation period of

the firm's changes in earnings as a percentage of common equity with the similarly computed variable for the market portfolio); and the five social responsibility disclosure categories listed above, with a further breakdown by disclosure type (monetary disclosure, non-monetary disclosure, and no disclosure). A technique reported by Sonquist, Baker and Morgan (1971) was used to assess whether a significant relationship existed between the category and type of social responsibility disclosure and CER when the data was sub-categorized, allowing for interactions of the other independent variables with significant explanatory power.

With respect to the environmental category of social performance disclosure, Ingram's results showed that firms with positive excess earnings in years 1971, 1973 and 1974 making monetary environmental disclosures, outperformed other firms in that subgroup that made either non-monetary or no environmental disclosures. And firms with negative excess earnings in years 1974 and 1975 in the foods and chemicals industries that made monetary environmental disclosures outperformed other firms in that subgroup that made either non-monetary or no environmental disclosures. In 1972 environmental disclosures were not significant for any subgroup.

In the second study using the Beresford/Ernst and Whinney data, Anderson and Frankle (1980) concentrated their attention on the year 1972, using basically the same data as Ingram. Their approach was to control for systematic risk by forming three sets of portfolios of 14 firms each: one group that did disclose social performance information and one that did not for each set. Using a technique reported by Gonedes,

et al (1976) each set of portfolios was formed so their systematic risk (beta) would be the same. The beta of the first set was set at .8, the second at 1.0, and the third at 1.2. Then the monthly returns of the two portfolios in each set were compared for the year centered on the December 31 fiscal year ends of all companies in the sample. It was found that the disclosing firms significantly ($\alpha = .01$) outperformed the non-disclosing firms in March of 1973 for each beta level. March is generally the month that the annual report is released for December 31 year-end firms. The procedure was repeated for the disclosing group subdivided based on whether the disclosures were monetary or non-monetary. In March of 1973 the firms disclosing monetary information significantly ($\alpha = .05$) outperformed the non-monetary disclosing firms at beta levels of 1.0 and 1.2.

Belkaoui [1976] also did a study of the association of the release of social responsibility (environmental) information in companies' annual reports with market- and risk-adjusted changes in the prices of their equity securities. He formed an experimental group of 50 companies disclosing pollution control expenses in their 1970 annual reports of at least one-percent of sales and a corresponding control group of 50 non-disclosing companies of similar size and industry classification as the firms in the experimental group. He concludes from his results (p. 29) that "for a period of four months after disclosure the performance of the stocks was better than the market, indicating a sharp reaction to disclosure." This statement may be a little strong considering that his results show an at least equal stock market performance for the control group in the two months after disclosure, and con-

sistently negative stock market performance for the 12 months preceding disclosure for the experimental group. However it at least did not appear that firms were penalized for having disclosed environmental performance information. As will be seen in the discussion of the next study to be reviewed, the disclosures may have been motivated by the poor performances of the disclosing firms in the preceeding year, in the sense that they may have been attempting to improve their images.

In an effort to explain why certain firms disclose social responsibility information while others do not and thus begin the development of a positive theory of social responsibility disclosures, Trotman and Bradley (1981) tested the hypothesis that voluntary disclosure of social responsibility information is associated with variables that are not necessarily related to financial performance. They used ". . . the total amount of social responsibility discussion on a line by line basis, as a percentage of total discussions on all issues" (p. 359) as the measure of social responsibility disclosure. The sample consisted of 207 companies included in a survey by Bradley (1978) that started with the 600 largest companies on the Australian Associated Stock Exchange. This measure was then correlated with variables measuring company size (total assets) on the 1978 balance sheet, systematic risk (market model beta for the period from January 1974 to June 1979), social pressures on the firm, and management's decision horizon. Measurements on the last two variables were obtained from the results of the questionnaire used in the Bradley survey. It was hypothesized that larger firms would disclose more about their social responsibility in order to reduce political costs (Watts and Zimmerman [1978]); firms with

higher systematic risk would attempt to reduce their perceived riskiness by disclosing more about their social responsibility; firms subject to greater social pressures would be subject to greater political costs and would have more incentive to disclose social responsibility information to reduce those costs; and companies with longer decision horizons would disclose more because the disclosures would tend to have long- rather than short-term pay-offs. The results supported the hypotheses as stated.

The studies on voluntarily reported social performance information generally support the notion that an association exists between disclosure of social performance information and stock market performance. The Trotman and Bradley study also provided some explanation for why some firms may choose to disclose this information (and presumably participate more in the activities that result in the internalization of social costs) while others do not.

The Research Questions Summarized

Three questions that have an impact on whether policy makers would want to consider mandating disclosure of social accounting information were raised in the introductory pages of this chapter. The first was whether an off-balance-sheet liability (or change in the firm's social contract) resulted when events occurred that could have increased the anticipation of more stringent standards for pollution control. No work has been reported in the literature on this issue. In the next chapter the theoretical impact of such events, if significant, on the value of the firm will be analyzed. In Chapters IV and V specific empirical

tests will be designed and the results reported assessing the significance of this impact. The establishment here of the significance of this off-balance-sheet liability would provide a foundation for the findings reported by most of the studies reviewed in this chapter - that a significant relationship exists between investment worth and social responsibility. It seems reasonable to expect that firms that have greater success in meeting the terms of a significant liability will be more desirable for investors' portfolios.

The second question raised was whether specific users of social accounting information could be identified, and if so, what was their expressed needs. Some of the work in this area was reviewed, showing some support for the notion that specific groups of investors do express a desire for social accounting information on certain issues. While this dissertation will not address this issue directly, it will provide evidence on the significance of the use of social accounting information. This was the third question raised in the introductory pages of this chapter.

In addressing this third question the Shane and Spicer event study will be extended to: a) assess associations with changes in systematic risk as well as overall price changes; and b) be more sensitive to the presence of a regulatory effect. As previously stated, this study will empirically examine the significance of changes in the risk and market values of firms when: a) events occurred that would have been likely to have signified a change in the firm's implied social contract for pollution control; and b) information was later disseminated concerning the degree to which the firm was fulfilling its social contract. Firms that

were studied in each of the CEP reports form the main experimental group to be examined. Three additional experimental groups will also be used, however, to assess the nature and strength of the regulatory effect of the CEP reports (i.e. a strong regulatory effect of a report could have an impact on firms not included in the report). These three additional groups will include smaller firms in the same industries the CEP reported on, firms in polluting industries other than those reported on by the CEP, and firms in CEP reports published after the report being examined. In the next chapter the theoretical impact on systematic risk and share prices of information exemplified by the CEP report data will be discussed. In Chapters IV and VI specific empirical tests will be designed to assess the significance of this impact and the results of the tests will be reported.

CHAPTER III

AN APPLICATION OF CAPITAL ASSET PRICING THEORY

As described in the last chapter the two research questions addressed in this study are: a) whether an off-balance-sheet liability resulted when events occurred that could have increased the anticipation of more stringent standards for pollution control; and b) whether investors have made significant use of social performance information. This chapter will provide a theoretical framework and Chapter IV will provide the methodology for the empirical analysis of these questions in Chapters V and VI. Question (a) is really a sub-category of the broader question of the effects of pressures on firms to internalize social costs. Question (b) is part of the broader question of the impact of information on the degree to which firms are internalizing social costs once they have been initially constrained to do so.

In this chapter the theoretical effects on the risk and present value of firms' equity securities of: a) events that increase the probability that firms will be constrained to internalize more social costs; and b) information subsequently disseminated concerning the degree to which particular firms are operating within the bounds of the constraint will be analyzed. For this purpose use will be made of the general equilibrium model of capital asset prices developed by Sharpe

[1964], Lintner [1965a, 1965b], and Mossin [1966].

The capital asset pricing model is based on the Markowitz [1952] portfolio model for making personal investment decisions. The most important assumptions underlying these models are that there are no restrictions on short selling or borrowing, investors make decisions in a single period context and are only interested in the mean and standard deviation of portfolio return distributions, investors have homogeneous expectations, and there is a perfect and competitive securities market with infinitely divisible objects of choice. For a more thorough analysis of these and other more readily relaxed assumptions of the models see Rubenstein [1973]. The analysis here will follow mainly that of Rubenstein [1973] who used the Sharpe-Lintner-Mossin model to produce a framework for analyzing the effects of asset expansion and capital structure on the systematic risk and price of equity securities. In addition to the works already cited, he drew heavily on the works of Hamada [1969], Modigliani and Miller [1958], and Mossin [1969].

The effects of phenomena (a) and (b), above, on equity security prices and the two components of systematic risk - financial risk and operating risk - will be analyzed in the sections that follow. Additionally regulatory effects of the phenomenon (a) events and separate disclosure and regulatory effects of the information in (b) will be discussed. The basic capital asset pricing model shown in (3.1a) below states that in equilibrium

$$E(R_i) = R_F + \beta_i [E(R_m) - R_F] \quad (3.1a)$$

where R_i is the return to holders of equity securities of firm i ,

R_F is the risk free rate of interest available to all individuals and firms,

R_m is the return on the market portfolio held by all investors with any risky assets in their portfolios, and

$\beta_i = \text{cov}(R_i, R_m) / \sigma^2(R_m)$ is defined as the systematic risk of security i .

It will also ease the analysis to express (3.1a) as

$$E(R_i) = R_F + \lambda \text{cov}(R_i, R_m) \quad (3.1b)$$

where $\lambda = [E(R_m) - R_F] / \sigma^2(R_m)$

Events Increasing Pressures to Internalize Social Costs

Effect on Equity Security Prices

Recall from Chapter II the concept of a social contract for each firm. The idea is that firms' rights to exist come from society and therefore they can be required to operate within certain constraints set by society. Picture an all equity firm that begins operations in an industry that uses the free goods, air and water, in a manner such that these natural resources become polluted. Initially the firm's implied social contract may not include any constraints on this pollution. Subsequently, however, events occur that cause society to come to regard pollution as a social cost. At this time society could choose to absorb the cost itself or impose a constraint on the firm requiring the firm to internalize all or a portion of the social cost, thus changing the firm's social contract. Assuming the latter choice is made the events

are defined to have a regulatory effect, and the firm will be forced into making investments in pollution control that would not otherwise have been made.

To simplify the analysis in accordance with the assumptions of the model in (3.1) above, suppose that the cost, C_i , of the pollution control investment required to abide by the new social contract is known with certainty or at least that C_i is the certainty equivalent of that cost. C_i is the equivalent cost (net of any tax breaks and other government-sponsored economic incentives) of investment in pollution control that would have to be incurred immediately after the event in order to fulfil the new terms of the firm's social contract. Assume further that the investment will be financed by issuing dN_i additional shares of stock at price, P'_i , where $C_i = dN_i P'_i$. In addition to the initial cost of the investment, it is likely that significant incremental fixed and variable costs will be incurred on an ongoing basis and that at least some of these costs will be passed on to consumers. Assume that the net incremental effect of the pollution control investment on the income available for distribution as dividends to stockholders or to be retained in the business for their benefit is dX_i , a random variable (possibly negative in sign) expressed as an equivalent annuity in perpetuity (this preserves the single period nature of the analysis). Expressed similarly, X_i is the uncertain income of the firm before acceptance of the new project. The equity value of the firm before the event requiring the investment in pollution control is $V_i = S_i = P_i N_i$, where V_i is the total value of the firm and S_i is the value of the equity shares. The rate of return to equity shareholders before the event is

$R_i = X_i/V_i$ and the return on the required investment in pollution control is $R'_i = dX_i/C_i$ (again possibly negative in sign).

The scenario above can now be used to analyze (in Rubenstein's [1973] framework) the effect of the event increasing pressure to internalize social costs on the price of the firm's equity securities. That is, given the outline above, what is the sign of $P_i - P'_i$? From equation (3.1b), before acceptance of the project since $R_i = X_i/N_i P_i$,

$$E(X_i) = R_F N_i P_i + \lambda \text{cov}(X_i, R_m) \quad (3.2)$$

After the event requiring acceptance of the pollution control project

$$E(X_i + dX_i) = R_F (N_i + dN_i) P'_i + \lambda \text{cov}(X_i + dX_i, R_m) \quad (3.3)$$

Since by definition $dX_i = R'_i C_i$ and $C_i = dN_i P'_i$, from equations (3.2) and (3.3)

$$\begin{aligned} R_F N_i P_i - R_F N_i P'_i &= \{E(X_i) - \lambda \text{cov}(X_i, R_m)\} - \\ &\quad \{E(X_i) + E(dX_i) - R_F dN_i P'_i - \lambda \text{cov}(X_i + dX_i, R_m)\} \\ P_i - P'_i &= \{C_i [R_F + \lambda \text{cov}(R'_i, R_m) - E(R'_i)]\} / R_F N_i \end{aligned} \quad (3.4)$$

Because both C_i and $R_F N_i$ are positive, the sign of $P_i - P'_i$ depends on the quantity $[R_F + \lambda \text{cov}(R'_i, R_m) - E(R'_i)]$. If $E(R'_i) < R_F + \lambda \text{cov}(R'_i, R_m)$, then $P_i - P'_i > 0$ indicating that the price of the company's stock after the event requiring acceptance of the pollution control project will have fallen. In other words, if the expected return, $E(R'_i) = E[dX_i/C_i]$, is less than the required rate of return on a security in the market portfolio with similar risk characteristics, acceptance of the pollution control project will cause the price of the equity securities

to fall. IF dX_i , the incremental effect of the project on the firm's earnings, is negative, the value of the firm's equity will fall as long as $\text{cov}(R'_i, R_m)$ is positive. Note from equation (3.4) that even if all of the costs of the pollution control equipment are expected to be passed on to the consumer (i.e. $dX_i = 0$), the rate of return on the project will still be less than the required rate and the price of the stock will fall.

Intuitively it seems that $P_i - P'_i$ would be likely to be positive. Otherwise, the firm should have invested in pollution control before being pressured to do so. Empirical evidence supporting this statement is provided in a study sponsored by Arthur Anderson and Company [1979], where it was noted that "incremental costs" of \$2 billion were estimated to have been incurred in 1977, alone, to comply with EPA regulations. Incremental costs were defined as "the direct costs of those actions taken to comply with a regulation that would not have been taken in the absence of that regulation."

The firms that have more than average exposure to the pressures may choose to incur political costs to counter the force of the pressures. Examples of political costs are those incurred to improve the firm's public image as a "good citizen" and, more directly, to lobby for less stringent pollution control laws and regulations. Firms with less than average exposure are not as likely to incur these costs because they can benefit, as "free riders", from the expenditures of the more exposed firms. That is, all polluters stand to benefit from lobbying for less stringent pollution control requirements, not only the ones paying for the lobbying. Presumably the more exposed firms would incur political

costs if the expected return, in terms of the degree to which C_i and dX_i would be reduced was worth the risk associated with that expected reduction. Thus, the decrease in price of the firms' equity securities, $P_i - P'_i$, is expected to be the net result of the degree to which firms are pressured to take on pollution control investments and the mitigation of these pressures through the incurring of political costs.

Effect on Systematic Risk

Financial Risk

As analyzed above, the equity value of a firm's securities is expected to fall by $D_i = N_i(P_i - P'_i) - P'_i dN_i$, the drop in value of the old shares (still outstanding) less the value of the newly issued shares. D_i can be viewed as a new off-balance-sheet debt (to society) that a previously all-equity firm has as a result of the event that changed its social contract, imposing a constraint to internalize a social cost. In other words society has claimed part of the value of the firm that previously belonged entirely to the shareholders. The value claimed by society is $D_i = S_i - S_i^*$, where the superscript, *, means after the event. The value of the firm, V_i , is the same before and after the event; but before the event $V_i = S_i$ and after the event $V_i = S_i^* + D_i$.

From the firm's point of view the return to society on this new off-balance-sheet debt is dX_i/D_i where dX_i is the reduction in the earnings available to the shareholders resulting from this debt. The magnitude of this return is uncertain but it is clear that society has put itself in a preferred position to the owners of the firm. After the event

changing the social contract, the firm is constrained to internalize, to some extent, the social cost of pollution or lose its right to exist. (Of course the constraint could take the form of a penalty tax if the firm chose to take that route, but the tax should be set by society such that the effect on the firm would be the same or worse.) In this sense, the interest of the shareholders in X_i , the future earnings of the firm before the event, has been subordinated to society who will carve out dX_i . This, of course, is analogous to the case of more traditional debt, where the shareholders subordinate their interests to the creditors by guaranteeing some interest rate. Thus, the change in the firm's social contract can be viewed, for the purpose of analysis, as a change in the firm's capital structure. The following analysis of the effect of a change in capital structure on systematic risk follows that of Rubenstein [1973].

To simplify the analysis of this change in capital structure, assume that dX_i is known with certainty and therefore $dX_i/D_i = R_F$. As noted previously the value of the all-equity firm before the pressures, V_i , is equal to S_i , the value of the shareholders' equity. The effect of the pressures to internalize social costs is to cause the value of the firm's shareholders' equity to drop by $D_i = S_i - S_i^*$; and since the firm was assumed to be an all equity firm before the event, $V_i = D_i + S_i^*$. From the definition of return, $R_i^* = (X_i - R_F D_i)/S_i^*$ and $R_i = X_i/V_i$. Now, using (3.1b) and the above definitions,

$$E(R_i^*) = R_F + \lambda \text{cov}[(X_i - R_F D_i)/S_i^*, R_m].$$

Simplifying and remembering that $X_i = V_i R_i$ and $V_i = S_i^* + D_i$,

$$E(R_i^*) = R_F + \lambda \text{cov}(R_i, R_m)(1 + D_i/S_i^*).$$

Substituting $E(R_i) = R_F + \lambda \text{cov}(R_i, R_m)$ and using (3.1a),

$$E(R_i^*) = R_F + \beta_i [E(R_m) - R_F] + \beta_i [E(R_m) - R_F] (D_i/S_i^*), \text{ or}$$

$$E(R_i^*) = R_F + [E(R_m) - R_F] [\beta_i + (D_i/S_i^*)\beta_i]$$

Since from (3.1a) $E(R_i^*) = R_F + \beta_i^* [E(R_m) - R_F]$,

$$\beta_i^* = \beta_i + (D_i/S_i^*)\beta_i. \quad (3.5)$$

β_i^* is the total systematic risk of firm i after the event that constrains the firm to internalize the cost of pollution. β_i is the total systematic risk of the firm without the event (the all-equity firm) and is defined as the business or operating risk of the firm after the event which changes the all-equity nature of the firm due to the new claim enforced by society on the firm's earnings. $(D_i/S_i^*)\beta_i$ is the financial risk of the firm after the event.

From the above analysis, equation (3.5) indicates that the effect of an event increasing the pressure on a firm to control pollution is to increase the systematic risk of the firm, ceteris paribus, due to an increased element of financial risk. Under the assumptions as outlined above (i.e. C_i and dX_i known with certainty), there would be no effect on the firm's operating risk. The next sub-section analyzes the effect of relaxing these assumptions on operating risk.

Operating Risk

In this section the event increasing the pressure on the firm to control pollution will be assumed to result in the firm taking on an investment project of uncertain cost, C_i , and one which will result in

an uncertain change, dX_i , in the earnings of the firm. The uncertain flows C_i and dX_i are converted into the perpetual annuity of uncertain amount dx_i . Now, in addition to the change in the systematic risk of the firm due to the new element of financial risk as shown in (3.5), the operating risk of the firm may also change, causing (3.5) to become

$$\beta_i^* = \beta_i' + (D_i/S_i^*)\beta_i' \quad (3.6)$$

where β_i' is different from β_i due to the uncertain nature of dx_i .

To see how the uncertainty of dx_i influences the operating risk of the firm, β_i' is represented as

$$\beta_i' = \{\text{cov}[(X_i + dx_i)/S_i^*, R_m]\}/\sigma^2(R_m) \quad (3.7)$$

From the formulation in (3.7) it is clear that any change in operating risk, $\beta_i' - \beta_i$, as a result of the event is directly related to the magnitude of dx_i relative to X_i and the covariability of dx_i with the market return. If $\text{cov}(dx_i, R_m) = \text{cov}(X_i, R_m)$ then the operating risk of the firm would not change due to the required investments in pollution control. Four factors will be discussed that could affect the sign of $\text{cov}(dx_i, R_m) - \text{cov}(X_i, R_m)$. First, to the extent that there is uncertainty regarding the manner in which the pressures will become institutionalized, the standard deviation of the firm's earnings that will be available to shareholders is expected to increase. In addition to the normal difficulty a firm has in predicting costs associated with a new investment project, there is the additional uncertainty, here, in the prediction of what investments will be required. Fama [1976 p. 255] points out that while the theoretically important factor in assessing

risk is the covariance, a higher variance of a firm's return is expected on average to be associated with a higher covariance with the market return, assuming no systematic relationship between variance and correlation. He provides empirical evidence to support this statement. The relationship between variance and covariance can be seen by rewriting $\text{cov}(dx_i, R_m)$ as $\rho(dx_i, R_m)\sigma(dx_i)\sigma(R_m)$. As will be discussed below the sign and magnitude of $\rho(dx_i, R_m)$ is unclear in both an absolute sense and relative to $\rho(X_i, R_m)$.

The second and third factors affecting the sign of $\text{cov}(dx_i, R_m) - \text{cov}(X_i, R_m)$ have an increasing affect on operating risk. Both factors relate to the expected ability of the firm to operate effectively within the new constraints and still offer the desired rate of return to its shareholders. This will largely depend on the synergistic benefit the firm is able to get from investment in pollution control. For example, as noted in Chapter II, Bragdon and Marlin [1972] argued that firms could actually reduce costs through more efficient use of their inputs by investing in pollution control. The synergistic benefits of investment in pollution control are likely to be greater for a growing firm that would be making capital improvements and expanding with or without the pressures to control pollution. The magnitude of dx_i relative to X_i and the covariability of dx_i with R_m will also depend on the extent to which firms are able to pass on the costs of pollution control to consumers. Both in the case of synergistic benefits and of passing on costs to consumers, it appears that the ability of the firm to operate effectively within its new constraints will be enhanced in times of general prosperity and will be weakened in more difficult economic

times. Thus, these second and third factors are expected to have a positive effect on the covariability of the firm's earnings on investments in pollution control with the return on the market portfolio.

A fourth factor, however, is expected to have a negative effect on $\text{cov}(dx_i, R_m)$. This factor relates to the degree to which general economic conditions affect the promulgation and enforcement of environmental standards. It is likely that firms will be held more strictly accountable for controlling pollution in times of prosperity than in times when society is more concerned with increasing productivity and lowering prices. The four factors discussed above lead to an ambiguous result. It is unclear whether events increasing the anticipation of more stringent environmental standards will have an increasing or decreasing effect on operating risk.

Summary of Effects of Events Increasing Pressures to Internalize Social Costs

In the preceding subsections of this chapter the theoretical effect of events increasing pressures on firms to internalize the social cost of pollution have been analyzed. When the events were viewed as constraining firms to invest in pollution control projects that otherwise would have been rejected because the expected return on the projects would have been less than that required on a security in the market portfolio with similar risk characteristics, it was shown that the price of the firm's equity securities would be expected to fall. It was also noted that the fall in share price may be mitigated somewhat by the incurring of political costs by firms that have more exposure to the pres-

tures.

The theoretical effect of the events on the financial risk of the firms is expected to be positive. This conclusion was reached when the decrease in the market value of the firm's equity shares was viewed as corresponding to a new debt to society equal to the present value of the social cost expected to be internalized. The constraint is similar to a debt in the sense that the interests of the shareholders are subordinated to those of society, much as the interests of shareholders are subordinate to creditors' interests in the firm's earnings.

The event's effect on the operating risk of the firm was unclear. The uncertainty associated with the manner in which the pressures to control pollution would become institutionalized would increase the variability of the earnings available for shareholders, and correspondingly the operating risk of the firm, *ceteris paribus*. However, the correlation of these earnings with the return on the market portfolio could either increase or decrease depending on the relative influence of three factors that were discussed.

The conclusion reached in this sub-section is that the events increasing pressures on firms to internalize social costs are expected to cause a decrease in the equity value of the firm and an increase in the systematic risk of the firm, due to an increasing effect of the events on the firm's financial risk.

Firm Specific Information Concerning the
Internalization of Social Costs

Disclosure Effect

If the information disclosure changes the market's perception as to how much the firm will have to invest to operate within the bounds of its social contract, then equation (3.4) and the corresponding analysis above indicate that a change in the price of the firm's securities is to be expected. Of course the direction of the change, $P_i - P'_i$, depends upon the market's prior expectations of C_i and R'_i in equation (3.4). As analyzed above any change in share price resulting from the information can be expected to also affect the financial risk component, $[(D_i/S_i^*)\beta_i]$, of (3.5) with the direction of the effect dependent on the market's prior expectations).

It seems reasonable to expect that the information would reduce the uncertainty concerning the degree to which the firm is able to a) reap synergistic benefits from the investments in pollution control and b) pass costs of pollution control on to consumers. Uncertainty, concerning the amount of investment, C_i , that will be necessary to fulfil the new social contract would also be expected to decrease. The effect of this uncertainty reduction on the firm's operating risk would depend on the direction of the effect of the events analyzed in the previous section on operating risk.

Regulatory Effect

In addition to the disclosure effect of information concerning the internalization by firms of social costs, there may also be a regulatory effect. The regulatory effect is especially relevant to the information source used in this dissertation. As noted in Chapter II that source is not the firm itself, but rather, an independent agency dedicated to enhancing the social responsibility of firms. The information dissemination could be viewed as an event, similar to the events analyzed in the first section of this chapter - i.e. one that increases the pressures on firms to internalize social costs and also increases the probability that these pressures will be more stringently institutionalized. The regulatory effect could be such that the more exposed firms incur political costs to mitigate the impact of the publication of the information.

The regulatory effect would, of course, be expected to cause the same types of market reactions as other events that increase the pressures to impose constraints on firms to internalize social costs. As noted earlier in this chapter, the expected effects are a decrease in equity security prices and an increase in systematic risk.

Summary

In this chapter the Sharpe-Lintner-Mossin capital asset pricing model has been used to analyze the theoretical effects of a) events that are likely to lead to constraints on firms to internalize social costs and b) information concerning the degree to which the firms are

operating within such constraints, on the prices and systematic risk of the firms' securities.

It was noted that phenomenon (a) would result in a regulatory effect reflecting the expected institutionalization of the pressures on firms to control pollution; and that political costs might be incurred to counter the force of the events, thus mitigating the regulatory effect. The political costs were expected to be incurred by the larger more exposed firms but smaller firms were also expected to reap the benefits of the expenditures. The net result was an expected decrease in the price of the firms' equity securities and an increase in systematic risk - with a more pronounced impact on larger more exposed firms.

Phenomenon (b), information dissemination, could result in a regulatory and/or a disclosure effect. The sign of the disclosure effect on share price and financial risk depends on the prior expectations of the market of the magnitude of the burden on the individual firms to operate within the bounds of their social contracts. The information disclosure is expected to reduce the uncertainty regarding the ability of the firm to operate successfully within the constraints of its social contract (e.g. the degree to which synergistic benefits are likely to come from pollution control investments and the degree to which the costs can be passed on to consumers). The effect of this uncertainty reduction on operating risk would depend on the direction of the effect of the earlier constraint-increasing events on operating risk.

Any regulatory effect of the information disclosure phenomenon is analyzed similarly to the earlier events leading to the social constraints. That is, share price is expected to fall (more so for larger

firms) and systematic risk is expected to rise.

In the next chapter the methodology to be applied to the empirical part of the dissertation is described. It is designed to yield results that will indicate the extent to which the theory outlined in this chapter is descriptive of real world phenomena.

CHAPTER IV

METHODOLOGY

In the last chapter the theoretical effect of two types of phenomena (pressures on firms to internalize social costs and the dissemination of information that assesses social responsibility across firms) on the price and riskiness of equity securities in equilibrium was analyzed. In this chapter the methodology will be developed to empirically test the significance of the associations of changes in price and risk with events corresponding to the phenomena of interest. The next chapter will specifically test for hypothesized associations of changes in price and risk with events increasing pressures for pollution control. Chapter VI will assess the associations of risk and price changes with the dissemination of social performance information.

This chapter is divided into three major sections. The first major section reviews the rationale for using the standard market model to test for hypothesized changes in price and risk associated with events of interest. Researchers using the standard market model to assess the information content of events have taken various approaches in obtaining and summarizing results. The basic approach taken in this dissertation will be explained in the second major section. Normally the standard market model has been used with weekly or monthly return data. In this study daily return data will be used. There are some problems in using

the standard market model when daily returns are used. The advantages of using daily returns in the analysis and the modifications of the standard market model approach that are deemed necessary will be discussed in the final major section of the chapter.

Rationale for the Market Model

The general equilibrium model forming the base of the theoretical analysis in Chapter III was the Sharpe-Lintner-Mossin capital asset pricing model (CAPM), given in (3.1). In that model risk is defined as:

$$\beta_i = \text{cov}(R_i, R_m) / \sigma^2(R_m).$$

As defined in the CAPM, β_i is unobservable in the sense that R_i and R_m are the returns that will occur in the next period for the security, i , and the market portfolio, M . (The model says nothing about the stochastic relationship between R_i and R_m .)

In order to empirically assess the effect on the riskiness of equity securities of any event (including the release of information), the concept of β_i must be operationalized. This is normally done by the use of the market model which defines the following linear stochastic relationship.

$$R_{it} = \alpha_i + \beta_i R_{mt} + u_{it} \quad (4.1)$$

where R_{mt} and R_{it} are the ex post observable returns in period t on the market portfolio and on security i (a member of the market portfolio), respectively,

α_i and β_i are the constant and slope coefficients, respectively derived from regressing R_{mt} on R_{it} , and

u_{it} is the random error term, assumed independent from period to period.

The development of the market model is attributed to Markowitz [1952]. Its derivation is explained thoroughly in Fama [1976]. Since β_i in the market model is defined as the slope of the linear relationship between R_{it} and R_{mt} it can be expressed as:

$$\beta_i = \text{cov}(R_i, R_m) / \sigma^2(R_m)$$

The β_i of the market model differs from the β_i defined as systematic risk in the CAPM in that the R_{it} and R_{mt} are now ex post observable variables. See Beaver [1972] for a detailed discussion of the four conditions under which the β_i of the market model, which can be measured empirically, is approximately equivalent to the β_i of the CAPM which cannot. Three of the four are trivial in that they rather obviously would be expected to hold. The least trivial condition is that the β_i 's of the two models must be assumed to be approximately stationary over time. Beaver notes empirical evidence (Blume [1968], Jensen [1969], and Beaver et al. [1970]) that suggests significant stationarity especially at the portfolio level. In this study all tests are at the portfolio level of analysis. It is therefore assumed that the market model β_i is a sufficient approximation to the theoretical construct of systematic risk in the CAPM to be used in assessing the impact of events on the riskiness of equity securities.

In addition to the observability of β_i , which can be used as an approximation of systematic risk, the market model can be used to assess the unexpected price change for security i in period t . The unexpected price change is directly related to the unexpected return, since return is defined as:

$$R_{it} = (P_t - P_{t-1} + D_t) / P_{t-1} \quad (4.2)$$

where $P_t - P_{t-1}$ is the price change in period t , with appropriate adjustments made for stock dividends and splits, and

D_t is the dividends of period t .

The market model implies that the expected return on security i in period t , given the observed value of R_{mt} is:

$$E(R_{it}) = \alpha_i + \beta_i R_{mt}.$$

Thus the unexpected return on security i in period t is:

$$u_{it} = R_{it} - (\alpha_i + \beta_i R_{mt}) \quad (4.3)$$

In (4.3) u_{it} is the unexpected return, after controlling for the normal effect of economy-wide events on R_{it} . Therefore, to the extent that a significant unexpected return from the model is identified for a firm in a period, one can reasonably suppose that an event or events occurred during that period which significantly influenced the price of the equity securities of the firm; and the relationship between the influence of the event or events on the firm and on the market was significantly different than the normal relationship between the influence of events on the firm and on the market. This supposition is based on the hypothesis that the market efficiently (or unbiasedly) impounds all publically-available information immediately upon its release. (See Fama [1976] for a development of the efficient markets hypothesis and its implications for determining the information content of events.) If the period of significant unexpected return, u_{it} , also happened to be a period in which a particular event of interest occurred, one might

suspect that the event of interest had something to do with the unexpected return. However, this suspicion is tenuous since one must wonder whether some other events with particular importance for the firm caused the unexpected price change.

An approach that lends more support to the hypothesized relationship between the event of interest and unexpected return is to summarize unexpected returns across firms that all are hypothesized to have been affected by the event. Then, while other events were undoubtedly affecting the firms, their effects can be assumed to cancel each other out with the total effect of the other events on the summarized unexpected returns expected to be zero. The strength of this assumption depends on the degree to which the firms are unrelated, except in their sensitivity to the event of interest. If the assumption is valid, then a significant unexpected return across firms at the same time as the event of interest gives strong evidence that the event had a significant effect, on the average, on the prices of the equity securities of the firms in the group. The influence of these other effects on u_{it} is often referred to as noise. Even when the expected effect of the noise on u_{it} is zero, the degree to which other effects are present will determine the magnitude of the variance of u_{it} . When significant noise is present in the data, the effect of the event of interest must be that much more significant in order to show up statistically. The researcher's ability to detect the effect of the events of interest is directly dependent on the variance of u_{it} , which in turn depends directly on the amount of noise in the data.

In this section the basic rationale has been discussed for using the market model to assess the significance of the effects of events on price and risk changes of equity securities. Studies using the market model in making such assessments are often called information content (or event) studies, because finding significant price or risk changes associated with events supports the conclusion that the events contained information used by market participants, in the aggregate, to evaluate the risk and present value of the equity of firms. Different information content studies take different approaches to obtaining and summarizing results from the standard market model of (4.1). The next section outlines the basic approach taken in this dissertation to obtain and summarize results from the market model.

More Detailed Procedures

Cross Sectional Analysis

As noted above, a procedure for summarizing unexpected returns across firms is useful in focusing attention on events of interest and randomizing the effects of other events. The procedure used to accomplish this here is to form portfolios of firms expected to be affected similarly by the events of interest. Then unexpected returns and changes in systematic risk are examined at the portfolio level.

The relationships derived from both the CAPM and the market model hold for portfolios as well as individual firms. The return on a portfolio is defined as in (4.4) below.

$$R_{pt} = (1/n) \sum_{i=1}^n R_{it} \quad (4.4)$$

where n is the number of firms in the portfolio.

Then (4.1) becomes

$$R_{pt} = \alpha_p + \beta_p R_{mt} + u_{pt} \quad (4.5)$$

and (4.2) becomes

$$u_{pt} = R_{pt} - (\alpha_p + \beta_p R_{mt}) \quad (4.6)$$

Choice of Market Index

Since all assets in the market can not practically be included in the market portfolio, a market index must be chosen. No theoretical support for one index over another is available. However, a simulation study was done by Brown and Warner [1980], which shows that use of an equally weighted index results in rejection of the null hypothesis more frequently when it is false than does the value-weighted index (i.e., it is more powerful). They also note that estimates of β are more efficient (lower variance) when the equally weighted index was used. Based on these results, the New York and American Stock Exchange equally-weighted index was used in this study to represent the market factor.

A Test for Changes in Systematic Risk

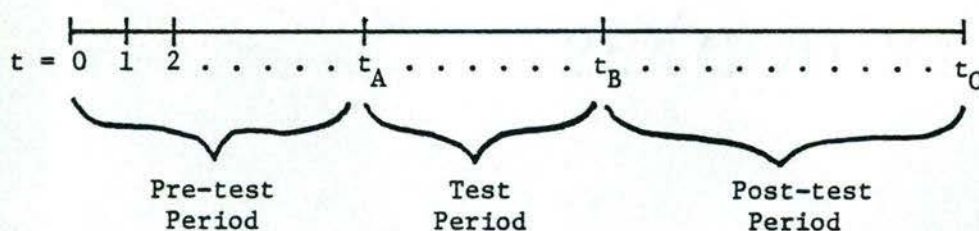
Once the portfolio return series has been constructed and test periods during which the events of interest occurred have been iden-

tified, tests for changes in risk associated with the events of interest can be performed.

For each test period there is a pre-test estimation period and a post-test estimation period, as shown in Figure 4A.

FIGURE 4A

Time Series of Interest



There are t_A returns in the pre-test period, $t_B - t_A$ returns in the test period, and $t_C - t_B$ returns in the post-test period.

To test for a change in systematic risk for the test portfolio from the pre-test to the post-test period, the returns in the test period are dropped from the time series and two models are estimated: a full model that allows for a change in β_p from the pre- to post-test period and a reduced model that holds β_p constant in the two periods.

The reduced model is the basic market model given in (4.5). The full model is shown in (4.7) below:

$$R_{pt} = \alpha_p + I\beta_p R_{mt} + I^* \beta_p^* R_{mt} + u'_{pt} \quad (4.7)$$

where $I = \begin{cases} 1 & \text{for } t = 2, 3, \dots, t_A \\ 0 & \text{for } t = t_{B+1}, \dots, t_{C-1} \end{cases}$;

$I^* = \begin{cases} 0 & \text{for } t = 2, 3, \dots, t_A \\ 1 & \text{for } t = t_{B+1}, \dots, t_{C-1} \end{cases}$; and

β_p is an estimate of systematic risk for the pre-test period; and

β_p^* is an estimate of systematic risk for the post-test period.

The significance of modeling the change in β_p from the pre- to post-test period can be estimated by comparing the unexplained variation in R_{pt} , $\sigma^2(u_{pt})$, from the reduced model (4.4) with the unexplained variation in R_{pt} , $\sigma^2(u'_{pt})$, from the full model (4.6). A significant reduction in the unexplained variation, $\sigma^2(u_{pt}) - \sigma^2(u'_{pt})$, resulting from modeling the change in β from the pre-test to post-test period would indicate that a change in risk associated with the events commonly affecting the firms in the test portfolio had occurred. The significance of $\sigma^2(u_{pt}) - \sigma^2(u'_{pt})$ is measured, relative to the unexplained variation of the full model, with the F-statistic (with 1 and $T - 2$ degrees of freedom) given in (4.8) below:

$$F = \frac{\{[\sigma^2(u_{pt})](T-2) - [\sigma^2(u'_{pt})](T-3)\}/1}{\{[\sigma^2(u_{pt})](T-2)\}/(T-2)} \quad (4.8)$$

where $T = t_A + t_C - t_B$ from Figure 4A

Tests for the Significance of Unexpected Returns

Estimates of expected returns, $E(R_{pt})$, in the test period are needed in order to test for significant unexpected returns. A problem in estimating expected returns arises when a change in β_p associated with the test period events has occurred. In such a case, any estimates of β_p on each day of the test period would be arbitrary. Therefore, (4.5) (the reduced standard market model just discussed) is used, over the time series that includes the pre- and post-test periods but drops out the test period, to estimate an average β_p for the test period. The reduced (standard) market model would also be used, of course, when there is no change in β_p to estimate the parameters of the model that will generate expected returns for the test period. In addition to an estimate of β_p , estimates of α_p , and $\sigma(u_{pt})$ are derived from regressing R_{mt} on R_{pt} over the combined pre- and post-test periods.

The expected returns for each period in the test period can then be compared to the actual returns of the period to generate u_{pt} 's. The u_{pt} 's are estimates of the unexpected returns on the test portfolio during the period when the event or events of interest occurred. The significance of the u_{pt} 's can be measured statistically using the t-statistic defined in (4.9) below as AR_{pt} , the abnormal return on portfolio p in period t.

$$\begin{aligned} AR_{pt} &= [u_{pt} - E(u_{pt})]/\sigma(u_{pt}) \\ &= u_{pt}/\sigma(u_{pt}) \end{aligned} \tag{4.9}$$

The AR_{pt} 's may be interesting in and of themselves and they may be accumulated over two or more periods within the test period as follows:

$$CAR_{pk} = \left[\frac{\sum_{t=t_s}^{t_f} AR_{pt}}{\sum_{t=t_s}^{t_f} \sigma^2(AR_{pt})} \right]^{1/2}$$

but the AR_{pt} 's are approximately normally distributed standardized random variables with standard deviations of 1, so the cumulative abnormal return (CAR) can be defined as in (4.10) below.

$$CAR_{pt} = \left[\frac{\sum_{t=t_s}^{t_f} AR_{pt}}{(t_f - t_s + 1)} \right]^{1/2} \quad (4.10)$$

where CAR_{pk} is the cumulative abnormal return for some sub-period k (accumulation period) of the test period,

t_s is the first period of the accumulation period, and

t_f is the last period of the accumulation period.

Looking at cumulative abnormal returns will be especially useful when either two or more event dates are close together or when it is unclear as to the exact day of a particular event's hypothesized effect.

Daily Returns

Benefits

There are two major benefits to this study in using daily return data. First, tests for associations of price and risk changes with events of interest have the potential of being more powerful than tests using longer return periods. For example, if monthly data is used, the smallest period of time for which an unexpected return of a test port-

folio can be computed is one month. There is much greater potential for events other than those of interest to the study (noise) increasing $\sigma^2(u_{pt})$ and interfering with the researcher's ability to see any effect of the event of interest when examining an unexpected return for a month than when examining an unexpected return for a day. Of course this depends, too, on the researcher's ability to identify a particular day when the event would be hypothesized to have a significant effect. In this study the days of hypothesized effects of the publication of the social responsibility information are not difficult to identify. It will be much harder to identify the days when changes in risk and price are expected for events corresponding to increased pressures on firms to internalize pollution costs. However, the second benefit of using daily data is especially applicable to these events.

The second benefit is that daily data provides more observations in a shorter time period for the purposes of estimating the parameters of an estimation model. This is especially important in this study because, as will be outlined in the next chapter, in just 21 months there are four test periods with hypothesized significant events increasing pressures on firms to control pollution. Between the second and third such period, for example, there is only a space of two months. In order to isolate the effects of each of the four sets of events, it is desirable to avoid having the pre- or post-test period corresponding to one test period overlap another test period. Consequently, monthly data would result in two observations for the second post-test period and third pre-test period, and weekly data would provide nine observations; whereas daily data results in the availability of 38 observations

for the models needed to be estimated in this estimation period.

These benefits of using daily data are not obtained without cost. First there is the nuisance that some securities in a test portfolio may not be traded on any particular day. Those securities will not have observable returns for those days, and an ad hoc estimation procedure must be applied. Two additional difficulties result from the standard market model, discussed in the last section, being less descriptive of the stochastic relationship between the portfolio return, R_{pt} , and the return on the market portfolio, R_{mt} , when daily data is used. The first is that autocorrelation in standard market model residuals has been observed for daily data. The second is that due to non-synchronous last trades of securities on any given day, β_i is not likely to capture the full relationship between R_{it} and R_{mt} in the standard market model. These three methodological problems are discussed next.

Complications in Using Daily Data

No Trade on a Day for a Security

Recall from (4.4) that the return on day t for portfolio p is $R_{pt} = (1/n) \sum_{i=1}^n R_{it}$. If security i in portfolio p was not traded for an x -day period, then a rate of return must be assigned to that security for each of the $x + 1$ days, for which the daily return is not observable.

The procedure chosen is based on the assumptions that the return for the $(x + 1)$ -day period was earned evenly over that time and that returns are compounded daily. Let $t = a$ be the last day before the x -day period that a trade occurs on security i . Assuming there are no dividends or

stock splits, the return for the x -day period is

$$r = (P_{a+x+1} - P_a) / P_a,$$

and the return assigned to each of the $(x + 1)$ days is derived as follows:

$$(1+R)^{x+1} - 1 = r$$

$$R = (1+r)^{1/(x+1)} - 1$$

Then, the return, R , is assigned to each of the $x + 1$ days for which a daily return was not observable, and the return on security i on each day between trading-days is given as

$$R = R_{i,a+1} = R_{i,a+2} = \dots = R_{i,a+x+1}.$$

Autocorrelation

Recall that estimation of the parameters of the market model given in (4.5) depend on the assumption that the u_{pt} are independent random variables. The independence assumption has been shown empirically to be violated [Fama 1965] for daily return data. The consequences of autocorrelation in the u_{pt} 's are that estimates of β_p will be inefficient and estimates of $\sigma(u_{pt})$ will be understated [Johnston 1972].

Box and Jenkins [1970] have developed techniques for identifying models, efficiently and unbiasedly estimating parameters, and forecasting future expected values for both univariate and multivariate time series of autocorrelated random variables. The techniques specifically model the autocorrelation as part of the stochastic process generating the time series. In accordance with this approach the autocorrelation in daily return data will be specifically accounted for in the extended market model developed and used in this study.

The first step in modeling the autocorrelation of the daily returns is to identify a model that fits the autocorrelation in the data. This was done with regard to a major assumption of the dissertation - that the market is efficient with respect to publically available information. This assumption implies that no trading gains after allowance for transactions costs are systematically available based on publically available information. The history of a portfolio's return data is certainly information available to the public. Therefore, any systematic correlations in a portfolio's return series would be expected to be immediately eliminated by arbitrage profits in an efficient market. The transactions costs associated with very frequently buying and selling securities is apparently responsible for the persistence of some autocorrelation in daily return data. But one should not expect these types of profits on less frequent lower-transactions-cost trading strategies. In this regard Fama [1976, p. 142] summarizing empirical evidence writes:

. . . the results for very small filters . . . indicate that it is possible to devise trading schemes based on very short term (preferably intraday but at most daily) price swings that on average outperform buy and hold.

The above analysis led to the adoption of an MA-1 (first order moving average) model. As noted in Nelson [1973, p. 34]

a very important property of MA-1 is apparent from the autocorrelation function, namely, that its 'memory' is only one period long. A given observation, say, Z_{53} , is correlated with its predecessor, Z_{52} , and its successor, Z_{54} , but not with any other members of the series . . .

The identification of an MA-1 model of autocorrelation in daily returns implies the following extended market model:

$$R_{pt} = \alpha_p + \beta_p R_{mt} - \theta u_{p,t-1} + u_{pt} \quad (4.13)$$

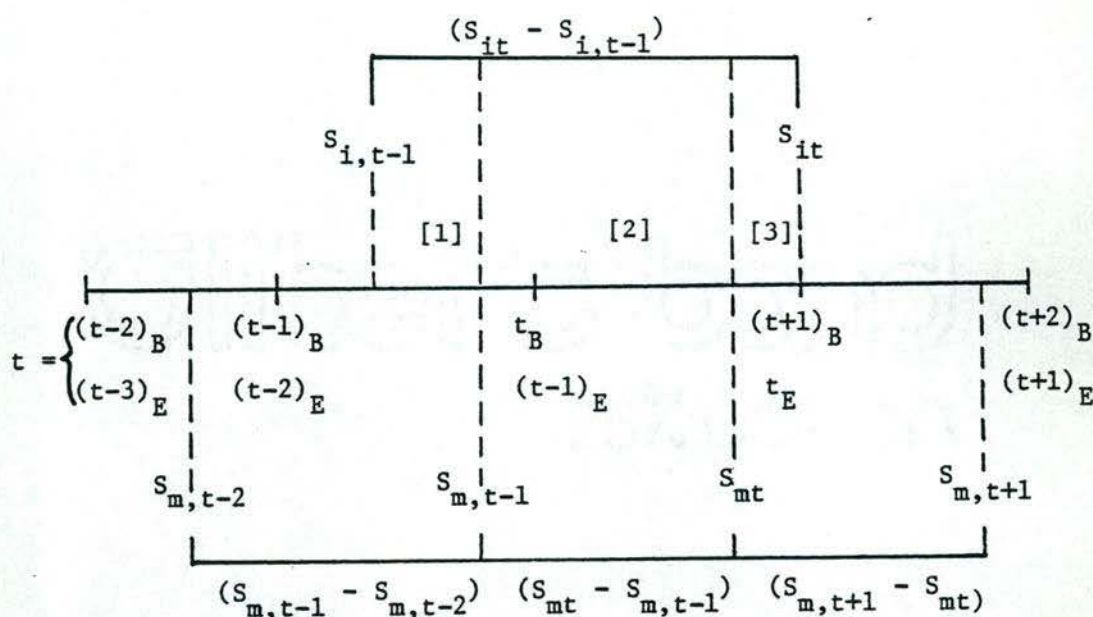
Non-synchronous Trading

Another problem faced in dealing with daily returns has been presented by Scholes and Williams [1977]. It is called the non-synchronous trading problem because it results from a situation where the last trade of security i on day t occurs at a different time than the last trades of other securities in the market portfolio. The problem will be demonstrated with an example. Assume for purposes of illustration that there is no autocorrelation in daily returns; and all securities in the market portfolio other than security i have their last trades at the same time on days, $t-1$, t , and $t+1$. The trading information is illustrated in Figure 4B below, where the subscript B means the beginning of trading, the subscript E means the end of trading, S_{it} is the total equity value of security i at the time of its last trade on day t , and S_{mt} is the total equity value of the market portfolio at the time of its last trade on day t .

As illustrated above one should not expect β_i from the standard market model to capture the entire relationship between the return on security i and the return on the market portfolio. For example, due to non-synchronous trading, the influence of market-wide events occurring in time period [1] above would be reflected in the measurement of the market return on day $t-1$, but would not be reflected in the return of

FIGURE 4B

Non-Synchronous Trading



security i , as it would be measured, until day t . Similarly, the market-wide events of period [3] would be reflected in the market return on day $t+1$ but would be reflected in the firm's return on day t . Based on this example, β_i of the standard market model should be expected to misestimate the relationship between security i and the market portfolio. This is due to certain information about the relationship being ignored. The inclusion of this extra information is not necessarily expected to cause the estimate of β_i to increase, but it is expected that the variance of β_i would decrease.

While the above example looked at an individual security's relationship with the market portfolio, the principle applies equally to the measurement of the relationship of a test portfolio with the market portfolio. Furthermore, the assumption that all securities in the market portfolio are traded at the same closing time is not restrictive. To demonstrate this it need only be noted that the covariance of the return on a test portfolio with the return on the market portfolio depends upon the individual covariances of the returns of all the securities in the test portfolio with the returns of all individual securities in the market portfolio.

Therefore, as with β_i above, one would expect, in the absence of autocorrelation of the return series, that β_p of the standard market model would be unbiasedly misestimated due to the problem of non-synchronous trading. Without the autocorrelation problem, the sum of the three betas in (4.14) below should capture the total relationship of R_{pt} with R_{mt} .

$$R_{pt} = \alpha_p + \beta_{1p} R_{m,t-1} + \beta_{2p} R_{mt} + \beta_{3p} R_{m,t+1} + u_{pt} \quad (4.14)$$

The fully extended market model, then, to allow for both non-synchronous trading and autocorrelation in daily data has been identified as (4.15) below.

$$R_{pt} = \alpha_p + \beta_{1p} R_{m,t-1} + \beta_{2p} R_{mt} + \beta_{3p} R_{m,t+1} - \theta_{p,t-1} u_{p,t-1} + u_{pt} \quad (4.15)$$

The next section describes the estimation of the parameters of the extended market model of (4.15) and its use in testing for risk and price changes as described earlier in the second major section of the chapter.

Estimation and Use of the Extended Market Model

The extended market model shown in equation (4.15) above identified and modeled two problems associated with the use of daily return data. The $\theta_{u_{p,t-1}}$ term is expected to control for any autocorrelation in the process being modeled which was identified as an MA-1. The three β 's (β_1 , β_2 , and β_3) are there to control for non-synchronous trading which could result in correlations of the portfolio returns with market returns of the same trading day, one trading day back, and one trading day forward. For descriptive purposes it would be nice if the significance of r measured the amount of autocorrelation in the process and the significance of β_1 and β_3 measured the significance of the non-synchronous trading problem. This, however, is not the case because of a multicollinearity problem. That is, to the extent that there is autocorrelation in the process, one would expect a relationship between R_{pt} and $R_{m,t-1}$ and between R_{pt} and $R_{m,t+1}$. For example, R_{pt} and $R_{p,t-1}$ are related due to autocorrelation, and we know that $R_{p,t-1}$ and $R_{m,t-1}$ are related, so there must also be a statistical relationship between R_{pt} and $R_{m,t-1}$. A similar case can be made for a relationship between R_{pt} and $R_{m,t+1}$ when autocorrelation is present.

The model estimation procedure to be discussed next does not attempt to purify the θ and β coefficients so that they are each only measuring one thing. The procedure is designed to do two important things. First it will produce only as complicated a model as is necessary to control for significant autocorrelation and non-synchronous trading - e.g., if it is found that autocorrelation and non-synchronous trading are not

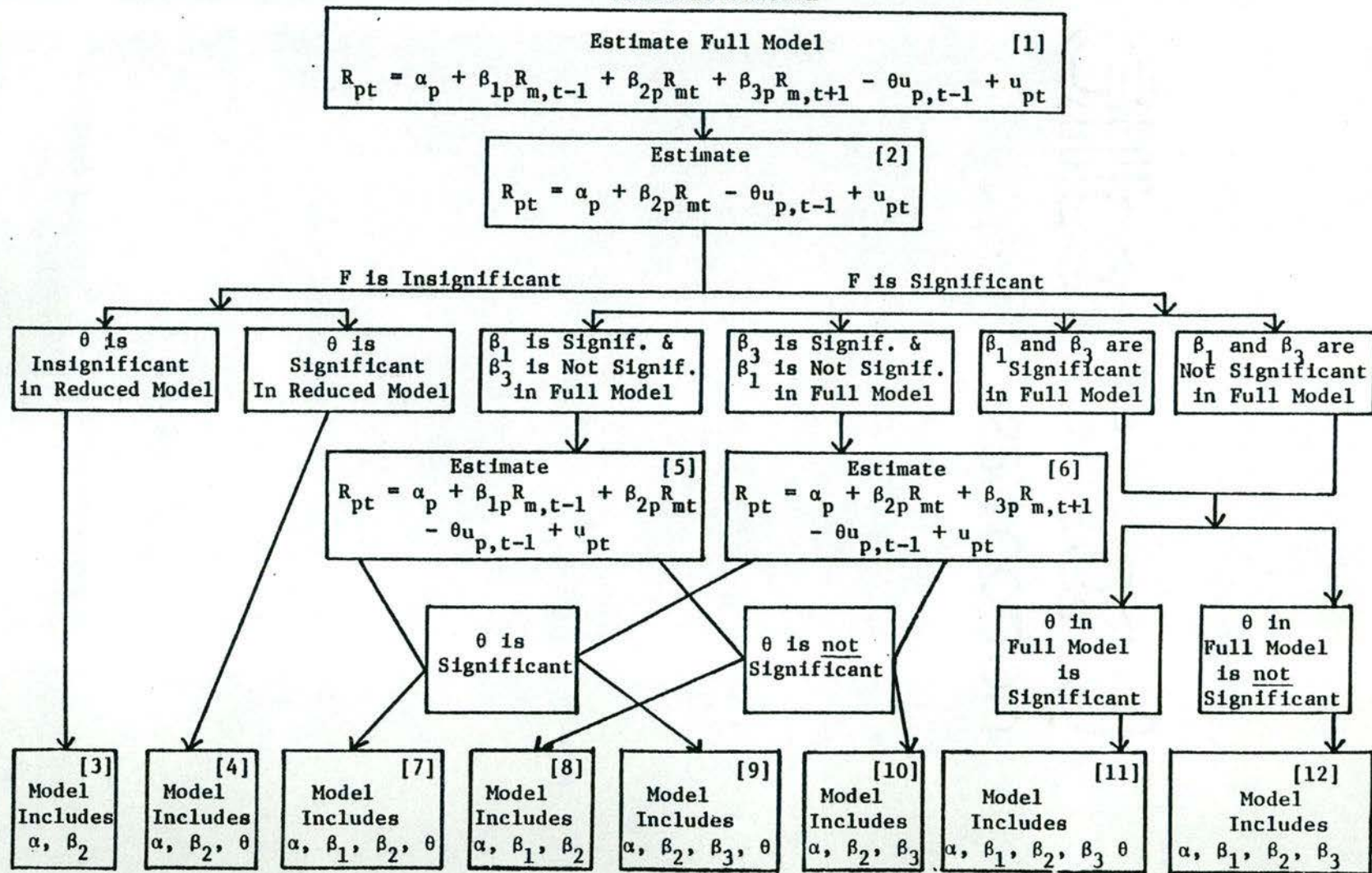
significant for a particular test period and test portfolio, then the standard market model with α_p and β_{2p} from (4.15) will result from the estimation procedure and be used in tests for risk and price changes. Secondly, it will only allow β_1 and/or β_3 into the model if they make a significant contribution toward explaining the stochastic process after θ is in the model - thus, the presence of β_1 and/or β_3 in the model ultimately used to test for risk and price changes will indicate a statistically significant non-synchronous trading problem for that test period and test portfolio. Since a major objective is to estimate changes in systematic risk as measured by the β terms, it is desirable to minimize the extent to which extra β terms are surrogates for autocorrelation terms. The next section describes the estimation procedure in detail followed by a section describing how the test procedures outlined for the standard market model will be used with the extended version.

Estimation

As indicated above, the objectives of the estimation procedure are to: a) derive the simplest market model possible while still controlling for any statistically significant autocorrelation and non-synchronous trading; and b) only allow β_1 and β_3 in the model if they are needed to control for statistically significant non-synchronous trading.

Figure 4C on the following page illustrates the estimation procedure. The first step at the top of the figure in box [1] is to estimate the parameters of (4.15) over the combined pre- and post-test

FIGURE 4C
Model Estimation



period. Then to determine whether non-synchronous trading is a significant problem, while controlling for autocorrelation, the reduced model shown in box [2] of Figure 4C is estimated. Following the figure down, an F test is then performed to see if including β_1 and β_3 in the model significantly reduces the unexplained variation of R_{pt} . If β_1 and β_3 are not jointly significant, then, as the figure shows, the significance of θ without β_1 and β_3 in the model is evaluated. This is done by examining the t-statistic, $r/\sigma(r)$, associated with the r estimated in box [3]. If θ is insignificant then the standard market model represented in box [3] would be used to test for risk and price changes. If θ is significant then the estimation model to be used is represented in box [4] of the figure.

Now assume β_1 and β_3 are found to be jointly significant in the fully extended market model in box [1] by means of the F-test comparing the unexplained variance of that model with that of the reduced model in box [2]. The next step simplifies the model to the extent possible by removing β_1 or β_3 if either but not both have insignificant t-statistics, $b/\sigma(b)$, in the fully extended market model shown in box [1]. Then, the t-statistic associated with θ is examined in the fully extended model of box [1], the reduced model of box [5], or the reduced model of box [6], depending on whether non-synchronous trading needs to be modelled with both β_1 and β_3 , only β_1 or only β_3 . The significance of θ combined with the β 's necessary to model the effect of non-synchronous trading determines the form of the final model to be used in tests of risk and price changes. The possible forms the final estimation model can take when non-synchronous trading is significant are

represented in boxes [7] through [12] of Figure 4C.

The procedure described above results in a final estimation model that is as simple an extension as possible from the standard market model, while still controlling for the effects of autocorrelation and of non-synchronous trading. The presence of β_1 and/or β_3 in the final model indicates a statistically significant non-synchronous trading phenomenon. The next section will describe how the final model will be used to perform the tests for risk and price changes outlined previously for the standard market model.

Extended Market Model: Tests for Risk and Price Changes

Once the simplest possible form of the extended market model has been estimated, the tests for risk and price changes described previously, in the section entitled "More Detailed Procedures" under the sub-headings "A Test for Risk Changes" and "Significance of Unexpected Returns" can be applied directly.

The test for risk changes shown previously in (4.7) and (4.8) with reference to Figure 4A would also be used with the extended model. For example, if the fully extended market model were the final estimation model, the estimation model allowing for a change in risk from the pre- to post-test period given in (4.7) for the standard market model is given in (4.16) below for the fully extended market model.

$$R_{pt} = \alpha_p + I(\beta_{1p} R_{m,t-1} + \beta_{2p} R_{mt} + \beta_{3p} R_{m,t+1}) + I^*(\beta_{1p}^* R_{m,t-1} + \beta_{2p}^* R_{mt} + \beta_{3p}^* R_{m,t+1}) - \theta u'_{p,t-1} + u'_{pt} \quad (4.16)$$

with I and I^* defined as before.

The model in (4.16), then, is the full model for purposes of testing for a change in risk associated with the events of the test period. The reduced model would be the fully extended market model shown in (4.15) estimated over the same combined pre- and post-test period data.

The significance of having the β^* terms in the model to account for any change in risk is measured by an F-statistic like the one shown in (4.8), except for two modifications. First, the number of observations of u_{pt} decreases from T to $T-2$ (the first observation of the pre-test period and the last observation of the post-test period are lost). This is due to missing $R_{m,t-1}$ on day 1 of Figure 4A and $R_{m,t+1}$ on day t_C of Figure 4A. Secondly, the extra β terms change the degrees of freedom associated with the F-statistic. It is now an F with 3 and $T-2-5$ degrees of freedom as shown in (4.17) below.

$$F = \frac{\{[\sigma^2(u_{pt})](T-5-2) - [\sigma^2(u'_{pt})](T-8-2)\}/3}{\{[\sigma^2(u_{pt})](T-5-2)\}/(T-5-2)} \quad (4.17)$$

$$\text{where } T = t_A + t_C - t_B$$

Use of an extended market model requires no modification of the tests described previously that assess the significance of unexpected returns in the test period. All of the statistics shown in (4.9) through (4.12) (computations of daily abnormal returns and of cumulative abnormal returns for both a single portfolio and the difference between two portfolios) start with u_{pt} . It does not matter what market model the u_{pt} came from. However, the use of the extended market model results in uncorrelated and lower variance u_{pt} 's, so it should also

result in better estimates of the significance of unexpected returns in the test periods. The u_{pt} 's are uncorrelated due to the specific modeling of autocorrelation and they should have a lower variance due to the additional explanatory power of the model when non-synchronous trading is accounted for.

Summary

This chapter has developed the statistical methodology to be used in the next two chapters to test for risk and price changes of test portfolios associated with events of interest occurring in selected test periods. Some test periods will include events that increased social pressures on firms to internalize the social cost of pollution. Other test periods will include the dissemination of information concerning the degree to which firms are internalizing these social costs.

A rationale for the use of the market model was given in the early part of this chapter. Then the basic testing procedures were outlined in the middle section. An extended market model appropriate for the use of daily return data was developed in the last section.

Chapters V and VI develop the specific hypotheses of the study with reference to the theoretical analysis of Chapter III; describe the selection of firms included in the test portfolios and the definition of events of interest along with associated test periods; apply the statistical methodology developed in this chapter; and give the results of the study. Chapter V is specifically concerned with assessing the association of changes in risk and price of equity with events increasing pressures for pollution control. Chapter VI assesses the as-

sociation of these changes with the dissemination of social responsibility information.

CHAPTER V

THE SIGNIFICANCE OF SOCIAL PRESSURES
TO INTERNALIZE SOCIAL COSTS

In Chapter II the social accounting literature was reviewed and the prospective contribution of this study was specified. It was noted that the major questions to be addressed are: 1) whether a liability with significant market value arose when events occurred that could have increased social pressures on firms to internalize social costs; and 2) whether significant use has been made by investors, in the aggregate, of social accounting information. Chapter III analyzed the theoretical effects that such pressures and subsequently disseminated information would have on investment decision parameters. Using the methodology described in Chapter IV, the dissertation now turns towards empirical answers to questions (1) and (2) above.

This chapter identifies events, corresponding to increased pressures on firms to internalize the social cost of pollution. The events are hypothesized to have significantly increased the probability that these pressures would be institutionalized and result in expressed changes in the firms' social contracts. The design and results of tests of the significance of the events to investors are reported. To ease the exposition these events will be referred to as the social pressure events. Chapter VI will report the design and results of tests of significance

to investors of the release of information in seven reports on social responsibility published by the Council on Economic Priorities. These reports will be referred to, henceforth, as the CEP reports.

The primary experimental group for all tests consists of firms included in the CEP reports (CEP firms). This will be the only experimental group used for tests in this chapter - the CEP firms comprising this group, as will be described below, are expected to be especially sensitive to the social pressure events. In addition to the experimental group of CEP firms, other experimental groups of non-CEP firms will be used for tests in Chapter VI. These other experimental groups will be useful for tests designed to assess the nature and strength of any regulatory effect of the CEP reports. The rationale for the formation of each experimental group will be given as the tests and results are presented in this chapter and in Chapter VI.

The first section of this chapter reviews the relevant theory presented in Chapter III and states the corresponding hypotheses to be tested. The second section specifies the choice and content of the experimental group of firms. The third section describes the process by which social pressure events of hypothesized significance were selected for analysis and defines the corresponding test and estimation periods. The fourth section gives the test design and results.

Review of Theory and Statement of Hypotheses

In Chapters II and III the concept of a social contract was described as an expressed or implied agreement that a firm has with

society, which imposes certain constraints on the firm's behavior. It was noted that events can occur that change a firm's social contract with respect to its use of public goods, such as air and water. The original social contract may not have required that the firm keep the air and water free of pollution. As a result the pollution could have built up over time until it came to be regarded by society as a significant social cost. Then certain events (social pressure events) could occur that result in a change in the firm's social contract. The change would be such that the firm is expected, after the social pressure events, to internalize part or all of the social cost of the pollution.

With reference to the capital asset pricing model, the theoretical effect of social pressure events was analyzed in Chapter III where it was shown that the events are expected to cause a decrease in the equity value and an increase in the risk of affected firms. The results of the analysis, showing a decrease in the equity value of the firm, were based on the supposition that, subsequent to the change in their social contract, firms would have to invest in pollution control projects that otherwise would have been rejected because their expected return would not have been commensurate with their risk. The decreased equity value of the firm was then viewed as a new debt to society equal to the present value of the social costs to be internalized. This view led to the conclusion that the financial risk of the firm would increase as a result of a significant social pressure event.

Based on the theoretical analysis just reviewed, the following general hypotheses will be tested in this chapter to assess the sig-

nificance to investors of the social pressure events chosen for analysis.

- H₀₁ Events increasing pressures on firms to internalize the social cost of pollution were not associated with an increase in the systematic risk of the constrained firms.
- H_{A1} Social pressure events were associated with an increase in the systematic risk of the constrained firms.

- H₀₂ Social pressure events were not associated with a decrease in the equity security prices of the constrained firms.
- H_{A2} Social pressure events were associated with a decrease in the equity security prices of the constrained firms.

The Experimental Group

Why the CEP Firms?

The experimental group of firms constrained by the social pressure events consists of firms included in the first CEP report on each of the four industries that were studied by the CEP. The four industries studied were the Pulp and Paper Producing Industry (Paper), the Electric Utilities Industry (Power), the Steel Producing Industry (Steel), and the Oil Refining Industry (Oil). The reports on the firms in these industries were all published after the last social pressure event chosen for analysis. (These publication dates were noted in Chapter II and will be referenced again in the next chapter (Table 9) as CEP report test periods are defined.)

The CEP firms were chosen as the main experimental group because the effects described in Chapter III, if present, are likely to be strongest for this group of firms. The CEP systematically chose to study the in-

dustries with the most severe pollution control problems, and the largest firms in each industry were the ones chosen for inclusion in the CEP reports. Watts and Zimmerman [1978] have noted that the larger firms are more likely to incur political costs in response to regulatory pressures. In Chapter III it was argued that the firms that incurred the most political costs would be the ones that had more exposure to the pressures to internalize social costs. While one would not expect the political costs to be incurred unless the firms expected a net benefit, less visible firms would also be expected to benefit as "free riders." Thus, the net effects of the pressures are still expected to be greater for the larger more visible firms.

A further indication that the CEP firms would be more sensitive to the impact of the social pressure events is the mere fact that the CEP, a public-interest group dedicated to promoting firms' social responsibility through market mechanisms by increasing investor awareness of the degree to which social costs result from the firms' activities, chose these firms to include in their reports. Furthermore, Lieber [1975] notes that when the EPA started up it systematically chose to make examples of the larger more visible polluters. Thus, one can reasonably expect that these firms would be the likely ones to be pressured into being the leaders in fulfilling the terms of the new social contracts imposed on polluting firms, in general, by the social pressure events. All firms would eventually be held accountable to the same new standards of social performance, but because of their visibility, the CEP firms are likely to be forced to respond sooner to the new terms of their social contracts. This issue of the timing of compliance was not

directly addressed in the single-period framework of the analysis in Chapter III, but basic present value analysis should lead one to the conclusion that the drop in the market value of the equity of CEP firms and correspondingly the increase in their systematic risk would be relatively greater than those effects for other less visible firms in the same industry or in other polluting industries.

Exclusion of Some CEP Firms

Not all firms in the CEP reports were included in the experimental group. Consolidated Papers (Paper), and Tennessee Valley Authority (Power) were excluded from the sample because they were not listed on the University of Chicago CRSP (Center for Research in Security Prices) tapes of daily returns of all companies traded on the New York and American Stock Exchanges at the time of the release of the CEP reports.

Five additional firms in the Paper Group were eliminated from the sample because their primary business interests were in other relatively non-polluting activities. These firms were Owens-Illinois, Continental Can, American Can, Georgia Pacific, and Marcor. Finally, Portland General Electric, a member of the Power Group, was eliminated because it was a hydroelectric operation, which is relatively non-polluting. All other power companies in the sample are fired by fossil fuels.

The CEP firms remaining in the sample after application of the exclusion criteria are listed in Appendix A-1. For each firm the first and last dates of the time series of returns on the CRSP tapes and identifying (CUSIP) number are given. There are 18 paper companies, 18 power companies, seven steel companies, and eight oil companies listed

in Appendix A-1. However, four of the power companies (designated with the letter E1) were not included in the first CEP report on that industry and are therefore not in the sample for tests of the significance of the social pressure events (hypotheses H_{01} and H_{02} in this chapter). This leaves a total of 47 firms in the experimental group.

The Time Series of Returns

A single time series of returns is formed for the experimental group for each test period and corresponding estimation periods. Recall from equation (4.4) in Chapter IV that the return on a portfolio is computed as $R_{pt} = (1/n) \sum_{i=1}^n R_{it}$. For each day of each test and estimation period, a portfolio return, R_{pt} , will be computed for each of the four industries represented in the experimental group. If a particular firm was not listed on the CRSP tapes for any particular day, it is left out of the computation of R_{pt} , and n for that industry is consequently reduced on that day. Once the R_{pt} 's are formed for each portfolio, they are summarized into the single time series, R_{gt} , shown in (5.1) below.

$$R_{gt} = \ln[1 + (1/k) \sum_{p=1}^k R_{pt}] \quad (5.1)$$

where k is the number of portfolios in the group (in this case 4);

and g represents the experimental group.

In this manner equal weight is given to each portfolio within an experimental group, so that an industry with a relatively large number of companies does not dominate the results; and the final time series of returns analyzed are converted into continuously compounded daily rates.

The R_{gt} of (5.1) are therefore the time series of continuously compounded daily rates of return for the experimental group within each test and estimation period.

The hypotheses to be tested were stated in the first section of this chapter, and the experimental group with its corresponding time series of returns was defined in this section. The next section describes the process of identifying social pressure events of hypothesized significance and defines the corresponding test and estimation periods.

The Social Pressure Events and Corresponding Test and Estimation Periods

The Choice of Social Pressure Events

Pressures were building in the late 1960's and early '70's that eventually led to the passage by Congress of two major pieces of pollution control legislation: the Clean Air Act Amendments of 1970 (CAAA), signed into law on December 31, 1970; and the Federal Water Pollution Control Act Amendments of 1972 (FWPCAA), passed over a presidential veto on October 18, 1972. This far-reaching legislation set certain enforceable deadlines that all firms had to meet to be using state-of-the-art pollution control equipment and to have reduced emissions of pollutants to certain specified levels. The Environmental Protection Agency (EPA) became effective on October 2, 1970, with the necessary power to operationalize and enforce the coming legislation.

Unfortunately, the dates of the passage of the above legislation and creation of the EPA, even if significant to investors, would not be expected to create much of a stir in a market that is efficient with

respect to publically available information. Events undoubtedly occurred earlier that created pressures that simply became institutionalized by means of the passage of legislation and creation of the enforcement agency. To the extent that the earlier significant events were publically known, the institutionalization would have been unbiasedly predicted by an efficient market. The variance of the prediction would be expected to decrease as the pressures built. What were these earlier events that significantly increased the pressures and corresponding probability of legally required internalization of social costs of pollution?

There is no way to provide a definitive answer to this question. No scientific theory exists for defining the major event or events that led to or caused a historical phenomenon. For example: what events significantly increased the probability that the United States would actively enter World War II? Historians can only hypothesize the events that led to the United States' entering the War and would be more hard-pressed to say which of the events significantly increased the probability of war (e.g., when the Japanese bombed Pearl Harbor the War may already have been predictably inevitable and the probability of war may not have increased that much). These hypotheses are difficult to test. One by-product of this dissertation is that some insight is provided into a potential method for testing hypotheses such as these. If one is willing to assume that the efficient markets hypothesis is true in the semi-strong form, and that there is theoretical support for the type of effect a historical phenomenon is expected to have on the publically traded equity of certain subsets of firms; then one can test

the significance of events hypothesized to have precipitated the historical phenomenon, using a methodology that analyzes the security price and/or risk changes associated with the events of hypothesized significance.

In this dissertation what is being tested are hypotheses about the significance of a historical phenomenon to investors. Therefore, the tests will be joint tests of three alternative hypotheses: the market is semi-strong efficient; the events chosen for analysis did significantly increase the probability that the historical phenomenon of interest would occur; and investors, in the aggregate, considered the historical phenomenon to be significant in evaluating the price and risk of equity securities of firms. Negative results could be due to any one of the alternative hypotheses being false. Positive results support the conclusion that all three are true.

The empirical analysis used to hypothesize significant event periods was to conduct a detailed historical review of the 5-year period from 1968 to 1972. The following sources were consulted:

1. Congressional quarterlies;
2. BNA (Bureau of National Affairs) weekly environmental reporter;
3. Wall Street Journal Index and articles;
4. New York Times Index and articles;
5. Council on Environmental Quality reports;
6. The Environmental Era: A Chronological Guide to Policy and Concepts, 1962-1972 (Shelton 1973).

From the historical review six precipitators were identified that helped to create a political environment amenable to the passage and subsequent

enforcement of the CAAA and the FWPCAA.

The first was the Santa Barbara oil leak which occurred on January 28, 1969. On that day a Union Oil drilling operation off the coast of Santa Barbara caused an oil spill that dramatically aroused public concern over environmental matters. This event has been commonly viewed by historians as giving the environmental movement the necessary springboard for the reshaping of U.S. environmental policy that occurred in the early 1970's. Shelton [1973] notes, with reference to public opinion polls and the growth of environmentally concerned organizations, that 1969 was the year of dramatic "awakening of public concern" for the environment. While offering no hypotheses of his own (as to what caused this awakening), he does refer to the suggestion of other historians that the "Santa Barbara oil spill radicalized a sizable segment of the public on the pollution issues" (p. 211). Lieber [1975], for example, refers to the event as this type of catalyst.

The second precipitator was the passing of the National Environmental Protection Act of 1969. This Act was a policy statement that became the cornerstone of the environmental era in the United States. Among other things, it required all federal agencies to review their policies making sure they were consistent with the promotion of environmental protection. Later, the SEC was, in fact, sued under this provision of the law by a public interest group that claimed that the SEC needed to require more extensive disclosure of environmental matters in corporate 10-K's. According to Shelton [1973, p. 316]

Both administrative and legal approaches to environmental concerns were revolutionized by the act and a whole set of new legislative approaches were soon proposed. New issues . . .

came to the fore within the context of national environmental policy. And national action stimulated a significant reaction among State governments.

The third significant precipitator identified from the historical analysis was President Nixon's Environmental Message to Congress given on February 10, 1970. The surprisingly far-reaching legislation proposed in this message made it clear for the first time that Nixon had jumped on an environmental bandwagon and that it was definitely politically popular to strongly support environmental protection.

The process of getting the bills, that were being formed into the CAAA and the FWPCAA, into and through Congressional Committees was considered significant, in itself, as a necessary precipitant setting the right political climate for the eventual enactment of the legislation. Congress tackled the clean air bill first and there was much pressure exerted by industry on both Houses to try to stop or water down this legislation. Congress's ability to withstand this pressure was significant.

Another event of historical significance was Earth Day on April 22, 1970. Many more people than expected were drawn to teach-ins and demonstrations promoting environmental concern and protection. It was estimated in Newsweek [May 4, 1970, p. 26] that 15 to 20 million people participated on 2,000 college campuses and in 10,000 schools. It was evident that the public was ready to force a significantly higher level of environmental responsibility on industry. Lieber [1975] refers to the event as the beginning of the movement that caused sustained legislative interest. As described in Shelton [1973],

. . . more than anything Earth Day marked the active emergence of student concern for the environment and the high point of popular sensitivity to environmental issues. Students and the general public thenceforth joined professional conservationists and concerned politicians in an increasingly broad-based approach directed toward achievement of environmental quality. For the public as a whole, historians might well term Earth Day as the first day of the current environmental era.

Finally, the creation of the EPA was significant because without effective operationalization the legislation on its way to being passed would be meaningless. The function of the EPA would be to set standards of environmental performance consistent with the legislation and to enforce those standards by administering fines and bringing suit. Lieber [1975] notes that "within the first few months (of its existence) EPA officials initiated 185 actions against air and water pollution violators."

The next stage in the development of event periods was to identify from the historical analysis significant dates associated with each of the six precipitators discussed above. Dates were chosen that were hypothesized to be associated with a significant increase in the probability that enforceable far-reaching environmental legislation would be passed. The dates chosen are listed below.

- 1/15/69 Senator Muskie introduced a clean water bill that focussed strongly on oil spills and thermal pollution.
- 1/28/69 The Santa Barbara oil leak occurred.
- 2/18/69 Senator Jackson introduced the National Environmental Protection Act (NEPA) in his sub-committee.
- 12/22/69 The House approved NEPA (it had been approved by the Senate two days earlier on a Saturday).
- 1/22/70 Nixon's State-of-the-Union Address emphasized en-

vironmental matters and pointed toward more specific details in a special message to Congress coming on February 10.

- 2/10/70 President Nixon delivered his Environmental Message to Congress.
- 4/22/70 Earth Day occurred.
- 6/ 3/70 The House approved its version of the CAAA which was much stronger than the President had proposed.
- 8/20/70 Muskie's Senate Sub-committee reported out the bill that would become the CAAA. According to the BNA Environmental Weekly Reporter, this proposed bill was a radical departure in regulatory history in that it would require industry to reduce harmful emissions by certain deadlines whether or not the technology was available or cease operation.
- 9/10/70 In spite of intense lobbying by industry, the Senate Public Works Committee approved the Muskie clean air bill much as it had been received from the sub-committee.
- 9/28/70 The last opposition to the creation of the EPA was squelched in the House.

The next section describes the formation of test and corresponding estimation periods that include the events listed above.

Social Pressure Test and Estimation Periods

Focussing on the event dates listed above, the test periods were formed as follows. First, five trading days on either side of each event date were included in the test period. Thus, each test period would be at least an 11-trading-day period centered on the event date. Secondly, any two event dates that were less than 41 trading days apart were included in the same event (or test) period. This would insure that there would be at least 30 days between test periods that could be used for model estimation. This resulted in the formation of four test

periods, SP1 through SP4, with corresponding estimation (pre- and post-test) periods as shown in Table 1.

The top half of Table 1 gives information about the test periods, and the bottom half describes the pre- and post-test estimation periods. In the test periods section, the first column gives each test period an identification code. The second column shows the first and last calendar dates of the test periods. The hypothesized periods of significant social pressure events (as listed previously in this chapter) begin on January 8, 1969 and end on October 5, 1970. It is during these 21 months that the most significant increases in the assessed probability of enactment and enforcement of significant pollution control legislation are hypothesized to have occurred. The third column of Table 1 gives the number of trading days, $t_B - t_A$, in the test period. These parameters refer to Figure 4A in Chapter IV where t is defined as the trading day, t_A is the last trading day of the pre-test period, t_B is the last trading day of the test period, t_C is the last trading day of the post-test period, and t ranges from 1 to t_C . The last two columns of the test periods section of the table gives the event dates, which were listed earlier in this chapter, with the corresponding trading day number of the test period.

The bottom half of Table 1 give the parameters of the estimation periods associated with each test period. Each pre- and post-test period is designed to be as long as possible, up to 100 days, without intersecting with a test period. For example, in the case of the social pressure event periods, the test periods SP2 and SP3 are closest together. The pre-test period for SP3 is 38 trading days long and it is

TABLE 1
Test Periods and
Estimation Periods
Periods of Pressures to Internalize
Social Costs of Pollution

Test Periods				
Period I.D.	Calendar Time	$t_B - t_A$	Events Dates	t
SP1	01/08/69-02/26/69	34	01/15/69 01/28/69 02/18/69	6 15 29
SP2	12/15/69-02/17/70	45	12/22/69 01/22/70 02/10/70	6 27 40
SP3	04/15/70-06/10/70	41	04/22/70 06/03/70	6 36
SP4	08/13/70-10/05/70	37	08/20/70 09/10/70 09/28/70	6 20 32
Estimation Periods				
Period I.D.	Pre-test Period		Post-test Period	
	Calendar Time	t_A	Calendar Time	$t_C - t_B$
SP1	07/18/68-01/07/69	100	02/27/69-07/23/69	100
SP2	07/24/69-12/12/69	100	02/18/70-04/14/70	38
SP3	02/18/70-04/14/70	38	06/11/70-08/12/70	44
SP4	06/11/70-08/12/70	44	10/06/70-12/04/70	43

The t's refer to trading days in a test or estimation period. Recall from Figure 4A of Chapter IV that the time series of interest has t_A observations in the pre-test period, $(t_B - t_A)$ observations in the test period, and $t_C - t_B$ observations in the post-test period, where t is the trading day and it can range from 1 to t_C .

identical to the post-test period for SP2.

More detailed information about each social pressure test period is given in Appendix B, which is presented in four parts, B-1 to B-4. Appendix B lists the calendar dates for each social pressure test period, with the corresponding trading day number. Then a historical analysis of the test period is shown where, along with descriptions of the events of hypothesized significance shown in this chapter, other events related in general to the building pressures of the environmental movement are noted. While these other events were not hypothesized to be as significant in their effects on the assessed probability of enactment of the CAAA and FWPCAA, they are potentially significant, especially when considered in combination with one another and with the events already described and shown in Table 1. For example, for test period SP1, Appendix B-1 shows the degree of attention that the Administration, via Secretary of the Interior Hickel, gave to the Santa Barbara oil leak. This could be significant since Hickel was not, at least prior to this, thought of as an environmentalist. As a matter of fact, environmentalists had been dissatisfied with his appointment. Commenting on the December 18, 1969 press conference held after Hickel's nomination by Nixon, a New York Times editorial said ". . . Nixon's choice . . . has confirmed the worst fears of those who regard the restoration and conservation of a ravished continent and purification of its polluted air and water as priority business for this generation of Americans" [quoted in Shelton 1973, p. 212]. Additional reference will be made to the historical analysis in Appendix B as results are presented in the next section.

The hypotheses to be tested have been stated, the experimental group has been defined and test periods have been delineated with hypothesized significant event dates and periods. The next section will apply the methodology developed in Chapter IV to test for: a) significant increases in risk of the experimental group from the pre- to post-test periods surrounding each test period; and b) significant decreases in prices during each test period.

Tests of Association Between
Social Pressure Events and Changes in Firms'
Systematic Risk and Security Prices

The Estimation Model

Following the methodology developed in Chapter IV, the first step in testing the association of social pressure events with increases in systematic risk (H_{A1}) and with decreases in security prices (H_{A2}) is to estimate the parameters of the extended market model. This model controls for autocorrelation and non-synchronous trading and was developed in (4.5). It is reproduced below as (5.2).

$$R_{gt} = \alpha_g + \beta_{1g} R_{m,t-1} + \beta_{2g} R_{mt} + \beta_{3g} R_{m,t+1} - \theta u_{g,t-1} + u_{gt} \quad (5.2)$$

Note that the subscripts, p, in (4.15) have been replaced by g's in (5.2) above. The R_{gt} is the time series of daily continuously compounded returns for the experimental group across four industry portfolios, as was described earlier in (5.1). The model in (5.2) is estimated, following the procedure described in Figure 4C of Chapter IV whereby the result is the simplest estimation model possible without

significant loss of explanatory power. As explained in Chapter IV the resulting estimation model should only include a β_1 or β_3 term if non-synchronous trading is empirically significant for the experimental group and time period being analyzed.

The four estimation models resulting from the process just reviewed are given in Table 2 for the estimation periods associated with test periods SP1 to SP4. The symbol "NA" in the table indicates that the beta parameter was not significant by itself or in conjunction with the other beta parameter used to model non-synchronous trading. Thus, non-synchronous trading was not an empirically significant phenomenon for the CEP firm group in producing estimation models for any of the social pressure periods. For each parameter estimate given in Table 2, the corresponding t-statistic indicating the significance of the parameter, is given in parentheses. The degrees of freedom for the t-statistics would equal the value for T in the last column of the table less the number of parameters in the model. In each case, T represents the number of u_{gt} 's in the combined pre- and post-test period used to estimate the model. Two observations are lost, as was described in Chapter IV, because the model requires an observation of the market return one day forward and one day back. With the exception of α in SP2, all parameters are significantly different from zero at alpha equal to ten percent or less. Autocorrelation is significant in every social pressure period as can be seen by the t-statistics associated with the θ parameter estimates. The number of CEP firms listed on the CRSP tapes and included in the experimental group is given in the table as n.

TABLE 2
Estimation Models for CEP Firms
for Social Pressure Periods

SP Period	α	β_1	β_2	β_3	θ	n	$T = \frac{(t_A - 1) + (t_C - t_B - 1)}{2}$
1	.0005 (1.67)	NA	.7396 (21.54)	NA	-.2747 (-3.96)	46	198
2	.0002 (.54)	NA	.7278 (19.73)	NA	-.3556 (-4.30)	47	136
3	.0022 (4.06)	NA	.8586 (16.62)	NA	-.3266 (-3.00)	47	80
4	.0018 (3.29)	NA	.7777 (13.40)	NA	-.2078 (-1.92)	47	85

Notes:

The numbers in parentheses under the parameter estimates are t-statistics.

The SP periods correspond to those described in Table 1.

α , β_1 , β_2 , β_3 , and θ are as defined in (5.2).

n is the number of CEP firms (out of 47) listed on CRSP during the period.

T is the number of observations (trading days) in the combined pre- and post-test periods, from which the estimation model was derived - t_A , t_B , and t_C are as defined in Figure 4A.

NA indicates that the parameter was insignificant per the analysis in Figure 4C.

Tests for Risk Increases (H_{A1})

Design

The next step in the testing procedure is to examine the significance of any change in systematic risk from the pre- to post-test period surrounding each test period, SP1 to SP4, for the CEP firm group. As explained in Chapter IV the extended market model just estimated becomes the reduced model in testing for shifts in beta. For each of the four social pressure periods the reduced models, as shown in Table 2, are of the form shown in (5.3) below.

$$R_{gt} = \alpha_g + \beta_{2g} R_{mt} - \theta_{g,t-1} u_{gt} + u_{gt} \quad (5.3)$$

Then as explained in Chapter IV the full model in each case adds only as many β^* terms as there were β 's in the estimation model. For each social pressure period the full model for the CEP firms is given in (5.4).

$$R_{gt} = \alpha_g + I\beta_{2g} R_{mt} + I^* \beta_{2g}^* R_{mt} - \theta_{g,t-1} u_{gt} + u_{gt} \quad (5.4)$$

$$\text{where } I = \begin{cases} 1 & \text{for } t = 2, 3, \dots, t_A \\ 0 & \text{for } t = t_{B+1}, \dots, t_{C-1} \end{cases} ;$$

$$I^* = \begin{cases} 0 & \text{for } t = 2, 3, \dots, t_A \\ 1 & \text{for } t = t_{B+1}, \dots, t_{C-1} \end{cases} ; \text{ and}$$

$$T = t_A + t_C - t_B - 2.$$

Then as given in (4.17) and reproduced in (5.5) below for the case where both β_1 and β_3 are left out of the model, the F statistic used to measure the significance of any change in systematic risk is

$$F = \frac{[\sigma^2(u)](T-3) - [\sigma^2(u')](T-4)}{\sigma^2(u)} \quad (5.5)$$

The parameters of (5.4) and the corresponding F statistics of (5.5) are given for the CEP firm group for each social pressure period in Table 3.

Results

The results in Table 3 show highly significant changes in β_2 from the pre- to post-test periods for the first two event periods. The probability is less than one-tenth of one percent that there was not a change in β_2 from the pre- to post-test periods surrounding the first test period. The similar type-one error for the second social pressure period is less than one-half of one percent. Thus the null hypothesis of no association of social pressure events with increases in systematic risk (H_{01}) is emphatically rejected for SP1 and SP2. The events of hypothesized significance in SP1 were: the introduction by Muskie in sub-committee of S7, a bill that would impose constraints on firms to reduce water pollution and that was especially concerned with oil spills; the Santa Barbara oil leak; and the introduction of NEPA by Jackson in sub-committee. The events of hypothesized significance in SP2 were: Congressional approval of NEPA; Nixon's State-of-the-Union Address; and the delivery by Nixon of his Environmental Message with much stronger than expected proposals for environmental legislation. These six events were associated with significant increases in the systematic risk (as measured by β from the extended market model) of the experimental group (the CEP firms). Similar results are not found for SP3 or SP4 and H_{01} is not rejected for these latter two periods.

TABLE 3

Risk Shift Models for CEP Firms
for Social Pressure Periods

SP Period	α	β_2	β_2^*	θ	F
1	.0006 (2.24)	.5917 (11.32)	.8306 (19.09)	-.2697 (-3.88)	11.60
2	.0003 (.68)	.6669 (16.58)	.9347 (12.20)	-.3597 (-4.31)	9.07
3	.0022 (4.11)	.8958 (10.44)	.8349 (12.95)	-.3159 (-2.85)	.32
4	.0018 (3.21)	.8149 (10.93)	.7180 (7.50)	-.2353 (-2.11)	.58

All parameters, including the F-statistic are defined in (5.4) and (5.5).

Tests for Price Declines (H_{A2})

Design

As noted in Chapter IV the reduced form of the extended market model is used to generate expected returns for an experimental group in a test period. For the CEP firm group for all social pressure test periods, this model was given in (5.3), and its parameter estimates were given in Table 2. Thus, the unexpected return on each day of each social pressure test period for the CEP firm group is

$$u_{gte} = R_{gte} - (\alpha_{ge} + \beta_{2ge} R_{mt} - \theta_{ge} u_{g,t-1,e}) \quad (5.6)$$

where e represents the social pressure test period and ranges from 1 to 4.

Then, as explained in Chapter IV and given in (4.9), abnormal returns for each test period day are measured as

$$AR_{gte} = u_{gte} / \sigma(u_{gte}) \quad (5.7)$$

where $\sigma(u_{gte})$ is the standard deviation of the u_t 's from (5.6) computed over the combined pre- and post-test estimation period surrounding the social pressure test period being analyzed.

In order to provide a summary of the abnormal returns surrounding and immediately preceding each social pressure event date of hypothesized significance and for each test period as a whole, cumulative abnormal returns (CAR) are computed. CAR's are derived as in (4.10) and reproduced in (5.8) below.

$$CAR_{gte}(L) = \left[\sum_{t=t_s}^{t_f} AR_{gte} \right] / (t_f - t_s + 1)^{1/2} \quad (5.8)$$

where t_s and t_f are the first and last days of the time period being analyzed, and

$L = t_f - t_s + 1$ is the length of the series.

CAR's are computed for the six-trading-day period leading up to and including each event date of hypothesized significance listed earlier, the 11-trading-day period centered on each of those event dates, and for each entire social pressure test period.

Results for Social Pressure

Test Period 1 (SP1):

1/8/69 - 2/26/69

Tables 4 to 7 give the results of tests for significant price declines of the CEP firm group associated with the social pressure events. Table 4 gives the AR's and CAR's for SP1, the first event period. The cumulative abnormal returns in test period SP1 are positive (indicating price increases for the CEP firm group) for the period as a whole and the first two events of hypothesized significance. Only the returns leading up to and surrounding the third event date are negative, as hypothesized formally in H_{A2} on the fourth page of this chapter. Of these results, the only period of overall significance is the 11 days centered on January 28, 1969, the day of the Santa Barbara oil leak, and the price change is in the opposite direction as hypothesized. The CAR for this period is 2.46, significant at $\alpha = .02$. As can be seen by looking at the more detailed AR's in Table 4, this result is driven by the abnormal returns of the six days starting on January 28, 1969 and

TABLE 4

Abnormal Returns for CEP Firms
First Social Pressure Period

Dates	CAR	t	Date	AR
1/8/69-2/26/69	1.04	1	1/8/69	1.15
		2	1/09	-.01
		3	1/10	-.05
1/8/69-1/15/69	.46	4	1/13	2.00
1/8/69-1/22-69	.75	5	1/14	-.67
		6	1/15	-1.30
1/21/69-1/28-69	1.22	7	1/16	1.28
1/21/69-2/4/69	2.46	8	1/17	-.90
		9	1/20	-.55
2/11/69-2/18-69	-.93	10	1/21	1.08
2/11/69-2/26/69	-.61	11	1/22	.44
		12	1/23	-.88
		13	1/24	.61
		14	1/27	-.22
		15	1/28	1.96
		16	1/29	.97
		17	1/30	.87
		18	1/31	1.92
		19	2/03	.23
		20	2/04	1.19
		21	2/05	.15
		22	2/06	.37
		23	2/07	-1.54
		24	2/11	-1.19
		25	2/12	-1.40
		26	2/13	.22
		27	2/14	-.07
		28	2/17	.07
		29	2/18	.11
		30	2/19	-.60
		31	2/20	-.10
		32	2/24	-.10
		33	2/25	1.17
		34	2/26	-.11

ending on February 4, 1969. Looking at the detailed historical analysis of the period in Appendix B-1, one would really not expect this result. The period was marked by signs, in addition to the events specified earlier, that federal agencies would move toward holding companies more accountable for oil spills, specifically, and pollution control more generally. On February 7, 1969, Hickel ordered a stop to all drilling operations off the coast of Santa Barbara until the oil spill had been cleaned up; on February 10 the Justice Department shut down an animal rendering plant in Baltimore for air pollution; also on that day it was announced that the Department of Health, Education, and Welfare would issue stringent guidelines for the control of air pollution by high sulphur coal and oil; and on February 12 it was announced that Nixon would form a panel to find ways to avoid oil spills. Looking again at the AR data in Table 4 there was an apparent price decrease associated with these other events just listed for the CEP group on Friday to Tuesday, February 7, 11 and 12. The abnormal returns on those days were -1.54, -1.19, and -1.40, respectively. The CAR for the three-day period would be -2.38, showing a significant price decline at $\alpha = .01$. Overall, however, for test period SP1 the results do not support the alternative hypothesis, H_{A2} , that the events of that period were associated with a significant decline in prices of the CEP firm group.

Results for Social Pressure
Test Period 2 (SP2):
12/15/69 - 2/17/70

Table 5 gives the Abnormal Returns and Cumulative Abnormal Returns for SP2, the second event period. For the overall test period it appears that there was an abnormal price decline for the CEP group. The CAR for the entire test period is -1.49, which is significant at $\alpha = .068$. That is, after adjustments for the normal effect of market-wide events, autocorrelation, and non-synchronous trading, there is only a 6.8 percent chance that there was not an unexpected price decline for the CEP group associated with the events that occurred in test period SP2.

The events of hypothesized significance in test period SP2 were: the approval by the House on Monday, December 22, 1969 of NEPA (the Senate had approved it only two days earlier); Nixon's State-of-the-Union Address on January 22, 1970 which emphasized environmental concerns; and Nixon's Message on the Environment delivered to Congress on February 10, 1970, which showed clearly that he would be trying to play a leadership role in the Environmental Movement.

Only the sub-periods leading up to and surrounding Nixon's State-of-the-Union Address on January 22, 1970 resulted in significantly negative CAR's. From Table 5 the CARS for the six-day period leading up to and including the date of the Address and the 11-day period centered on that date were -1.54 and -1.67, significant at α equal to .062 and .048, respectively.

TABLE 5

Abnormal Returns for CEP Firms
Second Social Pressure Period

Dates	CAR	t	Date	AR
12/15/69-02/17/70	-1.49	1	12/15/69	.68
		2	12/16	-.33
12/15/69-12/22/69	.85	3	12/17	.27
12/15/69-12/30/69	1.76	4	12/18	.36
		5	12/19	.36
01/15/70-01/22/70	-1.54	6	12/22	.75
01/15/70-01/29/70	-1.67	7	12/23	.21
		8	12/24	.51
02/03/70-02/10/70	-.75	9	12/26	.88
02/03/70-02/17/70	-.41	10	12/29	1.23
		11	12/30	.93
		12	12/31	-2.07
		13	01/02/70	-.86
		14	1/5	-2.76
		15	1/6	-1.02
		16	1/7	-2.18
		17	1/8	.39
		18	1/9	-.51
		19	1/12	-.32
		20	1/13	-1.02
		21	1/14	-.48
		22	1/15	-1.66
		23	1/16	.14
		24	1/19	1.16
		25	1/20	-.72
		26	1/21	-.44
		27	1/22	-1.30
		28	1/23	-.95
		29	1/26	.93
		30	1/27	-.67
		31	1/28	-.79
		32	1/29	-1.23
		33	1/30	1.17
		34	2/2	.71
		35	2/3	-.15
		36	2/4	1.46
		37	2/5	-1.62
		38	2/6	-.03
		39	2/9	1.30
		40	2/10	-2.80
		41	2/11	1.57
AR's (continued)				
t	Date	AR		
42	2/12	-1.92		
43	2/13	-.11		
44	2/16	-1.00		
45	2/17	1.95		

The 11-day sub-period centered on the day the House approved NEPA (December 22, 1969) produced a positive CAR, significant at $\alpha = .078$ for a two-tailed test. Apparently the passage of NEPA by the House and Senate did not significantly increase the assessed probability that firms would be effectively required to internalize a much greater degree of the social cost of pollution. Perhaps, NEPA was only significant in conjunction with the Administration's actions beginning with Nixon's the signing of NEPA nine days later on December 31, 1969 and ending with his Environmental Message to Congress on February 10, 1970. It would be Nixon's Administration that would have the responsibility for implementing the Act, and his position on environmental matters did not become clear until these first six weeks of 1970. (According to Andrews [1976] it was not until its passage that Nixon became a big proponent of NEPA - he had to for political reasons and used the issue to his greatest advantage.) When a CAR is computed for the period from December 31, 1969 to February 10, 1970 it is significantly negative (-3.03) at $\alpha = .001$. (Note that this period also includes the announcement of the introduction of Muskie's air pollution bill [see Appendix B-2].) The evidence of significant price declines for this sub-period, when viewed in conjunction with the overall CAR of the entire social pressure test period of -1.49, leads to the rejection of H_{02} for test period SP2. That is, the events of this test period do appear to be associated with a price decline of the CEP group.

Results for Social Pressure
Test Period 3 (SP3):
4/15/70 - 6/10/70

This third test period was marked by Earth Day on one end and on the other end by the reporting out of a clean air bill from a House Committee. The bill would later be merged into the Senate version to become the CAAA. As seen in Table 6, the six-day period leading up to and including Earth Day on April 22, 1970 and the 11-day period centered on that date did not produce significant CAR's. However, it seems reasonable to expect that the effect of Earth Day was being felt throughout the period. Appendix B-3 shows other events of the period that were, perhaps, related to Earth Day. For example: an exchange was highly publicized on May 12 and 13 between Ralph Nader and Muskie; a GAO report was released on May 15 which criticized industry for not paying its fair share of sewage treatment plant costs; Northern States Power was reported on May 26 to let environmental critics pick the site of a new power plant; and two smelting companies were reported on May 28 to complain of the output problems that would be caused by stiff pollution control laws.

Perhaps it was the mood created by Earth Day combined with the reporting out of a tough clean air bill on June 3 from the House Committee that produced the extremely significant negative CAR for the six-day period leading up to and including the day the House bill was reported out of Committee and for the 11-day period centered on that date. The CAR's reported in Table 6 for those periods were -7.17 and -5.19, respectively, significant at alpha less than .0001.

TABLE 6

Abnormal Returns for CEP Firms
Third Social Pressure Period

Dates	CAR	t	Date	AR
4/15/70-6/10/70	-1.72	1	4/15/70	.51
		2	4/16	.26
		3	4/17	.00
4/15/70-4/22/70	.36	4	4/20	-.54
4/15/70-4/29/70	.23	5	4/21	-1.01
		6	4/22	1.66
5/27/70-6/03/70	-7.17	7	4/23	.38
5/27/70-6/10/70	-5.19	8	4/24	-.17
		9	4/27	1.19
		10	4/28	1.77
		11	4/29	-3.30
		12	4/30	-.79
		13	5/1	-1.58
		14	5/4	1.52
		15	5/5	.73
		16	5/6	-3.08
		17	5/7	-1.45
		18	5/8	.08
		19	5/11	.51
		20	5/12	.64
		21	5/13	.92
		22	5/14	-.66
		23	5/15	-.58
		24	5/18	-.13
		25	5/19	1.56
		26	5/20	2.77
		27	5/21	-.93
		28	5/22	1.26
		29	5/25	3.69
		30	5/26	.91
		31	5/27	-4.80
		32	5/28	-3.06
		33	5/29	-.47
		34	6/1	-3.64
		35	6/2	-2.11
		36	6/3	-3.50
		37	6/4	.68
		38	6/5	.22
		39	6/8	-.57
		40	6/9	-.04
		41	6/10	.09

In any event the CAR for the entire test period, as seen in Table 6, is -1.72, significant at $\alpha = .042$. Thus, there is only a 4.2 percent chance that there was not an unexpected drop in the price of the equity securities of the CEP firm group associated with the events in SP2, which were hypothesized to have increased the probability of significant internalization of pollution costs being forced on industry.

Results for Social Pressure
Test Period 4 (SP4):
8/13/70 - 10/5/70

The most consistently and emphatically significant results of the tests for associations of price declines with social pressure events (H_{A2}) occur in the fourth test period. The events of hypothesized significance in this period were: the approval of Muskie's Clean Air Bill in Subcommittee on August 20, 1970 (it was much stronger than either the House or White House versions and would basically become the CAAA as eventually enacted); the approval on September 10 of the same bill by the Senate Public Works Committee over strong industry objection and lobbying; and the squelching of the last opposition to the EPA in the House on September 24.

Looking at the CAR's in Table 7 for this event period, one sees that the 11-day trading periods centered on the three events noted above produced significant cumulative abnormal returns of -1.83, -3.83, and -3.54, significant at α equal to .03, .0001, and .0002 respectively. And the CAR for the whole test period was -5.85, indicating less than a one one-hundredth of a percent chance that there was not an unexpected price decline associated with these events for the CEP firm group, after

TABLE 7

Abnormal Returns for CEP Firms
Fourth Social Pressure Period

Dates	CAR	t	Date	AR
8/13/70-10/05/70	-5.85	1	08/13/70	-.10
		2	08/14	-.12
		3	08/17	-.20
8/13/70-08/20/70	1.08	4	08/18	.68
8/13/70-08/27/70	-1.83	5	08/19	1.09
		6	08/20	1.30
9/02/70-09/10/70	-2.09	7	08/21	.49
9/02/70-09/17/70	-3.83	8	08/24	4.22
		9	08/25	-.84
9/21/70-09/28/70	-3.36	10	08/26	-2.64
9/21/70-10/05/70	-3.54	11	08/27	-1.52
		12	08/28	-1.10
		13	08/31	-1.36
		14	09/01	-.51
		15	09/02	-1.11
		16	09/03	-1.59
		17	09/04	-.65
		18	09/18	-.21
		19	09/09	-1.01
		20	09/10	-.55
		21	09/11	-2.80
		22	09/14	-.34
		23	09/15	-.83
		24	09/16	-1.45
		25	09/17	-2.17
		26	09/18	-2.06
		27	09/21	-1.15
		28	09/22	.93
		29	09/23	-1.79
		30	09/24	-2.64
		31	09/25	-1.13
		32	09/28	-2.45
		33	09/29	-1.47
		34	09/30	-.14
		35	10/01	-.67
		36	10/02	-1.26
		37	10/05	.02

controlling for the usual effect of market-wide events, autocorrelation, and non-synchronous trading. Furthermore, there were 31 negative unexpected returns in the 37-day test period. Assuming no price decline, one would expect only 18 or 19, and the probability of observing 31 negative AR's is less than .0001.

Another reason for the persistently negative AR's in the period can be surmised from examining the other related events of the period shown in Appendix B-4. Note that one week (five trading days) after approval of the clean air bill in the Public Works Committee it was reported out without being watered down, and five days later it was approved unanimously by the whole Senate. During this 12-day period there was intense industry lobbying, as noted in a September 14 Wall Street Journal article, to no avail. During the period from approval of the bill in Sub-committee to full Senate approval there were only three positive abnormal returns (none significant) and there were 20 negative abnormal returns (five significant at alpha equal to .05 or less).

Thus H_{02} is emphatically rejected for test period SP4, and with less than a .01 percent chance of error, it is concluded that a price decline for the main experimental group was associated with the passing through the Senate (from Sub-committee to full Senate) of the bill to become the CAAA and with the final establishing of the EPA.

Summary of Results

Table 8 summarizes the results of tests for increases in risk (H_{A1}) and declines in prices (H_{A2}) associated with social pressure events for

Table 8

Social Pressure Events
Summary of Results

	<u>SP1</u>	<u>SP2</u>	<u>SP3</u>	<u>SP4</u>
H ₀₁	P	P	N	N
H ₀₂	N	P	P	P

the four SP test periods. Negative results are designated N and indicate that the null hypothesis could not be rejected. Positive results indicating acceptance of the alternative hypothesis are denoted P. Overall the results are strongly supportive of the conclusion that investors, in the aggregate, did reassess either the risk or the risk-adjusted present value of equity securities of CEP firms when events occurred that were hypothesized to have increased the probability that firms would be effectively constrained to internalize the social cost of pollution. The support of the conclusion is in the rejection of at least one of the null hypotheses for each test period.

The theoretical model exhibited in Chapter III predicted that there would be both an increase in systematic risk and a decrease in price for each significant event. It is therefore important to point out here that either the theory is not rich enough to fully explain the results or the empirical testing procedures were not sharp enough to detect all significant changes in price and risk. Especially regarding the measurement of systematic risk with daily data, the statistical model is

known to be weak. This could be the reason for the negative results in testing H_{01} for the third and fourth test periods. However, it should also be noted that the third and fourth test periods differed from the first and second. In the latter two test periods the shaping of the clean air act in Congress took place. Thus the market became much more informed as to what the final legislation would look like. Perhaps the theory was not rich enough to distinguish the effects of these latter events from the earlier events which merely increased the probability of getting some legislation without a clear indication of what it would look like. The negative results in testing for a price decline in the first test period is viewed as an outlier, since the other three test periods were associated with statistically significant price declines.

In any case the tests conclusively showed significant investor reassessments of the risk and/or equity value of firms' securities when events occurred that were hypothesized to have increased the probability that these firms would be constrained to internalize the social costs of pollution. Regarding the question posed in Chapter II and reiterated in the first paragraph of this chapter, the results support the conclusion that a significant liability did arise when events, corresponding to increasing pressures to reduce social costs, occurred. The events chosen for analysis were hypothesized to increase the probability that firms would be constrained through institutional arrangements to internalize the social costs.

The next chapter empirically addresses the second question raised in the first paragraph of this chapter. That is, did investors, in the aggregate, make use of social accounting information that assessed the

degree to which firms were fulfilling the terms of their new social contracts.

CHAPTER VI

THE SIGNIFICANCE TO INVESTORS OF
THE DISSEMINATION OF
SOCIAL ACCOUNTING INFORMATION

As noted in Chapter II, an objective of this study is that it make a contribution toward understanding the degree to which investors (in the aggregate) use social accounting information. The social accounting information analyzed is of an environmental nature and more specifically is contained in seven reports, on the environmental performances of firms in four industries, that were published by the Council on Economic Priorities. As indicated in the section of Chapter V defining the choice of an experimental group, each report focused on a specific industry (Paper, Power, Steel, or Oil). Follow-up studies were done on the Paper, Power and Steel Industries. Chapter V reported results consistent with the hypothesis that a significant off-balance-sheet liability was created as firms became constrained to control pollution. This chapter reports evidence concerning the significance of investors' use of information about that liability.

This part of the dissertation extends the study by Shane and Spicer [1982] which analyzed the association of stock price changes (for firms included in the CEP reports) with the release of the information. Not being concerned with measuring changes in systematic risk, that study

used a methodology that did not control for the normal effect of market-wide events (i.e., a mean-adjusted expectations model was used to generate test period expected returns.) The use of this methodology was supported, as a relatively powerful approach for detecting abnormal returns, by the Brown and Warner [1980] simulation study of different techniques for detecting abnormal returns. The Shane and Spicer study found significantly negative unexpected returns across firms and reports on the two days preceding news articles announcing the release of the information in the reports. It was also found that the unexpected returns of the firms that received relatively high pollution control performance ratings were significantly higher than the returns for firms with relatively low pollution control performance ratings on the day of or the day after the news articles (with the timing of the significant difference dependent upon whether an absolute score or an improvement score was used to measure performance in the three follow-up reports).

This prior research by Shane and Spicer is extended here to specifically analyze changes in systematic risk associated with the release of the CEP report information. This extension will be described in the first section of the chapter. Then a partial replication of Shane and Spicer will be reported in the next section using slightly different data than was used in Shane and Spicer due to the difference in methodology as it was developed in Chapter IV. The third section of the chapter will describe an extension of the prior research that evaluates the strength and nature of any regulatory effect of the reports that could have affected the interpretation of the results of tests for the disclosure effect of the reports. In each of these sec-

tions, sub-sections will state hypotheses, give the experimental design, and analyze the results.

The Disclosure of CEP
Report Information and
Changes in Systematic Risk

Statement of the Hypothesis

The major extension of Shane and Spicer is the specific attention to changes in systematic risk associated with the release of the information in the CEP reports. Evidence was provided in Chapter V that supported the hypothesis that the pressures to internalize social costs in 1969 and 1970 did change the social contracts of firms sufficiently to create significant off-balance-sheet liabilities. The effect of fulfilling these new obligations to society on the earnings available to common shareholders was said to depend upon the future cost of investments in pollution control that would be required, the degree to which synergistic benefit in the form of better overall productive efficiency would be gained from these investments, and the degree to which the costs would be passed on to consumers. The CEP reports provided all three types of information. Thus it is hypothesized that the disclosure of the information in the CEP reports, if significantly used by investors, would be associated with an observable change in the operating risk of the firms reported on as the uncertainty regarding the effects of the pollution control laws on the individual firms reported on is reduced. Some resolution of this uncertainty is expected for all firms reported on. The direction of the change in operating risk will be

dependent on the original change in operating risk that occurred when the events analyzed in Chapter V occurred.

The pollution control performance ratings could as was pointed out in Chapter III, provide information that would change the expected value of the amounts that would be invested in pollution control projects that would not provide sufficient synergistic benefit to warrant the investments and would not be effectively passed on to consumers in the form of higher priced products. As explained in Chapter III, this information, if significant, would have the same type of effect on financial risk and present value of equity shares as did the SP events analyzed in the last chapter.

Recall the argument that more than expected investment in pollution control projects pursuant to social pressures is expected to cause a decrease in the equity value of the firm. The rationale was that if the projects' expected returns had been commensurate with their risk then, subject to capital rationing considerations, they would have been undertaken before the social pressures required it. The decrease in the equity value of the firm, due to the information that the firm would have to undertake more of these investments than previously expected, was then defined as the present value of the additional future social costs expected to be internalized. This quantity was, in turn, likened to additional debt - an increase in an off-balance-sheet liability. Correspondingly, since an increase in the debt to equity ratio of a firm has been shown to increase the financial risk of the firm, it was concluded that the information if significant would result in an increase in the financial risk component of the firm's systematic risk. Of

course, the information could have the opposite effect. That is, the assessment of the burden on the firm may not be as great as was expected. Thus, the direction of the information's effect on prices and financial risk would depend on prior market expectations, which are indeterminable from available data.

The factors that would be expected to determine the expected direction of the effect of the information on the price and financial risk of the CEP firms are reflected in certain CEP biases expressed in their reports. Three biases are apparent from reading the CEP reports. First, the CEP studies were motivated by the group's belief that investors did not realize the extent of the pollution caused by the operations of the firms chosen to include in the reports. A major motivation of the reports was to increase this awareness. If the CEP was generally right in this belief then one would expect the market, upon receipt of the information, to realize that the average firm reported on would have to do more to reduce pollution than expected. This would tend, theoretically, to cause a decrease in the price and a corresponding increase in the financial risk of the equity securities of the average firm reported on. However, two other biases are apparent from the CEP reports, which, if true, would be expected to have the opposite effect on the average firm's equity securities. First, the CEP apparently believed that the burden of pollution control, in terms of costs that neither could be passed onto consumers in the form of higher prices nor could provide synergistic benefits such as greater productive efficiency, was much smaller than investors expected. And secondly, the CEP reports, for the most part, asserted that the technology was available

to reduce pollutants to required levels. This was contrary to the claims of industry in its lobbying efforts to delay legislative deadlines for reducing pollution to specified levels. If these latter two biases were true, one would expect the market to translate the information into an increase in the price of the securities of the average firm and a corresponding decrease in systematic risk, because the burden would not be expected to be as great as would originally have been projected.

In Shane and Spicer the significant decrease in price found to be associated with the release of the information in the reports would support the conclusion that the overriding effect of the information on investor perceptions was consistent with the CEP's first bias. That is, apparently the market significantly increased its assessment of the value of CEP firms' off-balance-sheet liabilities for internalizing the social cost of pollution. The above analysis and the results in Shane and Spicer concerning price changes lead to the expectation that the systematic risk of the average CEP firm would increase due to an increase in financial risk when the information in the CEP reports was disclosed. Note that the discussion concerning the effect of the information on market price and financial risk has been in terms of the average CEP firm. Most CEP firms apparently were shown by the reports to have a more severe exposure to the pressures than expected, but it is likely that some also had less exposure than expected.

Thus far, factors have been identified that, according to the theory in Chapter III, would cause an increase in the financial risk of the average CEP firm (corresponding to the decline in market values found in

Shane and Spicer) and a change of unknown direction in the operating risk of all CEP firms (due to the reduction of uncertainty concerning the effects of the changes in firms' social contracts). The following hypothesis reflects this analysis.

- H₀₃ The release of the information in the CEP reports was not associated with a change in the systematic risk of the CEP firms.
- H_{A3} The release of the information in the CEP reports was associated with a change in the systematic risk of the CEP firms.

Experimental Design

The Experimental Groups and Relevant Time Series

Seven experimental groups are formed - one for each CEP report. The firms in the four groups for the first CEP report on each industry (Paper I, Power I, Steel I, and Oil) are exactly the same as the firms in the experimental group used to test for associations of risk and price changes with the SP events in Chapter V. The exclusion criteria described in the section of Chapter V entitled "The Experimental Group" are also applied here. The experimental groups for the three follow-up CEP reports were formed in the same manner. A second report on the eight Oil Companies was published five months after the first, but it is not included in this analysis because it was not a follow-up study - it contained much the same information (with different emphasis) as did the first report.

The 51 firms included in at least one of the experimental groups are listed in Appendix A-1. The 18 Paper Firms listed are all included in

the experimental group for Paper I, and only Riegel Paper Corp. is excluded in forming the experimental group for Paper II. (As noted in Appendix A-1, it had merged with Federal Paperboard Company and was no longer listed separately on the CRSP tapes at the time of Paper II.) Of the 18 Power Companies listed in Appendix A-1, 14 are included in the experimental group for Power I and 14 are included in the experimental group for Power II. Four firms were added to the original group and four were deleted by the CEP in choosing the firms to include in its follow-up report on the Power Industry. If a firm was excluded from either Power I or Power II, this is signified in Appendix A-1 by E1 or E2, respectively. The seven Steel Firms in Appendix A-1 were all in the experimental group for Steel I but only six were in the experimental group for Steel II. (Jones and Laughlin was excluded because it was no longer listed on the CRSP tapes when Steel II was published.) The eight Oil Companies listed were all in the experimental group for Oil.

The time series of returns, R_{gt} , for each of the seven experimental groups were formed in the same manner as was described in Chapter V (equation 5.1). Test and estimation periods are given in Table 9. Each test period consists of the 11 trading days centered on the news release in the Wall Street Journal, or, if not reported in the Wall Street Journal, in the New York Times. (Only Power II was reported in the New York Times and not in the Wall Street Journal.) This is the same method used to define event dates as described in Shane and Spicer. The same method as was described in Chapter V is used to define the pre- and post-test estimation periods shown in the table for each test period.

TABLE 9
Test Periods and
Estimation Periods

CEP Reports				
Test Periods				
CEP Reports	Calendar Time	$t_B - t_A$	Events	
			Dates	t
Paper I	12/10/70-12/24/70	11	12/17/70	6
Power I	04/10/72-04/24/72	11	04/17/72	6
Paper II	08/21/72-09/05/72	11	08/28/72	6
Steel I	05/15/73-05/30/73	11	05/22/73	6
Oil I	07/14/75-07/28/75	11	07/21/75	6
Steel II	09/19/77-10/03/77	11	09/26/77	6
Power II	11/30/77-12/14/77	11	12/07/77	6

Estimation Periods				
CEP Reports	Pre-test Period		Post-test Period	
	Calendar Time	t_A	Calendar Time	$t_C - t_B$
Paper I	10/06/70-12/04/70	43	12/29/70-05/20/71	100
Power I	11/12/71-04/05/72	100	04/27/72-08/16/72	78
Paper II	04/27/72-08/16/72	78	09/08/72-02/02/73	100
Steel I	12/13/72-05/09/73	100	06/01/73-10/22/73	100
Oil I	02/14/75-07/09/75	100	07/31/75-12/19/75	100
Steel II	04/22/77-09/14/77	100	10/06/77-11/25/77	36
Power II	10/06/77-11/25/77	36	12/19/77-05/11/78	100

Test Results

The procedure used to detect a change in risk for each experimental group from the pre-test to post-test period for that group was described in Chapter IV and applied to the SP test periods in Chapter V. The most general forms of the reduced and full extended market models used for the test were given in (4.15) and (4.16) and are rewritten below in (6.1) and (6.2).

$$R_{pt} = \alpha_p + \beta_{1p} R_{M,t-1} + \beta_{2p} R_{Mt} + \beta_{3p} R_{M,t+1} - \theta u_{p,t-1} + u_{pt} \quad (6.1)$$

$$R_{pt} = \alpha_p + I(\beta_{1p} R_{M,t-1} + \beta_{2p} R_{Mt} + \beta_{3p} R_{M,t+1}) + I^*(\beta_{1p}^* R_{M,t-1} + \beta_{2p}^* R_{Mt} + \beta_{3p}^* R_{M,t+1}) - \theta u'_{p,t-1} + u'_{pt} \quad (6.2)$$

$$\text{where } I = \begin{cases} 1 & \text{for } t = 2, 3, \dots, t_A \\ 0 & \text{for } t = t_{B+1}, \dots, t_{C-1} \end{cases} ;$$

$$I^* = \begin{cases} 0 & \text{for } t = 2, 3, \dots, t_A \\ 1 & \text{for } t = t_{B+1}, \dots, t_{C-1} \end{cases} ; \text{ and}$$

t_A , t_B , and t_C are as defined in Figure 4A.

The models shown above specifically control for any non-synchronous trading and autocorrelation empirically observed in the data. The reduced model is estimated first in the manner described in Figure 4C of Chapter IV, whereby the parameters extending the standard market model (β_1 , β_3 , and θ) are only included in the final estimation model if they provide significant additional explanatory power. Thus, any of the eight extended market models at the bottom of Figure 4C may result from the estimation procedure and be used to test for risk shifts. The full

model, represented in its most general form in (6.2), will always have the same parameters as the reduced model represented in (6.1).

The full models used to test for decreases in risk associated with the release of each CEP report are shown in Table 10. The symbol "NA" indicates that the parameter did not contribute significantly to the explanatory power of the reduced form of the model, and was therefore dropped from both the reduced and full models. Note that autocorrelation is significant in all but one case and non-synchronous trading was statistically observable in four of the seven cases. The number of firms in each experimental group are given as n . T represents the number of observations of the u_{pt} in the combined pre- and post-test estimation periods available to compute the F-statistic in the last column of the Table. The degrees of freedom for the F-statistic are T minus the number of β^* terms for the numerator and T minus the total parameters in the reduced form of the model (which does not include the β^* terms) for the denominator. The computation of F for the most general form of the models was explained in (4.17).

Assuming that θ captures most of the autocorrelation in the data, the sum of β_1 , β_2 and β_3 should represent the expected influence on the return of the experimental group of the return on the market portfolio - for the pre-test period; and the sum of β_1^* , β_2^* and β_3^* represents this relationship for the post-test period. Thus, the sum of the β terms represents the average systematic risk of the experimental groups' securities in the pre-test period; and the sum of the β^* terms represents the average systematic risk of the experimental group in the post-test period. These sums and the corresponding F-statistics are ex-

TABLE 10

Risk Shift Models for CEP Firms
Reported on in Each CEP Report
for CEP Report Periods

CEP Report Period	α	β_1	β_2	β_1^*	β_2^*	θ	n	T	F
Paper I	-.0004 (-.84)	NA	.6605 (5.98)	NA	.5550 (7.04)	-.1486 (-1.73)	18	141	.55
Power I	-.0004 (-.97)	NA	.4262 (6.83)	NA	.0521 (.53)	-.2416 (-3.22)	14	176	9.71
Steel I	.0011 (1.37)	-.0700 (-.50)	.8917 (6.35)	-.2803 (-2.36)	.9410 (7.84)	-.2814 (-4.03)	7	198	.65
Oil	-.0003 (-.49)	-.2756 (-3.04)	1.0320 (11.69)	-.2210 (-2.26)	.9512 (9.75)	-.2281 (-3.24)	8	198	.23
Paper II	.0001 (.30)	NA	1.0534 (9.20)	NA	.7541 (7.87)	-.1230 (-1.62)	17	176	3.94
Steel II	-.0025 (-2.94)	-.4122 (-2.09)	1.7271 (8.68)	-.6579 (-3.05)	1.3680 (6.37)	-.3704 (-4.45)	6	134	1.31
Power II	-.0012 (-4.60)	.2245 (2.79)	.5499 (6.92)	.0480 (.82)	.4068 (6.94)	NA	14	134	4.93

Note: β_3 was not significant in any of the above equations.

TABLE 11
Significance and Direction of
Risk Shifts for CEP Firms
in CEP Report Periods

CEP Report	$\beta_1 + \beta_2 + \beta_3$	$\beta_1^* + \beta_2^* + \beta_3^*$	F
Paper I	.6605	.5550	.55
Power I	.4262	.0521	9.71
Steel I	.8217	.6607	.65
Oil	.7564	.7302	.23
Paper II	1.0534	.7541	3.94
Steel II	1.3149	.7101	1.31
Power II	.7744	.4548	4.93

tracted from Table 10 and shown in Table 11.

As shown above the estimates of systematic risk of the experimental group included in each CEP report decreased from the pre-test to post-test periods surrounding the release of each of the reports. However, the erratic behavior of the measures of systematic risk from original reports to follow-up reports negates the significance of these results. Therefore, no conclusion is reached regarding a change in systematic risk for the CEP firms at the time the CEP reports were issued.

A Replication of the Shane and Spicer Study

The Shane and Spicer study did not address the issue of changes in systematic risk addressed above. It therefore used a very different methodology than was used in this study. The major test of Shane and Spicer will be replicated here for two reasons. First, a replication checks the validity of the methodology and results of both studies. And second, the results of the replication will provide a benchmark for evaluating the results of the next section on the regulatory effect of the reports.

In addition to not including any parameters for systematic risk in the estimation models, there are two major methodological differences between the two studies. In Shane and Spicer tests were conducted first at the individual firm level, then the results were summarized across firms, and finally across reports. Secondly, Shane and Spicer attempted to eliminate the effects of other events of the test period that could influence the results by doing a detailed analysis of those potentially confounding events. Firms that could have been significantly affected by the other events were eliminated from the sample. These approaches were not followed in this study mainly because of the focus on changes in systematic risk with the use of daily returns. Empirical estimates of beta formed at the individual firm level of analysis with daily data are known to be unstable and high in variability. Thus any tests performed at this level of analysis, that depend on estimates of beta, would be necessarily weak. The decision was, therefore, made to conduct tests at the portfolio level, where estimates of beta would more stable

and less variable (due to a reduction in unsystematic risk associated with diversification), thus increasing the power of the tests. An additional benefit of performing tests at the portfolio level is that any cross correlation among the returns of the securities in the portfolio is automatically controlled for. The approach used by Shane and Spicer to control for cross correlation would not work in the analysis of changes in systematic risk.

In this study no firms were eliminated from the sample because of any potentially confounding influence of other events in the test period. This was partially due to a desire to keep the portfolios as large as possible for the reason just noted. But also, any potential advantages to using that approach are limited by the subjective nature of the process. It was more important in Shane and Spicer to attempt to isolate the effects of confounding events because of the shrinkage in the sample size that was necessary to test the second hypothesis of that study. The assumption that the effects of confounding events are randomized for an experimental group becomes more tenuous as the size of the group gets small. The second hypothesis in Shane and Spicer involved an evaluation of the differences in returns between firms rated highly by the CEP and returns of the firms that received lower performance ratings. This evaluation necessitated first ranking the firms included in each report by a pollution control performance index derived from the detailed information in the reports. Then two portfolios were formed for each CEP report - one consisting of firms that received high ratings and the other consisting of firms with lower ratings. Thus, immediately experimental group sizes were cut in half, which is sig-

nificant when the average number of firms included in a CEP report was only 13. However, the problem is accentuated by the need to eliminate a middle group of firms from each report in order to insure a significant difference in the average rating of the high and low group for each report. None of the hypotheses in this study require further splitting of the sample beyond the level of the individual CEP report. Therefore, as described in Chapter IV, the assumption was made that the formation of portfolios would randomize the effects of confounding events, and while the noise in the estimates may be greater, the estimates are at least assumed to be unbiased.

As a means of evaluating the differences in the two methodologies, the major test in Shane and Spicer is replicated in this section, using the methodology for detecting abnormal returns described in Chapter IV. The second hypothesis tested by Shane and Spicer will not be tested here; because, use of the information derived from that test is not made in the dissertation, and as noted above, the methodology is not appropriate for the small experimental groups resulting from tests of that hypothesis.

Statement of Hypothesis

The hypothesis to be tested is the same as the main hypothesis in the previous study and is restated below.

- H₀₄ The release of the information in CEP reports was not associated with a change in the equity security prices of firms included in the reports.

- H_{A4} The release of the information in the CEP reports was associated with a change in the equity security prices of firms included in the reports.

As noted earlier in this chapter, the information in the reports could have caused investor reassessments of the expected cost to the firms of investments in pollution control projects that would not have been undertaken by the firms without the social pressures to control pollution that were analyzed in Chapter V. If these reassessments were significant, one should expect that H_{04} would be rejected, with the direction of the price change dependent upon the market's prior expectations.

Tests for Price Changes Associated with the Release of the CEP Reports

Design

The same experimental groups (shown in Appendix A-1) used to test for declines in systematic risk associated with the CEP report information release are used again here to test for price changes associated with the release of the information. The method follows the general description in Chapter IV and the application to tests involving security price changes in Chapter V.

The models used to generate expected returns in each test period are the reduced versions of the models already described and shown in Table 10. The test periods are the same as were used to test H_{03} and are given in Table 9. Abnormal returns, $AR_{pt} = u_{pt}/\sigma(u_{pt})$, are derived for each day of each test period from the formulation described in Chapter IV and shown in (4.9). Abnormal returns will also be summarized across

the four original CEP reports, the three follow-up reports, and all reports. The summarization is computed as shown in (6.3) to (6.5) below where the subscript, p , ranges from 1 to 7 (1 represents Paper I, 2 is Power I, 3 is Steel I, 4 is Oil, 5 is Paper II, 6 is Steel II and 7 is Power II). The subscripts o and f mean the original reports and the follow-ups, respectively. The AR_{pt} 's are assumed to be approximately normally distributed and by construction their estimation period means and variances are zero and one.

$$AR_{to} = \sum_{p=1}^4 AR_{pt} / 4^{1/2} \quad t = 1, 2, \dots, 11 \quad (6.3)$$

$$AR_{tf} = \sum_{p=5}^7 AR_{pt} / 3^{1/2} \quad t = 1, 2, \dots, 11 \quad (6.4)$$

$$AR_t = \sum_{p=1}^7 AR_{pt} / 7^{1/2} \quad t = 1, 2, \dots, 11 \quad (6.5)$$

These AR_t 's given in (6.3) to (6.5) can then each be converted into cumulative abnormal returns over the whole test period and sub-periods within the test period in the manner described in Chapter IV and used to test H_{02} in Chapter V.

Results

The abnormal returns associated with each CEP report and across CEP reports are given in the top half of Table 12, and cumulative abnormal returns are given in the bottom half. These results are consistent with (but weaker than) those reported in Shane and Spicer. The major finding

TABLE 12

Abnormal Returns for Firms
Reported on in CEP Reports
for CEP Report Periods

AR's										
t	All Reports	Original Reports				Oil	Follow-Up Reports			
		All	Paper	Power	Steel		All	Paper	Steel	Power
1	0.53	-0.27	0.27	-1.55	-0.12	0.86	1.12	0.52	1.03	0.39
2	-0.35	-0.01	-0.54	-0.83	1.05	0.29	-0.53	0.37	-1.05	-0.23
3	1.11	0.10	1.72	-0.45	-1.24	0.18	1.58	1.05	0.78	0.90
4	-1.14	-1.10	0.02	0.06	-0.48	-1.80	-0.47	0.03	-1.55	.071
5	-1.30	-1.50	-0.76	-1.29	0.34	-1.29	-0.26	-0.48	-0.38	0.41
6	-0.26	0.08	-0.22	-0.53	0.37	0.54	-0.50	-0.26	-0.52	-0.07
7	0.39	0.48	1.66	-1.50	0.48	0.32	0.04	0.50	-0.30	-0.14
8	0.62	0.80	-0.32	-0.10	1.40	0.61	0.02	0.75	0.61	-1.32
9	-0.41	-0.99	-0.57	-1.00	-1.75	1.34	0.52	-0.47	0.56	0.81
10	0.27	1.14	2.32	0.60	0.15	-0.80	-0.91	-1.85	0.94	-0.66
11	0.53	-0.38	-1.04	-0.04	-1.27	1.59	1.26	0.16	1.40	0.61

CAR's										
t	All Reports	Original Reports				Oil	Follow-Up Reports			
		All	Paper	Power	Steel		All	Paper	Steel	Power
4 to 5	-1.73	-1.84	-.52	-.87	-.10	-2.19	-.52	-.32	-1.36	.79
1 to 6	-.58	-1.10	.20	-1.88	-.03	-.50	.38	.50	-.69	.86
1 to 11	-.03	.50	.76	-2.00	-.32	.55	.56	.09	.46	.43

of Shane and Spicer was the significantly negative abnormal returns on the two days prior to the news release. The statistics measuring the significance of the abnormal returns across CEP reports on these two days were significant at alpha equal to .003 and .001, respectively, for one and two days before the report release. The statistics AR_t , measuring the same thing with a different methodology in Table 12 have values of -1.3047 and -1.1426, significant at alpha equal to .18 and .25 respectively for a two-tailed test. While these results do not on the surface strongly support the prior findings, when the AR's in Table 12 are accumulated over the two test period days, 4 and 5, the consistency with the prior findings becomes more apparent. The CAR, measuring the significance of the combined return over the two-day period, across CEP reports, is -1.73 which is significant at alpha equal to .08. Furthermore, six of the seven reports were associated with negative cumulative abnormal returns for the two days prior to their release. The probability of this occurring assuming the null hypothesis of no association is true is only .05.

Also consistent with the previous findings is the evidence in Table 12 that the price decline associated with the release of the original reports was stronger than that associated with the follow-up reports. As a matter of fact, Table 12 shows positive CAR's across follow-up reports (.38 and .56) for the six days leading up to and including the news release date and the whole 11-day test period centered on that date. Whereas, for the original reports, the CAR's for the two days immediately prior to the news release, for six days leading up and including the news release date, and for the entire test period are all

negative. The CAR of -1.84 for the two days prior to the news release is significant at alpha equal to .07 using a two-tailed test.

Overall, the results reported in Table 12 are not nearly as strong as those reported in Shane and Spicer, but they are sufficient to reject H_{04} and conclude with 92 percent confidence that there was an equity price change across reports for the two-day return period immediately prior to the news release dates. The weaker results are not surprising since the previous study used a technique that was determined in Brown and Warner [1980] to be more powerful for finding abnormal returns than a portfolio approach. The technique in the dissertation was developed, specifically, to be sensitive (using daily data) to changes in systematic risk.

Regulatory Effect of the Reports

The strong results reported in Shane and Spicer could have been due to a regulatory effect of the CEP reports as it was described in Chapters II and III. That is, the information in the reports may not have been important, per se. Rather, the publication of the reports may have been an event, similar to those analyzed in Chapter V, that generally increased the probability of firms being effectively pressured to control pollution. As noted in Chapter III this type of effect is expected to result in price declines and risk increases.

In this section tests will be performed to gain insight into the nature and strength of any regulatory effect of the reports. If none is found, then the significant decline in market values found by Shane and Spicer (especially for the original reports) at the time the reports

were released is more likely to be attributable to a disclosure effect of the reports.

Statement of Hypotheses

If there was a regulatory effect on firms included in each CEP report released, the three groups of "other polluting firms" listed below could also have been affected. ("Other polluting firms" means firms that are not included in the CEP report being issued but are in industries that create social costs due to pollution.)

Group 1. Other firms in the same industry as was reported on in the CEP report.

Group 2. Firms included in later CEP reports.

Group 3. Other firms with serious pollution control problems in industries never reported on by the CEP.

The information in the CEP reports did not pertain directly to the "other polluting firms" in the above groups. Therefore, it is assumed that any price or risk changes, for these groups, associated with the release of the CEP reports provide evidence for a regulatory effect of the reports. The two hypotheses below will be tested in order to evaluate whether the three groups just listed experienced price or risk changes in the previously defined test periods for the four original CEP reports.

H₀₅ The release of the four original CEP reports was not associated with a change in systematic risk for groupings of "other polluting firms."

H_{A5} The release of the four original CEP reports was associated with a change in systematic risk for groupings of "other polluting firms."

- H_{06} The release of the four original CEP reports was not associated with a price change for securities of groupings of "other polluting firms."
- H_{A6} The release of the four original CEP reports was associated with a price change for securities of groupings of "other polluting firms."

If there is a regulatory effect on the CEP firms, the corresponding firms in groups 1, 2 and 3 could conceivably be affected in one of two ways. The market may view these firms as also being subject to the increased pressures to control pollution, in which case the normal increase in risk and decline in market value associated with a regulatory effect is expected. On the other hand, the market may perceive that the focus of attention will be on firms reported on and the "other pollution firms" may experience a decline in risk and an increase in market values associated with the release of the reports. Furthermore, the reports could be expected to result in political costs of the firms reported on, which would benefit "other polluting firms" as "free riders." Thus, there is reason to believe that a regulatory effect of the reports could cause price and risk changes in either direction for the groups not included in the CEP report being issued. Therefore, the hypotheses above were stated without specifying direction. All tests will be performed for groups 1, 2, and 3 listed above in the same manner as was reported for the CEP firms in Tables 10 and 12. The test and estimation periods are as previously were defined in Table 9 for Paper I, Power I, Steel I, and Oil.

A strong regulatory effect would be expected to result in rejection of the null hypotheses of no association of the release of the CEP reports with either risk (H_{05}) or price (H_{06}) changes for groups 1, 2,

and 3 above. Of course, even if there were no change in price or risk for any of the groups above, there could still have been a regulatory effect on only the firms included in the CEP reports, caused by the particular attention given those firms. The tests cannot, therefore, conclusively show that there was no regulatory effect of the reports. If the null hypotheses, H_{05} and H_{06} , are not rejected, the evidence would be consistent with the statement that there was at most a weak regulatory effect of the reports. The tests can show that there was a strong regulatory effect that went beyond the firms reported on, if the null hypotheses are rejected. Furthermore, the directions of any changes in price and risk may provide insight into the nature of the regulatory effect present.

Experimental Design

The only new experimental design issue to be discussed here is the selection of firms to include in groups 1, 2, and 3 shown above. The firms in group 2 above will be subsets of the firms included in the sample already listed in Appendix A-1. For each of the four original CEP reports, this experimental group will include the firms listed in Appendix A-1 that were included in subsequently published original CEP reports. Thus, for the test period associated with the release of Paper I, experimental group 2 will include the firms from Appendix A-1, that were in Power I, Steel I, and Oil. For the second test period to be analyzed, experimental group 2 consists of the firms that were in Steel I and Oil. For the Steel I test period, experimental group 2 includes the firms in the Oil report. And there is no experimental group 2

related to the publication of the Oil report.

The objective in choosing firms for experimental group 1 above was to pick firms that were relatively concentrated in their business interests and that those interests be characterized by the same pollution control problems that caused the CEP firms to be picked for inclusion in the CEP reports. These firms are listed in Appendix A-2. As shown in the Appendix, this experimental group will consist of the three Paper Companies listed for Paper I; the 18 Power Companies listed for Power I, the six Steel Companies for Steel I, and the 13 Oil Companies for Oil.

Experimental group 3 consists of "other polluting firms" that were not in the same industries as the CEP firms. This group is the same for each of the four CEP reports (except when a firm was not listed on CRSP for all test periods) and consists of the 36 firms in the Chemicals, Nonferrous Metals, and Cement Industries listed in Appendix A-3. The reader is referred to Appendix C for the detailed procedure used to select firms for inclusion in experimental groups 1 and 3.

The time series of returns for each experimental group is formed in the same manner as described previously, whereby portfolio returns, R_{pt} , are computed at the industry level and then group returns are derived from the simple average of the portfolio returns in the group. The procedure, then, for examining risk and price changes for each experimental group follows exactly the application of the methodology developed in Chapter IV to tests of H_{01} and H_{02} performed in Chapter V.

Results

Firms in CEP Industries But Not in CEP Reports

Table 13 shows the results of the tests for associations of the release of the CEP reports with changes in risk (H_{05}) for the companies that were intensively engaged in the sorts of activities that the CEP firms were but that were not chosen by the CEP for inclusion in their reports. The estimates of the beta terms representing systematic risk decreased in two cases and increased in two cases, none of which were statistically significant at alpha equal to .10.

The results were more significant for tests of associations of the release of the reports with price changes (H_{06}) of the equity of this experimental group. These results are shown in Table 14.

TABLE 13
Risk Shift Models for
"Other Polluting Companies"
in CEP Industries for CEP Report Periods

CEP Report Period	α	β_1	β_2	β_3	β_1^*	β_2^*	β_3^*	θ	n	T	F
Paper I	-.0007 (-.64)	-.02 (-.08)	.4158 (1.65)	NA	.503 (2.78)	.4576 (2.52)	NA	-.1856 (-2.19)	3	141	1.58
Power I	-.0000 (-.09)	NA	.2996 (5.35)	NA	NA	.2321 (2.64)	NA	-.2181 (-2.89)	18	176	.43
Steel I	.0006 (.89)	NA	.7141 (5.83)	NA	NA	.6898 (6.49)	NA	NA	6	198	.02
Oil	.0000 (.01)	NA	.8835 (8.84)	NA	NA	.9745 (8.81)	NA	-.2179 (-3.10)	13	198	.37

TABLE 14

Abnormal Returns for
Other Polluting Firms
in CEP Industries
for CEP Report Periods

AR's					
t	All Reports	Paper I	Power I	Steel I	Oil
1	-1.3461	-1.5276	-0.9708	1.2760	-1.4698
2	1.6072	1.5619	-0.6171	1.1898	1.0798
3	-2.2510	-1.3966	-1.0506	-0.7104	-1.3445
4	-0.3147	2.0212	-0.2380	-0.8273	-1.5853
5	-1.7482	-2.0770	0.1469	-2.9946	1.4283
6	0.3521	0.8026	-0.5610	-0.0444	0.5071
7	-0.4706	-0.5075	-0.4225	0.9988	-1.0100
8	0.3356	-0.1840	-0.1949	1.1853	-0.1352
9	-1.4075	-0.8910	-0.7963	-0.5072	-0.6205
10	-0.0095	0.6053	-0.0032	-0.8510	0.2299
11	0.1136	0.7881	0.5565	0.0503	-1.1676

CAR's					
t	All Reports	Paper I	Power I	Steel I	Oil
4 to 5	-1.46	-.04	-.06	-2.70	-.11
1 to 6	-1.51	-.25	-1.34	-.86	-.57
1 to 11	-1.55	-.24	-1.25	-.37	-1.23

Abnormal returns across all four original CEP reports for the two-day period immediately preceding the Wall Street Journal article announcing their release, the six days up to and including the news article, and the whole 11-day test period were -1.46, -1.51, and -1.55, respectively, all significant at $\alpha = .14$ or less using a two-tailed test. Additionally, all four of the test periods produced negative CAR's for each sub-set of the test period. Generally, it appears probable that there was a negative price change on the securities of the firms in these groups associated with the release of the CEP reports. This supports the conclusion that there was a regulatory effect of the release of the reports, which went beyond the larger more visible firms in the industry.

Firms Included in CEP Reports
Subsequent to the Report Issued

Table 15 shows the results for tests of H_{05} for firms to be included in CEP reports to be published after the one released in the test period. The estimates of systematic risk decreased for the first and third test periods but increased in the second. None of the risk changes were significant.

Tests of H_{06} for this experimental group, shown in Table 16, were not significant either, when abnormal returns were summarized across reports. However, for the six-day period leading up to and including

TABLE 15
 Risk Shift Models for
 "Other Polluting Companies"
 In Subsequent CEP Reports
 for CEP Report Periods

CEP Report Period	α	β_1	β_2	β_3	β_1^*	β_2^*	β_3^*	θ	n	T	F
Paper I	-.0001 (-.19)	NA	.7521 (7.01)	NA	NA	.6517 (8.47)	NA	-.1825 (-2.16)	29	141	.59
Power I	.0004 (.82)	NA	.7393 (8.81)	NA	NA	.8598 (6.56)	NA	-.2436 (-3.31)	15	176	.62
Steel I	.0005 (.69)	-.2378 (-1.77)	.8876 (6.6)	NA	-.4522 (-3.98)	.9401 (8.18)	NA	-.2836 (-4.03)	8	198	.73

TABLE 16

Abnormal Returns for
"Other Polluting Firms"
in Subsequent CEP Reports
for CEP Report Periods

t	AR's			
	All Reports	Paper I	Power I	Steel I
1	0.0699	0.6386	-1.6950	1.1775
2	-0.1678	-0.1311	-0.4371	0.2776
3	-0.4007	0.1869	-1.0208	0.1398
4	0.5189	-0.2620	-0.1957	1.3565
5	0.2813	-0.0574	-0.7926	1.3373
6	-1.5140	0.7565	-1.2746	-2.1042
7	0.9799	-0.8909	1.5133	1.0748
8	2.0327	0.4169	0.8256	2.2783
9	-1.1110	-0.5506	0.1156	-1.4893
10	1.1499	0.7481	0.3216	0.9220
11	-1.6467	-0.2393	-1.2912	-1.3217

t	CAR's			
	All Reports	Paper I	Power I	Steel I
4 to 5	.57	-.23	-.70	1.90
1 to 6	-.49	.46	-2.21	.89
1 to 11	.06	.19	-1.19	1.10

the release of the report on the Power Companies, the Steel and Oil Companies reported on later by the CEP experienced a cumulative abnormal return of -2.21, significant at $\alpha = .03$ for a two-tailed test. In the same six-day period Table 12 shows that the Power Companies included in the report experienced a cumulative abnormal return of -1.88, and from Table 14 the Power Companies that were not in the CEP report had a CAR of -1.34 for the same period. Thus, it appears that the release of this report may have caused a regulatory effect that was related to the size of the affected companies.

Table 16 also shows a significant positive CAR of 1.9 for the Oil Companies, yet to be reported on, at the time the Steel report was released. A possible explanation for this result is that there was a regulatory effect associated with the release of the Steel report that benefited other polluting industries by causing environmental regulators to shift all attention to the Steel Industry, thereby giving breathing room to the other industries that might otherwise have experienced pressures to control pollution. Also, any political costs incurred by the Steel Companies in response to the report would, most likely, also benefit the other polluting industries and reduce the amount of political costs that they might otherwise have incurred. While Table 12 does not indicate a significant market decline for the Steel group during this two-day period, Shane and Spicer shows the Steel group experiencing standardized abnormal mean-adjusted returns of -2.43 and -2.63 on the day before and two days before the release of the report, respectively. Furthermore, Table 14 shows a CAR of -2.7 for the Steel Companies that were not included in this CEP report. Thus, it appears that

the Steel report may have caused a negative regulatory effect on Steel Companies and a positive regulatory effect on companies in other polluting industries.

Companies in Industries Not Studied by CEP

The results of the tests of H_{05} for the companies in the Non-ferrous metals, Chemicals, and Cement Industries are shown in Table 17. For three out of the four reports the estimated systematic risk of these companies decreased. In one of the cases - Oil - this decrease was significant at alpha less than .025 with an F ratio of 5.39. Table 18 shows that associated with this same report there was a significant (alpha = .02) CAR of -1.99 for the two-day period immediately preceding the news release. A decrease in both price and risk for "other polluting companies" in other industries when the CEP reported on the Oil Industry does not seem reasonable, and no explanation is offered here other than to say that either H_{05} or H_{06} is probably true with the observed result being in a tail of the probability distribution associated with the null hypothesis. For example, there may have been no change in the underlying risk parameter and the change in the estimate observed could have been one of the 25 times out of 1000 that such a change would be observed. This would not necessarily imply that the abnormal return observed was also due to chance. Thus, either the observed F from Table 17 or the observed CAR from Table 18 was probably representative of a real change in risk or price of the companies in the "other polluting industries" when the Oil report was published. This would be consistent with there having been a regulatory effect of that report.

TABLE 17

Risk Shift Models for
 "Other Polluting Companies"
 In Non-CEP Industries
 for CEP Report Periods

CEP Report Period	α	β_1	β_2	β_3	β_1^*	β_2^*	β_3^*	θ	n	t	F
Paper I	.0001 (.16)	NA	.9691 (9.82)	NA	NA	.7994 (11.34)	NA	-.2222 (-2.64)	35	141	1.91
Power I	.0002 (-.72)	NA	.9342 (16.56)	NA	NA	.7996 (8.73)	NA	NA	34	176	1.53
Steel I	.001 (2.65)	NA	.9253 (13.45)	NA	NA	1.07 (18.01)	NA	-.1271 (-1.77)	34	198	2.48
Oil	-.0007 (-1.75)	NA	.9195 (14.77)	NA	NA	.6982 (10.14)	NA	-.164 (-2.27)	32	198	5.39

TABLE 18

Abnormal Returns for
"Other Polluting Companies"
In Non-CEP Industries
for CEP Report Periods

AR's					
t	All Reports	Paper I	Power I	Steel I	Oil
1	1.4233	1.5448	0.6890	2.0821	-1.4693
2	0.2051	-0.7152	0.9815	0.4910	-0.3472
3	1.4449	1.2893	1.0246	0.6465	-0.0706
4	-0.5391	-0.5770	-0.6329	0.2440	-0.1123
5	-1.3724	0.1791	-0.6103	0.3881	-2.7018
6	1.3466	1.5538	1.1434	-0.7037	0.6996
7	-0.4340	-0.5515	1.4011	-0.7402	-0.9774
8	-0.2765	-0.6786	-0.8840	-0.1625	1.1722
9	-1.4645	-1.3418	1.3244	-2.6381	-0.2735
10	-1.8965	-0.0839	-0.8590	-1.2678	-1.5824
11	-0.4470	-0.9116	-0.6290	0.6460	0.0006

CAR's					
t	All Reports	Paper I	Power I	Steel I	Oil
4 to 5	-1.35	-.28	-.88	.45	-1.99
1 to 6	1.02	1.34	1.6	1.29	-1.63
1 to 11	-.61	-.09	.89	-.31	-1.71

The positive (though not significantly so) returns of the companies in the other polluting industries in the first six days of the period that the Steel report was issued is supportive of the results for the Oil companies when the Steel report was issued (discussed earlier in relation to Table 16). That is, there may have been a positive regulatory effect on polluting firms in other industries when the Steel report called attention to the Steel Firms.

Summary

The results of tests for associations of the release of the CEP reports with risk (H_{A5}) and price (H_{A6}) changes were mixed. For the firms in the same industries as the CEP but not included in their reports, H_{05} was not rejected but H_{06} was. That is, it was concluded that when the CEP reports were issued there did appear to be a price decline for these firms across the four event periods. This indicated the probable presence of a regulatory effect (increased general pressures for pollution control) of the reports.

The firms included in subsequently published CEP reports did not systematically exhibit price or risk changes across the three event periods. However, at the individual report level of analysis H_{06} was rejected for the Power report and the Steel report. When the Power report was released, firms to be reported on later in the Steel and Oil reports experienced significant price declines. When the Steel report was released, firms to be reported on later in the Oil reports experienced significant price increases. The explanation offered for the latter result was that perhaps the effect of the Steel report was to

shift regulatory attention away from other polluting industries, and perhaps polluting companies in these other industries may benefit further from the political costs that would be incurred by the Steel group to combat these pressures.

When analyzed across events, H_{05} and H_{06} were not rejected for the third experimental group (firms in other polluting industries never studied by the CEP). However, at the individual report level, some support was offered for rejection of H_{05} or H_{06} for the Oil report. At the time it was released, significant decreases in b and price were observed for the Chemicals, Non-ferrous Metals, and Cement Firms. Since no explanation for both changing in the same direction seemed reasonable, it was assumed that at least one of the changes was due to chance.

In conclusion of this section, some support was offered for there having been a regulatory effect of the original CEP reports. The results across experimental groups and reports were not consistent. Some explanations for the detailed results were offered as they were presented which may give some insight into the nature of the regulatory effect. To use one final statistic, when the abnormal returns are summarized across all three groups and all four CEP reports (Tables 14, 16 and 18), the summarized abnormal returns on days 4 and 5 of the test period are $-.24$ and -1.73 , respectively. The corresponding cumulative abnormal return for the two-day period is -1.4 . As a reference point a significant AR or CAR at $\alpha = .10$ would be 1.645 for a two-tailed test.

Summary

In Chapter V evidence was provided that was consistent with changes in firms' social contracts having occurred in 1969 and 1970. These changes were manifested in off-balance-sheet liabilities created for firms that would be constrained to internalize social costs of pollution.

In this chapter tests were performed to assess the usefulness to investors of social accounting information disseminated by the Council on Economic Priorities. Tests regarding changes in systematic risk associated with the release of the reports were inconclusive. However, tests were also performed and reported in this chapter that replicated the major portion of an earlier study by Shane and Spicer that used a different methodology. The results were consistent with but weaker than those in the earlier study, which showed highly significant average negative returns across CEP reports on the two days prior to the release of the reports (with a more pronounced effect evident for the four original CEP reports.)

To provide insight into whether the results of Shane and Spicer may have been due to a regulatory effect of the reports, the tests for risk and price changes were performed for three experimental groups of "other polluting firms" not included in the report of the test period analyzed. The test periods used were those that contained the release dates of the four original CEP reports. While evidence of a regulatory effect was

found, it was not very strong or consistent in its nature. Speculations concerning the nature of the effect were given as the results were presented.

CHAPTER VII

CONCLUSION

This final chapter of the dissertation has three sections. The first summarizes the research project and gives its major implication. The second provides the limitations of the research, and the last section suggests avenues for future research.

Summary

The Research Questions

Some might wonder how a dissertation in the field of Accounting could be written without reference to or use of any accountants' reports. This research was fundamental in the sense that the issue was whether a phenomenon that could potentially affect the information in financial accounting reports was economically significant enough to warrant further investigation.

The phenomenon has been described in terms of social costs and social contracts. More specifically, corporations were once allowed by society to operate without regard to the effects of their operations on their physical environment. Subsequently, these effects were judged to result in social costs. The social costs came to be regarded as sufficiently severe to warrant major changes in the firms' social con-

tracts. These changes became manifest in the significant environmental legislation of the early 1970's.

The major empirical question addressed has been whether the process of changing social contracts to require internalization of social costs of pollution resulted in the equivalent of economically significant off-balance-sheet liabilities for the firms. The conclusion reached here is that the liabilities have been found to be of sufficient economic significance to warrant further investigation.

Financial accounting has traditionally been concerned with providing information that would be useful for investment decisions. With this in mind, economic significance was evaluated in terms of the significance to investors of: a) the changes in the social contracts requiring internalization of social costs; and b) information subsequently disseminated (by non-accountants) concerning the performance of firms in fulfilling the new terms of their social contracts. The effects of (a) and (b) on two investment decision parameters, risk and expected return, were evaluated.

Theoretical Evaluation

The evaluation of effects on risk and expected return was first done on a theoretical level, using the Sharpe-Lintner-Mossin capital asset pricing model. The changes in social contracts were viewed as requiring investment in pollution control projects that would not otherwise have been undertaken because their expected returns (possibly even negative) would not have been as great as that on a security with similar risk characteristics. Consequently, increases in the probability that firms

would be so constrained were shown theoretically to cause a decrease in the present value of the firms' equity securities.

It was then argued that this decline in equity value is equivalent to new off-balance-sheet debt equal to the present value of the social costs expected to be internalized. The argument was based on the idea that shareholders' interests in the earnings of the firm had become subordinated to those of society in much the same way that they are subordinate to creditors' interests. Thus the total value of the firm remained the same, but some of it had been claimed by society for the purpose of reducing the social cost of pollution. As a result the debt to equity ratio of the firm was effectively increased due to the change in the firm's social contract. Consequently, it was shown that the financial risk component of systematic risk should also be expected to increase.

Information that would later assess the performance of firms in meeting the terms of their new social contracts (social performance information) was expected to have a potential regulatory effect, identical in nature to the effects of the events that originally created the off-balance-sheet liabilities, and two types of disclosure effects. The regulatory effect would result if the information was an event that increased the probability that firms would become further constrained to internalize social costs. The presence of this effect would be likely to depend on the information source. In this case the information source was the Council on Economic Priorities (CEP), a public interest group, whose intent was to produce this type of effect. Any regulatory effect of the reports of the CEP was expected to increase the risk and

decrease the price of the equity of the firms.

As it was explained, the first type of disclosure effect results from changes in the expectations concerning the cost to the firm of the pollution control necessary to fulfill the new social contracts. It was predicted that any changes in these expectations would have effects similar to the regulatory effects already mentioned. However, the prior expectations of investors would determine the direction of the effects - either increases in price and decreases in risk if the liability was reevaluated to be not as great as previously assessed, or decreases in price and increases in risk if it was reevaluated to be greater.

The second type of disclosure effect of the information was said to result from the reduction of uncertainty concerning the relative impact of the constraints on earnings that would be available to common shareholders, including the degree to which costs would be passed on to consumers and the synergistic benefits that would be reaped from the required investments. This reduction in uncertainty would, regardless of prior expectations, cause a change in the operating risk of the firms reported on. To summarize, the social performance information could have: a regulatory effect causing a decrease in price and increase in risk; a disclosure effect changing expectations which would cause either a decrease in price and increase in risk or an increase in price and decrease in risk depending on prior expectations; and a second disclosure effect reducing uncertainty which would cause a change in risk.

Empirical Evaluation

To empirically assess the significance of the effects described above, the basic market model methodology was extended to be more compatible with the daily stock price return data used in the analysis. Extensions involved the specific modeling of autocorrelation and non-synchronous trading. As previously described, the benefits from the use of daily data come from the ability to focus on smaller test periods and to obtain more observations in small estimation periods.

Effects of Events Increasing the Probability of Effective Changes in Social Contracts

The experimental group used in this part of the empirical analysis consisted of firms that were included in the CEP's first reports on each of the four industries that they studied. After applying certain exclusion criteria, the group consisted of 47 firms in the Paper, Power, Steel, and Oil industries.

Four test periods in the years 1969 and 1970 were identified, which contained events that were hypothesized to have significantly increased the probability that firms would be effectively constrained to a much greater extent to control pollution. Associated with the first such period, a significant decrease in the systematic risk, as measured by the market model, was observed for the experimental group. The events of the second test period were found to be associated with both a decline in price and an increase in systematic risk for the experimental group. In the third and fourth test periods a significant decline in

price was observed. Price declines in the last three periods were significant after controlling for normal effects of market-wide events, autocorrelation, and non-synchronous trading.

The theoretical analysis had predicted both a price decline and a risk increase for economically important changes in firms' social contracts that constrained the firms to internalize social costs of pollution. It was therefore apparent that either the theory was not rich enough to fully explain the results or the empirical testing procedures were not powerful enough to detect all significant price and risk changes present.

In any case, the events in each of the test periods were associated with either a highly statistically significant increase in systematic risk or decline in price or both. The evidence was therefore, consistent with significant regard by investors for the changes in firms' social contracts that resulted from the events of these test periods. Thus, the empirical evidence supported the conclusion that a significant off-balance-sheet liability equal to the present value of social costs of pollution expected to be internalized did arise during these periods.

Effects of Environmental Performance Information

Tests were designed to assess both the disclosure and regulatory effects of seven reports, including three follow-ups, published by the CEP. A prior study by Shane and Spicer [1982] had found a significant price decline associated with news releases summarizing and announcing the publication of the reports. However, the question of this being due

to a regulatory or disclosure effect was left open for future research.

The major test in this part of the empirical analysis was an examination of changes in systematic risk associated with the seven reports. In all seven cases the risk was found to have decreased (three with statistical significance) for the firms reported on. However, due to the erratic behavior of systematic risk estimates from the original report periods to the follow-up report periods, no conclusion regarding changes in systematic risk was reached.

Another set of tests were performed to evaluate the nature and strength of any regulatory effect of the reports. The assumption was made that any disclosure effect would only affect the firms reported on, whereas a regulatory effect could potentially affect "other polluting firms" not reported on. The tests were two-tailed because arguments were given for the effect going in either direction. If pressures on firms to control pollution increased generally, "other polluting firms" would be expected to be affected in the same way as those reported on. However, it is conceivable that the "other polluting firms" would benefit from a regulatory effect on the firms reported on for two reasons. First, regulatory attention could be taken off the "other polluting firms" and directed toward the firms reported on. Second, the firms reported on may choose to incur political costs to counter the social force of the reports, and these costs would benefit "other polluting firms" as free riders.

Three groups of "other polluting firms" were formed to test for a regulatory effect of the reports. Results showed some support for the existence of a regulatory effect going beyond the firms reported on.

Most of the support was consistent with the regulatory effect on "other polluting firms" being due to increased general pressures to control pollution. But some also was consistent with the other arguments given above, showing improvements for the "other polluting firms" associated with the release of the reports.

Implications

The results given above are consistent with the hypothesis that firms did incur significant off-balance-sheet debt in 1969 and 1970, when events were occurring that significantly increased the probability of effective new constraints to internalize the social costs of pollution.

While this dissertation dealt specifically with the issue of pollution, the analysis also applies to a more general phenomenon. That is, corporations' activities have been viewed by society as resulting in other social costs, as well as pollution. Whenever this occurs there is some probability that changes in the firms' social contracts will also occur. Evidence presented here suggests that the equity values of the firms will decrease by the present value of the expected social costs to be internalized. Thus, what was part of the equity value of the firm becomes off-balance-sheet debt.

The major implication of the analysis is that a portion of the claims to the value of the firm may be misclassified on financial statements that do not specifically account for the expected value of social costs to be internalized. A greater understanding of the social contracts of firms is needed in order to evaluate their effects on the

value of the firm and to evaluate how those effects can most effectively and efficiently be reported to investors.

This dissertation has hopefully made a step toward beginning to understand the relationship between social costs, social contracts, and the value of the firm. Also, it has hopefully provided an example of empirical techniques that can be used to evaluate the economic significance to investors of pressures on firms to internalize social costs. As was noted in Chapter V a by-product of this research is the potential usefulness of the methodology in testing hypotheses concerning the significance of certain events as precipitators of historical phenomena.

Limitations

Six limitations to this research and its conclusions are discussed in this section. First the power of the empirical tests were limited by the researcher's ability to define the times when the market reactions of interest should have been expected to occur. In the case of the changes in firms' social contracts, key event dates or periods when there were significant increases in the probability that the changes would occur could only be hypothesized by careful historical analysis. In the case of the CEP reports, at least some of the social responsibility information therein may have been known to the market before the publication of the reports. This may have been due to either leakage of the information or the public availability of such information from other sources.

A second potential limitation applies to any study using a methodology that depends on market efficiency. It was assumed here that the market is semi-strong efficient; that is, it immediately impounds all publically-available information. To the extent that the market is either less or more than semi-strong efficient, the power of the empirical tests is also weakened. As noted in Chapter V, the statistical tests were really tests of three alternative hypotheses: semi-strong market efficiency, properly defined test periods containing truly significant events, and significant associations of changes in equity prices and risk with changes in firms' social contracts and with subsequently reported social performance information. To the extent that the first two alternative hypotheses are not true, the power of the tests for detecting the third is weakened.

The third and fourth limitations concern the generalizability of the results. The experimental groups did not consist of random samples of firms from a broad population. As a first step toward identifying the significance of constraints to internalize social costs, firms were selected for the experimental group in this research project because they were especially vulnerable to the constraints. The results should not be generalized beyond this group of firms. Similarly the social performance information was a non-random subset of what was available to the market. Market reactions to its dissemination are not necessarily representative of the reactions that would occur to the publication of other social performance information.

The fifth and sixth limitations concern the use of the market model to estimate systematic risk and to control for market-wide effects of

other events that may have been occurring at the same time as the events of interest. First, as noted in Chapter IV, the beta of the market model is only an estimate of the theoretical construct of systematic risk which is unobservable (mainly due to its ex ante nature). And second, the events of interest may very well have had wide ranging impacts throughout the market, in which case the "residual analysis" used would miss the full impact of the events on the firms in the sample.

The limitations discussed above do not negate the findings of significant associations of the events of interest with price and risk changes of the experimental groups. They do, however, suggest that more powerful tests could produce better estimates of the magnitude of the economic effects of pressures to internalize social costs and of the usefulness of social accounting information.

Suggestions for Future Research

Social accounting was defined by the 1974 AAA Committee on Measurement of Social Costs to be concerned with "the social, human, and environmental constraints on organizational behavior." As noted in the dissertation, these constraints can be viewed as being imbedded in a firm's social contract. Social accounting, then, would provide information about firms' social contracts. This research endeavor has attempted to develop an approach to assessing the significance to investors of certain aspects of a firm's social contract. To the extent that information of significant usefulness for investment decisions is contained in a firm's social contract, policy makers may want to make social accounting information part of a firm's financial statements.

The research process of determining the significance to investors of social accounting information should also provide insight into effective and efficient methods of measuring and reporting the economic impacts of the constraints associated with a firm's social contract.

Much work remains to be done in understanding firms' social contracts and their implications for financial reporting. The most fundamental avenue for research in this area is to gain a better understanding of how the terms of firms' social contracts arise and change. For example, what is the process by which society comes to regard some aspect of a firm's activities as causing a social cost?

Once a social cost is perceived, how should society determine whether a change in the firm's social contract is needed? To maximize social welfare, what is the appropriate portion of the social cost that should be internalized? There may be a pareto optimal solution to this problem. For example, it may be cheaper for the corporation to recycle waste materials than it is for society to bear the cost of unclean drinking water. In which case, through a scheme of side-payments, a solution for cleaning up the pollution can be devised whereby both the corporation and society can be made better off. On the other hand, a pareto optimal solution may not be possible and a value judgement will need to be made as to the appropriate apportionment of the costs.

Development of a positive theory as to how society makes these value judgements may provide insight into the kind of social accounting information that would be useful. That is, knowing how the value judgements are made would help in knowing which social impacts of a corporation's activities would be important for investors to know about so they can

better predict the impact of prospective changes in social contracts.

A better understanding is also needed of the nature of the liability created by constraints on firms to internalize social costs. How should a value of this debt to society be determined? It has been defined here to be the present value of the social costs to be internalized. But how are those future costs determined and what is the appropriate interest rate to use in discounting them to their present value? What causes this discount rate to change?

This dissertation has been concerned with the significance of the particular change in firms' social contracts related to pollution control. Other changes, such as the effects on equity values of pressures to hire minorities, or to provide employees with safe and pleasant working conditions, or to expand the role of women in the organization, or to exhibit more truth in advertising, or to improve product safety provide fertile ground for obtaining a better understanding of social costs, their internalization, and the corresponding effects on the value of the firm.

The issue of the significance to investors of pressures on firms to internalize the social costs of pollution has certainly not been laid to rest by this dissertation. The impact of these pressures on firms other than those in the experimental groups used here can be examined. The theory can be developed to gain an understanding of how the effects of these pressures can be expected to differ across firms and industries. Emanating from the theory should be hypotheses that can be tested with a methodology similar to the one used here.

Additional sources of social accounting information need to be searched out and examined. Especially important is a better understanding of how the market forms expectations from the available information. Then meaningful tests of the significance of the information can be done by ranking firms based on their performance relative to prior market expectations. In testing the usefulness of social accounting information that has been made available, more work is needed in separating any regulatory effect of the publication as an event from the disclosure effect of the information in the publication.

Hopefully, this dissertation has been a small step toward answering some of the questions raised above.

APPENDIX A-1

CEP FIRMS IN SAMPLE

Paper Companies

Time Series on CRSP		Cusip	Name
First Day	Last Day		
06-02-65	**	9738310	BOISE CASCADE CORP
*	**	15852510	CHAMPION INTL CORP
*	**	22866910	CROWN ZELLERBACH CORP
*	**	25266910	DIAMOND INTL CORP
*	06-27-78	31571110	FIBREBOARD CORP
*	**	39109010	GREAT NORTHN NEKOOSA CORP
*	**	40830610	HAMMERMILL PAPER CO
09-29-64	02-24-77	43439810	HOERNER WALDORF CORP
*	**	46014610	INTERNATIONAL PAPER CO
*	**	49436810	KIMBERLY CLARK CORP
*	**	58283410	MEAD CORP
12-15-69	**	73762810	POTLATCH CORP
*	01-03-72	76646410	RIEGEL PAPER CORP (M)
*	**	79345310	ST REGIS PAPER CO
*	**	80987710	SCOTT PAPER CO
*	**	90553010	UNION CAMP CORP
*	**	96154810	WESTVACO CORP
12-06-63	**	96216610	WEYERHAEUSER CO

Steel Companies

*	**	4217010	ARMCO STL CORP
*	**	8750910	BETHLEHEM STL CORP
*	**	45747010	INLAND STL CO
*	11-22-74	48003410	JONES & LAUGHLIN STL CORP
*	**	63784410	NATIONAL STL CORP
*	**	76077910	REPUBLIC STL CORP
*	**	91265610	UNITED STS STL CORP

Notes: M. Merged with Federal Paperboard Company

* July 2, 1962

** Listed through end of the 1980 CRSP file.

APPENDIX A-1

CEP FIRMS IN SAMPLE
(continued)

Power Companies			
Time Series on CRSP		Cusip	Name
First Day	Last day		
*	**	2553710	AMERICAN ELEC PWR INC
*	**	5916510	BALTIMORE GAS & ELEC CO
11-29-65	**	15405110	CENTRAL ME PWR CO (E2)
*	**	20279510	COMMONWEALTH EDISON CO
*	**	20911110	CONSOLIDATED EDISON CO N Y INC
*	**	26439910	DUKE PWR CO (E1)
*	**	34108110	FLORIDA PWR & LT CO
*	**	44216110	HOUSTON INDS INC (E2)
*	**	46253710	IOWA RES INC (E2)
*	**	66577210	NORTHERN STS PWR CO MINN
*	**	67885810	OKLAHOMA GAS & ELEC CO (E2)
*	**	69430810	PACIFIC GAS & ELEC CO
01-03-66	**	69478410	PACIFIC PWR & LT CO (E1)
*	**	70905110	PENNSYLVANIA PWR & LT CO (E1)
*	**	84240010	SOUTHERN CALIF EDISON CO
*	**	84258710	SOUTHERN CO
*	**	90654810	UNION ELEC CO (E1)
*	**	92780410	VIRGINIA ELEC & PWR CO
Oil Companies			
*	**	4882510	ATLANTIC RICHFIELD CO
*	**	30229010	EXXON CORP
*	**	40246010	GULF OIL CORP
*	**	60705910	MOBIL CORP
*	**	82263510	SHELL OIL CO
*	**	85368310	STANDARD OIL CO CALIF
*	**	85370010	STANDARD OIL CO IND
*	**	88169410	TEXACO INC

Notes: E1. Not included in the first Power report
 E2. Not included in the second Power report

* July 2, 1962
 ** Listed through end of the 1980 CRSP file.

APPENDIX A-2

OTHER POLLUTING COMPANIES
CEP INDUSTRIES - NOT IN CEP REPORTS

Paper Companies

Time Series on CRSP		Cusip	Name
First Day	Last Day		
*	**	16515910	CHESAPEAKE CORP VA
*	**	57537910	MASONITE CORP
08-11-69	**	83585210	SORG PAPER CO

Power Companies

*	**	1741110	ALLEGHENY PWR SYS INC
*	**	4055510	ARIZONA PUB SVC CO
*	**	18610810	CLEVELAND ELEC ILLUM CO
*	**	19884610	COLUMBUS & SOUTHN OHIO ELEC CO
*	**	25084710	DETROIT EDISON CO
*	**	26622810	DUQUESNE LT CO
*	**	29164110	EMPIRE DIST ELEC CO
*	**	45543410	INDIANAPOLIS PWR & LT CO
*	**	48513410	KANSAS CITY PWR & LT CO
02-17-64	**	49167410	KENTUCKY UTILS CO
*	**	67734710	OHIO EDISON CO
*	**	73767910	POTOMAC ELEC PWR CO
*	**	74446510	PUBLIC SVC CO IND INC
09-16-70	**	74448210	PUBLIC SVC CO N H
*	**	79065410	ST JOSEPH LT & PWR CO
*	**	84316310	SOUTHERN IND GAS & ELEC CO
*	**	87512710	TAMPA ELEC CO
*	**	97665610	WISCONSIN ELEC PWR CO

APPENDIX A-2

OTHER POLLUTING COMPANIES
 CEP INDUSTRIES - NOT IN CEP REPORTS
 (continued)

Steel Companies

Time Series on CRSP		Cusip	Name
First Day	Last Day		
*	06-09-77	1160810	ALAN WOOD STL CO
*	**	14428510	CARPENTER TECHNOLOGY CORP
*	**	45870210	INTERLAKE INC
10-11-63	**	58227310	MC LOUTH STL CORP
*	**	81978510	SHARON STL CORP
*	**	96315010	WHEELING PITTSBURGH STL CORP

Oil Companies

*	**	2886110	AMERICAN PETROFINA INC
*	05-22-78	3751910	APCO OIL CORP
*	**	4454010	ASHLAND OIL INC
06-22-66	**	18148610	CLARK OIL & REFNG CORP
*	**	56584510	MARATHON OIL CO
*	**	62671710	MURPHY OIL CORP
02-10-64	**	67085810	O K C CORP
*	**	71850710	PHILLIPS PETE CO
*	**	74741910	QUAKER ST OIL REFNG CORP
*	**	85373410	STANDARD OIL CO OHIO
*	**	86676210	SUN INC
*	**	90777010	UNION OIL CO CALIF
01-22-70	**	91135810	UNITED REFNG CO

APPENDIX A-3

OTHER POLLUTING COMPANIES
NOT IN CEP INDUSTRIES

Chemical Companies

Time Series on CRSP		Cusip	Name
First Day	Last Day		
*	**	915810	AIR PRODS & CHEMS INC
*	**	1908710	ALLIED CHEM CORP
*	**	3662710	ANSUL CO
06-23-68	**	12705510	CABOT CORP
*	05-14-75	20238110	COMMERCIAL SOLVENTS CORP
10-12-66	05-19-78	29117310	EMERY INDS INC
*	**	42705610	HERCULES INC
*	**	45988410	INTERNATIONAL MINERALS & CHEM
12-08-64	04-02-75	60110710	MILLMASTER ONYX CORP
*	07-29-77	60874410	MOLYCORP INC
*	**	70017810	PARK CHEM CO
02-04-64	**	74310710	PRODUCTS RESH & CHEM CORP
*	**	85772110	STAUFFER CHEM CO

Non-Ferrous Metal Companies

*	06-18-71	3053710	AMERICAN ZINC CO
12-21-67	12-31-70	3203310	AMPCO METAL INC
*	01-12-77	3239310	ANACONDA CO
*	**	4341310	ASARCO INC
*	05-24-77	21752510	COPPER RANGE CO
*	07-31-78	45768610	INSPIRATION CONS COPPER CO
*	**	48300810	KAISER ALUM & CHEM CORP
*	**	48931410	KENNECOTT CORP
*	**	71726510	PHELPS DODGE CORP
09-26-68	**	75540010	READING INDS INC
*	**	76140610	REVERE COPPER & BRASS INC
*	**	76176310	REYNOLDS METALS CO
04-22-68	03-10-78	82988010	SITKIN SMLT & REFNG INC
*	**	90342210	U V INDS INC

APPENDIX A-3

OTHER POLLUTING COMPANIES
NOT IN CEP INDUSTRIES
(continued)

Cement Companies

*	**	2077110	ALPHA PORTLAND INDS INC
10-30-70	**	13054110	CALIFORNIA PORTLAND CEM CO
*	**	37051410	GENERAL PORTLAND INC
*	**	37453210	GIANT PORTLAND & MASONRY CEM
*	**	45154210	IDEAL BASIC INDS INC
03-02-71	**	54664210	LOUISVILLE CEM CO
*	09-16-76	57144310	MARQUETTE CO
*	01-26-79	58507210	MEDUSA CORP
*	05-25-77	60621510	MISSOURI PORTLAND CEM CO

APPENDIX B-1

FIRST SOCIAL PRESSURE TEST PERIOD
HISTORICAL ANALYSIS

Date	Day #	News
690108	1616	
690109	1617	
690110	1618	
690111		
600112		
690113	1619	
690114	1620	N.Y. Times article (p. 27): Nixon task force says environment should be high priority; Reusse to introduce bill in House to establish advisory environmental council.
690115		Muskie introduces S7 (a Clean Water Bill) in Senate subcommittee
690116	1622	
690117	1623	
690118		
690119		
690120	1624	
690121	1625	N.Y. Times article (p. 49): large discharge of oil in Long Island Sound
690122	1626	
690123	1627	
690124	1628	
690125		
690126		
690127	1629	
690128	1630	Santa Barbara oil leak occurs
690129	1631	
690130	1632	
690131	1633	
690201		
690202		
690203	1634	
690204	1635	N.Y. Times (p. 1): Hickel says oil companies have voluntarily stopped drilling in Santa Barbara Channel per his request; antipollution forces in Congress believe oil leak will significantly help their cause; Muskie subcommittee opens hearings on S7 which includes water pollution control provisions likely to get through this year; air pollution legislation is unlikely because 1967 Air Quality Act still in infancy

APPENDIX B-1

FIRST SOCIAL PRESSURE TEST PERIOD
HISTORICAL ANALYSIS
(continued)

Date	Day #	News
690205	1636	
690206	1637	Wall Street Journal article (p. 8): Muskie says Santa Barbara oil leak will help anti-pollution legislation;
690207	1638	Hickel orders all drilling on submerged lands of Santa Barbara halted
690208		
690209		
600210		WSJ (p.4): Justice Department shuts down Bishop Processing - first time such action taken for any industrial plant; HEW will announce tomorrow stringent criteria to curb air pollution by high sulphur coal and oil over strong industry objections; WSJ p. 12 - massive cleanup set for Santa Barbara beaches, offshore well finally plugged.
690211	1639	
690212	1640	WSJ (p. 40): Nixon to form panel to find ways to avoid oil spills
690213	1641	
690214	1642	
690215		
690216		
690217	1643	
690218	1644	Jackson introduces S1075 (NEPA) in subcommittee; N.Y. Times (p. 1): Hickel, under 1953 Act, holds oil companies responsible for spills even without proof of negligence; also amends federal oil regulations
690219	1645	
690220	1646	
690221		W.S.J. (p. 2): Hickel called off sale of federal oil, gas leases; moratorium on similar pacts - anti-pollution effort cited
690222		
690223		
690224	1647	
690225	1648	
690226	1649	

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SECOND SOCIAL PRESSURE TEST PERIOD
HISTORICAL ANALYSIS

Date	Day #	News
691215	1850	
691216	1851	
691217	1852	
691218	1853	
691219	1854	
691220		Senate approves S1075
691221		
691222	1855	House approves S1075
691223	1856	
691224	1857	
691225		
691226	1858	
691227		
691228		
691229	1859	
691230	1860	
691231	1861	Nixon signs S1075 (NEPA enacted)
700101		
700102	1862	NY Times p. 1: Nixon signs NEPA & pledges Admin. to now or never fight vs. pollution.
700103		
700104		
700105	1863	
700106	1864	
700107	1865	
700108	1866	
700109	1867	
700110		
700111		
700112	1868	
700113	1869	
700114	1870	
700115	1871	
700116	1872	
700117		
700118		
700119	1873	
700120	1874	
700121	1875	
700122	1876	Nixon State-of-the-Union emphasizes environmental goals.
700123	1877	NY Times p. 1 reports that Nixon says he will send

APPENDIX B-2

SECOND SOCIAL PRESSURE TEST PERIOD
 HISTORICAL ANALYSIS
 (continued)

Date	Day #	News
		environmental package to Congress that will be more comprehensive and costly than any in history, but many are skeptical.
700124		
700125		
700126	1878	W.S.J. (p. 6): Muskie will propose legislation requiring new factories to have best available anti-pollution gear; Newsweek devoted to "Ravaged Environment"
700127	1879	
700128	1880	
700129	1881	
700130	1882	
700131		
700201		
700202	1883	
700203	1884	
700204	1885	
700205	1886	
700206	1887	
700207		
700208		
700209	1888	
700210	1889	Nixon message on the environment impresses even the skeptics.
700211	1890	New York Times page 1 says Nixon offers plan for cleanup with many surprises: nation-wide air quality standards, federal/state water quality standards on all industrial and municipal sources of pollution, up to \$10,000/day fines if standards not met.
700212	1891	
700213	1892	
700214		
700215		
700216	1893	
700217	1894	

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THIRD SOCIAL PRESSURE TEST PERIOD
HISTORICAL ANALYSIS

Date	Day #	News
700415	1933	
700416	1934	
700417	1935	
700418		
700419		
700420	1936	
700421	1937	
700422	1938	Earth Day - crowds are much greater than anticipated
700423	1939	
700424	1940	
700425		
700426		
700427	1941	
700428	1942	
700429	1943	
700430	1944	
700501	1945	House subcommittee approves HR17255 - their version of Clean Air Act Amendments, including emissions standards for industry.
700502		
700503		
700504	1946	
700505	1947	
700506	1948	W.S.J. (p. 7): clean water advocates in Congress to vote Nixon more funds than he asked for.
700507	1949	
700508	1950	
700509		
700510		
700511	1951	
700512	1952	Nader attacks Muskie for being political with and dragging feet on pollution control.
700513	1953	Muskie replies to Nader.
700514	1954	
700515	1955	W.S.J. (p. 1): Nixon commission urges creation of EPA; GAO report says industry should pay its fair share of sewage treatment plant costs.
700516		
700517		
700518	1956	
700519	1957	House Commerce Committee amends and approves

APPENDIX B-3

THIRD SOCIAL PRESSURE TEST PERIOD
 HISTORICAL ANALYSIS
 (continued)

Date	Day #	News
		HR17255 which would toughen and expand pollution controls.
700520	1958	
700521	1959	Broad program to protect coastlines launched by Nixon.
700522	1960	
700523		
700524		
700525	1961	
700526	1962	W.S.J.: Northern states power lets critics pick site of new power plant.
700527	1963	
700528	1964	Kennecott Copper and American Smelting & Refining Company says new pollution laws in some Western states pose serious output problems.
700529	1965	
700530		
700531		
700601	1966	
700602	1967	
700603	1968	HR17255 reported out stronger than Nixon proposed
700604	1969	
700605	1970	
700606		
700607		
700608	1971	
700609	1972	
700610	1973	

APPENDIX B-4

FOURTH SOCIAL PRESSURE TEST PERIOD
HISTORICAL ANALYSIS

Date	Day #	News
700813	2018	
700814	2019	
700815		
700816		
700817	2020	
700818	2021	
700819	2022	
700820	2023	Senate version of CAAA approved at subcommittee
700821	2024	N.Y. Times (p. 1): Senate subcommittee approves Clean Air Bill which far exceeds both House and White House versions in stringency.
700822		
700823		
700824	2025	
700825	2026	
700826	2027	
700827	2028	
700828	2029	
700829		
700830		
700831	2030	
700901	2031	
700902	2032	plan to defeat 12 Congressmen launched by group that planned Earth Day
700903	2033	
700904	2034	
700905		
700906		
700907		
700908	2035	
700909	2036	
700910	2037	Senate Public Works Committee approves Clean Air Bill; Nixon call to action of his proposals sent to Congress.
700911	2038	N.Y. Times (p. 35); W.S.J. (p. 4): articles re events of September 10.
700912		
700913		
700914	2039	Fight over Air Bill looms in Senate - strong in- dustry lobbying (WSJ p. 13).
700915	2040	
700916	2041	

APPENDIX B-4

FOURTH SOCIAL PRESSURE TEST PERIOD
 HISTORICAL ANALYSIS
 (continued)

Date	Day #	News
700917	2042	Senate Public Works Committee reports out Clean Air Bill
700918	2043	
700919		
700920		
700921	2044	
700922	2045	Senate unanimously approves Clean Air Bill and sends it with HR17255 back to House; little chance of passage before adjournment.
700923	2046	
700924	2047	House rejected resolutions that would have disapproved EPA establishment.
700925	2048	
700926		
700927		
700928	2049	House rejected another resolution that would have disapproved EPA
700929	2050	
700930	2051	
701001	2052	
701002	2053	
701003		
701004		
701005	2054	

APPENDIX C

PROCEDURE FOR SELECTION OF
"OTHER POLLUTING FIRMS"

Three "other polluting firm" experimental groups were used to examine the nature and strength of a regulatory effect associated with the release of the CEP reports. The first group included firms whose business interests were concentrated in the same pollution causing activities that characterized the firms included in the reports. In the case of the Power Companies, the 1970 Moody's Utilities Manual was used to identify electric utility companies dependent upon coal as their main power source. The companies chosen serviced mainly the East North Central and East South Central United States. Eighteen such firms (not included in the CEP reports) were identified and are listed under Power in Appendix A-2.

The paper, steel, and oil companies, whose business interests were similar to those of the CEP firms, were selected as follows. First, all firms (other than firms included in the CEP reports) shown on the CRSP tapes as having the two digit SIC codes of 26 (Paper), 33 (Primary Metals including Steel), and 29 (Oil) were listed. Then, the 1973 U.S. Census Bureau Report, "Pollution Abatement Cost and Expenditures" was used to identify the 4-digit SIC codes associated with the majority of the pollution control capital investments of all firms in the two-digit

SIC codes shown above. For the Paper group these SIC codes were 2611 (pulp mills), 2621 (paper mills - except building paper), and 2631 (paperboard mills). For the Steel group it was 3312 (blast furnaces and steel mills). And for the Oil group it was 2911 (petroleum refining). The next step was to use the 1969 Standard and Poors Corporate Register, that lists firms with their 4-digit SIC codes of significant business activity, to exclude all of the firms selected from the CRSP tape that did not have at least one of the 4-digit SIC codes given above. Finally, the 1970 Moody's Industrial Manual, which lists firms with summary descriptions of their significant business activities, was used to eliminate firms that did not have significant business interests in the major pollution causing activities of either the Paper, Steel or Oil subgroups. For example, the firms listed under Oil of Appendix A-2 all have their substantial business interests in the activity of oil refining. Other firms chosen for the first experimental group are listed under Paper and Steel in Appendix A-2.

The procedure for forming the second experimental group consisting of firms remaining to be studied by the CEP at the time of each report, is straight-forward and was explained in the text. The third experimental group, firms in polluting industries other than those studied by the CEP, was formed in much the same way as the first. The same Census Bureau report was used to identify the five two-digit manufacturing SIC codes associated with the highest ratio of 1973 incremental capital expenditures on pollution control to total capital expenditures. The first three of these (29, 26, and 33) included the Oil, Paper and Steel industries that were studied by the CEP. The fourth and fifth highest

ratios were 28 (Chemicals) and 32 (Stone, Clay and Glass). The two-digit code, 33, can be broken down into a blast furnace and steel products group that was studied by the CEP and another primary metals group that was not. The four digit codes representing the majority of the pollution control expenditures for the other primary metals groups were 3331 (primary copper) and 3334 (primary aluminum), both in the non-ferrous metals category. The four-digit SIC codes representing the majority of the pollution control expenditures for the chemicals group were 2810 (industrial inorganic), 2860 (industrial organic), 2870 (agricultural), and 2890 (miscellaneous chemical products); and for the stone, clay and glass group it was 3241 (cement, hydraulic). Once the four-digit codes were obtained, the same procedure as given for the formation of the first experimental group was used again to form the third, with one additional criteria: all Chemical companies that were listed in N.D.C. [1972] as having a significant interest in developing and marketing pollution control equipment or services were eliminated. The resulting Chemicals, Non-ferrous metals, and Cement Companies in the third experimental group are listed in Appendix A-3.

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