**Bazaz, Mohammad Sadegh**

THE ECONOMIC EFFECTS OF FASB STATEMENT NO. 2 ON SMALL FIRMS' R&D EXPENDITURES

*The University of Oklahoma* PH.D. 1984

THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

# THE ECONOMIC EFFECTS OF FASB STATEMENT NO. 2 ON SMALL FIRMS' R&D EXPENDITURES

A DISSERTATION

PRESENTED TO THE UNIVERSITY OF OKLAHOMA

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

in

BUSINESS ADMINISTRATION

BY

MOHAMMAD SADEGH BAZAZ

Norman, Oklahoma

1984

THE ECONOMIC EFFECTS OF FASB

STATEMENT NO. 2 ON SMALL

FIRMS' R&D EXPENDITURES

A DISSERTATION

APPROVED FOR THE COLLEGE OF BUSINESS ADMINISTRATION

APPROVED BY:

Francis A. Agris

Joseph Lee Rogers III

Phillip D. Harsha

William F. Bentz

DISSERTATION COMMITTEE

The University of Oklahoma requires the signatures of all persons using or photocopying this thesis. Please sign below, and give address and date.

ABSTRACT

In 1974, the Financial Accounting Standards Board issued the highly controversial Statement No. 2, "Accounting for Research and Development Costs." In it, the Board mandated all U.S. firms to expense their R&D expenditures in the year of occurrence. The Board took its position primarily to make firms' financial statements more uniform and to be more conservative by avoiding capitalizing treatment that would introduce an asset into the balance sheet whose value and life are uncertain.

It has been proposed in the literature that this only-expensing rule has hurt small, formerly capitalizing firms and forced them to reduce their R&D expenditures. In this case, manager-controlled firms, which are more risk averse, were expected to reduce their spending on R&D more than owner-controlled firms. In reaction to the mandatory rule, some factors such as size and debt covenants of a firm are also anticipated to be influencing variables which may cause further reduction of R&D expenditures.

This study conducted an investigation via sampling from capitalizing as well as expensing firms and dichotomized them into manager- and owner-controlled groups. Using regression analysis, this study was able to support the

following hypotheses: (1) capitalizing firms have been adversely affected by the rule and sharply decreased their R&D expenditures, (2) manager-controlled firms have decreased more R&D expenditures than owner-controlled firms, and (3) degree of leverage was a negative factor for capitalizing firms causing to decrease their R&D expenditures even further. This study however, failed to find a significantly different reaction between smaller and larger firms, probably because the sample extracted from all small firms with fewer than 1500 employees.

IN THE NAME OF GOD, THE MERCIFUL, THE BENEFICIENT

To my parents who have sacrificed for many years without complaining. To them who have raised me in an Islamic way and taught me to love, give, share, and forgive but fear no one but Allah, the Creator, the Sustainer, the Supreme. To both of them who have taught me precious lessons that can never be learned in school. To them who have waited patiently for so long to see the day when my goals are achieved.

To the memory of my late father, Haj Aboulghasem Bazaz, who left this world before witnessing the fruit of his struggle. And to my respectful mother, Haj Nosrat Pourkeramati, I dedicate this humble work.

Mohammad Sadegh Bazaz

ACKNOWLEDGEMENTS

I gratefully acknowledge the cooperation of many individuals who generously and enthusiastically gave their support and time to help me during the course of this study. Their participation was essential to the completion of this project. In particular I would like to express my gratitute to the members of my dissertation committee, Professors Frances Ayres, William Bentz, Phillip Harsha, Kermit Rohrbach, and Joe Rodgers for their valuable contributions to this research. I greatly appreciate their helpful and constructive advice, comments, suggestions and criticisms of this work.

I am especially indebted to Professor Frances Ayres, the Committee chairperson, who guided, reviewed, and edited several drafts of the dissertation. Her numerous comments and suggestions have significantly improved the methodology and presentation of this study. Without her assistance, guidance, and patience this work could not have been completed.

I extend my appreciation to Professor Phillip Harsha for his invaluable advise in the conception of the idea, and editing of this dissertation.

I am also indebted to Professor William Bentz for his continued encouragement and unwavering support throughout the whole period of my graduate study at the University of Oklahoma.

I want to thank Mr. Waren Dickson for his valuable comments. Mr. John Van Horn for his drafting assistance, and professor Anthony Lis for the editing of this dissertation.

Finally, my family deserves my deepest thanks more than ever can be expressed here. My mother Nosrat, my wife Homa, and my sons Ehsan and Hamed have always provided me with moral support which I needed. Their cooperation, understanding, and patience, for which I am grateful, will never be forgotten.

Mohammad S. Bazaz

Norman, Oklahoma

June 1984

CONTENTS

## LIST OF TABLES

LIST OF FIGURES

# Chapter I

# INTRODUCTION

In 1974, the Financial Accounting Standards Board (FASB) mandated all United States (U.S.) firms to expense research and development (R&D) expenditures during the period in which they are incurred.

Before FASB Statement No. 2 (SFAS2), firms had the option of either expensing or capitalizing R&D costs for the preparation of their financial statements, as well as for tax purposes. The majority of U.S. firms, especially the large ones, were using the expensing accounting treatment for R&D expenditures (Dukes et al., 1980). Only a small number of firms were using the capitalizing method when SFAS2 was issued. However, most of them were small, high-technology firms that contribute a great deal to the innovation process every year. Any discouragement of R&D spending to these firms may have a significant negative effect on future innovation.

The mandatory switch to the expensing treatment of R&D expenditures is believed to have had several adverse effects on small firms that had previously been capitalizing R&D expenditures. As Horwitz and Kolodny (1980) note, the mandatory change from capitalizing to expensing causes an

immediate reduction of net income, assets, and owners' equity. As a result, key financial ratios, especially debt to equity, may be adversely affected. This change can lead to a potential violation of existing debt covenants, as well as increased difficulties with future borrowing. Small, technological firms that are often at a growing stage depend heavily on borrowing for their financing. Even prior to SFAS2, their degrees of leverage were higher than those of many larger firms. Daley and Vigeland (1983, p. 208) conclude that:

> ...R&D capitalizing firms were more highly levered, employed more public debt, had a higher ratio of dividends to unrestricted retained earning, and were smaller in size than R&D expensing firms.

To minimize the adverse financial statement impact caused by mandatory expensing, affected small firms may decrease their spending on R&D. This reaction of small firms to SFAS2 may create further adverse effect on the firms' earnings and the national economy as well.

This chapter is divided into five sections. In the first section, R&D accounting treatments before SFAS2 are described. A statement of the problem is presented in the second section. The role of a firm's level of control is considered in the third section. In the fourth section, the differences between this study and previous, related research are explained. Finally, the adverse economic effects of SFAS2 are summarized in the last section.

## 1.1 R&D ACCOUNTING BEFORE SFAS2

Prior to the establishment of the expense-only rule, U.S. firms were allowed by Accounting Research Bulletin (ARB) 44 to use either a capitalizing or an expensing method for financial reporting purposes. Ansari (1975) and Dukes et al. (1980) indicate that an enormous number of firms were using the R&D expensing treatment before the FASB abandoned the capitalizing method.

Several reasons may explain the preference of expensing over capitalizing method especially by large firms. Watts and Zimmerman (1978) argue that management preference in selecting a specific accounting method among alternatives depends upon the relative income effects of the method and the size of the firm. In particular, Watts and Zimmerman believe that larger firms will tend to adopt accounting methods that will reduce or (delay) the reporting of income.

In addition, according to the Internal Revenue Code of 1954 (sec 174-a), firms could choose between expensing or capitalizing R&D for tax purposes. Therefore, "almost all industrial firms treat R&D as current expense to gain the tax benefits" (Johnson, 1967, p. 166).

Finally, the uncertainty of the life and the amount of future benefits resulting from R&D expenditures, as well as a lack of direct immediate results, indicate that firms are more willing to use an expensing rather than a capitalizing method for their R&D costs (Orton, 1962). An American

Institute of Certified Public Accountants (AICPA) survey reported that over 90 percent of respondents had indicated that their company's philosophy was to recover R&D through current revenues (Gellein and Newman, 1973, p. 100).

The FASB in 1973 conducted an investigation of accounting treatments for research and development. The Board interviewed and sent questionnaires to financial analysts, bankers, and executive officers of major large firms in order to determine their views on R&D expenditures. The Board also reviewed several studies such as those conducted by Newman (1968), Johnson (1967), and Milburn (1971) to see the relationship between R&D costs and increased future benefits as measured by sales or earnings. According to the Board, these studies showed a high failure rate for R&D projects. After this investigation and in view of the fact that a large proportion of R&D projects were considered "failures," the Board finally concluded that all R&D should be treated as failures and expensed (SFAS2, Appendix B).

Statement No. 2 was issued with relatively little opposition because fewer than 20 percent of the publicly owned firms deferred R&D and most of those were small (Barrons, November 18, 1974, p. 3). Because of the absence of an effect on the majority of firms and the paucity of complaints, the SEC supported the idea and adopted the statement in 1975 via ASR#178.

## 1.2 STATEMENT OF PROBLEM

Since the passage of SFAS2, several researchers have attempted to determine the effects of this rule on firms, industries, and the economy (see, for example, Brugger (1978), Dukes et al. (1980), and Horwitz and Kolodny (1980, 1981)). They claim that SFAS2 may have an adverse effect on some firms, as well as on the economy. These adverse effects may be summarized as:

1. Horwitz and Kolodny (1980, p. 47) found that, if small capitalizing firms had instead used the expensing method for their R&D expenditure prior to SFAS2, their earnings would have been significantly lower than they had been during 1970-1975.
2. A switch to immediate expensing of R&D costs in many small firms may result in lower assets and thus lower stockholders' equity and higher debt/equity ratios.
3. As a result of the above effects, the market prices of the securities of research-intensive companies may drop.
4. Performance evaluation of management is often based on financial statements. Changing accounting data as a result of a mandatory switch by the FASB may force managers to alter their spending decisions to keep their performance ratings at a high level.
5. Reduction of a firm's earnings and assets may have a serious effect on its bond contracts. Bond holders

often set some restrictions such as peak level of borrowing, dividends to stockholders, etc., which are often tied to accounting data. The above effect on accounting numbers may violate bond agreements and force managers to renegotiate, pay less dividends, and/or borrow with higher cost of capital to meet dividend payment or other needs. Each of these situations may cause managers to reduce spending on various items including R&D.

6. In addition to the compensation and bond contracts mentioned above, accounting data may also be considered for such other purposes as security exchange listing requirements; obtaining loans, awards, or grants from government agencies; and ascertaining the expectations of trading creditors.

These factors may cause firms to change their behavior in investment and financing decisions that ultimately may result in less spending on R&D.

Specifically, this study was undertaken in an attempt to secure answers to the following questions: (1) What is the adverse effect of SFAS2 on small firms measured by the change in R&D expenditures from pre- to post-SFAS2 periods? (2) What are the different reactions of manager- and owner-controlled firms to SFAS2? (3) What is the possible effect of the size of a firm on the change in R&D spending?

And (4) what is the influence of debt position of a firm on the R&D spending changes due to SFAS2?

With regard to (1) above, evidence on adverse effects of SFAS2 on firms is mixed. This study will provide further evidence particularly for small firms.

Only one study (Dukes et al., 1980) has considered the issue of manager- versus owner-controlled firms in the area of reaction to SFAS2 and has failed to find any differences between the two. However, significant differences between manager- and owner-controlled firms are claimed by many studies on subjects other than R&D costs. Possible differences in reactions to SFAS2 resulting from firms' different levels of control are analyzed in this study.

Sampling of large and small firms has provided two opposing conclusions in previous R&D studies (Dukes et al., 1980; and Horwitz and Kolodny, 1980). The question of whether a firm's size is an influencing factor in reaction to SFAS2 will also be examined.

In addition to the first three questions that were the subject of previous studies, this study initiated an investigation of the effect of a firm's debt position on the changes in R&D expenditures due to reaction to SFAS2.

## 1.3 THE ROLE OF A FIRM'S LEVEL OF CONTROL

Mandatory expensing of R&D costs reduces the net income of affected firms in the year adopted and in subsequent years (Horwitz and Kolodny, 1980). Total assets and equity are also lower while the ratio of debt to equity is higher. As a result, firms' stock prices may fall (Grabowski and Mueller, 1972; Marris, 1964). The firms become more vulnerable to takeover by owners as their market valuations continue to fall below potential value. Consequently, hired managers may want to pay more dividends than planned in an attempt to obtain security from takeover and similar external pressures.

> If dividends provide utility to managers primarily by giving some security against the threat of loss of control, then higher variability in earnings will increase this threat if it produces lower stock prices and ceteris paribus, the managers should try to offset this with higher dividend payments. (Grabowski and Mueller, 1972, p.15)

According to the efficient market hypothesis, annual earning numbers provide relatively little information to market participants at the time of their release. Ball and Brown (1968), Ball (1972), and others provide evidence that investors are not be fooled by managers via a shift from one accounting method to another. If this is true, the question then arises as to why managers are so concerned with controlling accounting information in preparing their financial statements.

Two major factors that may lead to management reaction to a mandatory change in an accounting system are cited in the literature. One argument is that management compensation plans often allow managers to share profits in excess of a target level that is normally stated in terms of accounting income or return on the book value of assets. Holthausen and Leftwich (1983) and Dhaliwal et al. (1982) argue that managers may respond to a mandatory change in accounting method by altering the firm's spending decisions in order to reduce any resulting unfavorable impact on their compensation payments.

> Changes in accounting rules have economic consequences and there are incentives for managers to spend resources to voluntarily switch to different accounting principles, or to lobby for or against proposed mandatory accounting rule changes (Holthausen and Leftwich, 1983, p. 84).

The second factor relates to non-monetary incentives for a management group to report higher rather than lower profits. Williamson (1964, p. 30) points out that managers pay a great deal of attention to their "security" and "reputation for excellence." Dhaliwal (1982) emphasized that both, in some way, depend on reported profit. Therefore, managers attempt to control accounting information in such a way as to keep current shareholders satisfied and to guard against any attempted takeover of the firm by outside groups. This argument is consistent with an efficient stock market and does not assume that managers can influence the market price by manipulating accounting data.

Rather, it is based on the assumption that they maximize their utilities by attempting to convince shareholders that what they have done is creditable.

Both of the aforementioned arguments suggest that manager-controlled firms can be expected to have a reaction to the mandatory change in R&D accounting treatment that is different from that of owner-controlled firms in order to report more favorable financial statements.

Due to a decrease in total assets, a possible change in dividend policy designed to protect job security and/or a compensation plan, hired-manager firms may need more external capital. They may obtain these additional funds through issuing bonds or borrowing from creditors. However, the requirement of more money from the market, especially when the debt/equity and other key financial ratios have been changed, causes the firms to face a higher cost of capital and/or possibly to reach the limit of borrowing.

As a result of these difficulties, hired managers may decrease their R&D expenditures. Such a decrease may very well have adverse effects on these firms, as well as on the economy as a whole. Conversely, firms run by owners may not face such difficulties and, consequently, may not reduce their R&D expenditures. The reason is simply that owners, who are directly involved in day-to-day operations, are aware of the overall, comprehensive picture of the business. Owners do not feel as much uncertainty and thus do not

believe that additional cash dividends are required to appease other stockholders.

If this analysis holds, additional funding may not be as necessary as in firms run by hired managers, or, if additional funding is necessary, it may be supplied by the owners themselves.

## 1.4 RELATIONSHIP OF THIS STUDY TO PREVIOUS RESEARCH

This study differs from prior research in the area in two major respects. First, the sample of firms consists of small firms exclusively. Dukes et al. (1980) analyzed twenty-seven pairs of large capitalizing and expensing firms. They failed to find a relative significant reduction in R&D expenditure by capitalizing firms as a result of SFAS2. Horwitz and Kolodny (1980) found the opposite result with a sample of smaller firms. However, their sample, as well as their criteria for selecting small firms, differs from the sample used in this study. Horwitz and Kolodny considered firms with less than $100 million sales as small firms. This study focused on the number of employees as a size criterion. As a result, the sample of firms used in this study is much smaller than that used by Horwitz and Kolodny. In addition, according to Wolfson (1980), a large number of firms in the Horwitz and Kolodny sample changed their accounting for R&D voluntarily one or two years before SFAS2, leading to biased results.

There are three reasons why small firms may have shown a more pronounced effect of SFAS2. First, as noted by Horwitz and Kolodny, the major opposing voices to the passage of SFAS2 came from small firms. Second, the expenditures on R&D in proportion to other expenditures tend to be higher for small firms than for large firms. Third, deferred R&D may be a larger portion of total assets in small firms than in large ones. Hence, a required expensing treatment is likely to increase the variability of income and financial position to a greater extent for small firms than for large firms. This fluctuation can lead to adverse capital market effects, but to avoid this situation , small firms may reduce R&D spending.

The second major difference between this study and previous research is that the type of control (manager versus owner) is investigated as a variable influencing the change in R&D expenditures.

In addition to the two major differences discussed, this study also considers two other issues that are not covered by earlier works with respect to R&D expenditures. Conflicting results between Dukes et al. (1980) and Horwitz and Kolodny (1980) raised the question of whether the size of a firm really matters in reacting to SFAS2. This study focused on the latter phenomenon among small firms to determine whether the relative size of a small firm influences its response to SFAS2. For this purpose, size is measured in terms of dollar sales.

The second issue concerns a firm's financial leverage and debt covenants. Evidence demonstrates that financial leverage and accounting methods are associated because of the existence of restrictive covenants in a firm's credit agreements. Dhaliwal (1980), Bowen et al. (1981), Dhaliwal et al. (1982), and Holthausen and Leftwich (1983) are among those who unanimously agree that firms with a large amount of debt relative to total assets (equity) tend to choose accounting methods that result in higher or earlier reported earnings. Consistent with this hypothesis, small firms with a high degree of leverage were more likely to capitalize their R&D expenditures before SFAS2. Issuing of the expensing only rule for R&D expenditures may have created a serious difficulty for these small, highly levered firms. As a result, the capitalizing firms with higher debt/equity are expected to react to the rule and decrease their R&D expenditures.

## 1.5 SUMMARY OF SFAS2 ADVERSE EFFECTS ON SMALL FIRMS

The adverse economic effects of SFAS2 on small firms under consideration in this study are as follows:

1. Small capitalizing firms have been adversely affected by adopting SFAS2. It is hypothesized that small firms will have decreased their R&D expenditures in the post-SFAS2 period.

2. With respect to their reaction to SFAS2, small capitalizing firms controlled by hired managers are expected to have behaved differently from owner-controlled firms. It is expected that manager-controlled firms will have decreased R&D expenditures more than owner-controlled firms.
3. Conflicting results among previous studies in this area raise the question of whether firm size can account for the differences in reductions to the mandatory change in accounting for R&D. Accordingly, the decrease in R&D expenditures is expected to be greater as the size of the firm becomes smaller.
4. Evidence shows that firms with poor financial positions are more likely to react to an involuntary change in an accounting principle than are firms with better financial position (Elliott et al., 1984). Leverage, expressed as the debt/equity ratio, is often a component of firms' debt contracts. To the extent that firms are in danger of violating debt contracts, they have an incentive to reduce spending on R&D to avoid violation of debt covenants. Hence, it is hypothesized that degree of leverage may have influenced R&D expenditures in the post-SFAS2 period.

## Chapter II

## BACKGROUND

Research and development is conducted by almost all organizations and serves several purposes. The objectives of spending on R&D by a firm may include:

1. increasing wealth
2. extending productive activities
3. inventing and producing a new product
4. disclosing a better technique of operation which leads to increasing revenue and/or decreasing costs.

Various definitions of R&D expenditures have been proposed. One of the more comprehensive definitions is suggested by the Financial Accounting Standard Board (FASB) and is presented below.

> Research is planned search or critical investigation aimed at discovery of new knowledge with the hope that such knowledge will be useful in developing a new product or service...or a new process or technique...or in bringing about a significant improvement to an existing product or process.
>
> Development is the translation of research findings or other knowledge into a plan or design for a new product or process or for a significant improvement to an existing product or process whether intended for sale or use. It includes the conceptual formulation, design, and testing of product alternatives, construction of prototypes, and operation of pilot plants. It does not include routine or periodic alterations to existing products, production lines, manufacturing processes, and other on-going operations even

> though those alterations may represent improvements and it does not include market research or market testing activities (FASB Statement No. 2, para. 8).

This very general definition does not differentiate types of research. Marshall (1980, p. 86) criticized the FASB definition of R&D indicating that the "output from various R&D processes may differ fundamentally." He categorized research as "pure," where the goal may be unknown, and "directed," where the goal is to advance the state of the art along a predetermined dimension. Only a few major companies are engaged in pure research activity. Mansfield (1969, p. 66) found that only 9 percent of total R&D expenditures was used for basic (pure) research. The remaining 91 percent was used for either applied (directed) research or development that is the subject of investigation in this study.

According to Gambino and Gartenberg (1979), the basic purpose of most R&D is not technical achievement but profit achievement. Applied research is more directly related to the productive development of a firm. This idea supports the following two important aspects of this study:

1. Development costs are more likely to result in future benefits than are pure research costs. Therefore, a capitalizing treatment seems to be a more appropriate accounting technique for development costs.

2. Small firms are expected to spend nearly all their budgeted R&D expenditures on applied research (development) projects and , consequently, are an appropriate object for the present research.

## 2.1 R&D COSTS AND FUTURE BENEFITS

A significant portion of yearly expenditures spent on R&D by a typical firm can be described as an investment in innovation. Although the importance and the necessity of R&D expenditure for firms, industries, and the economy are obvious, substantial uncertainty exists regarding the amount and the expected economic life of the benefits. One group of researchers often points out that R&D by its nature may not result in a short-term material increase in revenue, earnings, and/or higher market share. However, they do believe that R&D expenditures have a positive influence upon the industry. (See, for example, Mansfield, 1964, 1969; Kamien and Schwartz, 1975; Grabouski and Mueller, 1974). This influence may vary depending on the nature of the industry (e.g. the pharmaceutical vs. the computer industries). Another group of researchers (Newman, 1968; Johnson, 1967; and Milburn, 1971) denies the relationship between R&D expenditure and increased future benefits. They failed to find any positive benefit from R&D projects. To these researchers, the future benefits derived from current R&D expenditure is so uncertain that one cannot trace any specific benefit to R&D expenditures.

## 2.2 THEORY OF R&D ACCOUNTING TREATMENT

A review of the literature concerning the theory of R&D may help elucidate the dichotomy in reporting R&D expenditures. The dichotomy is supported by two opposing schools of thought regarding desirable accounting treatment. Economics literature seems to indicate that R&D is considered to be related to increases in sales and productivity, as well as being subject to diminishing returns. Hence, for economists, R&D is very similar to traditional factors of production such as property, plant, and equipment. Moreover, as Mansfield found, the rate of return on R&D expenditures is substantially higher than on property, plant, and equipment. As a result, he stated that, in theory, R&D expenditures can be regarded as an investment decision made by management after comparing the likely profitability of research programs with alternative uses of the firm's funds (Mansfield, 1971). Many other economists have compared R&D expenditures with other tangible and intangible assets. With respect to promising future benefits, the basic concept of any asset, they concluded that R&D should be considered as a part of capital investment and, hence, should be capitalized. Elliott (1971, p. 410) summarized the case for capitalization:

> R&D expenditures are a form of investment which produce a quasi-capital stock consisting of the level of applicable production technology and of the firm's array of marketable products and services. The firm can be expected to be aware of this stock of technological capital, and continually engaged in an evaluation of its

> adequacy. This evaluation process implies the firm has a desired stock of technological capital against which the actual stock is compared.

This conclusion is consistent with a survey made by McGraw-Hill (1968). The study found that 90 percent of companies expected returns on their R&D in five years or less.

In addition to the consideration of R&D as an asset, economics literature contains a separate theory for explanation of R&D expenditures. According to this theory, an investment in R&D is an investment in the production of scientific knowledge or information. Information itself is a commodity that may have subtantially different characteristics from other commodities. Dukes (1976) maintains that technological information may be developed by the possessor who has taken a speculative position in the equity of those assets expected to benefit from the public dissemination of the information. In this case, the owner gains from the information because he speculates on the assets or entities expected to be affected by the discovery, not because of private ownership of scientific knowledge. In other words, the possessor of information benefits from revaluation of assets in which he has taken a speculative position.

According to this perspective, R&D is substantially different from investment in tangible, long-lived assets (Dukes, 1976). Benefits are realized indirectly through the

impact of the discovery on other assets, not through production or sale of the asset acquired. Whether or not R&D expenditures have such an impact on other assets and create indirect future benefits, as Hirshleifer (1971, 1973) claims, is a matter for extensive research. However, according to the above argument, R&D can still be considered as an asset and should be expensed in a way to match future revenue.

In contrast to economists, accountants do not share a common idea on recording R&D costs. Orton (1962) argues that the accounting for R&D costs should follow the same basic pattern as for other tangible and intangible costs having future benefits. Existence of uncertainty should not override the generally accepted accounting principles of income determination and balance sheet presentation. He suggests that R&D expenditures should be divided into these two basic types of activities: pure research that should be expensed currently and applied research that should be capitalized and allocated to the periods benefited.

Accounting Research Study No. 3 defines assets as economic resources representing future benefits to a particular entity. Under this definition, R&D expenditures would be considered as assets as a result of promising future benefits. Gellein and Newman (1973) in Accounting Research Study No. 14, Accounting for R&D Expenditure, make a very similar argument. They dichotomize period and

product costs. R&D costs are defined as discretionary costs that are not related to current operation. Rather, they are incurred to preserve the profitability of an enterprise over the long term. Bierman and Dukes (1975 p. 51) have an extensive argument against expensing R&D. In their discussion, they indicate that:

> It is incorrect to conclude that, because it has been difficult to observe a significant correlation between expenditures and subsequent benefits, future benefits are not generated by R&D expenditures.
>
> ...if value is excluded from consideration... and the choice is between zero (expensing) and costs, lacking other information cost will on the average be a better estimator of value than the zero asset value resulting from the expensing of R&D.

On the other hand, official accounting bodies and major firms favor expensing R&D expenditures. Arthur Andersen (April 1974, p. 6), in its article concerning accounting for research and development, indicates that:

> We recognize financial statements as the principal vehicle by which a business enterprise communicates information about its economic resources and changes in those economic resources. Economic resources of a business enterprise are those elements of wealth possessed by the enterprise that have economic value. To have economic value, an element of wealth must not only have utility, but it must be scarce and it must have exchangeability.

Based on this definition, deferred charges and some intangibles can no longer be considered as assets because they lack exchangeability. The remaining choice is to expense R&D cost. Tranter (1978, p. 34) adds that as R&D

relates to the future periods, it should be shown as a separate item in the income statement rather than buried in the cost of goods sold.

In the past, because of no significant impact on large firms' income, the uncertain future economic benefits of R&D and/or because of tax considerations, a large number of firms used the expensing method for their R&D expenditures. Other firms, most of which were small, used capitalizing accounting treatment. To ensure uniformity of accounting methods for R&D costs among firms, the FASB reviewed several studies and conducted hearings on the matter. Then in 1974, the Board concluded that expensing R&D in the period of spending was more appropriate. Consequently, all U.S. firms were mandated to do so.

According to Statement No. 2 (paragraphs 17-22 and 39-41), the major reasons the FASB offered for prescribing expensing accounting treatment were:

1. uncertainty of future benefits,
2. lack of causal relationship between expenditures and benefits,
3. difficulty with recognizing expenses according to the matching concept,
4. failure of accounting research studies to recognize R&D as an asset, and
5. more useful information for investment decisions.

Bierman and Dukes (1975, p. 48) sharply criticize the FASB for basing their decision on these reasons and for the method that led to SFAS2. They say:

> The Board reached its conclusion as a result of a reasoning process in which several preliminary premises were accepted as true. It may be possible to conclude for pragmatic reasons that the expensing decision reached by the Board is a reasonable practice, but we object to the process the Board used in arriving at the conclusion that R&D should be expensed.

Bierman and Dukes reject the FASB rationale with detailed explanation. For example, they cite several studies indicating significant correlation between R&D costs and future benefits. Bierman and Dukes argue that any asset recorded on a balance sheet involves future uncertainty. Even if it were agreed that R&D presents a greater risk (a position they do not accept), it is still not clear that this leads to the policy conclusion of expensing the costs of R&D.

Horwitz and Kolodny (1980) believe that the reason the FASB mandated the expensing treatment for R&D costs was the lack of enough firms deferring their R&D. Although, over 700 of the firms filing the 10-K report in 1973 had deferred R&D costs, they accounted for only three percent of the total dollar value of R&D (Ansari, 1975). Much evidence supports the assertion that small firms often used the deferral method before SFAS2 (Orton and Bradish, 1969; Gellein and Newman, 1973; San Migual, 1975; Horwitz and Kolodny, 1980; and Daley and Vigeland, 1983).

## 2.3 SMALL FIRMS AND INNOVATION

Small business is vital to the overall goal of continued innovation and the development of high technology. In fact, small business should be considered as a resource as it encompasses both human and financial resources. Thomas Farrington, President and Chief Executive Officer of Input-Output Computer Services, expressed his view before the U.S. House of Representatives (November 24, 1981, p. 29) as follows:

> In perspective, small business is the seed from which innovation, high technology and evolving industries in this country are developed and upon which we base our free enterprise system, and without continued incubation of the seed, then all else eventually will expire.

During this hearing, the role and the importance of small firms in innovating new products were emphasized by citing various studies. For example, during 1953-1973 almost 50 percent of all major U.S. innovations came from firms with fewer than 1000 employees. Furthermore, it is indicated that small businesses with fewer than 250 employees produced 90 percent of the 6.8 million jobs created from 1965 to 1976.

Horwitz and Kolodny cite from joint hearings (1978) that these small firms were high technology and made a disproportionately large contribution to the innovation process (about 24 times more than large firms per research dollar expended). The "Senate Special Report on Small Business and Innovation" (1978, p. 5) presents the following data quoted from the MIT Development Foundation (1976):

| | Young Tech. Companies | Innovative Companies | Mature Companies |
|---|---|---|---|
| Compound annual rate of increase in sales | 42.5% | 13.2% | 11.4% |
| Compound annual rate of increase in employment | 40.7 | 4.3 | 0.6 |
| Compound annual rate of increase in tax provision | 34.1 | 8.3 | 7.8 |

In view of the data presented above, it is quite possible that even a small change in R&D expenditures by these small, high-technology firms may have a significant effect on innovation in this country. The sensitivity of small firms in relation to R&D was the major reason that opposition to expensing arose both from small companies and the academic community. Nevertheless, SFAS2 that mandated the expensing treatment for R&D costs was issued in 1974.

The Board did not undertake further research on the economic consequences of this statement. Many people, however, conducted studies on R&D and focused on the effects of SFAS2. They have criticized the expensing-only treatment and indicated that the SFAS2 has had adverse effects on small firms, as well as the economy, (Horwitz and Kolodny, 1980, 81; Dukes, 1975; Bierman and Dukes, 1976; Dukes et al., 1980).

# Chapter III

# R&D AND MANAGEMENT BEHAVIOR

## 3.1 AGENCY THEORY

Jensen and Meckling (1976, p. 308) define an agency relationship as:

> ... a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent.

In an agency relationship the agent cannot always be expected to act in the best interests of the principal. Both can be expected, however, to attempt to maximize their own utilities. The self-interest of each individual depends on his utility function and wealth position, which are unlikely to be identical for any given principal and agent.

Agency theory is based on the premise that principals (owners) wish to induce agents (managers) to behave as if they were maximizing the owners' welfare. To do so, owners normally attempt either to put some restriction on the actions of managers or to direct that the interests of owners and managers be parallel to some extent. This involves agency costs that may appear in the following two forms: (1) the amount of resources sacrificed by owners to control manager behavior, and (2) the opportunity loss

caused by managers who run business in their best interests that are normally different from owners' interests (Jensen and Meckling, 1976). This opportunity loss often appears where owners lack sufficient control of managers' activities. Managers may cause a long-term loss to the firm via limiting the ability of a firm to take full advantage of profitable opportunities. Possible reduction of R&D expenditures in reaction to SFAS2 is an appropriate example of action that managers may take to protect their compensation profits.

These two costs will have an equilibrium point in a firm. Whenever the owner's control on manager behavior decreases, spending decreases and, as a result, lost profit increases. The equilibrium point depends on the level of implicit and explicit contracts between principals or providers of outside capital and managers or agents. The theory of the firm proposed by Jensen and Meckling (1976) and founded on agency relationship focuses on a complex process in which the conflicting objectives of individuals are brought into equilibrium within a framework of contractual relations.

Horwitz and Kolodny (1980) address two types of contract changes; namely, borrowing and managerial compensation, which relate to the R&D issue and may affect the equilibrium position of firms' agency costs. Agreements between principals and agents are based on, among other

things, accounting information. A mandatory change in accounting technique, such as that in SFAS2, may change key measurement variables and thus may have a great effect on a firm's contracts, as well as on its equilibrium.

Using the agency theory framework, Watts and Zimmerman (1978) developed a positive theory of accounting based on two propositions:

1. managers attempt to maximize their utility, and
2. their utility is positively related to their compensation.

According to this theory, managers may react to any mandatory change in accounting treatment and exercise control over the information released regarding the firm's performance in an attempt to present the results of the firm's operation in the most favorable way. By altering the firm's investment and financing decisions, managers can reduce any unpleasant impact of the mandatory change on their compensation payments. This line of argument suggests that managers will prevent the increase of debt/equity ratio, resulting from SFAS2, by choosing accounting methods that result in higher or earlier reported earnings and higher reported equity. In general, Dhaliwal et al. (1982) indicate that closely held firms are likely to choose accounting methods that are different from those chosen by manager-controlled firms.

## 3.2 BEHAVIOR OF FIRMS WITH RESPECT TO RISKS

The theory of firms' behavior indicates that owner-controlled firms differ from manager-controlled firms. Here, control refers to power exercised in directing or determining the guiding policies of the corporation. For the purpose of this study, owners need not necessarily be active in routine decision making of the firm. Control is determined by the distribution of the firm's voting securities. The ability of the stockholder group to force its goals upon management is dependent upon how closely the stock of the corporation is held (Smith, 1976).

Many economists argue that there is a conflict between managers' and owners' goals in an enterprise. They contend that owners are more willing to undertake risky ventures because they receive the benefits if successful. In owner-controlled firms, incentive for accounting manipulation may not exist.

Hired managers, on the other hand, tend to be more conservative and avoid risky decisions. They are reluctant to pursue high-risk projects when their own reputations and the funds of the company are involved. Their firms have less variability in earnings, may grow more slowly, and may be less likely to go bankrupt than they would if managers sought to maximize profits. Hired managers are very careful to maintain and improve their positions in the firm. They

often tend to maximize their own lifetime earnings by keeping the shareholders happy.

Gordon (1964,p.257) explains in this regard that:

> With the separation of ownership and operating control that exists in the modern corporation, financial statements perform an analogous function for the stockholders, creditors and other persons who have an interest in and influence over the decisions of management. If the corporation is doing well, the stockholder supports the existing management. If the corporation is doing poorly, the stockholder sells his stock, votes for a new management, or takes any other action within his power to change the management.

Because small stockholders have limited access to information, they are forced to be satisfied with that reported by managers. They often leave managers free to pursue policies that are to their own advantage. These stockholders will intervene actively in the affairs of the corporation only when an acceptable level of profits is not attained. Because managers are often evaluated via financial information, Gordon (1964) argues that management will use accounting policy decisions to eliminate income fluctuations and to achieve desired effects upon performance measures. Managers, under pressure from shareholders for higher stock prices, may modify accounting procedures to favorably influence financial reports. This may be partly because of their own self-interest and partly as a result of applying a propaganda system to influence shareholders and

public opinion. Managers' reactions may not always be in the best, long-term interest of shareholders. Their behavior may have adverse effects on the wealth of the firm. Tranter (1978, p. 42) has an interesting example in this regard:

> In 1970, during a prolonged earnings slump, Chrysler changed its method of accounting for inventories. This change had the effect of reducing its reported loss for that year and the restated financial statements showed an improved pattern of earnings. The reduction in the loss, however, increased Chrysler's tax liability by more than $50 million.

Another example is the reaction of management in the capital market area. As mentioned briefly in Chapter I, when the marginal return on investment falls below the stockholders' opportunity cost, the firm's stock price starts to fall (Grabowski and Mueller, 1972; and Collins et al, 1981). The firm becomes more vulnerable to takeover by outsiders as its market valuation falls below its potential value. Grabowski and Mueller argue that management may attempt to pay greater dividends in order to guard against a takeover.

The two above examples are short-run reactions by manager-controlled firms. However, manager decisions may also have long-term effects. For example, SFAS2 forced firms to charge all their R&D expenditures at the time of spending. Similarly, FASB Statement No. 19 mandated oil and gas companies to expense their exploration costs at the time of occurrence. These policies had a profound adverse effect

on net income, as well as on the capital structure of the firms. The mandated switch to the expensing method not only decreased net income but also reduced the equity of the affected firms both currently and retroactively. A decrease in equity means an increase in the ratio of debt to equity as well.

The debt to equity ratio is used by lending institutions for evaluating a firm's financial situation. An increase in the ratio makes borrowing money difficult, especially for small firms. Debt covenants may restrict management's ability to create wealth transfers between debt and equity holders (Jensen and Meckling, 1976; and Smith and Warner, 1979). Affected firms, therefore, might be required to make smaller dividend payments than they planned, or they might have to finance more money with a higher cost of capital. At the same time, restrictive covenants may have set a limit on issuing new debts. These simultaneous factors will increase the firm's level of risk. To avoid higher risk, hired managers may attempt to decrease the level of expenditure on exploration and research activities. Horwitz and Kolodny (1980,p. 55) mention a typical statement by the president of an independent oil and gas company to support this theory:

> ...if we are forced to make this change (switch from full-cost to successful-efforts), we will reduce the dollar magnitude of our domestic petroleum exploration effort. We have not yet determined the exact amount of this reduction, but

> it will be significant. In determining future exploration strategy investment decisions will be judged not simply on economic merit and exploration risk, but also on the "false" criteria of short term earnings' impact. We also probably will revise the nature of the balance of our exploration effort to reduce participation in high risk situations.....We will seek out lower risk opportunities.

Although the FASB indicated in Statement No. 19 that firms were required to use the expensing (successful efforts) method, the SEC later overruled this because the rule was damaging the small, growing oil and gas companies. Mandated change from "full cost" to "successful efforts" lowered reported earnings. It has been claimed that this result made it difficult and more expensive for small firms to raise capital. Similar results may be considered for SFAS2.

## 3.3 EFFECTS OF SFAS2 ON MANAGEMENT DECISIONS

The treatment of R&D mandated by SFAS2 is aimed at creating uniformity among firms that is useful for interfirm comparability of results. However, it may harm some firms economically, especially those that are dependent on external funds for their development. Citing the chairman of the SEC, Horwitz and Kolodny (1980, p. 44) have emphasized this idea in a general form by saying that not only is investors' protection important for setting a

regulation, the impact of a regulation on the ability of small businesses to raise capital is also important and should be considered.

Among the adverse effects of SFAS2 have been the reactions of affected firms toward the rule. Many studies provide evidence that these reactions subsequent to the mandated changes ultimately resulted in reporting less net income (see Harrison, 1977; Collins and Dent, 1979; Lev, 1979; Dukes et al., 1980; and Horwitz and Kolodny, 1980). This behavior is more likely to happen in manager-controlled firms than owner-controlled firms.

The mandated switch to the expensing method in 1975 reduced the equity of affected firms because R&D could no longer be considered an asset. As a result, key financial accounting levels and ratios, including the debt to equity ratio, have changed significantly, especially in smaller firms. This change in ratios may have had a corresponding effect on firms' operating and financing decisions. The following examples may clarify this point:

1. Mandated switching of R&D treatment to the expensing method will decrease reported net income in the year of the change. As a result, affected firms may have to pay smaller dividends for current and future periods. To avoid the risk of possible takeover, management may decide to borrow and pay the same or even higher dividends.

2. Increasing the ratio of debt to equity, as well as changes in other key ratios as a result of expensing R&D, may limit the firm's capability to issue additional debt. Consequently, the firm would not be able to borrow money at the same interest rate. Therefore, it may be faced with a higher cost of capital.
3. Higher cost of capital and limited possibilities for financing may affect a firm's choice of investment. In particular, the expense-only rule may force management to reduce planned R&D and change the pattern of future expenditures in order to compensate for the adverse impact on financial constraints.

These results should not be expected within a year; rather, the reduction of R&D investment may appear in the long-run. Three years after the issuance of SFAS2, an international public accounting firm drew attention to the reduction in R&D outlay by noting that:

> ...the immediate expense recognition method required by FASB Statement No. 2 ...may influence R&D spending decision. If the immediate earnings impact becomes an important factor in making these expenditure decisions, there may be adverse long-term impact on those companies (Coopers & Lybrand, August 17, 1978).

Similar statements have been expressed by small company representatives during the hearing on the R&D measurment

issue. Because these small firms were in the minority, they had little effect on the FASB decision even though they produced twenty-four times more major innovations per research dollar expended than did large firms (Horwitz and Kolodny, 1980).

## Chapter IV

## LITERATURE REVIEW

A review of accounting literature shows that both the theoretical and practical accounting treatments for R&D costs have been considered by professionals since the early 1920's. Ansari (1975) has done a comprehensive study of the literature on accounting for innovation. Concentrating on R&D, he points out that, at a regional cost conference of the National Association of Cost Accountants (NACA) in 1922, the favored treatment was that work related to product development should be capitalized as an asset. On the other hand, Ansari points out that the second edition of the Accountants Handbook (1932) states that "it would be unsound to capitalize (R&D) as patents or otherwise all costs of research." He cites two major reasons:

1. much of the research provides no peculiar advantage to a company, and
2. separation of research cost into various, often combined, activities is difficult.

From the beginning then, contradictory views on accounting treatment of R&D costs have existed with opponents of capitalizing believing that it is impossible to relate R&D costs to subsequent benefits.

Evidence regarding treatment of R&D expenditures in the 1920's and 1930's is mixed. Ansari (1975) notes that a NAA survey in 1924 found some of its member firms capitalizing product development costs. A major factor in more firms capitalizing R&D costs prior to World War II, Ansari states, may have been the relatively small amounts involved. In the post-World War II period, business firms had substantially higher R&D expenditures and began moving from a capitalizing to an immediate expensing treatment of R&D costs for tax benefits, as well as conservatism.

The Internal Revenue Service (IRS), for its own reasons, did not emphasize capitalization of R&D costs during the 1930's and 1940's. Section 174 of the Internal Revenue Code of 1954 provided firms with a choice of expensing or deferring their R&D costs making both accounting treatments acceptable for tax reporting. Many firms took advantage of this and attempted to expense their R&D expenditure in order to pay less income tax.

The second and most important reason given for immediate write-off was conservatism. Orton and Bradish (1969) specify four arguments based on conservatism:

1. Because of the high risk of failure, and uncertain future benefits, deferring R&D costs until the outcome is known means considering an asset with uncertain value in the balance sheet.

2. Because the uncertain life of knowledge gained from research is by no means accurate.
3. The outcome of pure research is not determinable by any product or period.
4. Deferring R&D expenditure as an uncertain asset causes an uncertain increase in tax liability.

Many other analyses, as well as empirical studies, have favored an expensing treatment as a result of considering the uncertain benefit from R&D costs.

Although capitalizing R&D costs may have been a popular treatment during earlier years, firms' opinions have shifted toward an expensing treatment since World War II. Since the shift from capitalizing to expensing, much research has been devoted to determining the relationship between R&D expenditures and some improvement criteria such as sales, earnings, and market share resulting in substantial support of the hypothesis that R&D efforts produce benefits for the firm. Kamien and Schwartz (1975), in a review of this literature, found many studies providing evidence to support the existence of a positive relationship between R&D efforts and future benefits. Some researchers, such as Grabowski and Mueller (1972), found strong ties between net income and R&D. They conclude that R&D increases the profitability of the firm.

One explanation for the high reported earnings of industries like chemicals, electronics, and pharmaceutical, which supports the importance of R&D expenditure, has been advanced by Mansfield and Hamburger (1963), Bailey (1972), and Clarkson (1977). Studying twenty-two major firms in the chemical and petroleum industries, Mansfield and Hamburger found that the bulk of R&D projects carried out by these firms often had better than a 50 percent chance of technical success that lead to higher earnings (Mansfield, 1969). Baily (1972) focused on benefits of patents kept by the firms and concluded that "earnings of companies over time are clearly related to the number of patents held by the company." However, he was not able to find the direction of causality between these two variables. Clarkson (1977) found support for the benefits of R&D, especially in the long run, and stated, "(the expenditures) are investments because they produce income in future years and, moreover, they are frequently made at times when they contribute little or nothing to current income."

Other empirical research, such as that by Grabowski (1969), Branch (1970), Elliot (1971), and Angilley (1973), suggests a significant but not a strong correlation between R&D costs and current earnings. However, numerous studies determined little or no relationship between R&D expenditure and an increase in future benefits. The failure to find a significant correlation between R&D costs and subsequent

sales (Newman, 1968), earnings (Johnson, 1967), or industry sales (Milburn,1971) is noted in the literature. Unfortunately, the FASB focused mainly on this latter group of research studies in creating the rule of immediate expensing (Discussion Memorandum, 1973, Appendix B).

A thorough consideration of the studies shows that some had methodological problems. For example, the study by Newman (1968) developed a regression model using sales as a dependent variable and R&D expenditures for several previous years (1-9) as the independent variable. He used data for five individual firms, as well as U.S. industry as a whole. The weaknesses of this study are (1) a failure to enter other factors that may have affected sales in the regression and (2) correlating total R&D expenditures to sales in the entire U.S. industry, which seems to be too broad a consideration. In this case, even existence of a high correlation may not be indicative of a relationship between the variables, because other variables (e.g. inflation, capital investment, and merchandising expenditures) may have raised both R&D costs and sales simultaneously. Moreover, an assumption of changes in sales over the nine years of study only because of change in R&D expenditures is too strong and probably far from reality.

After SFAS2, the focus of research was directed toward possible consequences of SFAS2 with several researchers concentrating on the effects on firms' net income, market

value of stocks, shareholders' equity, etc. (See for example, Bierman and Dukes, 1975; Dukes, 1976; Sinning, 1978; and Gambino and Gartenberg, 1979). Although several studies have been devoted to the impact of SFAS2 on R&D expenditures (Brugger, 1978; Dukes et al., 1980; Horwitz and Kolodny, 1980, 81; and Elliott et al. 1984), most of this research has failed to find a significant impact of SFAS2 on R&D (Gambino and Gartenberg, 1979 and Dukes et al., 1980). Major reasons for a failure to find an impact may include the short run considerations of the studies as well as a concentration on large firms.

Brugger(1978) found that R&D expenditures among capitalizing firms were sharply decreased in the year before SFAS2 and increased again in subsequent years. He concluded that management does alter its investment behavior as a result of a change in external reporting requirements. However, he emphasized that this altered behavior was due to the uncertainty generated by the debate concerning change, not because of the change itself.

Horwitz and Kolodny (1980,1981) conducted two separate analyses in their study to determine the effects of SFAS2 on small firms. In the first analysis, they used a survey method in which Horwitz and Kolodny sent seventeen questionnaires to the chief financial officers of 380 firms (168 R&D capitalizing and 212 R&D expensing firms) extracted from the OTC Compustat tape. After examining the responses

(they had a response rate of 34 percent), they found significant results (at alpha =.05) regarding the folowing specific areas:

1. the reduction of R&D outlays by deferral firms,
2. the greater difficulty created in the evaluation of the performance of small capitalizing firms by unsophisticated investors,
3. the capitalizing method is more appropriate for young deferral firms,
4. the greater need of small firms to have the option of using both R&D methods, and
5. capitalizing firms changed their methods of tax reporting more often than expensing firms.

More than half of the capitalizing, as well as all of the expensing firms, showed strong agreement on the point that R&D outlays for small firms would be greater if the deferral method were still available. Horwitz and Kolodny (1980, p. 53) found that:

> Firms with sales less than $10 million responded significantly more often than larger firms that the deferral method is appropriate, that both methods should be available, that mandating the expense method will cause difficulty in assessing a firm's performance, and that the variability of R&D expenditure would increase.

In the second analysis, Horwitz and Kolodny used empirical tests focusing on the level and the variability of R&D outlays. Two questions were analyzed in this part of the study. One of the questions relates to a reduction of

R&D outlays by capitalizing firms in post-SFAS2 periods compared with expensing firms.

The second question focused on cross-period reduction of R&D outlays by capitalizing firms from pre- to post-SFAS2 periods relative to expensing firms. Horwitz and Kolodny used forty-three R&D capitalizing firms matched with an equal number of expensing groups both identified on the OTC Compustat tapes. The criteria used for matching purposes were industry code, sales size, average growth of R&D in pre-SFAS2 periods, and average ratio of R&D to sales for a firm over pre-SFAS2 periods. Horwitz and Kolodny used four different dependent variables to measure the change in R&D outlays using a separate analysis for each. The dependent variables were (1) the percentage change in R&D outlay, (2) the ratio of R&D to sales, (3) the ratio of R&D to income before R&D, and (4) the ratio of R&D for the treatment company to the sum of R&D for the treatment company and that of the match company. Horwitz and Kolodny found significant results for all dependent variables with the exception of one, the ratio of R&D to income before R&D.

There have been two major criticisms levied at the Horwitz and Kolodny study. Wolfson (1980) sharply criticized the accuracy of their data and noted that, "I discovered that of the forty-three companies in the deferral group, forty of them had adopted the requirements of SFAS2 one or two years prior to the date that the change was

required". The second problem, common among other studies in this area, relates to the usage of the dependent variable, R&D to sales. The dependent variable ignores the differences in original R&D spending by firms. Further investigation concerning this criticism is available in the latter part of Chapter VI in this study.

Dukes et al. (1980) also focused on the adverse effect of SFAS2 on changes in R&D expenditures. Their research design was based on three phases involving separate tests. In phase one, a test was based on a matched sample of twenty-four pairs of capitalizing and expensing firms. The dependent variable was R&D as a percentage of sales. In that study Dukes et al. sought to ascertain any differences between R&D outlays of capitalizing and expensing firms for the following periods: (1) 1974 (pre-SFAS2), (2) 1976 (post-SFAS2), and (3) 1974-1976 (cross periods). They applied nonparametric analyses to investigate their hypotheses.

Dukes et al. in phase two of the analysis randomly selected twenty-seven unmatched capitalizing and expensing firms. The dependent variable in this model was the ratio of R&D to sales of both group of firms transformed by subtracting industry averages. This dependent variable was then regressed on several independent variables of R&D intensity changes of a firm for one year before, level of control (manager versus owner separated by ten percent

control in the hand of one party), liquidity of a firm, and a firm's growth measured as a percentage of its sales to the industry sales. An analysis of covariance technique was applied to test the predicted variables for 1974, 1976, and across periods.

Finally, Dukes et al. used a logit model to predict or better classify a firm as an R&D capitalizing or an R&D expensing firms. In this model, they used these five predictors: (1) firm(R&D/sales)/ industry(R&D/sales), (2) R&D/PPE, (3) level of control, (4) deferral tax credit/ total assets, and (5) the age of a firm. Dukes et al. used an analysis of variance to test their predictions based on the logit model.

In neither analysis mentioned above did Dukes et al. find evidence to confirm the adverse effect of SFAS2 on capitalizing firms' R&D expenditures. They also failed to find any significant difference between manager-controlled and owner-controlled firms in changing R&D expenditures because of SFAS2. The authors indicated, however, that selection of samples from large firms could be one of the major reasons they failed to get expected results. For very similar reasons, Gambino and Gartenberg (1979) also failed to support their hypothesis that the SFAS2 would decrease R&D expenditures of capitalizing firms.

Elliott et al. (1984) attempted to reconcile the differences between the results in Dukes et al. and Horwitz

and Kolodny. They used 34 listed firms (large firms) in their analysis and compared them with 43 Horwitz and Kolodny OTC firms (small firms). Matched control firms were obtained for each of these two groups of capitalizing firms. While using the same matched control firms of Horwitz and Kolodny study, a new set of matched control firms were chosen for the listed firms. The dependent variable was cumulative R&D expenditures as a percentage of cumulative sales for each firm over either pre- or post-SFAS2 periods. Elliott et al. used nonparametric tests and concluded that a firm's size was a significant factor influencing changes in R&D expenditures due to SFAS2. They maintained that the tests using OTC firms and the Horwitz and Kolodny (1980) methodology were the most significant. The one insignificant test statistic was for the listed firms using the Dukes et al. (1980) switch-year methodology.

In addition, Elliott et al. (1984) in a separate analysis within the same study concluded that R&D capitalizing firms generated significantly smaller earnings before research and development, lower funds flow from operations, and lower retained earnings. They emphasized that firms with financial difficulties, by having negative retained earnings previous to SFAS2, had decreased their R&D expenditures more than other firms.

While not examining R&D specifically, many studies such as Watts and Zimmerman (1978), Zmijewski and Hagerman

(1981), Bowen et al. (1981), and Dhaliwal et al. (1982) have investigated the motivation for management's choice among alternative accounting principles. They suggested that there is an association between a firm's characteristics such as the size, level of control, degree of leverage, and the relative economic effect of the accounting methods chosen by the firm from the set of available methods. For example, Bowen et al. (1981), among others, found that firms with a high degree of leverage and more restricted debt covenants tend to choose the capitalizing method for interest expense.

Daley and Vigeland (1983, p. 195) conducted a study to determine the factors that influenced a firm's decision to capitalize R&D expenditures. Using a multivariate statistical technique for comparison of capitalizing and expensing firms before SFAS2, Daley and Vigeland concluded:

> Firms which capitalized R&D costs were more highly levered, used more public debt, were closer to dividend restrictions, and were smaller than firms which expensed R&D costs.,

In summary, evidence on the adverse effect of SFAS2 on firms' R&D expenditures is mixed. Horwitz and Kolodny (1980) used a sample of small firms and found significant reduction of R&D expenditures by small firms from pre-SFAS2 to post-SFAS2 periods. Dukes et al. (1980) failed to confirm such a reduction among their sample firms. Finally, Elliott et al. (1984) reconciled these two studies and found that size of a firm is a significant factor to explain the

difference between the results of these two studies. All of these studies used as a dependent variable the ratio of R&D to sales. This is subject to criticisms that will be explained in Chapter VI.

The present study extends the study of the adverse effects of SFAS2 on small firms' R&D expenditures. It attempts to avoid the problem experienced by Horwitz and Kolodny (1980) relative to their sample and to use a different dependent variable to isolate base differences of R&D expenditures among firms. In addition, the unaddressed issue of differences between manager-controlled and owner-controlled firms' reaction to SFAS2 raised by Dukes et al. (1980) will be considered in this study. Other studies such as Dhaliwal et al. (1982), and Daley and Vigeland (1983) have addressed the significant influences of a firm's size and degree of leverage on a choice of accounting method. This study also tests the effects of these two variables on firms' reduction of R&D expenditures due to SFAS2.

## Chapter V

## METHODOLOGY

In Chapter I, the question of the adverse effect of SFAS2 on small firms was raised. Because of several factors, small firms that capitalized R&D expenditure prior to SFAS2 are expected to have decreased the amount of spending on R&D in the long run. This issue has been divided into four separate research questions:

1. whether or not small R&D capitalizing firms were affected by the rule and whether they actually decreased their spending after adopting SFAS2;
2. whether or not manager-controlled firms reacted differently from owner-controlled firms and whether they decreased R&D expenditure to a greater extent;
3. whether or not a firm's size, as measured by total dollar sales, is a significant factor in explaining the reaction to SFAS2; and
4. whether or not firms with a higher debt to assets ratio have reacted differently to SFAS2 than have those with a lower ratio.

Regression analysis is applied in an attempt to answer these questions and consider all of them simultaneously. The rationale for this technique, the variables used in

analysis, the definition of the population, and the sample selection are described later in this chapter.

For organizational purposes, this chapter is divided into three parts. In part one, the variables used in the analyses are defined. The research hypotheses are developed in part two. In part three, the population that was sampled is defined and the sampling plan is explained. Problems associated with data collection are also addressed in part three.

## 5.1 VARIABLES

The consideration of changes in R&D expenditure alone as a dependent variable is not free from problems, since firms are not identical in all respects. Their spending on R&D depends on their size and their level of expenditure before facing the change in treatment of accounting. Thus, R&D expenditure needs to be deflated (divided) by a relatively constant basis such as sales. "R&D/Sales" will be referred to as research, or R&D, intensity. In order to control the heterogeneity of the changes in R&D intensity among firms, the percentage of change is used as the dependent variable. In other words, the dependent variable for this model is

$$(avg(R\&D/Sales)_a - avg(R\&D/Sales)_b) / avg(R\&D/Sales)_b$$

Where:

'avg' denotes the average of the ratio over the relevant

years;

'a' refers to the period after adopting SFAS2 by a firm (197x - 1980);

'b' refers to the period before adopting SFAS2 by a firm (1970 - 197x); and

197x = 1973 if the firm adopted SFAS2 in 1974

197x = 1974 if the firm adopted SFAS2 in 1975.

Dollar value of total sales among other variables is chosen as a denominator of research intensity for calculation of the dependent variable and also for matching purposes discussed later in sample selection. The major reasons behind such a selection are as follows:

1. Sales volume may be relatively constant and represents the size of a firm.
2. Sales and R&D expenditures are both operating items and may be more correlated to each other than to any other item such as total assets.
3. The advantage of sales over total assets is that total assets in many firms are measured in historical cost, while sales are as current as R&D expenditures.
4. Total assets may contain capitalized leases which may have less correlation with R&D than other assets.
5. Deferred R&D for many capitalizing firms prior to SFAS2 are unobtainable. Therefore, using total assets net of deferred R&D costs, a smaller sample would be available than if sales is used.

The dependent variable, explained above for this model, is a function of several factors:

$$D = f(A, B, Sales, DTA) \text{ or}$$

$$D = \beta_0 + \beta_1 A + \beta_2 B + \beta_3 Sales + \beta_4 DTA + e$$

where:

$$D = (avg(R\&D/Sales)_a - avg(R\&D/Sales)_b) / avg(R\&D/Sales)_b$$

$\beta_0$ is the intercept;

$\beta_i$ is the coefficient of the ith independent variable in the general linear model;

A is a qualitative variable of R&D accounting method with two treatment levels: expensing (A0) and capitalizing (A1);

B is a qualitative variable of control with two levels: owner-controlled firms (B0) and manager-controlled firms (B1);

Sales is a quantitative continuous variable of the firms' size in terms of dollar sales volume;

DTA is a quantitative continuous variable of the firm's degree of leverage denoted by the ratio of total debt to total assets; and

e is the residual value of the model.

Independent variables consist of four factors two of which are dichotomous qualitative and consist of two

different levels, and two of which are continuous quantitative. Factor one (A) is the R&D accounting method consisting of capitalizing (A1)and expensing (A0) accounting treatment. Factor two (B) represents the type of control over a firm exercised either by its hired managers (B1) or its owners (B0). Factor three is the size of firms measured in millions of dollar of sales revenue for the year of adopting SFAS2. Factor four represents the degree of leverage measured by the average ratio of total debt to total assets for the pre-SFAS2 period.

To control for industry effects, all firms are matched according to the closest three digits of the firms' industry code(SIC). In addition, the average R&D intensity for years before SFAS2 (avg (R&D/Sales)$_b$ ) is also used as a further criteria for matching purposes in an attempt to eliminate R&D differences among firms for the years before SFAS2.

## 5.2 RESEARCH HYPOTHESES

To analyze the effect of the SFAS2 on small firms, four research hypotheses have been considered. To derive the first hypothesis, let M denote the average R&D intensity for the firm over the years before adopting SFAS2, and let N denote the average R&D intensity for the firm over the years after adopting SFAS2. The percentage of change, D, for each firm may be shown as either:

$$D_c = (N_c - M_c)/M_c \quad \text{or} \quad D_e = (N_e - M_e)/M_e$$

Where:

c denotes a capitalizing firm and e denotes an expensing firm.

The following relationship is expected to exist if capitalizing firms are adversely affected by the requirement of SFAS2:

$$D_c - D_e < 0$$

Accordingly, the first null hypothesis is:

$H_o^1$ : There is no difference in the percentage of change in the average R&D intensity for the per-SFAS2 to the post-SFAS2 periods between capitalizing and expensing firms. Or

$$H_o^1 : D_c = D_e$$

The alternative to the first null hypothesis can be expressed as:

$H_A^1$ : The difference in the percentage of change in the average R&D intensity from the pre-SFAS2 to the post-SFAS2 periods between capitalizing and expensing firms (defined

as $D_c - D_e$ ) is (ceteris paribus) negative. Or

$$H_A^1 : D_c < D_e$$

According to discussion in Chapter III, managers are interested in maximizing their utilities and job security. Hired managers are also more risk averse than owner/managers and so are expected to react differently. Accordingly, the second null hypothesis is:

$H_o^2$ : There is no difference between the percentage of the change in the average R&D intensity for pre-SFAS2 to post-SFAS2 periods between manager-controlled firms and owner-controlled firms. Or

$$H_o^2 : D_m = D_o$$

The second alternative hypothesis is:

$H_A^2$ : The difference in the percentage of change in the average R&D intensity from the pre-SFAS2 to the post-SFAS2 period between manager-controlled and owner-controlled firms (defined as $D_m - D_o$ ) is (ceteris paribus) negative. Or

$$H_A^2 : D_m < D_o$$

To determine whether or not a firm's size plays an important role in the reduction of R&D expenditures, a third factor representing size in terms of total dollar sales is entered into the analysis. Each firm has a specific dollar sales volume that is not identical to that of any other firm. Therefore, this independent variable is continuous. Thus the third null hypothesis is:

$H_o^3$ : The percentage of change in the average R&D intensity from pre-SFAS2 to post-SFAS2 is not related to dollar sales volume.

As has been discussed earlier in this paper, smaller firms may be more risk averse than larger firms and, therefore, less inclined to continue spending on higher risk activities such as for R&D after the mandatory expensing rule was adopted. Consequently, the alternative to the third null hypothesis is:

$H_A^3$ : Smaller firms have decreased (increased) their R&D intensity over the period following

the adoption of SFAS2 more (less) than larger firms. Hence, the change in R&D intensity defined as D is positively related to sales volume.

Agency theory explains the existence of contracts between principals (owners) and agents (managers). Bond indenture contracts are examples that impose restrictions on the activities of borrowers. Many other restrictions are expressed in terms of accounting numbers, especially the debt to asset ratio. A significant increase in this ratio may violate a basic part of the agreement and force managers into a new contract with more restrictions. Managers in firms affected by SFAS2 may attempt to decrease their R&D expenditures in order to lower their debt to asset ratio. Accordingly, the fourth hypothesis is:

$H_o^4$: R&D capitalizing firms with a higher debt to asset ratio decrease R&D intensity no more than other firms with a lower debt to asset ratio.

The fourth alternative hypothesis may be presented as:

$H_A^4$: R&D capitalizing firms with a higher degree of leverage decrease (increase)

their R&D intensity more (less) than firms with a lower degree of leverage. Hence, The change in R&D defined as D is negatively related to degree of leverage.

Debt to asset ratio (degree of leverage), like the firm size independent variable, is also continuous.

In addition to the previously defined dependent variable this study also employs a type of dependent variable ($avg(R\&D/Sales)_a - avg(R\&D/Sales)_b$) similar to those used in previous studies. The difference between this dependent variable and the previously noted variable used in this study is that previous work disregarded the possible differences in the amount of original R&D spending among firms and only considered changes of R&D intensity between years before and after SFAS2.

Very similar hypotheses are examined using the dependent variable, ($avg(R\&D/Sales)_a - avg(R\&D/Sales)_b$), to compare the findings of this study with those of previous studies.

## 5.3 POPULATION AND SAMPLE SELECTION

Generally, the population under consideration consists of small firms that have been forced to change their accounting treatment. Specifically, for the purpose of this study the population consists of those small firms which have been mandated to switch their accounting treatment from capitalizing to immediate expensing of R&D expenditures.

Only a few people have attempted research in this area because the necessary accounting data are rare and difficult to find. The difficulties are due to the determination of two R&D figures for each capitalizing firm, namely R&D expenditure and deferred R&D cost. Many firms either did not disclose their R&D expenditures prior to the SFAS2, or if their R&D expenditures were reported, they were combined with their R&D contracts, making data nearly unobtainable. COMPUSTAT tapes do not show the separately deferred R&D cost of certain firms using the capitalizing method prior to SFAS2; rather, they include deferred R&D costs in "other assets." To obtain these two items, extensive investigation of these firms' financial statements is required that is often costly and time consuming.

Despite the above difficulties, this study has attempted to gather the required data by a detailed examination of available financial statements of the firms for the years 1970-1980. The following steps were taken in selecting a sample to represent the experimental group:

1. A list of most of the firms that had qualified audit reports as a result of switching from capitalizing to expensing methods of R&D expenditure was extracted from the Disclosure Journal (Corporate Events and Companies Information) for the years 1973-1976. This list consists of more than 700 firms, most of which were small.
2. The 10-Ks and Annual reports, as well as the Proxy Statements of almost all the firms available in the library at the University of Texas in Austin, were investigated. Based on available reports, a data base consisting of the following information was prepared for the years 1970-1980:
   a) The name of the firms,
   b) the firms' industry code,
   c) the number of employees,
   d) the percentage of direct and indirect ownership by managers and executive officers as a group in a firm,
   e) the R&D expenditure, R&D expense, and R&D assets,
   f) the sales,
   g) the total assets, and
   h) the net income before and after extraordinary items.
3. Using the criterion found in the Senate Special Reports on Small Businesses (1978, p42), firms with

less than 1500 employees are considered to be small firms for the purpose of this study.

4. This study used a higher percentage of ownership as a cutoff point for control than did most previous stidies. The justification is that the sample of this study consists of only small firms that normally have less widespread shareholders than large firms. Using the criterion set forth in APB Opinion No. 18, those firms in which directors and executive officers as a group own, either directly or indirectly, more than twenty percent of the firms' voting securities are considered to be owner-controlled firms. Otherwise they are considered to be manager-controlled firms. Dhaliwal et al. (1982) also used the criterion of twenty percent for persons active in the management of the firm.
5. Random sampling from the entire population was not possible due to the lack of sufficient data for all relevant firms. Therefore, a list of 46 manager-controlled firms offering at least seven years of data was prepared from the above data base.
6. An equal number of owner-controlled firms was also selected from the data base, subject to the availability of sufficient data, as well as consideration of the two criteria for matching firms given below.

7. The selected owner-controlled firms were matched with manager-controlled firms based on the first three digits of the firms' industry code, as well as the closeness of the corresponding average ratios of R&D expenditures to sales for the years before adopting SFAS2 for the two firms in each pair.

Furthermore, the following steps were used in obtaining a sample to represent the control group (R&D expensing firms):

1. A list of firms from the Over-the-Counter COMPUSTAT tape and a separate list of firms from the Industrial Annual COMPUSTAT tape were prepared. Both lists contain only firms with at least seven years' data and have at most 1500 employees.
2. To differentiate between manager- versus owner-controlled firms, the percentages of ownership by directors and managers of the firms in both lists are extracted from their Proxy Statements of the closest period (1978- 81) to the year of adoption of SFAS2 available in the library at the University of Oklahoma.
3. Enough firms were selected from the above lists to be matched with the experimental firms on a company-to-company basis. To do so, the following three criteria were used:

a) The ownership consideration (i.e. manager- versus owner-controlled firms),

b) the closest possible three digits of industry code, and

c) the closest relative average ratio of R&D expenditure to total assets for years before adopting SFAS2 by related capitalizing firms.

Among the 46 firms per cell, some companies had inappropriate data that have been deleted from the list. Among these, one firm switched to the expensing method too early (in 1973) simply on the basis of the expectation of the outcome of the Discussion Memorandum. Two firms that adopted SFAS2 too late (in 1976) were removed from the list. Among the remaining firms two companies were not able to be satisfactorily match with firms from other cells. After removing the above firms, the final sample consisted of forty-one firms for each cell shown in Appendix A. The following table shows the summary of provided samples:

TABLE 1

Summary of Data

| | Capitalizing firms | Expensing firms | Total |
|---|---|---|---|
| Owner cont'd | 41 | 41 | 82 |
| Manager cont'd | 41 | 41 | 82 |
| Total | 82 | 82 | 164 |

To obtain the degree of leverage for the above firms, this study used the average ratio of (total debt/ total assets) over the periods before adopting SFAS2. For calculating a firm's total debt, this study used the summation of current liability (item 34) and long-term debt (item 9) as defined in COMPUSTAT Manual (1983, section 4, p. 19). The required accounting data for determining the independent variable of total debt/ total assets for the sample firms were extracted either from COMPUSTAT tapes or Moody's manuals.

## Chapter VI

## DATA ANALYSES

This chapter discusses the analyses of data and presents the findings regarding the effects of SFAS2 on small firms. As was indicated in the previous chapter, change in R&D expenditures is hypothesized to be a function of R&D accounting treatment used by the firm, type of firm control, firm size, and debt position of the firm. The general form of the model is:

$$D=f(A, B, Sales, DTA)$$

Where:

$D = (avg(R\&D/Sales)_a - avg(R\&D/Sales)_b)/avg(R\&D/Sales)_b$;

A is a qualitative variable with two treatment levels:

A1 = capitalizing firms (coded 1 in the analysis), and

A2 = expensing firms (coded 0 in the analysis);

B is a qualitative variable with two treatment levels:

B1 = manager-controlled firms (coded 1 in the analysis), and

B2 = owner-controlled firms (coded 0 in the analysis);

Sales is a continuous variable representing the firm's size; and

DTA is a continuous variable representing the firms' degree of leverage and is calculated as the average ratio of total debt to total assets over the pre-SFAS2 period.

Avg is the average of the ratio over relevant years.

a is the years after SFAS2 adopted by a firm.

b is the years before SFAS2 adopted by a firm.

The dependent variable in this model, denoted by D, is the percentage of change in the average R&D intensity (R&D expenditure/sales) of a firm from periods before to after SFAS2 become effective. Note that the direction or sign of D is consistent with the change in R&D intensity. For example, whenever the value of D is positive, it indicates that, on average, R&D intensity increased in the period following SFAS2 when compared with R&D expenditures in the period preceding SFAS2. On the other hand, a negative value of D indicates that, on average, R&D intensity decreased in the post-SFAS2 period when compared with the pre-SFAS2 period.

Independent variables consist of both qualitative and quantitative variables. Factor A is a qualitative or dummy

variable that takes on the values one and zero for the two different R&D accounting treatments of capitalizing and expensing, respectively. Factor B is also a qualitative variable and represents the type of firm control with two treatment levels of manager-controlled versus owner-controlled firms which are indicated by one and zero respectively in the analysis. Size of a firm, measured by dollar sales during the year of adopting the requirement of SFAS2, is a continuous independent variable. Finally, DTA is the debt position of a firm (degree of leverage) and is a continuous variable measured by the average ratio of total debt to total assets for the years before adopting SFAS2. In this ratio the total debt is calculated by summing a firm's total current liabilities and its long-term debt, as defined by the industrial COMPUSTAT manual (1981, section 4, p. 19).

## 6.1 REGRESSION ANALYSIS

Linear regression analysis was used to determine how much variation in the dependent variable is accounted for by each of the independent variables. The analysis was performed with the Statistical Analysis System (SAS) package version 82.4. The intercept and the coefficient (the standard error shown in parentheses) of variables in the regression model are estimated to be:

$$D = \underset{(.1125)}{.2152} - \underset{(.1001)}{.3910}\,A - \underset{(.0948)}{.2198}\,B + \underset{(.0000021)}{.00000049}\,Sales + \underset{(.2308)}{.0666}\,DTA$$

Table 2 also shows degrees of freedom, the parameter estimates, the standard error of those parameters, the Student-t values, and the p-values. ( The p-value is the smallest level for which the null hypothesis can be rejected.)

The above regression model, as was expected, has a positive intercept. It indicates that, when all variables are equal to zero, the value of the dependent variable is positive. Stated differently, owner-controlled firms that were expensing R&D expenditures before SFAS2 (A = B = 0) have increased their R&D expenditures in periods following SFAS2.

The coefficient of each variable reflects the scale of measurement and the level and direction of the effect of that variable on the change in R&D spending. The absolute values of the coefficients of the qualitative variables are higher than those of the quantitative variables. Based on the p-value of the variables presented in Table 2, the qualitative variables appear to have considerably more explanatory power than the quantitative variables.

An absolute value of a coefficient alone does not show whether an independent variable explains a significant amount of variation in the dependent variable that in this study is a measure of the change in R&D expenditures. To determine the significance level for the explanatory power

of each variable, in the context of the whole model, believed to be influencing the change in R&D intensity, one needs to calculate the Student-t statisic which is presented in column (4) of Table 2 .

TABLE 2

Summary of Regression Analysis

| (1) Variables | (2) Df | (3) Parameter Estimates | (4) Standard Error | (5) T for Ho: Paramtr=0 | probability > \|T\| (p-value) |
|---|---|---|---|---|---|
| intercept | 1 | 0.2152 | 0.1125 | 1.910 | 0.0575 |
| A | 1 | -0.3910 | 0.1001 | -3.900 | 0.0001 |
| B | 1 | -0.2198 | 0.0948 | -2.325 | 0.0217 |
| Sales | 1 | 0.0000 | 0.0000 | 0.232 | 0.8184 |
| DTA | 1 | 0.0666 | 0.2308 | 0.290 | 0.7735 |

* R-square associated with the no interaction model is 0.1231.

To determine whether the independent variables really account for the changes in R&D expenditures, the Student-t statistics are calculated to determine the level of

significance for parameter estimates. Column (5) of Table 2 shows the p-values of the Student-t for each variable.

It appears that null hypothesis one, $(H_o^1)$, can be rejected due to the low probability of a type I error (p-value = 0.0001) for factor A. This tends to indicate that small firms that were capitalizing their R&D expenditures prior to SFAS2 have been affected differently by the expensing-only rule than were those that were already expensing before SFAS2. Presumably, those firms that were already expensing before SFAS2 were not affected by SFAS2 and the difference is due only to an effect of SFAS2 on those firms that were required to change accounting treatment. Thus, it can be concluded that after switching to the expensing method, the R&D capitalizing firms have significantly changed their policy of spending on R&D. This is consistent with the results of Horwitz and Kolodny (1980). A closer examination of the data will be presented below in Table 3 to determine whether this tentative conclusion is valid.

Although the p-value for the coefficient of factor B (.0217) is not as low as that of factor A, the second null hypothesis, $(H_o^2)$, is also rejected with alpha equal to five percent. This indicates that the change in R&D intensity from pre-SFAS2 to post-SFAS2 for manager-controlled firms is significantly different from that of owner-controlled firms.

Two questions are raised at this point. The first, which actually has two parts, is which group of firms, manager-controlled or owner-controlled, had the greater change in R&D expenditures and in what directions were the changes. The second question is whether the differences between changes in R&D intensity for manager- and owner-controlled firms within the two subgroups of previously capitalizing and previously expensing firms are similar to each other and similar to the overall difference.

The expectations were that both manager- and owner-controlled firms that were previously using the capitalizing method have decreased their R&D expenditures due to SFAS2 but that manager-controlled firms have decreased their expenditures significantly more than have owner-controlled firms. On the other hand, it was assumed that the firms already using the expensing method would not be affected by SFAS2. Due to general growth, these firms were expected to increase their R&D expenditures over time. Manager-controlled, expensing firms, however, were expected to increase R&D expenditures less than owner-controlled, expensing firms due to their more conservative reaction to uncertainty in R&D projects. Drawing these expectations together, a significant difference was expected between the change in R&D expenditures from pre- to post-SFAS2 periods for the composite of manager-controlled firms and the composite of owner-controlled firms.

The first of these two questions, presented in the first paragraph of the previous page, can be answered by comparing the mean change in R&D intensity for the two levels of factor B shown in Table 3 . The second question will not be answered here but instead will be addressed in the section titled "Individual Comparison of Cell Means" later in this chapter.

Table 3 presents the means of each level, the difference between the two means, and the lower and upper confidence limit for both factors A and B.

A negative value of the difference between the two means for either factor A or factor B indicates that the change in R&D expenditure is in the expected direction. Capitalizing firms have sharply decreased (p-value=.0001) their spending on R&D after adopting SFAS2. Manager-controlled firms may have also reacted similarly and have changed their R&D expenditures significantly different from owner-controlled firms. The 95 percent confidence interval of each independent variable A or B does not contain the value zero, the mean difference under the relative null hypotheses of one and two. Thus, again both null hypotheses can be rejected. The location and the detail of these significant differences are clarified later in this chapter in the section in which the individual comparison of cell means is analyzed.

TABLE 3

Mean Differences and Confidence Intervals

| comparison | means level1 | means level0 | Differences between means lower %95 confidence limit | Difference | Differences between means upper %95 confidence limit |
|---|---|---|---|---|---|
| A1-A0 | -.2537 | .1340 | -.5687 | -.3878** | -.2068 |
| B1-B0 | -.1685 | .0488 | -.3982 | -.2173* | -.0364 |

Where:

A1 is for capitalizing firms

A0 is for expensing firms

B1 is for manager-controlled firms

B0 is for owner-controlled firms

* significant at 0.05

** significant at 0.0001

On the other hand, the probability of the Student-t statistic for sales falling in the type I error area, shown in Table 2, is very high. This means that null hypothesis three, ($H_{o}^{3}$), cannot be rejected at a reasonable level of significance (p-value =.82, Table 2). Consequently, within the category labeled "small firms", the firm size seems not

to be a determining factor in explaining the firms' change in R&D intensity from the pre-SFAS2 to the post-SFAS2 period. By eliminating the sales variable from the whole model used in Table 2, little change appeared in R-square (R-square=.1228). This may confirm further that the sales variable, at least for data used here, may not explain the variation in the dependent variable. This finding appears to contradict the claims of previous studies, such as Dukes et al. (1980) and Elliot et al. (1983), who concluded that small firms react differently to the SFAS2 than large firms relative to spending on R&D. However, the result of this study can be justified by differentiating between the firm sizes used in this study and those of other studies. Small firms are defined to be those with fewer than 1500 employees for this study, while Dukes et al. (1980) used mostly large firms in their data analysis. Elliott et al. (1984) also compared large firms with small firms in their reaction to the SFAS2. Drawing these findings together, one may conclude, at least for the type of sample used in the present study, that firms' size among small firms does not appear to be an influencing variable for R&D spending decisions in relation to SFAS2.

Based on the Student-t statistic for the DTA coefficient, shown in Table 2, the fourth null hypothesis, ($H_o^4$), cannot be rejected at a resonable level (P-value=.77,

Table 2). Again, if the DTA variable is eliminated from the whole model used in Table 2, the new R-square (.1227) remains almost the same as that of the whole model. Accordingly, one may conclude that firms' degree of leverage, measured by the ratio of total debt to total assets, is not by itself a significant factor in explaining any change in R&D intensity from pre-SFAS2 to post-SFAS2. Stated another way, this study was not able to confirm that small firms, in general, with higher degrees of leverage had decreased their R&D expenditures compared with other small firms after SFAS2 became effective. However, analysis of DTA in specific groups of firms, presented later in this chapter, may provide some evidence indicating that degree of leverage is an influencing factor on R&D spending decisions.

## 6.2 FURTHER ANALYSIS OF CLASS VARIABLES

The regression analysis in the previous section demonstrates that neither size (sales), nor degree of leverage (DTA) are good predictors of small firms' changes in R&D intensity from pre- to post-SFAS2 adoption. Thus, these two continuous variables are temporarily omitted from the model. The remaining variables are the two class variables each having two treatment levels. To determine the effect of each of these two factors in the absence of continuous variables, a two-way fixed effect analysis of variance model is applied. The results are presented in Table 4 .

TABLE 4

Summary of Two-Way Analysis of Variance

| Source | Df | SS | MS | F-value | Pr > F (p-value) |
|---|---|---|---|---|---|
| A | 1 | 6.1653 | 6.165 | 17.30 | 0.0001 |
| B | 1 | 1.9358 | 1.936 | 5.43 | 0.0210 |
| A*B | 1 | 1.0446 | 1.045 | 2.93 | 0.0888 |
| Error | 160 | 57.0135 | 0.356 | | |
| | --- | ------- | | | |
| Total | 163 | 66.1592 | | | |

* R-square =0.1382

6.2.1 Main effects

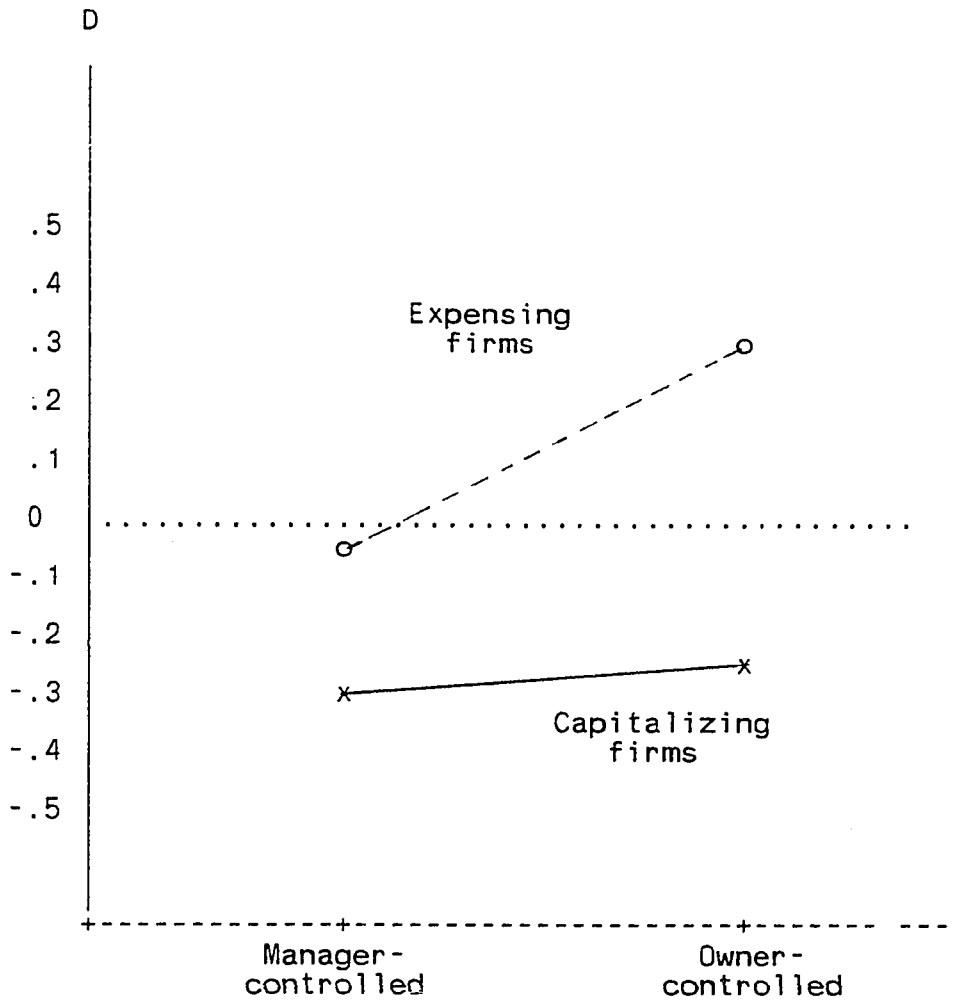
As in regression analysis, Table 4 shows that both factors A and B have significant main effects. R&D capitalizing firms are affected by SFAS2 and have significantly decreased their R&D intensity (at the 0.0001 level of significance) after adopting the rule. The manager-controlled firms have also reacted similarly and have significantly changed their spending on R&D (at the 0.021 probability) over the post-SFAS2 period when compared with the pre-SFAS2 period. The cause and the location of the significant changes, however, are not clear at this

moment. This will be clarified later in this chapter when individual comparisons between sub-groups (cells) are presented.

### 6.2.2 Interaction Effect

The p-value of A*B, shown in Table 4, indicates that the interaction effect of factors A and B is also significant at a level less than ten percent. Figure 1 shows the graphic picture of the whole interaction effect in which the two lines have positive, but highly different slopes. Closer inspection of Figure 1 reveals that capitalizing firms have negative mean values for both manager and owner-controlled firms. As was expected, capitalizing firms have decreased their spending on R&D since adopting the SFAS2. Within capitalizing firms, manager-controlled firms have reduced R&D expenditures, but the reduction does not appear to be significantly more than owner-controlled firms.

Manager-controlled firms and owner-controlled firms in the expensing group also differ in changes in R&D spending from pre-SFAS2 to post-SFAS2 periods. In this group, the mean R&D intensity of manager-controlled firms does not appear to have changed significantly, while in owner-controlled firms it appears to have greatly increased over the period. Both results are consistent with the general conclusion of previous studies that managers are more risk averse than owners.




$$D = \frac{(\text{avg}(R\&D/Sales)_a - \text{avg}(R\&D/Sales)_b)}{\text{avg}(R\&D/Sales)_b}$$

Figure 1: A*B interaction

## 6.3 INDIVIDUAL COMPARISON OF CELL MEANS

The result of the two-way analysis of variance presented in Table 4 indicates that the interaction effect between factors A and B is significant. The information in Table 4, however, did not pinpoint the location of significance, leaving unanswered the question of whether there are significant differences among the four groups in R&D intensity changes. Figure 2 shows the cell means, as well as the mean of each factor per treatment level of sample firms.

To determine the significance of differences in the changes in R&D intensity, individual comparisons of cell means were determined using the Student-t statistic calculated by (t=(x1-x2)/ SQRT( 2*MSE/n)). Taking a conservative (Bounferroni) approach, the alpha level of five percent is maintained by dividing it by four and using 1.25 percent in subsequent analyses of the four-cell comparisons. Accordingly, the critical t-value is extracted from the table of the Dunn Multiple Comparison Test. The results are presented in Table 5 .

The information from Table 5 indicates that two of the four pairs of cells compared are significant at overall alpha of five percent. The mean of firms' dependent variable for both manager- and owner-controlled firms within

| | Factor A | | |
|---|---|---|---|
| | C | E | Averages |
| M | $\bar{D}$=-0.2826<br>$\bar{DTA}$=0.3516 | $\bar{D}$=-0.0544<br>$\bar{DTA}$=.2710 | $\bar{D}$=-0.1685<br>$\bar{DTA}$=0.3113 |
| Factor B<br>O | $\bar{D}$=-0.2249<br>$\bar{DTA}$=0.3846 | $\bar{D}$= 0.3225<br>$\bar{DTA}$=0.2238 | $\bar{D}$= 0.0488<br>$\bar{DTA}$=0.3042 |
| Averages | $\bar{D}$=-0.2537<br>$\bar{DTA}$=0.3681 | $\bar{D}$=0.1340<br>$\bar{DTA}$=0.2474 | |

Where:

C is R&D capitalizing firms

E is R&D expensing firms

M is manager-controlled firms

O is owner-controlled firms

$\bar{D}$ is the average of dependent variable

$\bar{DTA}$ is the average of debt-to-asset ratio

Figure 2: Means of Variables per Factor and Cell

TABLE 5

Summary of Individual Comparison

| Cell | Mean Differences | * Student-t | Prob. >\|T\| (p-value) |
|---|---|---|---|
| CM-CO | -0.0577 | 0.4378 | 0.6700 |
| EM-EO | -0.3769 | 2.8601 | 0.0050 |
| CM-EM | -0.2282 | 1.7317 | 0.0875 |
| CO-EO | -0.5474 | 4.1539 | 0.0001 |

* The critical value of Student-t (overall alpha=.10 per comparison alpha= .025) is 2.28.
** The critical value of Student-t (overall alpha=.05 per comparison alpha= .0125) is 2.54.
*** The critical value of Student-t (overall alpha=0.01 per comparison alpha= .0025) is 3.09.

Where:

CM is the cell for the location of capitalizing manager-controlled firms;

CO is the cell for the location of capitalizing owner-controlled firms;

EM is the cell for the location of expensing manager-controlled firms; and

EO is the cell for the location of expensing owner-controlled firms.

the capitalizing (experimental) group are negative but not significantly different from each other. This means that

both these two groups, as was expected, have sharply decreased their R&D intensity as a result of SFAS2. Although capitalizing manager-controlled firms have decreased more than owner-controlled firms, the difference is not significant, (alpha per comparison =.0125).

According to Figure 2, the mean change in the R&D intensity of the expensing firms is positive (0.1340). It shows that expensing firms, on which SFAS2 was assumed to have no effect, generally increased their spending on R&D. The means for the manager- and the owner-controlled firms within the expensing (control) group, however, do differ in that expensing manager-controlled firms have a negative mean (-.0544) indicating that they have slightly decreased their R&D expenditures. Expensing owner-controlled firms, on the other hand, have a high positive mean (.3225) indicating that they have greatly increased their R&D intensity. The significant difference in spending behavior (Student-t = 2.8601) between expensing manager- and expensing owner-controlled firms may confirm previous studies such as Smith (1976) that conclude managers are generally more risk averse than owners and tend to spend less on R&D which might have no immediate, clear return.

Closer examination of Figure 2, from the view point of the firms' type of control, shows that manager-controlled firms have decreased (-.1685) and owner-controlled firms have slightly increased (.0488) their R&D intensity.

Individual comparison of the relevant cells reveals the effect of SFAS2 on each of these two groups. The last two lines of data in Table 5 present these cell comparisons. The capitalizing, manager-controlled firms have decreased their R&D intensity significantly (P-value=.0875, Table 5) when compared with the expensing, manager-controlled firms. Although this level of significance is not as strong as the overall analysis (P-value of factor B is equal to .021, Table 4), it does provide some evidence in support of the hypothesis that capitalizing firms within the manager-controlled group are adversely affected by SFAS2 as hypothesized in Chapter V.

This adverse effect of the expensing-only rule is much more prominent in the case of owner-controlled firms. While expensing firms have increased their R&D intensity (.3225), capitalizing firms have decreased theirs (-.2249) as can be seen in Figure 2 . The difference between these two changes in R&D expenditures is highly significant as can be seen in Table 5 . As expected, capitalizing firms within the owner-controlled group also appear to be adversely affected by the SFAS2 as hypothesized in Chapter V.

## 6.4 R&D SPENDING DECISIONS AND DEBT COVENANTS

This study previously concluded that a firm's degree of leverage alone is not sufficient to explain a reduction in R&D expenditures. It is expected, however, that highly levered firms, facing an undesired policy change, may react differently from other firms. A similar behavior may also be true for firms with various levels of control. To clarify this issue, the data were first sorted by the two different levels of factor A and the two different levels of factor B. The effect of degree of leverage (DTA) on R&D intensity changes (D) was examined separately for each individual group of firms. Second, the data were sorted again based on a combination of factors A and B. In other words, the sample was divided into four cells to find out the relationship between D and DTA within each cell. The means of the degree-of-leverage

variable ($\overline{DTA}$) for the groups of firms sorted above are shown in Figure 2 . Also the results of these two analyses are presented in the following subsections.

### 6.4.1 Analysis under two Separate levels of Factor A and B

In addition to the overall analysis described earlier, separate regressions were run to examine the relationship between the DTA and D within each group of R&D capitalizing and expensing firms. A large part of the change in R&D intensity (D) is explained by the firms' degree of leverage

(DTA). Despite the overall analysis presented earlier in this chapter and also in the following table, DTA has a marginally significant effect on R&D spending decisions at the .05 alpha level for both capitalizing and expensing firms. The major reason these results appear to conflict with the results presented earlier is that the effects upon capitalizing and expensing firms are in opposite directions. Table 6 presents the separate results of the analyses for both experimental and control groups.

TABLE 6

Results of the GLM Analyses

| Parameter | Estimate | STD Error of Estimate | Student-t | prob. >\|T\| (p-value) |
|---|---|---|---|---|
| Overall firms: | | | | |
| Intercept | 0.0039 | 0.087 | 0.04 | 0.964 |
| DTA | -0.2072 | 0.232 | -0.89 | 0.375 |
| Capitalizing firms: | | | | |
| Intercept | -0.1285 | 0.0844 | -1.52 | 0.132 |
| DTA | -0.3406 | 0.1916 | -1.78 | 0.079 |
| Expensing firms: | | | | |
| Intercept | -0.1054 | 0.1503 | -0.70 | 0.485 |
| DTA | 0.9678 | 0.5112 | 1.89 | 0.062 |
| Owner Cont-rolled firms: | | | | |
| Intercept | 0.1699 | 0.1385 | 1.23 | 0.224 |
| DTA | -0.3980 | 0.3719 | -1.07 | 0.288 |
| Manager cont-rolled firms: | | | | |
| Intercept | -0.1701 | 0.1021 | -1.67 | 0.099 |
| DTA | 0.0052 | 0.2709 | 0.02 | 0.985 |

* dependent variable is:
D = (avg(R&D/Sales)$_a$ -avg(R&D/Sales)$_b$ )/avg(R&D/Sales)$_b$

The estimated coefficient of DTA for capitalizing firms is negative while for expensing firms it is positive. These

opposing signs offset the significance of each other. Consequently, DTA, in the overall model, is no longer significant. The sign of the DTA coefficients are consistent with the anticipated directions of the relationship between DTA and D for both treatment levels of factor A.

The negative coefficient of DTA for capitalizing firms indicates that capitalizing firms tended to decrease their R&D expenditures as their debt increased. Conversely, the positive coefficient of DTA for expensing firms is consistent with the expectation that these firms may not have reacted to SFAS2 and instead have increased their R&D expenditures due to the availability of funds through borrowing.

A similar analysis is done for firms dichotomized by type of control. In neither manager- nor owner-controlled firms is DTA a significant factor in explaining changes in R&D intensity (see Table 6).

Appendix B present the plotting distribution of the overall data, as well as the categorized data under either capitalizing versus expensing firms and manager- versus owner-controlled firms. Significantly, a detailed analysis of the distributions of the D and DTA relationship reveals that a low degree of leverage (between zero and 0.30) in firms tends to increase their spending on R&D. The peak point of R&D intensity changes is reached when a firm's debt

ratio is between 0.30 to 0.40. Then, as the degree of leverage increases beyond 0.40, a firm's behavior changes and R&D expenditures sharply decrease. The distribution of data seems to be quadratic. It appears that the thirty to forty percent debt-to-asset ratio marks a risk zone and, as a firm's debt increases beyond this zone, uncertainty increases causing a decrease in R&D intensity. Tests of this relationship are required for a more precise analysis. This has been reserved for future research.

### 6.4.2 Analysis Within Cells

Further investigation was undertaken to determine the behavior of D in relation to DTA with consideration of both factors A and B combined. A regression model was applied for this purpose. In this model, two class variables A and B and the continuous variable DTA were used to predict the dependent variable D, R&D intensity change. Interaction effects of these three independent variables were also entered into the regression model. The resulting regression equation was:

$$D = -.1169 + .0195\,A - .1640\,B + 1.963\,DTA + .1102\,A*B - 2.294\,A*DTA - 1.127\,B*DTA + 1.085\,A*B*DTA$$

$$\qquad (.1917)\quad (.2529)\quad (.2501)\quad (.7533)\quad (.3432)\qquad (.8340)\qquad (.8977)\qquad (1.0456)$$

By substituting dummy variables of one and zero for the relative levels of factors A and B, one finds that the following equations result for different types of firms:

| | | |
|---|---|---|
| CM | D= -.1513 - .373 DTA | |
| | (.1166) (.2782) | |
| CO | D= -.0974 - .331 DTA | |
| | (.1248) (.2706) | |
| EM | D= -.2810*+ .836 DTA* | |
| | (.1583) (.4811) | |
| EO | D= -.1169 + 1.963 DTA* | |
| | (.2691) (1.0578) | |

Where:

CM = capitalizing manager-controlled firms;
CO = capitalizing owner-controlled firms;
EM = expensing manager-controlled firms; and
EO = expensing owner-controlled firms.

Note: The Standard Errors of Estimates are shown in parentheses under the Coefficients.

* Significant at alpha=0.10.

By diagraming the regression lines, the interpretation of this analysis is clarified. Figure 3 shows all the lines on the same axes. The horizontal axis shows the degree of leverage, DTA; and the vertical axis represents the

measurement of the R&D intensity changes, D. According to the diagram, firms with a low degree of leverage exhibited a similar change in spending on R&D. Firms with a higher degree of leverage, however, exhibited noticeable different R&D spending behavior.

RELATIONSHIP BETWEEN R&D INTENSITY CHANGES
AND THE RATIO OF DEBT TO TOTAL ASSETS

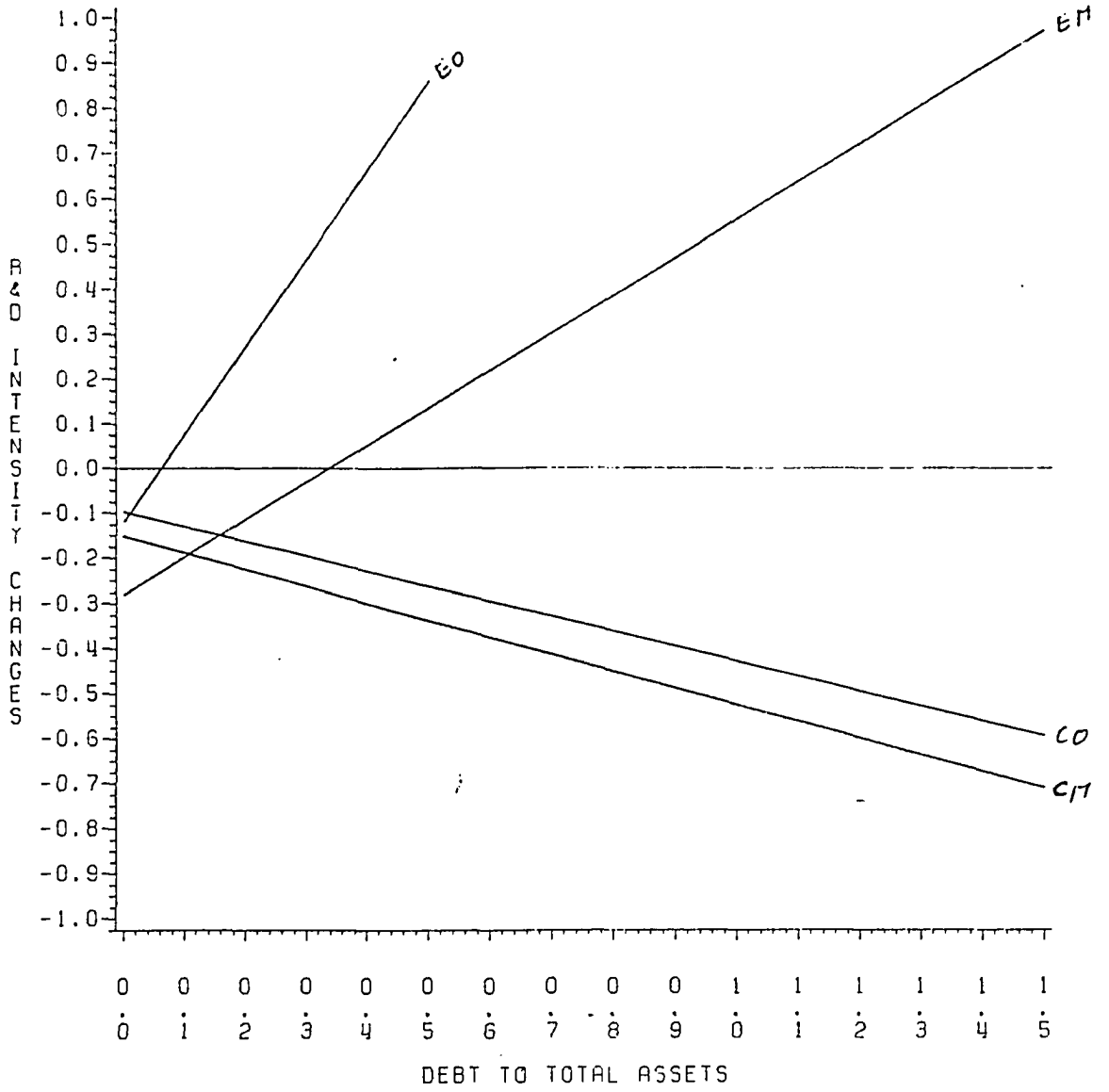



Figure 3: Behavior of D in Relation with DTA Within Cells

CO = CAPITALIZING OWNER CONTROLLED FIRMS
CM = CAPITALIZING MANAGER CONTROLLED FIRMS
EO = EXPENSING OWNER CONTROLLED FIRMS
EM = EXPENSING MANAGER CONTROLLED FIRMS

The negative slope of the regression lines for capitalizing firms supports the hypothesis that those firms that are tied to a debt covenant increase their income by implementing different accounting techniques (Dhaliwal et al., 1982). However, in the case of R&D expenditures, firms have no choice in selecting a technique. They appear to have attempted to increase their income via decreasing their spending on R&D. Figure 3 shows that with a higher degree of leverage, a greater reduction in R&D expenditure results for capitalizing firms.

The behavior of manager-controlled and owner-controlled firms within the R&D capitalizing group are very similar. A higher negative intercept for manager-controlled firms appears to support that, disregarding the debt position, managers are generally more risk averse and attempt to spend less on R&D than owners. Similarity of the slopes may indicate, however, that both the manager- and owner-controlled subgroups of capitalizing firms are concerned about debt covenants and behave similarly. This behavior is characterized by a greater decrease in R&D expenditures for those firms with higher degrees of leverage and a smaller decrease in R&D expenditures for those firms with lower degrees of leverage.

On the other hand, a different relationship exists for expensing firms. Regression lines for the two categories of expensing firms have positive slopes. This indicates that

in spite of an increasing degree of leverage, R&D expenditures increased over the periods after the SFAS2 when compared with pre-SFAS2 periods for expensing firms. In explanation of this situation, it was assumed that no reaction occurred with the passage of SFAS2 since these firms were already expensing. However, it may be that a greater ability to borrow may have resulted in greater expenditure on R&D. Again, in the case of expensing firms, Figure 3 reveals that managers are more conservative than owners in terms of R&D expenditure (i.e., managers spend less on R&D than owners). This behavior difference continues to increase via a higher (total debt/total assets) ratio. The cell's plot distributions of data presented in Appendix C also are consistent with the risk zone found and explained in the previous section.

## 6.5 COMPARISON OF THIS STUDY AND SOME PREVIOUS STUDIES

The purpose of this section is to repeat the analysis with a different dependent variable in an attempt to present a comparison of two different results. This time, the dependent variable is very similar to the one used in previous work such as Dukes et al. (1980) and Horwitz and Kolodny (1980). The dependent variable (D1) here is simply calculated by subtracting the average R&D intensity of a firm over the period pre-SFAS2 from that of the period post-SFAS2, i. e., $(\text{avg}(R\&D/Sales)_a - \text{avg}(R\&D/Sales)_b)$. This

dependent variable is the same as the numerator of the dependent variable used in the earlier analysis of this study, D.

This subsequent analysis shows a relatively lower R-square than the former one. Table 7 presents the main effects of all four independent variables on both dependent variables using a general linear model statistical technique. Based on the dependent variable

$$D1 = (avg(R\&D/Sales)_a - avg(R\&D/Sales)_b)$$

only factor A (capitalizing versus expensing firms) is significant at alpha equal to five percent. The p-value of factor B is higher in this case ( .0698 vs. .0217) and indicates that manager-controlled firms did not decrease their R&D expenditures significantly (alpha=0.05) more than owner-controlled firms in response to SFAS2. Unlike the previous analysis in this study, the two continuous independent variables, sales and DTA, are marginally significant at alpha equal to ten percent. Thus, analysis with the new dependent variable indicates that all four independent variables are more or less influencing factors in reacting to the mandatory change in accounting treatment of R&D expenditures.

Further differences in the results of the analysis based on the two different dependent variables of D and D1 are shown in Table 8 . Data in this table indicate that the results of the two analyses are noticeably different.

TABLE 7

Summary of the GLM Analyses

| | For Dependent Variable of D1 | | | For dependent Variable of D | | |
|---|---|---|---|---|---|---|
| Sources | Df | SS | p-value | Df | SS | p-value |
| A | 1 | .0363 | .0109 | 1 | 6.165 | .0001 |
| B | 1 | .0083 | .0698 | 1 | 1.936 | .0217 |
| Sales | 1 | .0086 | .1095 | 1 | 0.016 | .8184 |
| DTA | 1 | .0072 | .1139 | 1 | 0.030 | .7735 |
| Error | 159 | .4546 | | 159 | 58.012 | |
| Total | 164 | .5149 | | 164 | 66.159 | |

Where:

D1 = (avg(R&D/Sales)$_a$-avg(R&D/Sales)$_b$ ) used in previous studies

D = D1/avg(R&D/Sales)$_b$ used in this study

b = years before adoption of SFAS2

a = years after adoption of SFAS2

Note: P-value is the smallest alpha value for which a null hypothesis will just be rejected.

In the first analysis, not only factors A and B but

also their interaction have more explanatory power for D than for D1. Under analysis with D, the interaction of A*B with p-value of eight percent is marginally significant (alpha= 0.05), while it is not significant under dependent variable of D1, (p-value=.64).

In the last two analyses, in addition to factors A and B, the continuous sales and DTA variables are entered into the model separately. The corresponding p-values show that, despite the analysis with the dependent variable D, both sales and DTA individually are able to explain the dependent variable D1 significantly.

The major reason for the significant differences between these results can be found in the difference between the two dependent variables of D and D1. Actually, the results based on the dependent variable of D1 are subject to criticism. The raw data of the change in R&D expenditures from pre- to post-SFAS2 ignores completely the original investment on R&D by a firm. Therefore, the original differences of spending on R&D among firms may bias the results under analysis with the dependent variable of D1. A simple example may clarify this issue. Suppose there are two hypothetical firms: one firm whose original spending on R&D was $100, has changed its R&D expenditures by $20. The other firm has also changed its R&D expenditures by $20, but its original spending on R&D was $1000. Although both firms have changed their R&D expenditures by the same amount of

money, the percentage of the changes in R&D expenditures by these two firms are significantly different from each other. The former firm has changed its spending on R&D by 20 percent while the latter has changed by only two percent. According to this extreme example, an analysis based on the absolute change without considering the base investment on R&D may be considered meaningless.

TABLE 8

Summary of Various Analyses

| | Analysis 1 | | | Analysis 2 | | | Analysis 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | A | B | A*B | A | B | Sales | A | B | DTA |
| **Analysis Based on D1:** | | | | | | | | | |
| Df | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| SS | .036 | .008 | .001 | .036 | .008 | .008 | .036 | .008 | .008 |
| P-V | .001 | .093 | .644 | .002 | .065 | .085 | .004 | .096 | .089 |
| MS Error | | .00293 | | | .00289 | | | .00289 | |
| **Analysis Based on D:** | | | | | | | | | |
| Df | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| SS | 6.16 | 1.94 | 1.04 | 6.16 | 1.94 | .016 | 6.17 | 1.94 | .027 |
| P-V | .0001 | .021 | .088 | .0001 | .022 | .835 | .0001 | .022 | .786 |
| MS Error | | .35633 | | | .36276 | | | .36269 | |

Where:

$D1=(avg(R\&D/Sales)_{a} - avg(R\&D/Sales)_{b})$ used in previous studies

$D = D1/avg(R\&D/Sales)_{b}$ used in this study

b = years before adoption of SFAS2

a = years after adoption of SFAS2

P-V= p-Value of variables

## 6.6 LIMITATION OF THE STUDY

There are several limitations of this study that may threaten either its internal or external validity:

1. Unavailability of or difficulty in obtaining accounting data did not allow this researcher to select samples randomly among R&D capitalizing, as well as expensing firms. For matching purposes, in order to control for extraneous variables, the samples were self-selected. As a result, the finding of the study may not be generalizable to all small businesses.
2. The proxy statements of the selected firms for the period during which SFAS2 was adopted are not available in the library of either the University of Texas or the University of Oklahoma. Therefore, the data regarding the type of firms' control (manager versus owner) were extracted from the earliest available proxy statements; i.e., the period 1979-1981. The level of ownership by some firm's managers and executive officers may have changed between the period of adoption of SFAS2 and the period when the data were extracted. This study assumes that the firm's change in level of control was not enough to shift the firm from one category to another (manager-versus owner-controlled firms). The internal validity of the results is threatened if this assumption is not valid.

3. The result of this study may be biased because the majority of small businesses are owner-controlled firms.

## 6.7 SUMMARY AND CONCLUSIONS

In 1974, the Financial Accounting Standards Board issued the highly controversial Statement No. 2, "Accounting for Research and Development Costs." Statement No. 2 mandated all U.S. firms to expense their R&D expenditures in the year of occurrence. The Board took its position primarily because expensing is the more conservative of the two accounting treatments and because capitalization would introduce an asset into the balance sheet whose value and life are uncertain.

Prior to the issuance of SFAS2, firms could treat R&D costs for financial purposes in one of two ways:

1. capitalize when incurred and then amortize over the periods benefited from the research performed, or
2. charge against current income.

A majority of firms used the second option because of the lack of income effects for large firms, tax considerations, and/or uncertain future benefits from research projects. The remaining firms, most of which were small, used the capitalizing method prior to SFAS2.

Following the issuance of SFAS2, the Board did not conduct further research to find out the possible

consequences of this rule on firms and on the economy. Several researchers, however, attempted to measure the impact of the expensing-only rule on firms' behavior specifically toward R&D expenditures. Almost all researchers in this area believe that the SFAS2 may have an adverse effect on firms' R&D spending. Tranter (1978, p. 52), for example, has stated:

> Consequently, the treatment of R&D mandated by SFAS2 may be both theoretically unsound and economically harmful. By reducing the motivation to use R&D as a smoothing device, capitalization of these expenditures might possibly lead to an actual increase in R&D spending - a demonstrably desirable result.

A variety of possible explanations has been offered to justify a possible reduction of R&D expenditures as a result of a firm's reaction to SFAS2. The primary reasons for this reaction may include the following:

1. Firms using an R&D expensing method show lower earnings than if they apply the capitalizing method.
2. A mandatory switch to an immediate expensing of R&D expenditures reduces a firm's net income, total assets, and equity for the year following the change. As a result some key financial ratios, such as the degree of leverage, are increased.
3. To prevent such negative consequences on an income statement and a balance sheet, a firm may attempt to spend less on R&D than originally intended.

4. Debt contracts that are normally set and tied to a firm's accounting numbers and ratios may stimulate a reaction to the rule and cause even further reduction of R&D expenditures.
5. Hired managers, whose benefits are tied to compensated contracts, are more risk averse than owners. Therefore, manager-controlled firms are expected to spend less on R&D costs due to uncertain future results in general, and because of the negative aspects of SFAS2 in particular.

The above possible effects of SFAS2 are expected to be more visible in small firms than in large ones. The major reasons behind this anticipation may be summarized as follows: according to Horwitz and Kolodny (1980), most of the firms forced to change their R&D treatment were small, developing, and high-technology firms. These firms made a disproportionately large contribution to the innovation process. The amounts of R&D costs with respect to their other expenditures are relatively large compared with those of large firms. Therefore, an immediate change in these costs has a greater impact on their accounting information and their financial position.

Because of unavailability and/or difficulty of obtaining appropriate data, few researchers have directly measured the possible reaction of R&D expenditures to SFAS2. Of primary interest are the 1980 studies of Dukes et al. and

Horwitz and Kolodny. Dukes et al. (1980) concentrating on capitalizing firms, most of which were large, failed to find a significant effect of the expensing-only rule. Horwitz and Kolodny (1980) who focused on small firms, however, conclude that small firms have decreased their spending on R&D after adopting SFAS2.

The study reported herein extends this line of research by selecting a sample of small firms (fewer than 1500 employees) to analyze over a longer period of time (1970-1980) than previous studies. Differentiating beween owner and manager behavior, effect of firms' size, and impact of debt on firms' decisions of R&D spending are further considerations of this study.

Based on analyses done in this study, the following conclusions can be summarized:

1. This study was able to support the Horwitz and Kolodny (1980) finding that small, capitalizing firms appear to have been significantly affected by the rule and to have decreased their R&D intensity over the periods following SFAS2 when compared with the pre-SFAS2 periods.
2. This study may also provide some support to the finding of previous works such as Smith (1976), Tranter (1978), and Dhaliwal (1980, 1982) that managers are more risk averse than owners and will spend less on uncertain projects like R&D. The

results of the analyses indicate that manager-controlled firms for both overall and expensing groups have decreased their spending on R&D compared with owner-controlled firms. This study, however, did not find a significant further reduction of R&D intensity for manager-controlled firms within capitalizing group. Differently stated, manager- and owner-controlled firms (at least in this study) have reacted similarly with respect to the requirement of SFAS2.

3. The result of this study regarding the effect of a firm's size in reaction to SFAS2 was different from the conclusion of Dukes et al. (1980) and Elliott et al. (1984). One major reason that this study failed to find a firm's size effect on the change in spending on R&D may be the differences between firms' size used in this study and other studies. Because the sample in this study was merely selected from small firms, the size may no longer be a determinable factor to explain R&D spending behavior.
4. This study found that, for capitalizing firms that had to change their R&D treatment, debt-to-asset ratio was a negative factor causing firms to decrease their R&D expenditures even further. A higher degree of leverage in a capitalizing firm is associated with lower spending on R&D. Conversely, for expensing

firms that were assumed not to be affected by the rule, debt is a positive factor leading them to spend more on R&D. A higher degree of leverage in this group is associated with higher spending on R&D projects, possibly due to availability of funds through borrowing.

5. Finally, this study found that, when a firm's debt-to-asset ratio is between thirty and forty percent, the firm may reach its peak point of spending on R&D. Then, as this ratio increases beyond forty percent, the spending behavior changes and R&D intensity sharply decrease. It seems that a thirty- to-forty- percent degree of leverage signals a risk zone beyond which a firm faces a noticeable uncertainty and thus causes a decrease in R&D expenditures.

## 6.8 SUGGESTION FOR FURTHER RESEARCH

Several points were recognized during the course of analysis that might be fruitful for further research.

1. The data base provided in this study does not contain data for many R&D capitalizing firms for several years due to the unavailability of the firms' 10-K's and /or annual reports in the two libraries (University of Texas at Austin and University of Oklahoma) checked by this author. It would be

worthwhile to complete the data base, thus allowing for random selection and generalizability of the results.

2. The analysis of this study shows relatively low R-square. Entering more variables such as income and cash flow from the previous year may better explain the dependent variable (change in R&D expenditures).
3. It would be interesting to consider various levels of control or even to enter the actual level of control as a continuous variable rather than considering only manager- versus owner-controlled firms.
4. This study provided further evidence that managers are more risk averse than owners. Further evidence may be obtained to see whether owners are more willing than manager to spend on R&D.
5. Accounting literature supplies some evidence that a small firm run by owners is more profitable than one run by hired managers. The direction of causation with respect to R&D, however, is not known. Consequently, it is not clear whether owner-controlled firms spend more on R&D because they are more profitable or whether they are more profitable because they spend more on R&D.

BIBLIOGRAPHY

Angilley, A., "Return to Scale in Research in the Ethical Pharmaceutical Industry: Some Further Empirical Evidence," Journal of Industrial Economics (December 1973), pp. 81-93.

Ansari, S., "Accounting and Reporting R&D Costs-Current Practices and Problems," Research Management (November 1976), pp. 28-34.

-------, "The Literature on Accounting for Innovation," Manuscript, New York University (August 1975).

Arrow, K., Economic Welfare and the Allocation of Resources for Invention, The Rate and Direction of Inventive Activity: Economic and Social Factors. Princeton: Princeton University Press (1962).

Arthur Andersen Chronicle, "Accounting for Reseach and Development and Similar Costs," (April 1974), pp. 4-23.

Baily, M., "Research Development Costs and Returns: The U.S. Pharmaceutical Industry," Journal of Political Economy Vol. 80 no. 1, (January/February 1972), pp. 70-85.

Ball, R., "Discussion of Accounting for Research and Development Costs: The Impact on Research and Development Expenditures," Journal of Accounting Research Vol. 18, (Supplement 1980), pp. 27-37.

--------, "Changes in Accounting Techniques and Stock Prices, Empirical Research in Accounting," Journal of Accounting Research (Supplement 1972), pp. 1-38.

--------, and P. Brown, "An Empirical Examination of Accounting Income Numbers," Journal of Accounting Research (Autumn 1968), pp. 159-177.

Bierman, H., and R. Dukes, "Accounting for Research and Development Costs," The Journal of Accountancy (April 1975), pp. 48-55.

Bowen, R. M., E. W. Noreen, and J. M. Lacey, "Determination of the Corporate Decision to Capitalize Interest," Journal of Accounting an and Economics Vol. 3, no. 2, (August 1981), pp. 151-178.

Branch, B., "Research and Development, Profits and Ssales Growth." Ph.D. Dissertation, the University of Michigan (1970).

---------, "Research and Development and its Relation to Sales growth," Journal of Economics and Business Vol. 25, (Winter 1973), pp. 107-111.

Brugger, K., "Impact of FAS2 on Industrial Research and Development Expenditure," D.B.A. Dissertation, Arizona State University (1978).

Collins, D., "Financial Reporting Methods and Management Decisions: An Empirical Examination of Information Inductance." Ph.D. Dissertation, Northwestern University (1978).

----------, and W. Dent, "The Proposed Elimination of Full Cost Accounting in the Extractive petroleum Industry: An Empirical Assessment of Market Consequences," Journal of Accounting and Economics (March 1979), pp. 45-76.

----------, M. Rozeff, and D. Dhaliwal, "The Economic Determinants of the Market Reaction to proposed Mandatory Accounting Changes in the Oil and Gas Industry," Journal of Accounting and Economics Vol.3 no. 1, (March 1981), pp. 37-71.

Comanor, S. W., "Market Structure, Product Differentiation, and Industrial Research," Quarterly Journal of Economics (November 1967), pp. 639-657.

Coopers & Lybrand, Letter to the Financial Accounting Standards Board on Statements 1-12 (August 17, 1978).

Council of Economic Advisers, Economic Report of the President Washington D.C., U.S. Government Printing Office, (1977), p. 48.

Daley, L. A. and R. L. Vigeland, "The Effect of Debt Covenents and Political Costs on the Choice of Accounting Methods: The Case of Accounting for R&D Costs," Journal of Accounting and Economics Vol. 5, No. 3, (December 1983), pp. 195-211.

Dhaliwal, D., "The Effect of the Firm's Capital Structure on the Choice of Accounting Methods." The Accounting Review (January 1980), pp. 78-84.

----------, G. Salamon, and E. Smith, "The Effect of Owner Verses Management Control on the Choice of Accounting Methods," Journal of Accounting and Economics Vol. 4, no. 1, (July 1982), pp. 40-53.

Dukes, R., "An Investigation of the Effects of Expensing Research and Development Costs on Security Prices." In proceedings of the Conference on Topical Research in Accounting, edited by Michael Schiff and George Sorter, New York: Ross Institute of Accounting Research, School of Business, New York University (1976), pp. 147-193.

---------, and T. Dyckman, J. Elliott, "Accounting for Research and Development Costs: the Impact on Research and Development Expenditures," Journal of Accounting Research Vol. 18, (Supplement 1980), pp. 1-26.

Elliott, J., "Funds Flow vs. Expectational Theories of Research and Development Expenditures in the Firm," Southern Economic Journal (April 1971), pp. 409-22.

----------, G. Richardson, T. Dyckman, and R. Dukes, "The Impact of SFAS No.2 on Firm Expenditures on Research and Development: Replications and Extentions," Journal of Accounting Research Vol. 22, No. 1, (Spring 1984), pp.85-102.

Financial Accounting Standards Board, Discussion Memorandum: An Analysis of Issues Related to Accounting for Research and Development and Similar Costs. Stamford, Conn.: FASB (1973).

---------, Statement No. 2, Accounting for Research and Development Costs. Stamford, Conn.: FASB (1974).

Gambino, A. and M. Gartenberg, Industrial R&D Management. New York: National Association of Accountants (1979).

Gellein, O., and M. Newman, Accounting for Research and Development Expenditures. Accounting Research Study No. 14, New York: AICPA (1973).

Gordon, M., "Postulates, Principles and Research in Accounting," The Accounting Review (April 1964), pp. 251-263.

Grabowski, H., "The Determinants of Industrial Research and Development: A Study of the Chemical, Drug, and Petroleum Industries," Journal of Political Economy (March/April 1968), pp. 292-306.

Grabowski, H. and Mueller, "Managerial and Stockholder Welfare Models of Firm Expenditures," The Review of Economics and Statistics (February 1972), pp. 9-24.

Hagerman, R. L., and M. E. Zmijewski, "Some Economic Determinants of Accounting Policy Choice," Journal of Accounting and Economics Vol. 1, no. 2, (August 1979), pp. 141-161.

Harrison, T., "Different Market Relations to Discretionary and Nondiscretionary Accounting Changes," Journal of Accounting Research (Spring 1977), pp. 84-107.

Hirshleifer, J., "The Private and Social Value of Information and the Reward to Inventive Activity," American Economic Review LXI(September 1971), pp. 561-574.

----------, "Where Are We in the Theory of Information?," American Economic Review LXII(May 1973), pp. 31-39.

Holthausen, R. W. and R. W. Leftwich, "The Economic Consequences of Accounting Choice," Journal of Accounting and Ecconomics (August 1983), pp. 77-117.

Horwitz, B. and R. Kolodny, "The Economic Effects of Involuntry Uniformity in the Financial Reporting of R&D Expenditures," Journal of Accounting Research Vol. 18, (Supplement 1980), pp. 38-74.

----------, "The FASB, the SEC, and R&D," The Bell Journal of Economics (Spring 1981), pp. 249-262.

Jensen, M. and W. Meckling, "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure." Journal of Financial Econamics (October 1976), pp. 305-60.

Johnson, O., "A Consequential Approach to Accounting for R&D," Journal of Accounting Research (Autumn 1967), pp. 164-72.

Kamien, M., and N. Schwartz, "Market Structure and Innovation: A Survey," Journal of Economic Literature (March 1975), pp. 1-37.

Lev, B., "The Impact of Accounting Research on the Stock Market: The Case of Oil and Gas Companies," The Accounting Review (July 1979), pp. 485-503.

Mansfield, E., "Industrial Research and Development Expenditures: Determinants, Prospects and Relations to Size of Firm and Inventive," Journal of Political Economy (August 1964), pp. 319-340.

----------,. "Industrial Research and Development: Characteristics, Costs, and the Diffusion of Results," American Economic Review (May 1969), pp. 65-79.

----------, ET AL. Research and Innovation in the Modern Corporation, New York: Norton (1971).

McGraw-Hill Department of Economics, Business Plans for Research and Development Expenditures, 1968-1971, New York: McGraw-Hill (1968).

Marris, R., The Economic Theory of 'Managerial' Capitalism, Glencoe, Ill.: Free Press (1964).

Milburn, A., "An Empirical Study of the Relationship of Research and Development Expenditures to Subsequent Benefits," Working paper, University of Illinois (1971).

Modigliani, F. and M. Miller, "The Cost of Capital Corporation Finance, and the Theory of Investment," American Economic Review Vol.48, (June 1958), pp. 261-297.

Newman, M., "Equating Return from R&D Expenses." Financial Executive (April 1968), pp. 26-33.

Orton, B., and R. Bradish, "The Treatment and Disclosure of Research and Development Expenditures," Management Accounting Vol. 51 (July 1969), pp. 31-34, 42.

---------, "Research and Development Costs and Income Determination: An Examination of Accounting Theory and Practice," Ph.D. dissertation, University of Washington (1962).

San Miguel, J., "Accounting by Business Firms for Investment in Research and Development," Manuscript, New York University (August 1975).

Senate Special Report No. 95-1413, Small Business and Innovation, U.S. Government Printing Office Washington (1978).

Sinning, K., "An Evaluation of the Information Content of Statement of Financial Accounting Standard No. 2," Ph.D. Dissertation, Michigan State University (1978).

Smith, C., "The Effect of the Separation of Ownership from Control on Accounting Policy Decisions," The Accounting Review (October 1976), pp. 707-723.

---------, and J. Warner, "One Financial Contracting: An Analysis of Bond Covenants," Journal of Financial Economics (July 1979), pp. 117-161.

Tranter, T., "The Effect of Alternative Methods of Accounting for Research and Development Expenditures on the Amount of Research and Development Expenditures," Ph.D. Dissertation, University of Washington (1978).

U.S. House of Representatives, 97th Congress, Hearing before the Subcommittee on Science, Research and Development of the Science and Technology (November 24, 1981).

Watts, R. and J. Zimmerman, "Toward a Positive Theory of the Determination of Accounting Standards," The Accounting Review (January 1978), pp. 112-134.

Williamson, O. E., The economics of Discretionary Behavior: Managerial Objectives in a Theory of a Firm, Prentice-Hall, Englewood Cliffs, NJ (1964).

Wolfson, M. A., "Discussion of The Economic Effects of Involuntary Uniformity in the Financial Reporting of R&D Expenditures," journal of Accounting Research Vol. 18, (Supplement 1980), pp. 75-83.

Zmijewski, M. and R. Hagerman, "An Income Strategy Approach to the Positive Theory of Accounting Standard Setting/ Choice," Journal of Accounting and Economics (March 1981), pp. 129-149.

Appendix A

LIST OF FIRMS USED IN THIS STUDY

| SIC | FIRMS | TYPES |
|---|---|---|
| 356 | National Mine Service | CM |
| 356 | Standum Inc. | CM |
| 357 | Terminal Data Corp. | CM |
| 357 | Anderson Lab. Inc. | CM |
| 357 | Datacard Corp. | CM |
| 357 | Measurex Corp. | CM |
| 357 | Graham Magnetics Inc. | CM |
| 357 | Belco Pollution Corp. | CM |
| 365 | Educational Dev. | CM |
| 366 | Electronic Research Ass. | CM |
| 366 | Lynch Comm. System Inc. | CM |
| 366 | Microdyne Corp. | CM |
| 366 | Electro Magn. Scie. Inc. | CM |
| 366 | Sensormatic Electronics | CM |
| 366 | Dataram Corp. | CM |
| 366 | Cyclotron Corp. | CM |
| 366 | Loral Corp. | CM |
| 366 | Fabrion Elec. | CM |
| 366 | Liquidonics Ind. Inc. | CM |
| 366 | Butler National Corp. | CM |
| 366 | American Nucleonics Inc. | CM |

| | | |
|---|---|---|
| 369 | Tensor Corp. | CM |
| 369 | Texcan Corp. | CM |
| 369 | Jetronic Ind. | CM |
| 366 | The Birtcher Corp. | CM |
| 372 | Aeronca Inc. | CM |
| 381 | Electro Nucleonics | CM |
| 381 | Raymond Precision Ind. | CM |
| 383 | Sperti Drug Prod. Ins. | CM |
| 383 | Microform Data System | CM |
| 383 | Kalvar Corp. | CM |
| 383 | Horizon Research Inc. | CM |
| 384 | Frigitronics Inc. | CM |
| 384 | Desert Pharmaceut'l Inc. | CM |
| 737 | Applied Data Research | CM |
| 737 | Anderson 2000 | CM |
| 739 | Electrogas Dyn'cs Inc. | CM |
| 739 | Napco Ind. | CM |
| 801 | Life Science Inc. | CM |
| 283 | Forest Lab. Inc. | CM |
| 349 | Plant Ind. | CM |
| 356 | Salem Corp. | CO |
| 356 | Mira-Pack | CO |
| 357 | Digilog System Inc. | CO |
| 357 | Fabri-Tek | CO |
| 357 | Access Corp. | CO |
| 357 | Computer Transceiver Inc. | CO |
| 357 | Admaster Corp. | CO |

| | | |
|---|---|---|
| 357 | Reface Tech'gy Dev. Corp. | CO |
| 365 | Advent Corp. | CO |
| 366 | Alden Elect. & Impulse | CO |
| 366 | Buck Engineering | CO |
| 366 | Infrared Ind. | CO |
| 366 | Mark Products | CO |
| 366 | Technical Comm. | CO |
| 366 | Moog Inc. | CO |
| 366 | S.R.C. Lab. | CO |
| 366 | Schaevitz Eng. | CO |
| 366 | Exotech Inc. | CO |
| 366 | Sunair Electronics | CO |
| 366 | General Datacom Ind. | CO |
| 366 | Kustom Electronics | CO |
| 369 | Sealectro Corp. | CO |
| 369 | Hickok Electr'l Ind. Inc. | CO |
| 369 | T. Bar Inc. | CO |
| 369 | North Atlantic Ind. Inc. | CO |
| 372 | Bellanca Aircraft Corp. | CO |
| 381 | Transidyne General | CO |
| 381 | New Port Lab. Inc. | CO |
| 383 | Optical Radiation | CO |
| 383 | Med General | CO |
| 383 | Electro Catheter Corp. | CO |
| 383 | Danker and Wohlk | CO |
| 384 | Nuclear System | CO |
| 384 | Data Scope | CO |

| | | |
|---|---|---|
| 737 | DBA System | CO |
| 737 | Graphic Scaning | CO |
| 739 | Volt Information | CO |
| 739 | Mathematica Inc. | CO |
| 801 | Biospherics Inc. | CO |
| 283 | Alcolac Inc. | CO |
| 349 | Valtek Inc. | CO |
| 356 | Hein Werner | EM |
| 356 | Duriron Co. | EM |
| 357 | Compuscan | EM |
| 357 | Scope Inc. | EM |
| 357 | Computer Communication | EM |
| 357 | Computer Automation | EM |
| 357 | Electronic Associates | EM |
| 357 | Tannetic Inc. | EM |
| 356 | Telescience | EM |
| 367 | Unitrode | EM |
| 366 | Plantronics | EM |
| 366 | Scientific Atlanta | EM |
| 366 | Adams Russell | EM |
| 367 | Combex | EM |
| 367 | Semtech | EM |
| 366 | Intel Corp. | EM |
| 366 | Alpha Ind. | EM |
| 366 | Espey Mfg. & Electronics | EM |
| 366 | Standard Microsystems | EM |
| 366 | Solid State Scientific | EM |

| | | |
|---|---|---|
| 367 | Siliconix Inc. | EM |
| 369 | Tech-Sym Corp. | EM |
| 369 | Medironic | EM |
| 369 | GTI Corp. | EM |
| 369 | Xonics Inc. | EM |
| 372 | Superior Ind. Int'l | EM |
| 381 | Coherent Inc. | EM |
| 381 | Whitehall Corp. | EM |
| 383 | Bowmar Instrument | EM |
| 383 | Genrad Corp. | EM |
| 383 | Computer Products | EM |
| 383 | Nicolet Instrument | EM |
| 384 | Concept | EM |
| 384 | USR Ind. | EM |
| 737 | Shared Medical Sys. Inc. | EM |
| 737 | Comshare Inc. | EM |
| 739 | Tymshare | EM |
| 739 | National Data Corp. | EM |
| 820 | National Educat'l Corp. | EM |
| 283 | Zenith Laboratories | EM |
| 349 | Metex Corp. | EM |
| 357 | CPT Corp. | EO |
| 356 | Sullair Corp. | EO |
| 357 | Analogic | EO |
| 357 | Wang Lab. C.L.B. | EO |
| 357 | Recognition | EO |
| 357 | Computer Vision Corp. | EO |

| | | |
|---|---|---|
| 357 | Beehive Int'l | EO |
| 357 | TEC Inc. | EO |
| 367 | Silicon General Inc. | EO |
| 366 | Torotel Inc. | EO |
| 366 | Molex Inc. | EO |
| 366 | Servo Corp. of America | EO |
| 366 | Ind'l Electronics | EO |
| 366 | King Radio | EO |
| 366 | Veeco Ind. | EO |
| 366 | Analog Devices | EO |
| 366 | Clarostat Mfg. | EO |
| 366 | Methode Electronics Inc. | EO |
| 366 | Phone Mate Inc. | EO |
| 366 | Barnes Engineering | EO |
| 366 | EECO | EO |
| 366 | Western Marine Elec. Co. | EO |
| 367 | Narda Microwave Corp. | EO |
| 367 | Ripley Co. Inc. | EO |
| 366 | Timeplex | EO |
| 372 | Champion Parts Rebuilder | EO |
| 381 | Orion Research | EO |
| 381 | Intercont'l Dynamics | EO |
| 383 | Instron | EO |
| 382 | Hathaway Corp. | EO |
| 383 | Cobe Lab. | EO |
| 383 | Fluke Mfg. | EO |
| 382 | Moore Products | EO |

| | | |
|---|---|---|
| 384 | Puritan Bennet Corp. | EO |
| 737 | Market Facts Inc. | EO |
| 737 | Keydata | EO |
| 739 | Core Lab. | EO |
| 739 | Datatab Inc. | EO |
| 806 | National Medical Care | EO |
| 283 | Marion Lab. | EO |
| 349 | Jamesbury Corp. | EO |

# Appendix B

## DISTRIBUTIONS OF OVERALL AND FACTOR GROUP FIRMS

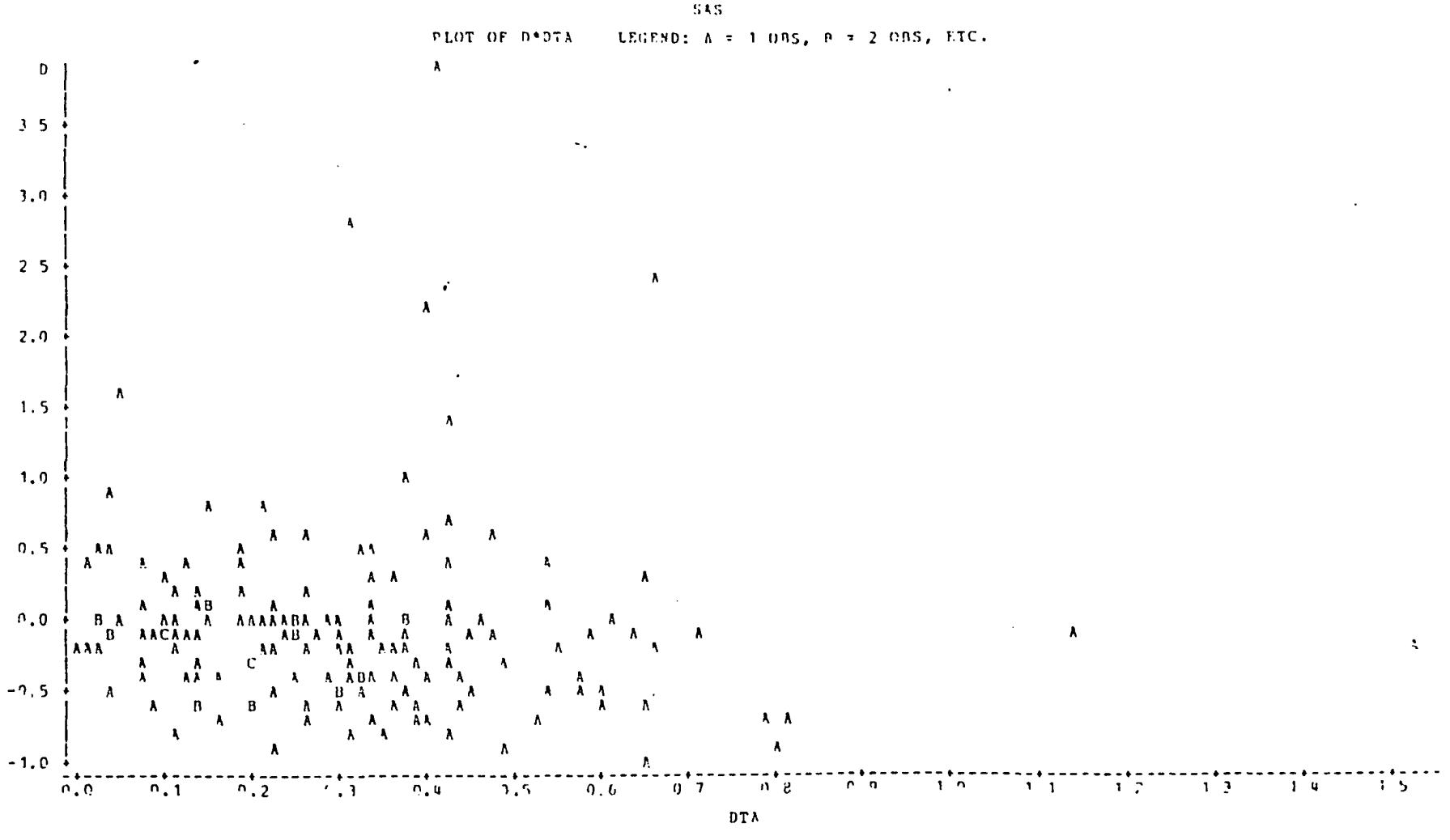



Figure 4: Distribution of Data for Overall Firms

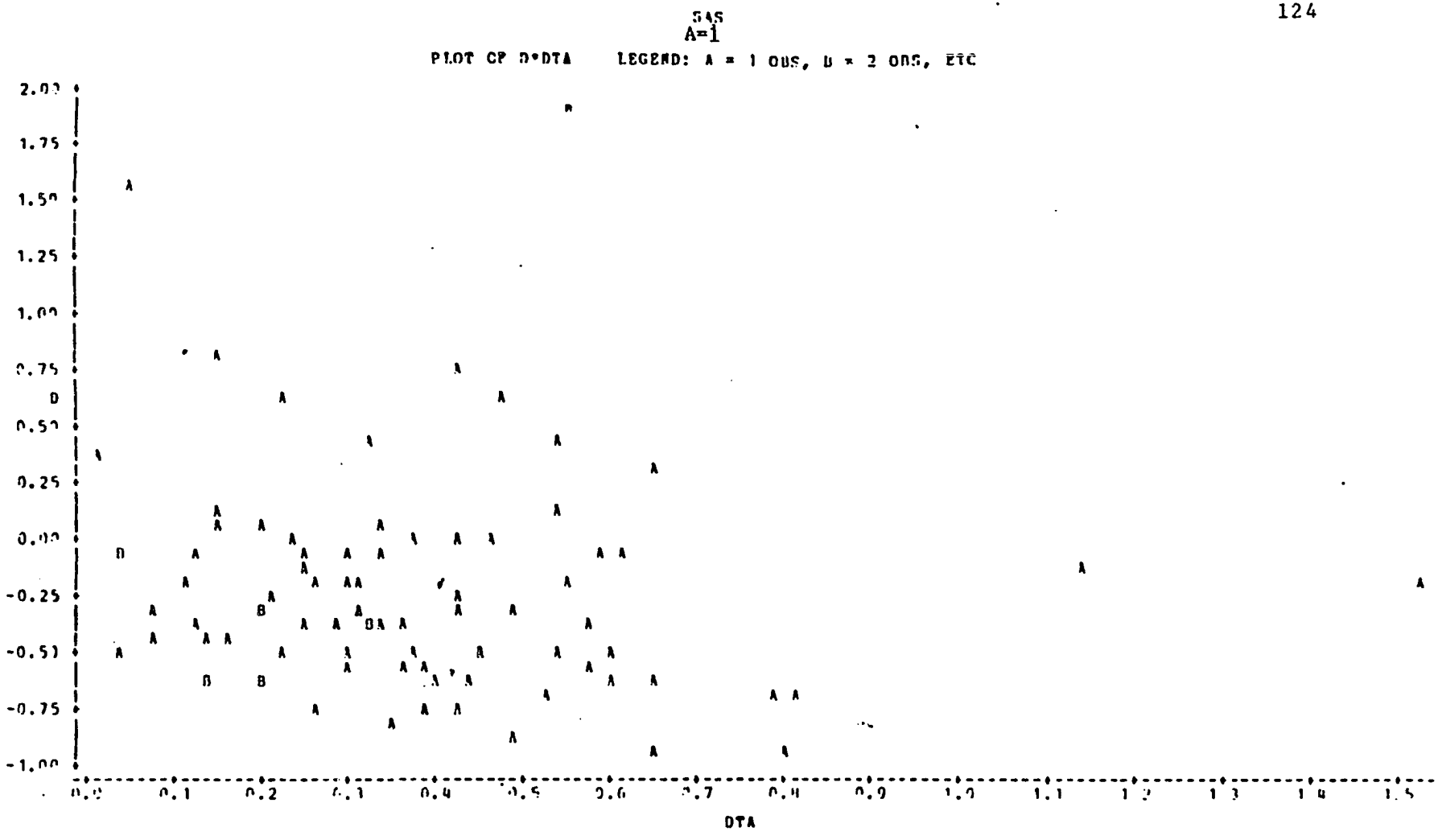



Figure 5: Distribution of Data for Capitalizing Firms

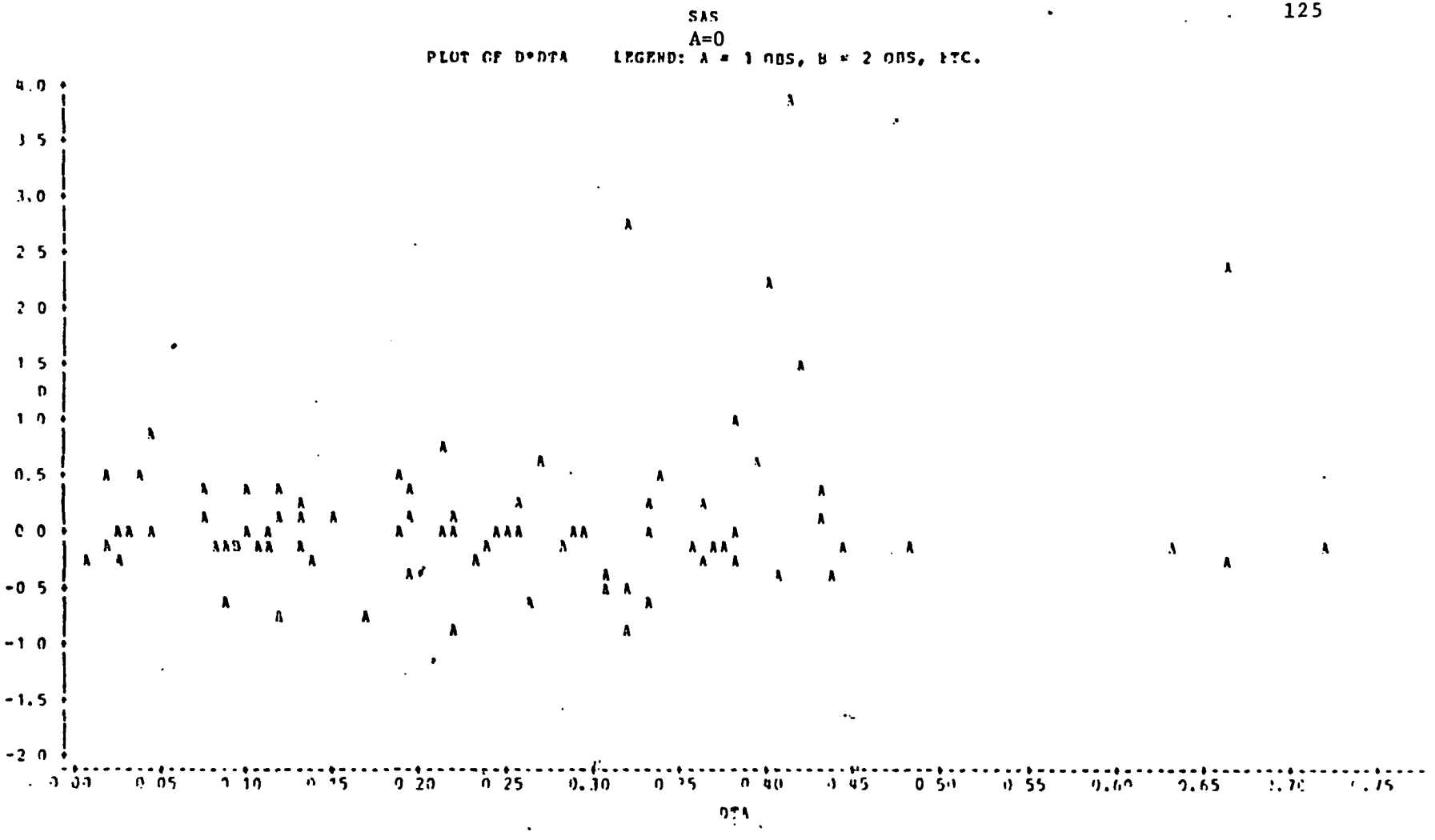



Figure 6: Distribution of Data for Expensing Firms

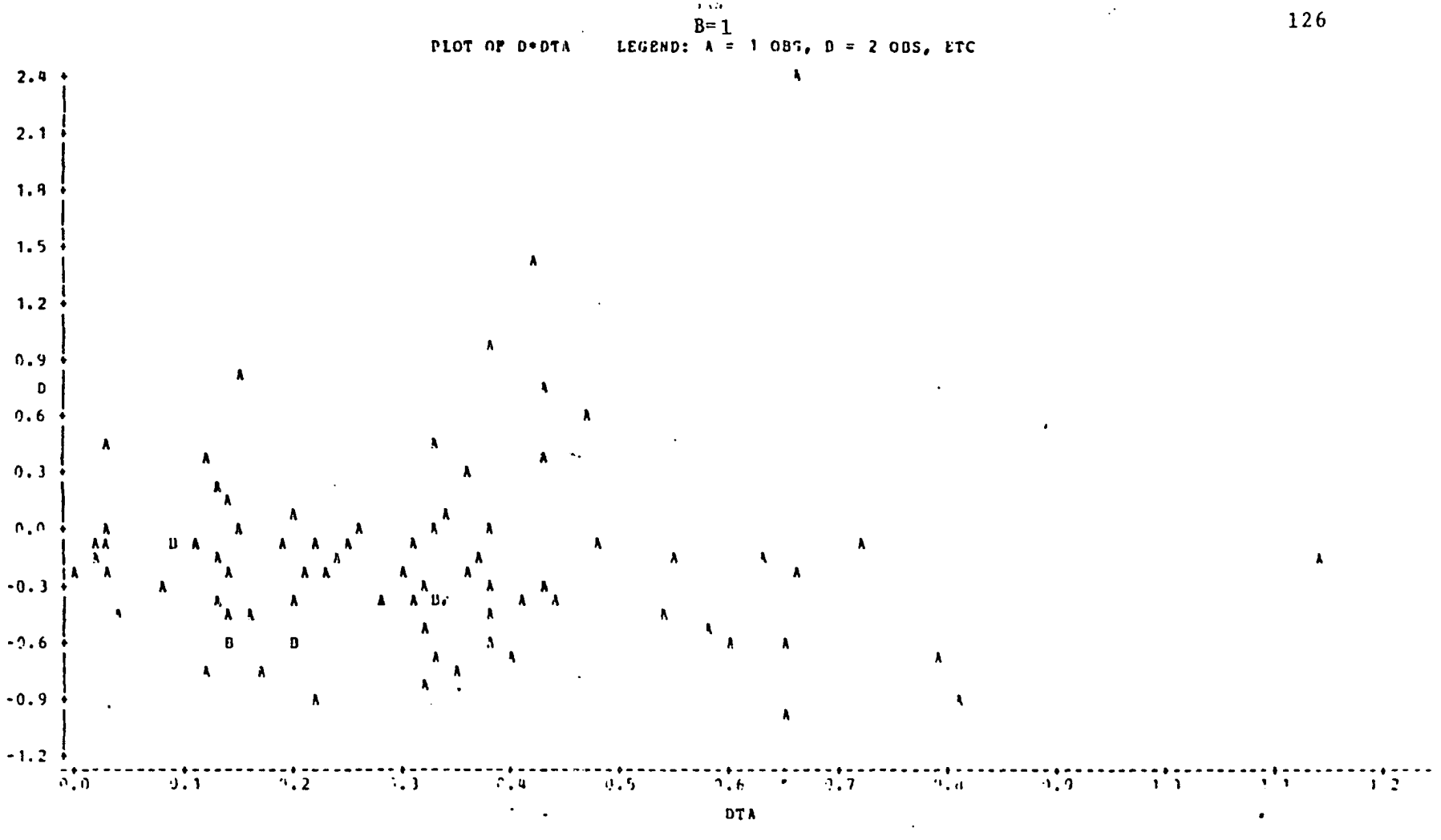



Figure 7: Distribution of Data for Manager-Controlled Firms

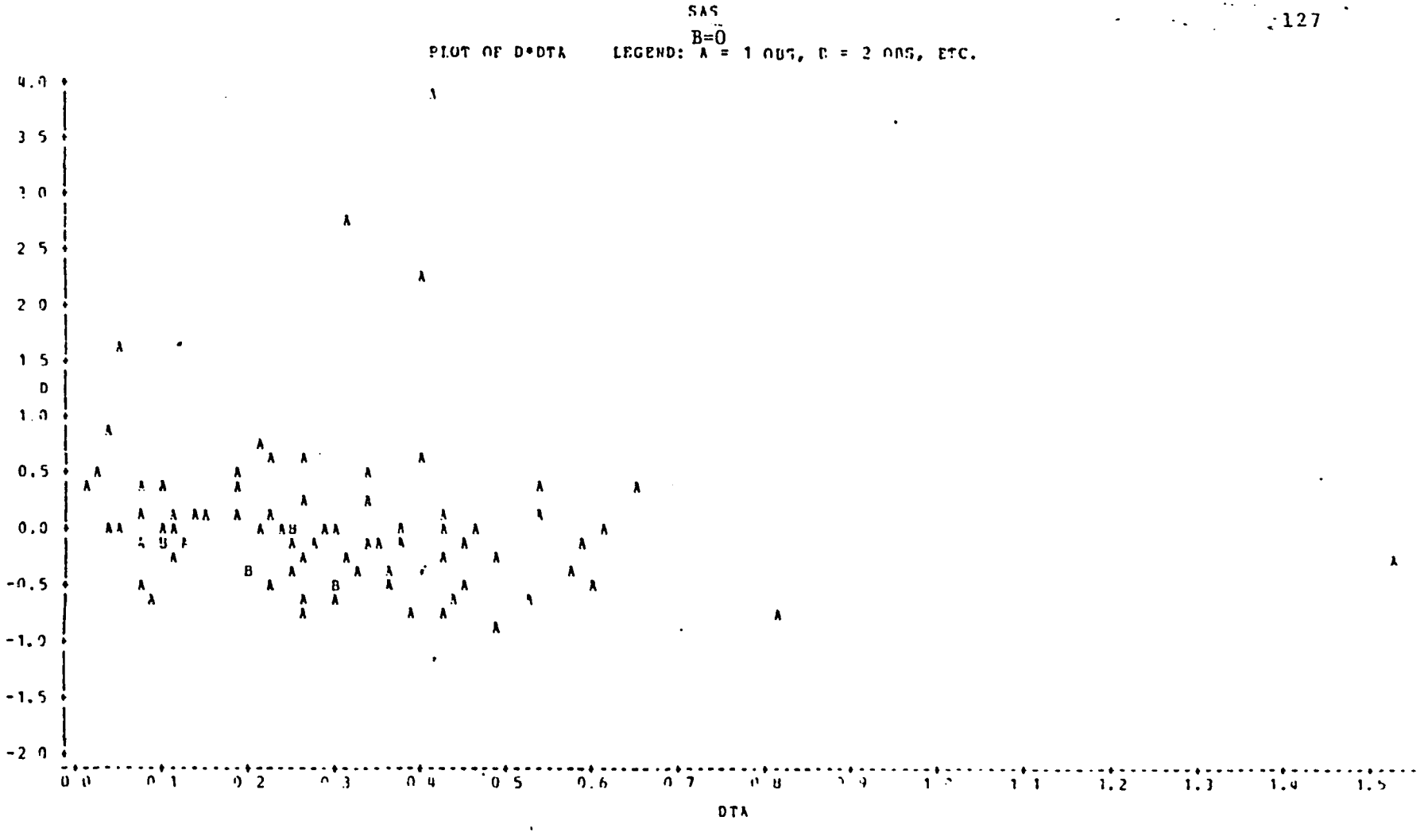



Figure 8 Distribution of Data for Owner-Controlled Firms

# Appendix C

## DISTRIBUTIONS OF CELLS GROUP FIRMS

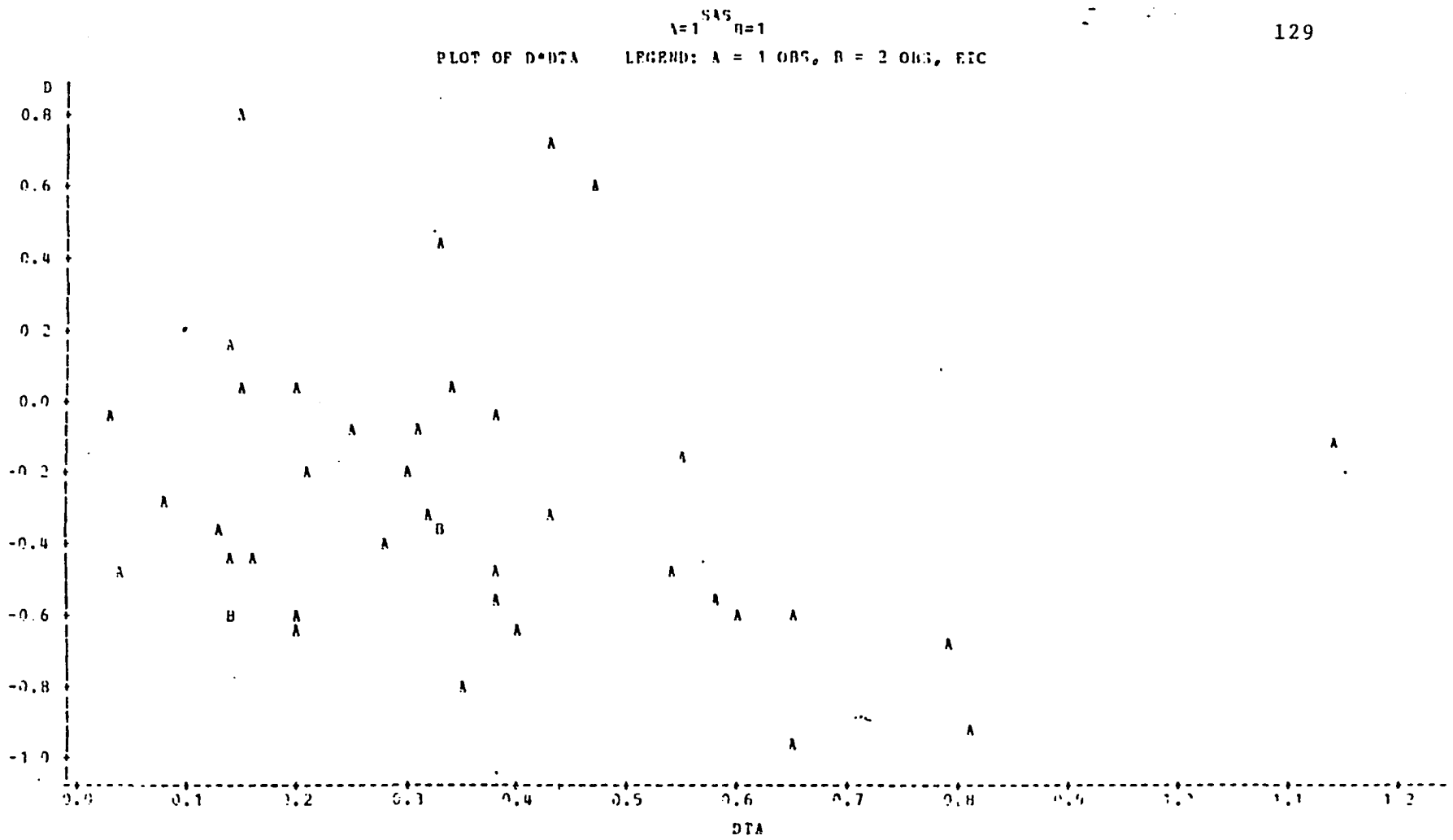



Figure 9: Distribution of Data for Capitalizing, Manager-Controlled Firms

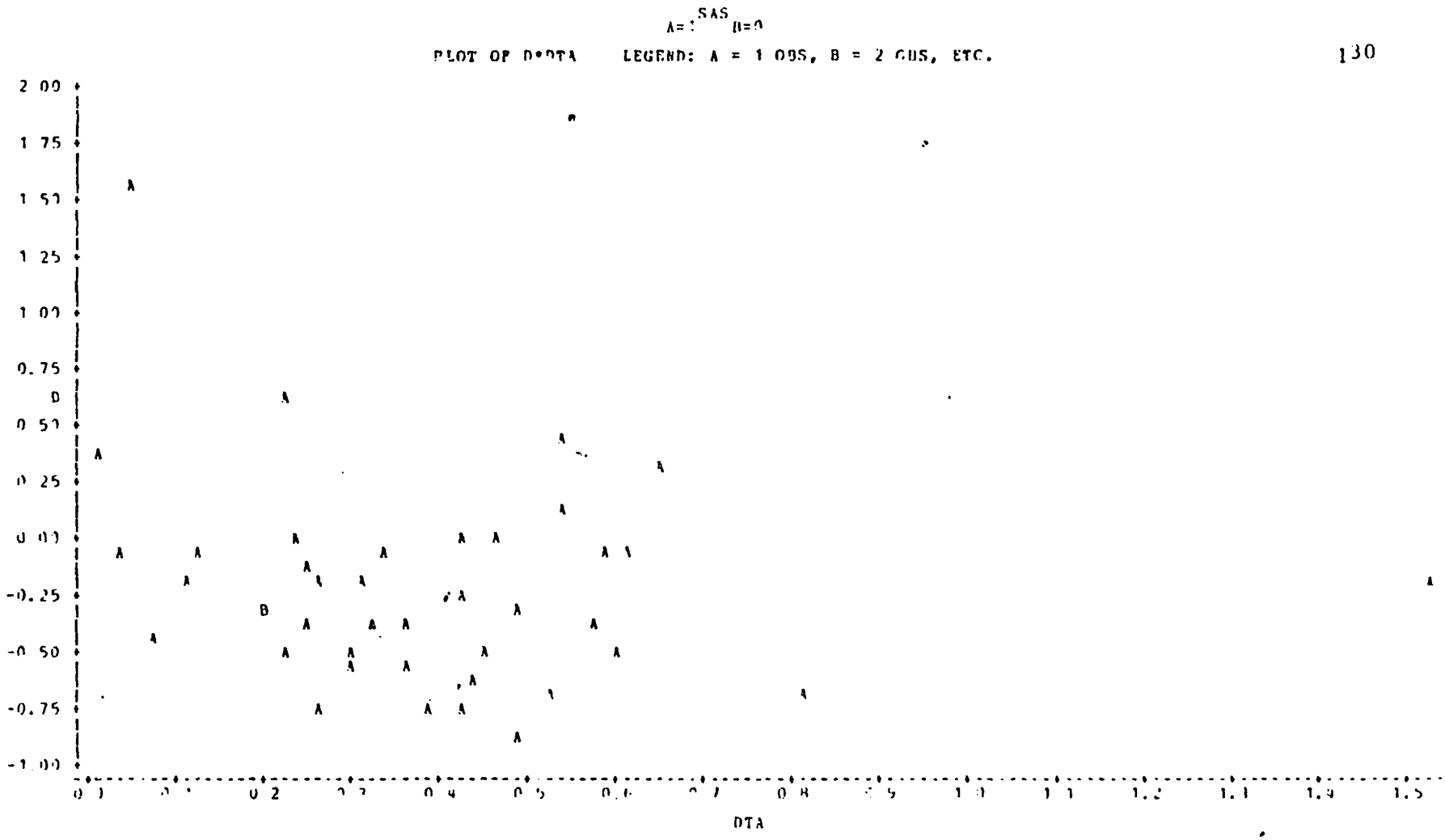



Figure 10: Distribution of Data for Capitalizing, Owner-Controlled Firms

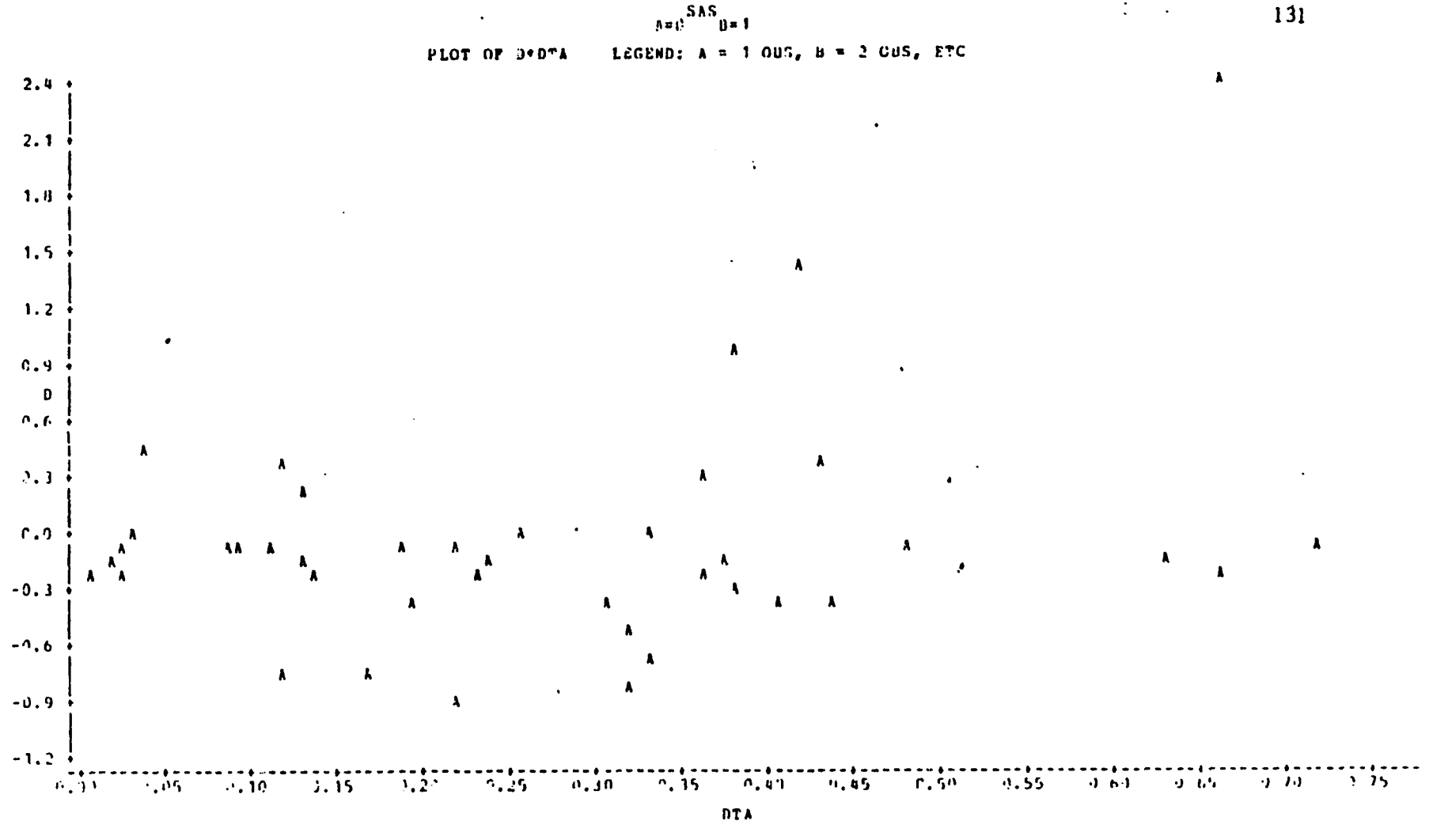



Figure 11: Distribution of Data for Expensing, Manager-Controlled Firms

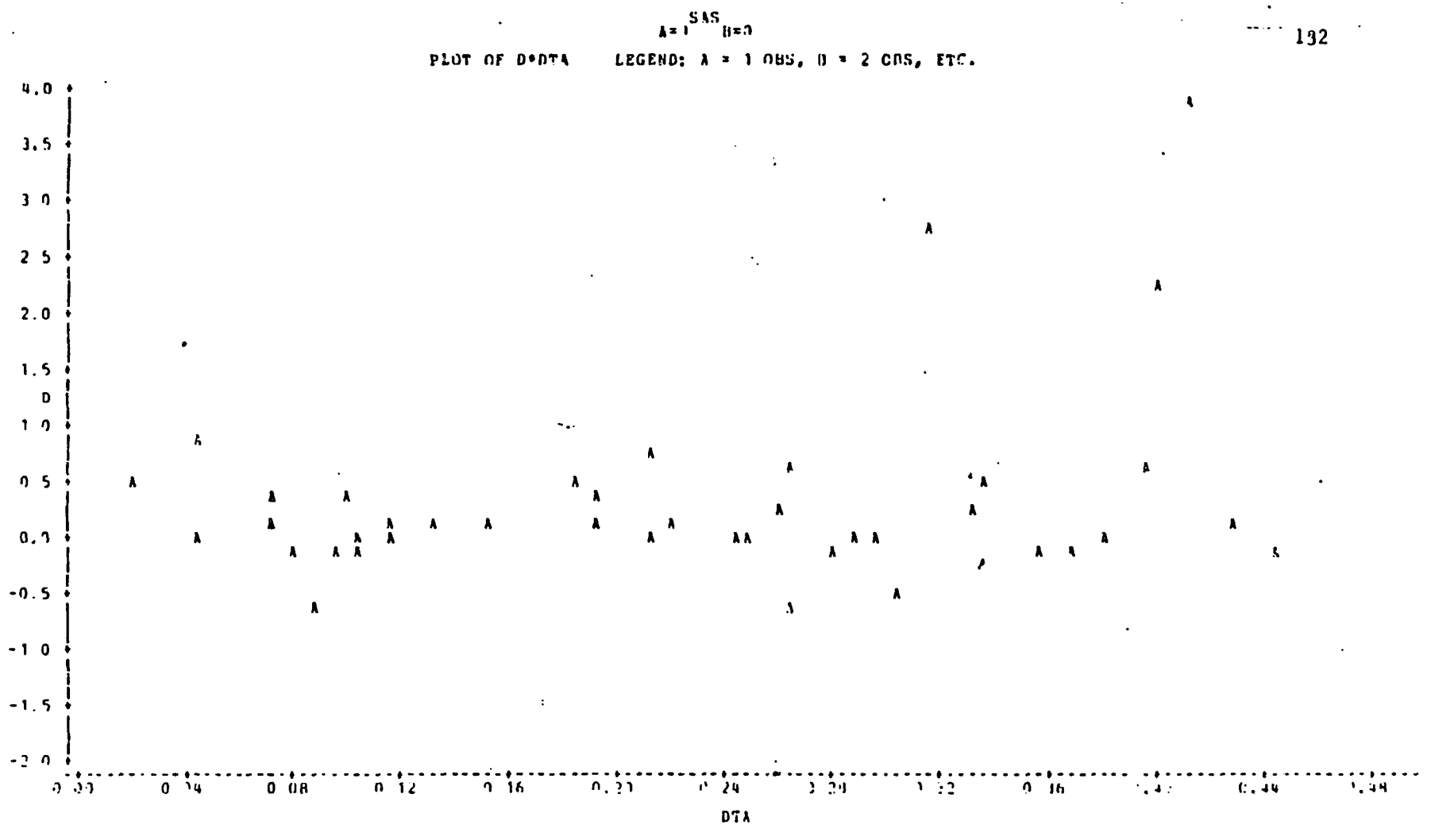



Figure 12: Distribution of Data for Expensing, Owner-Controlled Firms