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1977
INCOME SMOOTHING: A LABORATORY EXPERIMENT

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of the Ohio State University

By

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* * * * *

The Ohio State University
1977

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To my loving parents
ACKNOWLEDGMENTS

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iii.
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CHAPTER I
INTRODUCTION

The Problem to be Investigated

Generally accepted accounting principles provide a variety of alternatives to account for a given set of financial occurrences. For example, there are many "acceptable" methods of depreciating an asset. Also management has the capability of timing financial transactions (such as delaying a sale) and making discretionary expenditures. Because of this flexibility, management has a limited capability to manage reported income from year to year.

One possible strategy of managing earnings is income smoothing which is defined by Copeland [1968, p. 102] as:

the repetitive selection of accounting measurement or reporting rules in a particular pattern, the effect of which is to report a stream of income with a smaller variation from trend than would otherwise have appeared.

However this definition of income smoothing indicates only that income smoothing is accomplished through the use of accounting reporting rules. But, income smoothing may also result from the inception and timing of actual transactions. Dascher and Malcom [1970, pp. 253-254] suggest that income smoothing is a dichotomy as follows:

1.
Real smoothing refers to an actual transaction that is undertaken on the basis of its smoothing effect on income, whereas artificial smoothing refers to accounting procedures which are implemented to shift costs and/or revenue from one period to another.

For purposes of this paper, income smoothing is defined as the act of diminishing the variability in a stream of reported income numbers toward a perceived target income stream. This general definition overcomes the restrictiveness of Copeland's definition by encompassing both real and artificial income smoothing.

Income smoothing is a form of management behavior. This type of behavior is exhibited due to the separation of the management in many public corporations from the ownership in these corporations. This division permits the opportunity as well as the motivation for managers to smooth income. This phenomenon was recognized as early as 1932 by Berle and Means [1932, p. 91] who foresaw the present separation of management and ownership as follows:

Economic power, in terms of control over physical assets, is apparently responding to a centripetal force, tending more and more to concentrate in the hands of a few corporation managements.

Since managers are capable of actions that enhance their own position which may or may not be in the owners' best interest, managers may follow a policy other than profit maximization. Baumol [1956, p. 81] states that:

the desire to keep the stockholders contented may not motivate management to seek to maximize the rate of rise in
security prices.

Williamson, [1968, p. 299] also in agreement with the premise that managers act in their own behalf, states:

utility maximizing managements (where the utility function reflects, in addition to profits, a positive managerial preference for hierarchial staff, emoluments, and leisure) will respond to changing environmental conditions in such a way to attenuate intemporal performance in comparison to a profit maximizing management.

Monsen and Downs [1965, p. 225] have developed a theory of large, managerially oriented firms. Their two main hypotheses are as follows:

1. Owners desire to have each firm managed so that it provides a steady income from dividends and a gradual appreciation of the market price of the stock.

2. Managers act so as to maximize their own lifetime incomes.

Monsen and Downs indicate that hypothesis one is correct because the owner does not have complete information on his company. Since he only knows what is publicly available, the owner prefers a steady income from dividends and a gradual appreciation of market price over possible higher but fluctuating dividends and market prices. If this is the case, the manager can maximize his utility by giving the owner what he wants as suggested in hypothesis two. Assuming the above hypotheses are correct, managers will probably have the motivation to smooth income.

Cyert and March [1963, p. 38] suggest that discretionary resources may be used by a firm in order to diminish
fluctuations in performance. Such a discretionary resource called slack may be used as follows:

By absorbing excess resources it retards upward adjustment of aspirations during relatively good times; by providing a pool of emergency resources, it permits aspirations to be maintained (and achieved) during relatively bad times.

Management tries to control the level of aspiration of its stockholders. By dampening this level when the company prospers, it is easier to maintain performance at a given level when the company does not prosper. By fulfilling stockholders' aspirations, management enhances its own position of control over the firm.

According to Baumol, Williamson, Mosen and Downs, and Cyert and March, managers act in their own best interests. Sometimes these interests result in the reporting of a steady growing stream of income, market prices or dividends. Mosen and Downs suggest that this is what is desired by stockholders of large managerially controlled firms. If management perceives that stockholders desire smooth income, they will provide the stockholders with what they want. An example of this is the current investigation of Gulf and Western Incorporated by the Securities and Exchange Commission.

Some former officials at Gulf and Western stated that the chairman of the board wanted a steady fifteen percent growth rate in the hope that it would please Wall Street analysts. Seymour Hersh [1977, p. 34] states:
Most corporations set goals for growth in earnings. But to achieve these goals, former officials said, the profit and loss records of Gulf and Western were extensively distorted.

The financial press appears to perceive that income smoothing is widely practiced. This is evident as Mr. Hersh continues by stating that the practices of Gulf and Western in this area were excessive, even though most corporations set goals for earnings growth. Therefore, it is important to examine the degree in which income smoothing is practiced.

**Purpose of the Study**

The purpose of this study is to apply an experimental methodology to the income smoothing area. This study also develops a basic economic model of income smoothing using time-series analysis.

There are three specific issues examined in this study. First, the experiment attempts to determine how much total earnings per share a controller is willing to sacrifice to smooth earnings per share from year to year. This could be a surrogate for managements' motivation to smooth income. Second, smoothing behaviors' relationship to organizational structure is examined. Specifically, the degree of smoothing displayed by a controller for a widely held corporation is compared to the degree of smoothing for a closely-held corporation. This is a continuation of some of the current research by Kamin et al. [1976], Smith.
The third topic is the examination of the real smoothing, artificial smoothing dichotomy. This issue has not yet been investigated by income smoothing researchers. The existence of a behavioral preference to smooth by either real variables (real smoothing) or artificial variables (artificial smoothing) within a context devoid of certain legalistic and economic constraints will be revealed in this study.

Method of Investigation

Most income smoothing studies have used the ex post facto research design, defined by Kerlinger [1969, p. 379] as follows:

...systematic empirical inquiry in which the scientist does not have direct control of independent variables because their manifestations have already occurred or because they are inherently not manipulable. Inferences about relationships among variables are made, without direct intervention from concomitant variation of independent and dependent variables.

With income smoothing, the accounting researcher has no control over the independent variables. All he can do is select for use one of the many smoothing variables. Once the effect of these smoothing variables have already occurred, existing empirical studies of income smoothing are classified as ex post facto research.

The advantages of ex post facto research are its wide applicability to situations that would be impossible to
test experimentally. But such research is subject to three inherent weaknesses suggested by Kerlinger [1969, p. 390] as follows:

1) the inability to manipulate independent variables, 2) the lack of power to randomize and 3) the risk of improper interpretation. In other words, compared to experimental research, other things being equal, ex post facto research lacks control; this lack is the basis of the third weakness: the risk of improper interpretation.

Because of these weaknesses, it may be more appropriate to use a different methodology. A research design that is not ex post facto is the laboratory experiment. This methodology is the one selected in this study. A laboratory experiment is defined by Kerlinger [1969, p. 398] as follows:

a research study in which the variance of all or nearly all of the possible influential independent variables not pertinent to the immediate problem is kept at a minimum. This is done by isolating the research in a physical situation apart from the routine of ordinary living, and by manipulating one or more independent variables under rigorously specified, operationalized, and controlled conditions.

The main conceptual advantage of a laboratory experiment is its high degree of internal validity. The experimenter is able to have a large degree of control over his variables without being concerned about extraneous influences. Randomization of the sample is a simple task in a laboratory experiment. Other advantages of this form of research are the capability of precisely defining all variables and the accuracy of measurement instruments. Accuracy is an
important feature of the laboratory experiment.

Although the laboratory experiment has a high degree of internal validity, it is sometimes lacking in external validity. Since the setting is artificial, the results may not be completely generalizable to the real world.

Operationally, the laboratory experiment is easily adaptable to the income smoothing area. Due to the difficulties in stating variables as well as target income (see Chapter II) these could be treated as givens and precisely defined in a laboratory setting. Their relationship can be defined. The laboratory experiment is designed to discover existing relationships under uncontaminated circumstances. This methodology has not yet been applied to the income smoothing area. If smoothing behavior can be demonstrated under these conditions, further research should be attempted to overcome the external validity problem. However, first it is necessary to understand some of the underlying behavioral characteristics of income smoothing. Since income smoothing research requires controllability as well as variable specification, the laboratory experiment has been selected as the appropriate methodology to use in this study.

The Experiment

The subjects of the experiment consisted of 74 financial executives from thirty-one large corporations
located in the state of Ohio. Each subject was individually administered the experiment in his own place of business.

The experimental task consisted of choosing among various earnings per share streams. Each subject does this twelve times to differentiate between artificial and real smoothing variables, closely held and widely held companies, and the degree of trade-off between total earnings per share and the variability of earnings per share from year to year.

Results of the experiment were all significant. These results may be summarized as: (1) the higher the trade-off between total earnings per share and variability of the earnings per share stream, the less the subjects smooth earnings, (2) there is more smoothing using artificial variables than there is using real variables, and (3) there is more smoothing in widely held companies than there is in closely held companies.

**Expected Contribution**

The use of an experimental methodology on a traditional accounting topic can be beneficial. This study could reconcile some of the conflicting results obtained in previous studies. Also, this should encourage further applications of a similar methodology to traditional accounting issues when it is appropriate.

Another expected contribution of this study is the re-examination of the degree of management control and its
effect upon income smoothing as examined by Kanin et al. [1976], Smith [1974], and Smith [1976]. This could furnish additional information on the topic. Also, it could aid the auditor in determining which setting to concentrate on if the auditor desires to determine to what extent, if any, the firm being audited is smoothing.

Within this study there is an examination of real versus artificial income smoothing. This is a topic that has not been investigated. If artificial smoothing occurs, which the experiment does indicate, a policy making board may desire to reduce the flexibility of the existing accounting rules to diminish the amount of income smoothing. This board may also want to increase the flexibility of the accounting rules in order to encourage income smoothing because income smoothing may have advantageous ramifications for the general public. If real smoothing occurs, it may be necessary to design and implement auditing procedures that will detect this form of income smoothing.

This study contains an initial attempt to develop an economic smoothing model. Several benefits may be derived from the development of this type of model. First, the model itself can provide a basis for expanding and refining a model of the income smoothing process. This model could aid in the understanding of the relationship of the factors that influence income smoothing. Finally, a smoothing model could be used as a predictive device in order to forecast
Organization of the Study

The next chapter reviews the literature on income smoothing. Chapter III contains an economic analytic analysis of the income smoothing process. The methodology for testing the three major hypotheses are presented in Chapter IV. The results of the study are given in Chapter V. Chapter VI summarizes the work and discusses the implications of the findings.
CHAPTER II
LITERATURE REVIEW

Income Smoothing in the Accounting Literature

Hepworth [1953] is the first to suggest income smoothing as an accounting issue. He listed some of the advantages of smoothing as tax benefits, improvement of relations with creditors, investors, and workers; and the dampening of business cycles through psychological processes. Tax advantages of smoothing can be derived in a progressive tax structure. By maintaining smooth earnings, it may be possible to keep down the percentage of income that is taxable. The improvement of relations with investors is brought about by increasing the predictability of the income stream and is discussed throughout this dissertation. A smooth income stream may improve relations with creditors because it is easier to predict the ability of a firm to repay its obligations if income is presented in a smooth fashion. By examining the income trend, it can be determined whether sufficient income will be available in the future to repay the loan. Income smoothing may improve relations with labor because a smooth income stream helps labor leaders to determine their salary demands according to what the company is able to pay.

12.
This task is simpler with less variability in the income stream. Income smoothing may have countercyclical effects because in bad years, income is reported to be generally higher, thus maintaining confidence in the business and the economy in general.

In addition to Hepworth's arguments, there have been several recent proposals of why management would smooth income. Biedleman [1973, p. 654] states:

To the degree that auto-normalization of earnings is successful and that the reduced covariance of returns with the market is recognized by investors and incorporated into their valuation processes, smoothing will have beneficial effects on share values.

Income smoothing could cause the price of a security to rise by reducing the systematic risk of that particular security.

Another reason to smooth income is given by Biedleman [1973] and Barnea, et al. [1976]. They suggest that smoothing income aids users of the financial statements in predicting future cash flows of a company. Managers convey their future cash flow expectations through smoothed income numbers.

Income smoothing is theoretically proposed as a researchable accounting problem because of the multitude of alternative accounting principles made available to the management of a firm. Gordon [1964, pp. 261-262] stated his propositions and theorem as follows:
Proposition 1. The criterion a corporate management uses in selecting among accounting principles is the maximization of its utility or welfare. Whether or not a management should be so motivated is a value judgment that need not concern us here. That managements are in fact so motivated is taken as axiomatic.

Proposition 2. The utility of a management increases with (1) its job security, with (2) the level and rate of growth in the management's income, and with (3) the level and rate of growth in the corporation's size...

Proposition 3. The achievement of the management goals stated in Proposition 2 is dependent in part on the satisfaction of stockholders with the corporation's performance. That is, other things the same, the happier the stockholders the greater the job security, income, etc. of the management. Further, these variables increase by diminishing marginal amounts with stockholder satisfaction...

Proposition 4. Stockholder satisfaction with a corporation increases with the average rate of growth in the corporation's income (or the average rate of return on its capital) and the stability of its income...

Theorem. Given that the preceding four propositions are accepted or found to be true, it follows that a management should within the limits of its power, i.e., the latitude allowed by accounting rules, (1) smooth reported income, and (2) smooth the rate of growth in income.

The above propositions agree with those proposed by Baumol, Williamson, and Monsen and Downs. These four propositions state that management will do whatever it can to make stockholders satisfied. If this is accomplished, their own utility will be maximized. As stated in the theorem, this
can be carried out by smoothing income. However, there exists an inconsistency in Gordon's theorem. No support has been given to Gordon's propositions to reach the second conclusion in the theorem. This states that management will smooth the rate of growth in income. If the rate of growth implies the growth rate over the life of a company, it makes no sense to smooth it. It is illogical to smooth a single observation. If the rate of growth implies growth from year to year, nothing is mentioned in the four propositions to substantiate that yearly growth should be smoothed. Consequently, part (2) of the theorem does not follow from the propositions. This does not interfere with the smoothing conclusion that Gordon obtained in part (1) of the theorem.

Some of the accounting research in the income smoothing area is summarized in Table 1.

In addition to the studies listed in Table 1, Ball and Watts [1972] briefly discussed income smoothing in relation to their study of the time-series properties of income. If income follows a submartingale process (a process for which one observation becomes the basis for the expectation of the next observation), they concluded income smoothing makes little sense. However under all time-series processes, Gonedes [1972] has subsequently demonstrated that, income smoothing is logical.¹

¹These processes include the submartingale, martingale, and mean-reverting processes.
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<th>Target Income</th>
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<td>$I_t = I_{t-1}$</td>
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<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td>Biedleman (1973)</td>
<td>Pension retirement expenses, Incentive compensation, Research and development expense, Remitted earnings from unconsolidated subsidiaries, Sales and advertising expense, Plant retirement</td>
<td>1. Linear trend line of income against time. 2. Logarithmic trend line of income against time.</td>
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<td></td>
<td>Gordon, Horwitz, and Meyers (1966)</td>
<td>Investment tax credit</td>
<td>1. $Y_t = R_t - \hat{R_t}$ 2. $Z = \frac{Y_t - \hat{Y}_t}{\hat{Y}_t}$ 3. $C_t = Y - \hat{Y}_t$</td>
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<th>Study and Publication Date</th>
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<th>Target Income</th>
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<td>White (1970)</td>
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<td>Discretionary accounting changes</td>
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<tr>
<td>Cushing (1969)</td>
<td></td>
<td>Any change in accounting policy</td>
<td>$G_t = Y_{t-1} + 0.4(Y_{t-1} - Y_{t-2}) + 0.3(Y_{t-2} - Y_{t-3}) + 0.1(Y_{t-3} - Y_{t-4}) + 0.2(Y_{t-4} - Y_{t-5})$</td>
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| Smith (1976)                     |                           | Extraordinary gains and losses Accounting changes requiring footnote disclosure but not opinion qualification (Type B) | 1. $I_t = I_{t-1}$  
2. $I_t = I_{t-1} + (I_{t-1} - I_{t-2})$  
3. $I_t = I_{t-1} + 0.5(I_{t-1} - I_{t-2}) + 0.3(I_{t-2} - I_{t-3})$  
4. $I_t = I_{t-1} (1 + Q_{t-1})$  
5. $I_t = I_{t-1} (1 + 0.5Q_{t-1} + 0.3Q_{t-2} + Q_{t-3})$ |
| Dopuch and Drake (1966)          | Accounting for non-subsidary investments (cost or equity method) | N/A |
| Gagnon (1967)                    | Purchase versus Pooling   | Same as Gordon study  
2. $I_t = I_{t-1}$ |
<table>
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<tr>
<th>Results on existence of smoothing</th>
<th>Study and Publication Date</th>
<th>Smoothing Variables</th>
<th>Target Income</th>
</tr>
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<tr>
<td>NEGATIVE</td>
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<td>Dividends from unconsolidated subsidiaries</td>
<td>$I_t = I_{t-1}$</td>
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\[ \text{N/A} = \text{Not applicable} \]
\[ \text{R} = \text{Rate of growth in earnings per share} \]
\[ Y_t = \text{Actual income per share in period } t \]
\[ \overline{Y}_t = \text{Smoothed income per share in period } t \]
\[ R_t = \text{Simple Average income of the industry} \]
\[ \overline{R}_t = \text{The rate of growth in industry earnings per share} \]
Management Control and Income Smoothing

Income smoothing and management control have recently been investigated by Smith [1976], Kamin, et al. [1976], and Amihud, et al. [1977]. Within his study, Smith [1976] used various smoothing models. By using a zero growth model, he found significantly more smoothing for manager controlled firms than for owner controlled firms.

The Kamin, et al. [1976] study used two different smoothing objects which were net operating income per share before fixed charges and extraordinary items, and net income before extraordinary items. Also, two smoothing variables were identified as operating expenses not in cost of goods sold, and ordinary expenses including non-manufacturing depreciation and fixed charges. Normal or target income was determined by using a time trend of reported income and a market trend. The degree of barrier to entry was also examined.

The results of the Kamin, et al. [1976] study varied according to the smoothing object, the smoothing variable, the income trend and the barrier to entry. In most cases, when the barrier to entry was high, there was significantly more smoothing for a manager controlled firm than for an owner controlled firm. The opposite results were obtained for low barrier to entry firms. The overall results of this study are mixed.
The Amihud, et al. [1977] study found support for smoothing in both managerially controlled and owner controlled firms. Also, Sharpe's [1964] Single Index Market Model was used to determine if owner controlled firms have higher risk than management controlled firms. Significant results were found in the direction indicated above.

Methodological Problems with Research in Income Smoothing

Most research in the area of income smoothing has utilized a method of determining whether reported income is above or below some target income. This is accomplished by comparing reported income with a target income generated by some model. Various target income models are presented in Table 1. Once the target income is determined, the selection of various accounting alternatives are assumed to bring reported income closer to target income. This is accomplished through examination of published information about a firm. There are several problem areas that must be resolved to accomplish this task. These are as follows: (1) defining target income, (2) selecting appropriate smoothing variables, (3) obtaining the needed information about the use of these variables as this data is often not disclosed in financial statements, and (4) selecting the appropriate sample firms.

Target income is simply the level of income that management desires to report. This can be thought of in two ways.
Conceptually, target income should be the attainable level of income reported to the stockholders that maximizes the utility of management. This number would be difficult if not impossible to obtain because each stockholder has his own level of aspiration with respect to performance. Also, since stockholders have varying degrees of control over a firm depending on the amount of voting stock owned, it is difficult to arrive at income numbers that will satisfy all stockholders. Another possible definition of target income is what managers perceive to be stockholders' desired income. This information could be obtained through questionnaires or interviews. The problem with this technique is aggregating these perceptions of the managers. The existing studies do not use either of these two definitions.

Due to operational difficulty, the above conceptual definitions have not been used. A surrogate must be used in their place. A common surrogate is last year's reported income. As noted in Table 1, this income model is used by Archibald, Copeland and Licastro, Copeland, and Gagnon. The advantage of using this model is its simplicity. However, growth (both positive and negative) probably expected by the stockholders is not included. Other possible surrogates are earnings plus an average growth rate based on prior years' earnings, or earnings plus an industry growth rate relative to the economy. The problem associated with these models is that they could lead to a negative target income if the firm's
income or the industry income in the previous years were negative. Stockholders are unlikely to be satisfied with negative growth. The advantage of these models are their provision for a growth rate. Although Smith [1974] finds some empirical support for the zero growth model and the industry growth model, no studies exist that indicate whether these or any other models are correct. The results of the empirical studies with respect to their conclusions about the existence of income smoothing, are sensitive to the selection of a target income model.

Analagous to target income, there are many opinions about the characteristics of a smoothing variable. A smoothing variable is defined as that which is utilized by management for the purpose of smoothing income. Copeland [1968] suggests the following five attributes of a smoothing variable: (1) if used, no future commitment of use is made, (2) falls within generally accepted accounting principles, (3) leads to material shifts from year to year, (4) does not require a transaction with an external party, and (5) should be used over a period of time. The third criterion should be eliminated because many variables may be used to smooth income. Therefore, any one variable becomes immaterial, while all of them considered together are material. The lack of materiality of any one individual variable is not sufficient cause for its elimination because when combined with another variable, it could be material. The fourth criterion is what has been
previously referred to as artificial smoothing. Although this is not a result of using the flexibility inherent in accounting principles, the results of artificial smoothing accomplishes the same goal as real smoothing.

In the published studies in this area (see Table 1), none of the variables used meet all of the criteria suggested by Copeland. Variables do not exist which meet such rigid criteria. Cushing [1969, p. 197] states:

Neither the present study nor any previous study worked with a decision variable which meets all of Copeland's criteria.

Most or all of the smoothing variables used by a firm in order to detect smoothing should be determined since it is unlikely that all variables are used for smoothing at any given time. If a particular variable is chosen for examination, and it was not used for smoothing at that time, evidence would be found against the smoothing hypothesis. It is conjectured that many variables are available to management for smoothing income. Each one probably has varying degrees of dollar effect in reaching target income. Also, there may be differences in the ease in which the variables are used. One may presume a different aggregation of variables are used each year for the purpose of income smoothing.

Another problem in most income smoothing experiments is obtaining the necessary data to perform the experiment. The same attributes that make a smoothing variable effective sometimes make it difficult to detect. If the effect
of a smoothing manipulation is disclosed, there is little or no advantage of using it. Presumably, users of income smoothing could calculate un-smoothed income by reversing the effect of the smoothing variable. Therefore, the best smoothing variables are the ones that are not disclosed and are difficult to obtain data about.\(^2\)

There are two inherent problems in firm selection. First, as Smith [1976] suggests, smoothing is exhibited primarily by firms that have minimal control over management. If the owner has control of the firm, there is no opportunity or motivation for management to smooth income. Alternatively, the manager-owner may smooth anyway. He could be motivated to smooth income for creditors or potential investors, if the need for outside funding exists. Most studies randomly select the sample firms without regard to the degree of control.\(^3\) However, some studies follow Gordon's procedure of using the chemical industry to select the sample population. Within this and other industries, each firm will likely possess a different degree of owner control. Selecting firms by industry does little to eliminate the management control bias. The degree of owner control will be one of the independent variables to the proposed experiment. This may demonstrate the existence of an inverse

\(^2\)For example, a change in the expected write-off period of a fixed or intangible asset.

\(^3\)Usually the CRSP tape is used for data selection. The sample selected is usually chosen with respect to either time period or by salient variables.
relationship between income smoothing and owner control, as posited by Smith.

As was previously discussed, the second problem is that firms who smooth income probably do not disclose the variables needed to find smoothing experimentally. Consequently, the firms that disclose the needed information are maintained in a specific sample and those firms that do not disclose the needed information are eliminated from the sample. If so, experimental results are biased against the smoothing hypothesis because firms that are willing to disclose the salient changes probably do not use these changes for smoothing purposes. It makes little sense to smooth income if a firm discloses that they do indeed smooth and then reveals the amount of the resultant smoothing. Unless functional fixation exists (the practice of looking at an aggregated figure, such as net income without checking how it was derived), stockholders would simply reconvert income to unsmoothed income in this case.

Although there are variations in research methodology, any published study is subject to at least one of the above criticisms. The results of these studies are inconclusive and sometimes conflicting as may be discerned from examination of the studies listed in Table 1.
Existing Techniques: The Ex Post Facto Research Design

Most smoothing studies use one of two general methods in order to demonstrate whether or not smoothing exists. These two methods are called the chi-squared method and the regression method.

The chi-squared method is the one most commonly used. In order to use this method, the normal or target income, reported income, and a single smoothing variable must be known. The basic design for this method is illustrated in Figure 1.

For a particular firm, smoothing is registered in cell B or cell C (see Figure 1). If preliminary reported income is below target income, the smoothing variable should increase reported income to bring it closer to target income. Also, if reported income is above target income, the smoothing variable should decrease reported income to bring it closer to target income.

For a statistical demonstration of smoothing, a significant result must be obtained using the chi-squared test. Also, the direction of the data within the contingency table should be examined by multiplying cells A and D and cells B and C (see Figure 1). If smoothing occurs, a necessary but not sufficient condition is \((B + C) > (A + D)\).

Besides the target income and variable selection problems (discussed in the previous section), there is a problem with the magnitude of a smoothing variable. This design
27. Effect of Smoothing variable

<table>
<thead>
<tr>
<th>Effect of Smoothing variable</th>
<th>Above Target Income</th>
<th>Below Target Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoothing variable increases income</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Smoothing variable decreases income</td>
<td>C</td>
<td>D</td>
</tr>
</tbody>
</table>

Figure 1. Basic Design for the Chi-squared Method of Analyzing Income Smoothing
classifies only differences in direction and not differences in magnitude. A variable that has a very slight smoothing effect on income for one firm may have a strong smoothing effect in the same direction for another firm. When this occurs, both cases get placed into the same cell of the chi-squared contingency table and are weighted equally.

When this method is used, there is also a risk that the smoothing may be misclassified. Cushing [1969, p. 198] provides an example of this as follows:

<table>
<thead>
<tr>
<th>&quot;Earnings per share&quot;</th>
<th>Firm X</th>
<th>Firm Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>$2.00</td>
<td>$2.00</td>
</tr>
<tr>
<td>Under first alternative</td>
<td>3.00</td>
<td>2.05</td>
</tr>
<tr>
<td>Under second alternative</td>
<td>1.95</td>
<td>1.00</td>
</tr>
</tbody>
</table>

In this example you are forced to choose one of the two alternatives. If both firms choose the first alternative, they would be placed in cell A (see Figure 1) since they both select the smoothing variable that raises earnings per share above the normal or target earnings per share. If both firms choose the second alternative, they would be placed in cell D. In this case, both firms selected the alternative that lowers earnings per share below the target earnings per share. Since both alternatives either raise or lower reported earnings per share either above or below targeted earnings per share, respectively, there is no way to classify these actions in cells B or C in this example. However, alternative two could be considered a smoothing
action over alternative one for firm X and alternative one could be considered a smoothing action over alternative two for firm Y. In both cases, the specified alternative brings reported earnings per share close to target earnings per share and thus could be considered to be a smoothing action.

Another analytical technique used in income smoothing research is regression. Usually, regression is used in order to obtain an estimate of normal or target income. Also, the error term is examined from year to year to see if income is above or below the target. There are numerous other ways of employing regression techniques in income smoothing research. Some studies using the regression method are Amihud, et al. [1977], Barnea, et al. [1976], Biedleman [1973], Dascher and Malcom [1970], Kamin, et al. [1976], and Ronen and Sadan [1975].

These studies are subject to some of the same criticisms as the chi-squared studies. With this method, it is still necessary to make a value judgment in order to select both target income and the appropriate smoothing variables.
CHAPTER III
AN ECONOMIC MODEL OF SMOOTHING

The Model

Economic arguments demonstrating that corporations may smooth income [Gordon, 1964] were given over a decade ago. Since then, no formal economic model of smoothing has been proposed. An economic model of smoothing could have several uses. First, it could serve as a predictive device to help forecast future years earnings. Also, the relationships among the variables could be analyzed, using sensitivity analysis, to determine the effects of these variables on smoothed income. Finally, after the model is empirically verified, it could classify a firm as a smoothing firm and measure the degree of smoothing taking place.

The proposed model is an initial attempt at creating a useful economic presentation of income smoothing. This model is given as follows:

\[ U_m = f(I_t) \]
\[ I_t = g(E, X, R, P) \]
\[ E = h(I_{t-1}, I_{t-2}, \ldots, I_{t-n}, \beta) \]
\[ (\alpha_1 + \alpha_2) = i(X, R, P) \]
\[ X = \left( \frac{I_{t-1}}{\Delta GNP_{t-1}} \right) \]

30.
where:

\[ U_m = \text{Manager's utility} \]

\[ I_t = \text{Reported income in period } t \]

\[ E = \text{Managers' perception of stockholders' expectations} \]

\[ X = \text{Specific economy wide effects on reported income in period } t. \]

\[ R = \text{Managers' attitude toward risk} \]

\[ P = \text{Smoothing potential} \]

\[ \beta = \text{A random variable reflecting stockholders' attitudes toward extraordinary events where } E(\beta) = 0. \]

\[ \alpha_1 = \text{Average smoothing over } n \text{ years} \]

\[ \alpha_2 = \text{This year's adjustment to smoothing} \]

\[ \text{GNP}_{t-1} = \text{Last year's Gross National Product} \]

\[ \Delta \text{GNP}_{t-1} = \text{GNP}_{t-1} - \text{GNP}_{t-2} \]

\[ \lambda_i = \text{Weight attached to } I_t \text{ where } \sum \lambda_i = \text{growth rate.} \]

**CASE 1**

For the first case assume \( \lambda_2, \lambda_3, \ldots, \lambda_n = 0. \)

Then,

\[ I_t = (\alpha_1 + \alpha_2) \lambda_1 I_{t-1} + X \quad (1) \]

with:

\[ I_{t-1} = \alpha_1 \lambda_1 I_{t-2} + \beta. \quad (2) \]

\[ \beta = I_{t-1} - \alpha_1 \lambda_1 I_{t-2} \quad (3) \]

Setting \( K = t-2: \)

\[ \beta = I_{k+1} - \alpha_1 \lambda_1 I_k \quad (4) \]
Setting $\beta = 0$:

\begin{align*}
0 &= I_{k+1} - \alpha_1\lambda_1 I_k \\
0 &= m - \alpha_1\lambda_1(m)^0 \\
m &= \alpha_1\lambda_1
\end{align*}

Since generally $\beta \neq 0$, the answer is in the form:

\[ I_k = c_1(\alpha_1\lambda_1)^k + I_k^* \]  

(8)

Returning to equation (3) and solving for a particular solution we get the answer in the form of $I_k^* = A$:

\begin{align*}
\beta &= A - \alpha_1\lambda_1 A \\
A &= \beta/(1-\alpha_1\lambda_1)
\end{align*}

(9) (10)

Substituting in for $I_k^*$:

\[ I_k = c_1(\alpha_1\lambda_1)^k + \beta/(1-\alpha_1\lambda_1) \]  

(11)

Now to determine $c_1$, putting $I_k = I_0$:

\[ I_0 = c_1 + \beta/(1-\alpha_1\lambda_1) \]  

(12)

Solving for $c_1$:

\[ c_1 = I_0 - \beta/(1-\alpha_1\lambda_1) \]  

(13)

Substituting (13) into (8):

\[ I_k = [I_0 - \beta/(1-\alpha_1\lambda_1)][\alpha_1\lambda_1]^k + \beta/(1-\alpha_1\lambda_1) \]  

(14)

Substituting into equation (2) for $k = t-2$:

\[ I_{t-1} = [I_0 - \beta/(1-\alpha_1\lambda_1)][\alpha_1\lambda_1]^{t-1} + \beta/(1-\alpha_1\lambda_1) \]  

(15)

Substituting equation (15) into equation (1):

\[ I_t = (\alpha_1 + \alpha_2)\lambda_1 [I_0 - \beta/(1-\alpha_1\lambda_1)][\alpha_1\lambda_1]^{t-1} + (\alpha_1 + \alpha_2)\lambda_1 [\beta/(1-\alpha_1\lambda_1)] + X \]  

(16)

With the following restrictions:

(1) $\alpha_1\lambda_1 \neq 1$

(2) $I_0 \geq 0$
(3) \( \lambda_1 \geq 1 \)

To demonstrate Case I, the parameters in equation (16) can be set as follows:

**Example 1A and 1B**

\( I_0 = \$200,000. \)

\( \alpha_1 = 1 \)

\( \alpha_2 = \pm (0.1) \) The sign fluctuates in the opposite direction to \( \Delta \text{GNP}_{t-1} \) to counteract its effect.

\( \beta = 0 \)

\( \lambda_1 = \text{rate of growth} = 1.08. \)

\( \text{GNP}_{t-1} = 1.0 \times 10^{12} \) or \( 9.2 \times 10^{11} \) alternately

\( \Delta \text{GNP}_{t-1} = \pm 0.8 \times 10^{11} \) with the sign changing every year beginning with \( -0.8 \times 10^{11}. \)

The results of this example are presented in Table 2 and pictured in Figure 2.

The stream of income numbers from example 1A demonstrate a 10% smoothing effect (\( \alpha_1 = \pm 0.1 \)).

In example 1B there is no smoothing effect. This is accomplished by setting \( \alpha_2 = 0 \) and holding all other parameters to be the same as in example 1A.
Figure 2. Diagram of Example 1A and 1B

<table>
<thead>
<tr>
<th></th>
<th>1A - smoothing</th>
<th>1B - no smoothing</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_0$</td>
<td>$200,000$</td>
<td>$200,000$</td>
</tr>
<tr>
<td>$I_1$</td>
<td>$210,400$</td>
<td>$232,000$</td>
</tr>
<tr>
<td>$I_2$</td>
<td>$238,308$</td>
<td>$213,106$</td>
</tr>
<tr>
<td>$I_3$</td>
<td>$245,813$</td>
<td>$268,990$</td>
</tr>
<tr>
<td>$I_4$</td>
<td>$277,933$</td>
<td>$248,708$</td>
</tr>
<tr>
<td>$R_2$</td>
<td>$0.962$</td>
<td>$0.597$</td>
</tr>
<tr>
<td>SSE</td>
<td>$1.41 \times 10^8$</td>
<td>$12.2 \times 10^8$</td>
</tr>
</tbody>
</table>
To determine how effective the smoothing model is in reducing fluctuation, a regression was run on income over time for both examples. Two measures of smoothing may be used in analyzing smoothing effectiveness. First, the multiple coefficient of determination ($R^2$) gives a measure of how well a linear model (which smoothing implicitly is) fits the determined income numbers. Also, the sum-of-square of error (SSE) gives a measure of the variability around the fitted regression line. A smoothed income stream should have less variability than a non-smoothed income stream.

The results of the two regressions are listed in Table 1. As expected, the $R^2$ is higher for the smoothed example. Also, the SSE is considerably lower for the smoothed example than the non-smoothed example.

**CASE II**

For the second case assume $\lambda_2 \neq 0$ and $\lambda_3, \lambda_4, \ldots , \lambda_n = 0$. Then,

$$I_t = (a_1 + a_2)(\lambda_1 I_{t-1} + \lambda_2 I_{t-2}) + X$$

(1)

with

$$I_{t-1} = a_1 \lambda_1 I_{t-2} + a_1 \lambda_2 I_{t-3} + \beta$$

(2)

Solving for $\beta$

$$\beta = I_{t-1} - a_1 \lambda_1 I_{t-2} - a_1 \lambda_2 I_{t-3}$$

(3)

Setting $k = t-3$

$$\beta = I_{k+2} - a_1 \lambda_1 I_{k+1} - a_1 \lambda_2 I_k$$

(4)

Setting $\beta = 0$ to get homogeneous equations:

$$0 = I_{k+2} - a_1 \lambda_1 I_{k+1} - a_1 \lambda_2 I_k$$

(5)
Using $ax^2 + bx + c$:
\[ x = \frac{-b \pm (b^2 - 4ac)^{1/2}}{2a} \]

\[ m = a_1 \lambda_1 \pm (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}/2 \]

Note, $m$ is a real number.

Putting this in the form of $I_k = c_1(m_1)^k + c_2(m_2)^k$:
\[ I_k = c_1 \left[ a_1 \lambda_1/2 + (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}/2 \right]^k \]
\[ + c_2 \left[ (a_1 \lambda_1/2 - (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}/2 \right]^k \]

(9)

Since generally $B \neq 0$, the answer is in the form:
\[ I_k = c_1 \left[ a_1 \lambda_1/2 + (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}/2 \right]^k \]
\[ + c_2 \left[ (a_1 \lambda_1/2 - (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}/2 \right]^k + I_k^* \]

(10)

where $I_k^* = A$

Returning to equation (3) and solving for a particular solution, the answer is in the form of $I_k^* = A$:
\[ \beta = A - a_1 \lambda_1 A - a_1 \lambda_2 A = A(1-a_1 \lambda_1 - a_2 \lambda_2) \]

(11)

\[ A = \beta/(1-a_1 \lambda_1 - a_1 \lambda_2) \]

(12)

Substituting in for $I_k^*$:
\[ I_k = c_1 \left[ a_1 \lambda_1/2 + (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}/2 \right]^k \]
\[ + c_2 \left[ (a_1 \lambda_1/2 - (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}/2 \right]^k \]
\[ + \beta/(1-a_1 \lambda_1 - a_1 \lambda_2) \]

(13)

Now $c_1$ and $c_2$ are determined by putting $I_k = I_0$ and $I_k = I_1$ and solving simultaneously:
\[ I_0 = c_1 + c_2 + \beta/(1-a_1 \lambda_1 - a_1 \lambda_2) \]

(14)

\[ I_1 = c_1 \left[ a_1 \lambda_1/2 + (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}/2 \right]^k \]
\[ + c_2 \left[ (a_1 \lambda_1/2 - (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}/2 \right]^k \]
\[ + \beta/(1-a_1 \lambda_1 - a_1 \lambda_2) \]

(15)
Rearranging equation (14) gives (16) and (17):
\[
c_1 = I_0 - c_2 - \beta/(1-a_1\lambda_1 - a_1\lambda_2) \tag{16}
\]
\[
c_2 = I_0 - c_1 - \beta/(1 - a_1\lambda_1 - a_1\lambda_2) \tag{17}
\]
Substituting (16) into (15):
\[
I_1 = [I_0 - c_2 - \beta/(1-a_1\lambda_1 - a_1\lambda_2)](a_1\lambda_1/2 + (a_1^2\lambda_1^2 + 4a_1\lambda_2)^{3/2}/2) + c_2[a_1\lambda_1/2 - (a_1^2\lambda_1^2 + 4a_1\lambda_2)^{3/2}/2] + \beta/(1-a_1\lambda_1 - a_1\lambda_2) \tag{18}
\]
\[
I_1 = c_2[(a_1\lambda_1/2) - (a_1^2\lambda_1^2 + 4a_1\lambda_2)^{3/2}/2]
- c_2[a_1\lambda_1/2 + (a_1^2\lambda_1^2 + 4a_1\lambda_2)^{3/2}/2]
+ (I_0 - \beta/(1-a_1\lambda_1 - a_1\lambda_2)][a_1\lambda_1/2
+ (a_1^2\lambda_1^2 + 4a_1\lambda_2)^{3/2}/2] + \beta/(1-a_1\lambda_1 - a_1\lambda_2) \tag{19}
\]
\[
I_1 = -c_2(a_1^2\lambda_1^2 + 4a_1\lambda_2)^{1/2} + (I_0 - \beta/(1-a_1\lambda_1 - a_1\lambda_2)][a_1\lambda_1/2 + (a_1^2\lambda_1^2 + 4a_1\lambda_2)^{3/2}/2]
+ \beta/(1-a_1\lambda_1 - a_1\lambda_2) \tag{20}
\]
Solving for \( c_2 \)
\[
c_2 = (a_1^2\lambda_1^2 + 4a_1\lambda_2)^{-3/2}[(I_0 - \beta/(1-a_1\lambda_1 - a_1\lambda_2))(a_1\lambda_1/2)
+ (a_1^2\lambda_1^2 + 4a_1\lambda_2)^{3/2}/2]
+ \beta(1-a_1\lambda_1 - a_1\lambda_2)(a_1^2\lambda_1^2 + 4a_1\lambda_2)^{-1/2}
- I_1/(a_1^2\lambda_1 + 4a_1\lambda_2)^{1/2} \tag{21}
\]
\[
c_1 = I_0 - (a_1^2\lambda_1^2 + 4a_1\lambda_2)^{-3/2}(I_0 - \beta/(1-a_1\lambda_1 - a_1\lambda_2))(a_1\lambda_1/2)
+ (a_1^2\lambda_1^2 + 4a_1\lambda_2)^{3/2}/2) - \beta(1-a_1\lambda_1 - a_1\lambda_2)(a_1^2\lambda_1^2 + 4a_1\lambda_2)^{-1/2}
+ I_1/(a_1^2\lambda_1 + 4a_1\lambda_2)^{1/2} - \beta/(1-a_1\lambda_1 - a_1\lambda_2) \tag{22}
\]
Simplifying equations (21) and (22):
\[
c_1 = [(a_1^2\lambda_1^2 + 4a_1\lambda_2)^{3/2}-a_1\lambda_1)]I_0/[(2(a_1^2\lambda_1^2 + 4a_1\lambda_2)^{3/2})]
+ \beta[a_1\lambda_1 + (a_1^2\lambda_1^2 + 4a_1\lambda_2)^{3/2}/2])/(1-a_1\lambda_1 - a_1\lambda_2)(a_1^2\lambda_1^2 + 4a_1\lambda_2)^{3/2}
+ 4a_1\lambda_2)^{3/2}] + I_1/(a_1^2\lambda_1^2 + 4a_1\lambda_2)^{1/2} \tag{23}
\]
\[ c_2 = I_0 \left[ a_1 \lambda_1 + (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}} \right] / [2(a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}] \]

\[ + \beta \left[ 2 - (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}} - a_1 \lambda_1 \right] / [2(1 - a_1 \lambda_1]

- a_1 \lambda_2 (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}} - I_1 / (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}} \]

Substituting (23) and (24) into (13):

\[ I_k = \left\{ \left[ (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}} - a_1 \lambda_1 \right] I_0 + \beta (a_1 \lambda_1 + (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}} - 2) \right\} / [2(1 - a_1 \lambda_1]

- a_1 \lambda_2 (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}] \]

\[ + I_1 / (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}] \left\{ (a_1 \lambda_1 / 2 + (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}) / 2 \right\}^k + \left\{ (I_0 (a_1 \lambda_1 + (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}} + (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}) / (2(a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}})

+ \beta (2 - (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}} - a_1 \lambda_1) / ((1 - a_1 \lambda_1)

- a_1 \lambda_2 (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}] \right\} \}

- I_1 / (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}] \left\{ a_1 \lambda_1 / 2 - (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}} / 2 \right\}^k + \beta / (1 - a_1 \lambda_1 - a_1 \lambda_2)

For 0 < k < t - 1

Substituting equation (25) into equation (2) for k = t - 2 and t - 3:

\[ I_{t-1} = a_1 \lambda_1 \left\{ \left[ (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}} - a_1 \lambda_1 \right] I_0 / [2(a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}

+ 2a_1 \lambda_2) \right\}^k + \beta (a_1 \lambda_1 + (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}

- 2) / [(1 - a_1 \lambda_1 - a_1 \lambda_2) (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}]

+ I_1 / (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}] \{ a_1 \lambda_1 / 2 + (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}} / 2 \}^t - 2

+ a_1 \lambda_1 \left\{ I_0 [a_1 \lambda_1 + (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}] / [2(a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}]

+ \beta (2 - (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}} - a_1 \lambda_1) / [(1 - a_1 \lambda_1)

- a_1 \lambda_2 (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}] - I_1 / (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}] \left\{ a_1 \lambda_1 / 2

- (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}} / 2 \right\}^t - 2 + a_1 \lambda_2 \left\{ I_0 (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}

- a_1 \lambda_1) / [2(a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{\frac{1}{2}}] + \beta a_1 \lambda_1
\[+(\alpha_1^2 \lambda_1^2 + 4\alpha_1 \lambda_2)\frac{1}{2} \cdot 2)/[(1-\alpha_1 \lambda_1 - \alpha_1 \lambda_2)(\alpha_1^2 \lambda_1^2 + 4\alpha_1 \lambda_2)\frac{1}{2}]\]
\[+I_1/(\alpha_1^2 \lambda_1^2 + 4\alpha_1 \lambda_2)\frac{1}{2}\{[1-\alpha_1 \lambda_1/2] + [(\alpha_1^2 \lambda_1^2 + 4\alpha_1 \lambda_2)\frac{1}{2}/2]\}t^{-3}\]
\[+\alpha_1 \lambda_2\{(I_0(\alpha_1 \lambda_1) + (\alpha_1^2 \lambda_1^2 + 4\alpha_1 \lambda_2)\frac{1}{2})\}/[2(\alpha_1^2 \lambda_1^2 + 4\alpha_1 \lambda_2)\frac{1}{2}]\]
\[+\beta [2 - (\alpha_1^2 \lambda_1^2 + 4\alpha_1 \lambda_2)\frac{1}{2} - \alpha_1 \lambda_1] /[(1-\alpha_1 \lambda_1 - \alpha_1 \lambda_2)] \cdot \beta\]

Substituting for \(I_{t-2}\):

\[I_{t-2} = \alpha_1 \lambda_1 \quad I_{t-3} + \alpha_1 \lambda_2 \quad I_{t-4} + \beta\]  
\[(27)\]
\[I_{t-2} = \alpha_1 \lambda_1 \{(\alpha_1^2 \lambda_1^2 + 4\alpha_1 \lambda_2)\frac{1}{2} - \alpha_1 \lambda_1\}I_0/[2(\alpha_1^2 \lambda_1^2 + 4\alpha_1 \lambda_2)\frac{1}{2}] + \beta (\alpha_1 \lambda_1 + (\alpha_1^2 \lambda_1^2 + 4\alpha_1 \lambda_2)\frac{1}{2})\]
\[+I_1/(\alpha_1^2 \lambda_1^2 + 4\alpha_1 \lambda_2)\frac{1}{2}\{[1-\alpha_1 \lambda_1/2] + [(\alpha_1^2 \lambda_1^2 + 4\alpha_1 \lambda_2)\frac{1}{2}/2]\}t^{-3}\]
\[+(\alpha_1^2 \lambda_1^2 + 4\alpha_1 \lambda_2)\frac{1}{2} - \alpha_1 \lambda_1] /[(1-\alpha_1 \lambda_1 - \alpha_1 \lambda_2)] \cdot \beta\]  
\[(28)\]
Substituting equations (26) and (28) into equation (1):

\[ I_t = (a_1 + a_2) \{ a_1 \lambda_1^2 \{ \lambda_0 \{(a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2} - a_1 \lambda_1 \} / [2(2a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}] \} + \beta [a_1 \lambda_1 + (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2} - 2]/[1 - a_1 \lambda_1 - a_1 \lambda_2] (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}] \]

\[ + \{ I_0 \{ (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2} \} \} \{ a_1 \lambda_1 / 2 \} + [(a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2} / 2 \} \} \} \} \] t^{-2}

\[ + a_1 \lambda_1^2 \{ I_0 \{ a_1 \lambda_1 + (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2} \} / [2(a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}] \} + \beta [2 - (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2} - a_1 \lambda_1] / [(1 - a_1 \lambda_1 - a_1 \lambda_2)(a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}] \]

\[ + \{ I_1 \{ (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2} \} \} \{ a_1 \lambda_1 / 2 \} - [(a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2} / 2 \} \} \} \} \] t^{-3}

\[ + 2a_1 \lambda_1 \lambda_2 \{ I_0 \{ (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2} - a_1 \lambda_1 \} / [2(a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}] \} + \beta [2 - (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2} - a_1 \lambda_1] / [(1 - a_1 \lambda_1 - a_1 \lambda_2)(a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}] \]

\[ + \{ I_0 \{ (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2} \} \} \{ a_1 \lambda_1 / 2 \} - [(a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2} / 2 \} \} \} \} \] t^{-3}

\[ + a_1 \lambda_2^2 \{ I_0 \{ (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2} - a_1 \lambda_1 \} / [2(a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}] \} + \beta [2 - (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2} - a_1 \lambda_1] / [(1 - a_1 \lambda_1 - a_1 \lambda_2)(a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2}] \]

\[ + \{ I_0 \{ (a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2} \} \} \{ a_1 \lambda_1 / 2 \} - [(a_1^2 \lambda_1^2 + 4a_1 \lambda_2)^{1/2} / 2 \} \} \} \} \] t^{-3}

With the following restrictions:

1. \( a_1 \lambda_1 \neq 1 \)
2. \( I_0, I_1 \geq 0 \)
3. \( \lambda_1 + \lambda_2 \geq 1 \)

To demonstrate Case II, two separate examples will be given. The first example (example 2A and 2B) looks at \( \lambda_1 = \lambda_2 \).
The second example of Case II examines $\lambda_1 > \lambda_2$.

**Example 2A and 2B**

$I_0 = \$200,000$.

$\alpha_1 = 1$

$\alpha_2 = \pm (0.1)$ The sign fluctuates in the opposite direction to $\Delta \text{GNP}_{t-1}$ to counteract its effect.

$\beta = 0$

$\lambda_1 = \lambda_2 = .55$. The rate of growth = $\lambda_1 + \lambda_2 = 1.1$.

$\text{GNP}_{t-1} = 1.0 \times 10^{12}$ or $9.2 \times 10^{11}$ alternately

$\Delta \text{GNP}_{t-1} = \pm 0.8 \times 10^{11}$ with the sign changing every year beginning with $-0.8 \times 10^{11}$.

The results of this example are presented in Table 3 and pictured in Figure 3. As in example 1B, $\alpha_2 = 0$ represents the no smoothing condition.
Figure 3. Diagram of Example 2A and 2B

<table>
<thead>
<tr>
<th>TABLE 3</th>
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<tbody>
<tr>
<td>Results of Example 2A and 2B</td>
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</table>

<table>
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<th>2A - smoothing</th>
<th>2B - no smoothing</th>
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</thead>
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<tr>
<td>i0</td>
<td>$200,000</td>
<td>$200,000</td>
</tr>
<tr>
<td>i1</td>
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<td>250,030</td>
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<td>i4</td>
<td>253,362</td>
<td>226,955</td>
</tr>
<tr>
<td>i5</td>
<td>259,531</td>
<td>283,624</td>
</tr>
<tr>
<td>i6</td>
<td>288,386</td>
<td>258,354</td>
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<tr>
<td>i7</td>
<td>294,875</td>
<td>322,242</td>
</tr>
<tr>
<td>R2</td>
<td>0.961</td>
<td>0.763</td>
</tr>
<tr>
<td>SSE</td>
<td>3.21 x 10^8</td>
<td>30.3 x 10^8</td>
</tr>
</tbody>
</table>
Two separate regressions were run on example 2A and 2B similar to example 1A and 1B. The results suggest that the smoothing model again is more linear and has less variance than does the non-smoothing model.

Example 3A and 3B is the same as example 2A and 2B except $\lambda_1 > \lambda_2$. In this example $\lambda_1 = 0.6$ and $\lambda_2 = 0.5$. The results are presented in Table 4 and Figure 4.

Figure 4. Diagram of Example 3A and 3B
Two separate regressions were run on example 3A and 3B similar to example 1A and 1B. The results are the same obtained in both example 1A and 1B, and example 2A and 2B.

**Relationship of the Model to the Experiment**

Before the proposed model can be used to investigate the issues tested in the experiment, the accuracy of the model should be determined. This may be accomplished by ascertaining how accurately the model predicts present income if the previous years income and other empirical data are inserted into the model. If the model predicts the present years income accurately, it could provide further evidence about the three issues tested in the experiment.

The first issue investigated is the amount of total earnings per share a subject is willing to trade-off in order to reduce the variability of the earnings per share stream from year to year. The results of the experiment
indicate that the higher the trade-off of total earnings per share for variability in the earnings per share stream, the less smoothing occurs. An examination of the cost of smoothing of different firms and a determination of $\alpha_2$ (this year's adjustment to smoothing) could provide evidence about this issue. If $\alpha_2$ is lower for a firm with a high cost of smoothing than it is for a firm with a low cost of smoothing, the trade-off hypothesis would be verified.

A second issue investigated in this study is the affect of artificial and real variables on smoothing behavior. The results of the experiment indicate that managers prefer to smooth more using artificial variables than real variables. If $\alpha_2$ represents this year's smoothing and the amount of artificial smoothing is known, $\alpha_2$ minus the artificial smoothing would represent the degree of real smoothing. The extent of artificial smoothing is easier to determine because of disclosure requirements and the high degree of complexity in making real business decisions. If this can be accomplished, a comparison of real and artificial smoothing for an individual firm can be made.

The final issue examined in the experiment is the degree of smoothing for widely held and closely held companies. The results of this experiment indicate that there is more smoothing for widely held companies than there is for closely held companies. In order to validate this result, the model could be used to obtain $\alpha_2$ for a random sample of
closely held and widely held firms. If \( a_2 \) is higher for the widely held firms, further evidence is provided about the conclusion of the experiment.

**Future Applications**

There are several research projects that can be performed in conjunction with this economic smoothing model. First, there could be empirical validation of the model. Variable \( X \) is readily available. Lambda \((\frac{\pi}{i})\) could be obtained for a firm by regressing reported income over time. If the model is proven to be valid, it can be used as a predictive model of future smoothed income. Also, sensitivity analysis can be performed on this model using a simulation technique. This is helpful in understanding the internal characteristics of the model. Beyond this, there is need to expand the model as well as explicitly incorporating other variables such as risk preferences.
CHAPTER IV
METHODOLOGY

Development of the Hypotheses

There are three hypotheses in this study. The first hypothesis relates to the motivation to smooth earnings per share. A measure of motivation in this experiment is defined as the amount of total earnings per share, for six years, that a subject is willing to trade-off in order to reduce the variance of that earnings per share stream. The reduction of the variability of the earnings per share stream is smoothing. The null hypothesis (H0) and the alternative hypothesis (H1) is given as follows:

H0: The degree of trade-off of earnings per share (no, medium and high) has no effect upon smoothing behavior.

H1: The degree of trade-off of earnings per share does have an effect upon smoothing behavior.

The second hypothesis involves the smoothing of the earnings per share stream using artificial variables (accounting decisions) and real variables (business decisions). No study has demonstrated whether management prefers to smooth with real or artificial variables. The null
and alternative forms of the second hypothesis is given as follows:

\[ H_0^2: \text{The degree of smoothing of earnings per share is the same for real and artificial variables.} \]

\[ H_a^2: \text{The degree of smoothing of earnings per share is not the same for real and artificial variables.} \]

Hypothesis three is related to management control and income smoothing. This topic was developed in Chapter II. Specifically, this hypothesis states how the degree of management control, represented by the number of owners, affects the amount of smoothing of earnings per share. The null and alternative form of the third hypothesis is given as follows:

\[ H_0^3: \text{The degree of smoothing of earnings per share is the same for closely held companies and widely held companies.} \]

\[ H_a^3: \text{The degree of smoothing of earnings per share is not the same for closely held companies and widely held companies.} \]

The Subjects

Businessmen probably learn smoothing behavior after they graduate from college. Scholastic experiences usually do not stress income smoothing, but rather income maximization. Also, since there are not pressures from stockholders on students, there is not any motivation to smooth. For these reasons, the subjects of this experiment consisted of
businessmen, rather than students.

Once the decision to use businessmen was made, appropriate subjects were selected. Since it was important to have subjects that were involved in the financial decision making process, financial executives were selected to participate in this study. The sample consisted of controllers, treasurers, financial vice-presidents and accounting managers, or their equivalent.

Seventy-four executives from thirty-one different companies participated in this experiment. Due to the lack of availability of top level financial executives, the sample was not random. All of the companies are located in the state of Ohio. Since all of the experimental instruments were personally administered in the subjects' place of business, this was necessary. The travel time and expense limited the study to the state of Ohio.

A list of the participating firms is given in Table 5. This table reveals that many large firms, which represent a diverse group of industries, are included in the sample. The sample is somewhat indicative of a national representation of commercial enterprises.

The number of subjects that a company could provide was limited to three persons. This was done to insure that no individual company had a disproportionate effect on the results of the experiment. The number of subjects provided by each corporation is listed in Table 5.
<table>
<thead>
<tr>
<th>Company</th>
<th>Number of Subjects Provided</th>
<th>Rank in Fortune's Top 1000 Industrials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Anchor Hocking</td>
<td>3</td>
<td>347</td>
</tr>
<tr>
<td>2. Armco Steel</td>
<td>2</td>
<td>59</td>
</tr>
<tr>
<td>3. Ashland Chemical - Division of Ashland Oil</td>
<td>3</td>
<td>45</td>
</tr>
<tr>
<td>4. B. F. Goodrich</td>
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</tr>
<tr>
<td>5. Banc Ohio</td>
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<td>6. Borden</td>
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<td>7. Buckeye International</td>
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<td>893</td>
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<td>8. City National Bank</td>
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<td>9. Columbus and Southern Ohio Electric Company</td>
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<td>31. Worthington Industries</td>
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</table>
The Experimental Instruments

The Independent Variables

The general design of the experiment is presented in Figure 5. An example of the actual experiment is in Appendix A. There are three independent variables in this experiment as follows: (1) the degree of trade-off, (2) the type of smoothing variable and (3) the form of ownership.

The three trade-off conditions are without trade-off (no trade-off), medium tradeoff, and high trade-off. The total earnings per share figures are obtained by adding the pre-decision earnings per share for each of the six years to one of the four choices. (See Appendix A). The no trade-off condition is represented by cells 1AX, 1BX, 1BY and 1AY (not pictured) in Figure 5. In the no trade-off condition, the variance of the earnings per share stream increases from choice to choice but the total earnings per share remains constant. (See Table 6). A subject does not have to give up anything in order to reduce the variance of the earnings per share stream.

Medium trade-off is represented by cells 2AX, 2BX, 2BY and 2AY (not pictured) in Figure 5. In this condition, there are small decreases in total earnings per share associated with decreases in the variance in the earnings per share streams. A subject must give up a small amount of total earnings per share in order to have a reduction of the
Figure 5. The Experimental Design
<table>
<thead>
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<th>Years</th>
<th>Total earnings per share</th>
<th>Variance</th>
<th>Slope</th>
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<th>Years</th>
<th>Total earnings per share</th>
<th>Variance</th>
<th>Slope</th>
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<td>$0.30 $0.40 $0.30 $0.40 $0.30 $0.40</td>
<td>$2.10</td>
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<td>0.0171</td>
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<td>Earnings per share stream</td>
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<td>0.90</td>
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variability of the earnings per share stream.

Cells 3AX, 3BX, 3AX and 3BY represent the high trade-off condition. In this condition, there are larger differences in earnings per share than there are in the medium trade-off condition. Also, there are larger differences in the variances of the earnings per share stream than there are in the medium trade-off condition. This is illustrated in Table 6. Smoothing of the earnings per share stream in the high trade-off condition requires greater sacrifice than does smoothing in the other conditions.

There are two types of smoothing variables in this study: (1) real smoothing variables represented by business decisions and (2) artificial variables represented by accounting decisions. The accounting decisions are represented by cells 1AX, 2AX, 3AX, 1AY (not pictured), 2AY (not pictured), and 3AY in Figure 5. The business decisions are represented by cells 1BX, 2BX, 3BX, 1BY, 2BY, and 3BY in Figure 5. Accounting and business decisions are explained in the directions as follows:

In your role as controller, you will be making two accounting decisions and two business decisions. The accounting decisions consist of the selection of a depreciation method (straight-line vs. sum-of-years digits), and the selection of a method for the investment tax credit (flow-through vs. deferred). Similarly, the business decisions consist of the selection of an advertising plan (Plan A vs. Plan B), and the selection of a research and development project (Project X vs. Project Y). The accounting decisions in
no way effect the outcomes of business
decisions and the business decisions in
no way effect outcomes of accounting
decisions. The decisions you make should
be based on information provided in this study.

The variables are presented with the choice of an earnings per share stream. This is shown in the experimental portion of Appendix A. There is a direct correspondence between a trade-off condition and a smoothing variable. The total earnings per share stream for six years are identical for the real and artificial variables in all trade-off conditions. This can be demonstrated by summing the pre-decision earnings per share to one of the four choices in cell 1AX. If the same procedure is followed for the corresponding decision in cell 1AY, the total earnings per share streams are identical. This will be valid for all comparable cells in the experiment. The subjects are required to total their choice with the pre-decision earnings per share in order to make the manipulation effective. The purpose of this manipulation is to make the real and artificial variables equivalent for statistical analysis.

The third independent variable is related to the degree of owner control. This was introduced in the instructions of the experiment as follows:

You are asked to assume the role of controller of two corporations (A and B). The two corporations are of equal size but are separate and independent of each other. The objective of both corporations
is the maximization of stockholder wealth. Corporation A's stock is traded on a major stock exchange and has highly diverse ownership. Corporation B does not list its stock on an exchange and has a small group of owners. Your job security, salary, bonuses, and advancement will probably be affected by how satisfied the stockholders are with reported earnings.

Corporation A has diverse ownership and may be considered as a manager controlled firm. This is represented in Figure 5 by cells 1AX, 2AX, 3AX, 1BX, 2BX and 3BX. Corporation B has few owners and may be considered as an owner controlled firm. This is represented in Figure 5 by cells 1AY (not pictured), 2AY (not pictured), 3AY, 1BY, 2BY, and 3BY.

The cases (cells) were presented in such a way that each one was given twice. One cell represented diverse ownership and one cell represented limited ownership. For example, if the no trade-off condition for artificial variables was presented, the subject would be told to repeat this case for each of the two ownership conditions.

In conclusion, the three independent variables represent the experimental manipulations. These variables are: (1) the degree of trade-off of total earnings per share for variability of the earnings per share stream, (2) the type of variable used (artificial or real), and (3) the degree of management control. These variables correspond to the three hypotheses.
The Dependent Variable

The dependent variable is represented by the earnings per share stream chosen for each of the twelve cases. The choices represent different degrees of smoothing. In order to make the total earnings per share salient, the subject was asked to circle his choice and add his selection to pre-decision earnings per share. If pre-decision earnings per share is added by the subject to his choice, the subject must view the total earnings per share stream. This permits the subject to recognize the ramifications of his decision. The real variables are then equated with the artificial variables.

There are four choices available in all twelve cases. Each choice is associated with a different degree of smoothing. After completing the task, the subjects' responses were coded into one of four ordinal numbers. The number one represents the largest amount of variance reduction and the greatest degree of smoothing. The number four represents the least amount of variance reduction and the least amount of smoothing. The numbers two and three were assigned to a medium degree of smoothing and a small amount of smoothing respectively. One number was assigned to each of the twelve cases for each subject. This procedure was applied to obtain a compatible measure of smoothing between all of the experimental conditions.
Validity

Internal Validity

The internal validity of any research is crucial to the design of the experiment and the interpretation of the results. Without it, nothing may be said of external validity. If results are incorrect, it is unimportant whether or not they are externally valid or generalizable. Four major steps were taken to promote a high degree of internal validity as follows: (1) conducting a pilot study, (2) randomizing the presentation, (3) controlling for intervening variables and (4) conducting manipulation checks.

During the development of the experimental instrument, a pilot study was run on thirty-five undergraduates majoring in accounting. All pilot subjects were interviewed after they completed the experiment. The results of the interviews revealed that all subjects understood the experimental task. Also, the experimental manipulations were successful. The pilot study was not entirely the same as the actual experiment. However, the format was close enough to the actual experiment to indicate that the instrument was functioning properly.

This experiment is a repeated measures design. A possible contaminant of a repeated measures design is order effects. A repeated measures design, in this case, is defined as one in which all subjects receive all treatments.
An order effect is the order of presentation of the treatments which has an effect upon the results. An example of an order effect is a learning effect. This is the effect on later treatments from the learning that takes place during the completion of earlier treatments. Two steps were taken to counteract order effects. First, the presentation of treatments was randomized for each subject. Second, an example was given to demonstrate the experimental task. This allows the subject to learn about the experiment before it actually begins. This should decrease the effect of learning (if there is one) in the experimental task.

Within an experiment, the possibility exists that some variable(s) other than the independent variable(s) are impacting upon the dependent variable(s). This causes improper interpretation of the results since some undesignated cause is affecting the outcome. There are two possible areas that are analogous to the above situation. First, a subject could infer a growth rate from the earnings per share stream. This could dominate the differences in the variances of the earnings per share streams if different growth rates were attached to different variances in the four earnings per share choices. An interpretation of growth is the slope of a trend line fitted to the earnings per share stream. In all cases, the slope was kept very close to zero. (See Table 6). Since all of the growth rates are approximately equal to zero, it cannot have an effect upon the
choice of an earnings per share stream.

Another area of misinterpretation is tax effects. If the earnings per share numbers have associated tax consequences, there could be related cash flow effects. For example, a subject may maximize cash flow by minimizing earnings per share. This would negatively affect the trade-off between total earnings per share and the variance of the earnings per share stream. Managers probably have different strategies for cash flow than they have for earning per share. To eliminate this disturbance, the instructions stated that tax effects were to be ignored. Also, additional oral instructions were given to the subjects before the experiment to reinforce the elimination of tax consequences.

The final step taken to strengthen internal validity was the execution of manipulation checks. The manipulation check consisted of an interview of the subject immediately after the experimental task was completed. The subject was questioned about the strategy he used for completing the experimental instrument. The subjects' responses were verified by their replies in the post-test interview. Consistency was found in all subjects. The subjects were asked if they understood all aspects of the instructions. They were questioned about whether or not the tax effects were eliminated. The tax manipulation was successful. Finally, a general interview about income smoothing was conducted with each subject. This revealed their opinions about income
smoothing. Also, material for future research was obtained as an added benefit of conducting the interviews.

A possible source of misinterpretation of the results exists in the high trade-off condition. Since the total earnings per share of this condition is higher than the other conditions (See Table 6), and the ratio of variance reduction is smaller, the subjects possibly maximized in this condition because of a perceived lack of reward for exhibiting smoothing behavior. The amount of reduction of variability in the high trade-off condition is not exactly comparable to the other trade-off conditions. However the post experimental interviews indicate that this phenomena did not occur.

External Validity

A characteristic of laboratory experiments is that it has a high degree of internal validity since the independent variables are controllable. In order to properly isolate these variables from extraneous influences, reality is frequently suppressed. This dilemma is recognized by Kerlinger [1964, p. 400] as follows:

Although laboratory experiments have relatively high internal validity, then they lack external validity.

Most laboratory studies, including this experiment, lack some external validity. The task was made as realistic as possible in order to overcome some of the shortcomings of
external validity. Also, real businessmen were used as sub-
jects. There is a need to be cautious in extrapolating the
results of this experiment beyond the laboratory.

**Statistical Analysis**

**Selection of the Test**

This experiment is a three-way design. The principal
methods of analysis that fit this design are analysis of vari-
ance and the Friedman test. Analysis of variance is a para-
metric procedure and the Friedman test is a non-parametric
procedure. A controversy exists whether a parametric or a non-
parametric test should be employed in this type of experiment.

Gaito [1959] states several advantages of non-parametric
techniques. Two of the relevant advantages of non-parametric
tests are given by [Gaito 1959, pp. 118-119] are as follows:

1. Probability statements are exact when obtained
from most non-parametric tests regardless of
the shape of the population distribution from
which the sample was drawn.

2. Non-parametric techniques are computationally
more simple and easier to learn.

In both cases, Gaito indicates that these two advantages are
relatively unimportant. He also lists some disadvantages of
non-parametric techniques. The example he uses as a para-
metric test for purposes of comparison to a non-parametric
procedure is analysis of variance. Gaito [1959, p. 120]
summarizes two of the disadvantages of non-parametric tests
as follows:

1. If the assumptions of a parametric technique are met or approximated but non-parametric techniques are used, the latter are less powerful.

2. There are few non-parametric tests for interaction effects...however, these are crude or computationally laborious.

He concludes that analysis of variance is more powerful than a corresponding non-parametric procedure, if the assumptions of the parametric test are met. Also, analysis of variance reveals interaction effects which are very important in interpreting the results of many studies.

The coding of the experimental instrument consists of ranking the degree of smoothing. This involves the use of an ordinal scale. Stevens [1946] suggests that parametric techniques require an interval or ratio scale. If this is true, analysis of variance would not be appropriate to use in analyzing the results of the experiment. The argument that ordinal scale data is not appropriate for analysis of data has subsequently been rejected by Gaito [1959] and Anderson [1961]. The controversy still exists, but analysis of variance and other parametric procedures are widely used in the psychological literature in conjunction with ordinal data.

Analysis of variance was selected as the method of analysis for three reasons. First, the interaction effects are very important in interpreting the results of this study.
Second, there are many ties in the data. A tie is defined as the number of identical responses across treatments by an individual subject. Too many ties weakens the conclusions that may be drawn from the Friedman test. Finally, the literature cited previously indicates that the use of analysis of variance in conjunction with ordinal data is appropriate.

The Model

The data was analyzed by a repeated measures analysis of variance model. This model is specified as follows:

\[ Y_{ijkm} = u + \eta_i + \alpha_j + \beta_k + \gamma_m + (\eta \alpha)_{ij} + (\eta \beta)_{ik} \]
\[ + (\eta \gamma)_{im} + (\alpha \beta)_{jk} + (\alpha \gamma)_{jm} + (\beta \gamma)_{km} + (\eta \alpha \beta)_{ijk} \]
\[ + (\eta \alpha \gamma)_{ijm} + (\eta \beta \gamma)_{ikm} + (\alpha \beta \gamma)_{jkm} + (\eta \alpha \beta \gamma)_{ijkm} \]
\[ + \epsilon_{ijkm}. \]

where:

- \( Y_{ijkm} \) = the score of subject \( i \).
- \( u \) = the grand mean.
- \( \eta_i \) = \( u_i - u \), the main effect of subject \( i \).
- \( \alpha_j \) = \( u_j - u \), the main effect of treatment \( A_j \).
- \( A_j \) = the trade-off of total earnings per share with the variability of the earnings per share stream on \( Y_{ijkm} \).
- \( \beta_k \) = \( u_k - u \), the main effect of treatment \( B_k \).
- \( B_k \) = The effect of real or artificial variables on \( Y_{ijkm} \).
- \( \gamma_m \) = \( u_m - u \), the main effect of treatment \( C_m \).
\[ C_m = \text{the effect of the degree of owner control on } Y_{ijkm}. \]

\[ (\eta \alpha)_{ij} = u_{ij} - u_i - u_j + u, \text{ the interaction effect of } \eta_i \text{ and } A_j. \]

\[ (\eta \beta)_{ik} = u_{ik} - u_i - u_k + u, \text{ the interaction effect of } \eta_i \text{ and } B_k. \]

\[ (\eta \gamma)_{im} = u_{im} - u_i - u_m + u, \text{ the interaction effect of } \eta_i \text{ and } C_m. \]

\[ (\alpha \beta)_{jk} = u_{jk} - u_j - u_k + u, \text{ the interaction effect of } A_j \text{ on } B_k. \]

\[ (\alpha \gamma)_{jm} = u_{jm} - u_j - u_m + u, \text{ the interaction effect of } A_j \text{ and } C_m. \]

\[ (\beta \gamma)_{km} = u_{km} - u_k - u_m + u, \text{ the interaction effect of } B_k \text{ and } C_m. \]

\[ (\eta \alpha \beta)_{ijk} = u_{ijk} - u_{ij} - u_{ik} - u_{jk} + u_i + u_j + u_k - u, \text{ the interaction effect of } \eta_i, A_j, B_k. \]

\[ (\eta \alpha \gamma)_{ijm} = u_{ijm} - u_{ij} - u_{im} - u_{jm} + u_i + u_j + u_m - u, \text{ the interaction effect of } \eta_i, A_j, C_m. \]

\[ (\eta \beta \gamma)_{ikm} = u_{ikm} - u_{ik} - u_{im} - u_{km} + u_i + u_k + u_m - u, \text{ the interaction effect of } \eta_i, B_k, C_m. \]

\[ (\alpha \beta \gamma)_{jkm} = u_{jkm} - u_{jk} - u_{jm} - u_{km} + u_j + u_k + u_m - u, \text{ the interaction effect of } A_j, B_k, C_m. \]

\[ (\eta \alpha \beta \gamma)_{ijkm} = u_{ijkm} - u_{ijk} - u_{ijm} - u_{ikm} - u_{jkm} + u_{ij} + u_{ik} + u_{im} + u_{jk} + u_{jm} + u_{km} - u_i - u_j - u_k - u_m + u \]

\[ \epsilon_{ijkm} = Y_{ijkm} - u_{ijkm}, \text{ the error component.} \]

Assumptions of the Model

There are three common assumptions required for the use of analysis of variance [Lindquist, 1953]. These are stated by Gaito [1959, p. 115] as:
(1) The errors must be independent.

(2) The variance of the different portions of the appropriate error term is the same for each treatment population.

(3) The distribution of the observations which are used as the appropriate error term must be normal in the treatment population.

Gaito states that condition (1) is the same for parametric and non-parametric tests. Also, assumptions (3) and (3) have been widely studied. The results of these studies indicate that analysis of variance is robust to deviations in normality and homogeneity of variance.

The Repeated Measures Design

This experiment utilizes the repeated measures design. This is defined as an experiment in which all subjects receive all treatments. Some of the advantages of this design are given by Gaito [1961] and Myers [1972]. They suggest that the repeated measures design is economical because it requires less subjects than does a non-repeated measures design. Also, the variance due to different subjects assigned to different treatments is removed. This lower subject variation increases the precision of the analysis, which Myers [1972, p. 168] expresses as follows:
The design will generally be more efficient than even the treatments X blocks design, since variability due to individual differences will be more effectively separated from error variance.

There are several forms of the repeated measures design. Gaito [1961] specifies these forms as follows: (1) same order, (2) randomization of order, (3) balanced design -- interactions zero, (4) simple Latin Square -- interactions present, (5) Lindquist Type II design---interactions present and (6) balanced treatments X subjects design---interactions present. He suggests that unless the experimenter is certain that specific interaction effects do not exist, the best method to use is the randomization of order design. Gaito [1961, p. 295] concludes:

It would appear that if one does have a repeated measures design, the safest procedure would be to randomize the order or treatments so that order and all interactions containing order would be included in σ² and appears in all effects, unless he has strong reasons for believing that certain interactions are not present.

Since the experiment could have order effects and the possibility of other interactions exist, the randomized order of presentation is utilized in the study.

The randomization of presentation is accomplished by randomly selecting the order of presentation of cells 1AX, 2AX, 3AX, 1BX, 2BX and 3BX. The closely held and widely held cells (Factor X-Y) are not randomized. For any of the
six cells listed above, the cell was presented twice on the same page of the experiment (See Appendix A). The subjects were given oral instructions that the cells on the same page are identical with the exception of the ownership. This procedure was followed because it reduces the length of time required to complete the experimental task and it increases the saliency of the ownership manipulation. Since the subjects are instructed that the cells are identical, no order effects of presentation for this variable should appear.
CHAPTER V
RESULTS

Test of the Hypotheses

Hypothesis 1

The null (Hol) and alternative (Hal) forms of the first hypothesis are given as follows:

Hol: The degree of trade-off of earnings per share (no, medium, and high) has no effect upon smoothing behavior.

Hal: The degree of trade-off of earnings per share does have an effect upon smoothing behavior.

This hypothesis is tested by analysis of variance. A summary of the results of the analysis of variance is given in Table 7.

Hypothesis one corresponds to source A in Table 7. The null hypothesis (Hol) is rejected in favor of the alternative hypothesis (Hal). This is significant beyond the 0.001 level. Therefore, the degree of trade-off does affect the smoothing behavior of the subjects.

Although smoothing behavior is affected by the degree of trade-off, it may be useful to examine how this occurs. This is represented in Table 8 under the heading "Trade-off."
<table>
<thead>
<tr>
<th>Source</th>
<th>Degree of Freedom</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance Level = p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1</td>
<td>4834.664</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>73</td>
<td>2.215</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>2</td>
<td>165.761</td>
<td>84.727</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>18.450</td>
<td>14.985</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>149.207</td>
<td>66.636</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td>SA</td>
<td>146</td>
<td>1.956</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SB</td>
<td>73</td>
<td>1.231</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SC</td>
<td>73</td>
<td>2.239</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AB</td>
<td>2</td>
<td>3.491</td>
<td>3.771</td>
<td>p &lt; .025</td>
</tr>
<tr>
<td>AC</td>
<td>2</td>
<td>2.667</td>
<td>3.153</td>
<td>p &lt; .05</td>
</tr>
<tr>
<td>BC</td>
<td>1</td>
<td>0.072</td>
<td>0.128</td>
<td>p &gt; .10</td>
</tr>
<tr>
<td>SAB</td>
<td>146</td>
<td>0.926</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAC</td>
<td>146</td>
<td>0.846</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBC</td>
<td>73</td>
<td>0.565</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABC</td>
<td>2</td>
<td>0.626</td>
<td>1.581</td>
<td>p &gt; .10</td>
</tr>
<tr>
<td>SABC</td>
<td>146</td>
<td>0.396</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE 7 (continued)

A = Trade-off of total earnings per share for variability in the earnings per share stream.

B = Smoothing for artificial vs. real variables.

C = Smoothing for the widely held vs. the closely held company.

AB = The interaction between the smoothing variable and the degree of trade-off.

AC = The interaction between the ownership structure and the degree of trade-off.

BC = The interaction between the smoothing variable and the ownership structure.

ABC = The interaction between the smoothing variable, the ownership structure, and the degree of trade-off.
The means of the cells increase as the trade-off becomes larger. This implies that the lower the trade-off of total earnings per share for the degree of variability of the earnings per share stream, the more the subjects display smoothing behavior. An explanation of this behavior on an _a priori_ basis is that financial executives prefer to smooth earnings if they do not have to reduce total earnings per share. The more total earnings per share that is given up, the less the tendency for managers to smooth earnings per share.

For the trade-off condition, another interesting aspect of the cell means is that some smoothing occurred in all conditions. This is evident even in the high trade-off condition in which the overall mean is 2.993. If a subject maximized total earnings per share, a score of 4.0 would have been assigned. Since 2.993 is less than 4.0, the subjects still elected to smooth minimally even though the cost to smooth represented by total earnings per share was high. This may indicate that smoothing is widely practiced, particularly if the penalties for smoothing are not large.

**Hypothesis 2**

The results of the test of the second hypothesis are given in Table 7. The null (Ho2) and alternative (Ha2) of this hypothesis are given as follows:

Ho2: The degree of smoothing of earnings per share is the same for real and artificial variables.
TABLE 8

The Cell Means* for the Treatments

<table>
<thead>
<tr>
<th>Trade-off</th>
<th>No Trade-off</th>
<th>Medium Trade-off</th>
<th>High Trade-off</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.520</td>
<td>2.486</td>
<td>2.993</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>Artificial</th>
<th>Real</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.189</td>
<td>2.477</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Companies</th>
<th>Widely held</th>
<th>Closely held</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.923</td>
<td>2.743</td>
</tr>
</tbody>
</table>

* Cell scores are assigned as follows:
1 = high smoothing
2 = medium smoothing
3 = low smoothing
4 = no smoothing
Hypothesis two corresponds to source B in Table 7. The null hypothesis (Ho2) is rejected in favor of the alternative hypothesis (Ha2). This is statistically significant beyond the 0.001 level. The degree of smoothing is affected by the type of smoothing variable.

Since there is an effect on smoothing behavior according to whether real or artificial variables are used, it is useful to examine what the effect is. This is illustrated in Table 8 under the title "Variables." There is more smoothing with artificial variables than with real variables. This provides insight into what type of smoothing variables are used in practice.

In order to determine which variables are actually applied in smoothing income, the generalizability of this part of the study should be examined. There are probably three primary constraints in selecting a smoothing variable. The first constraint is the availability of a particular type of smoothing variable (artificial or real). If there are no accounting alternatives available for smoothing purposes, the artificial smoothing variable could not be used. Smoothing is accomplished through the most readily available type of variable. Second, there are legal constraints in using a particular variable. If generally accepted accounting principles are violated in order to smooth
earnings, there could be additional penalties attached to smoothing. These are qualifications of the auditor's opinion or potential lawsuits. Finally there may be negative cash flow effects that result from the use of a particular variable. One example of this is the use of an inventory method. Since the same method must be used for tax and financial purposes, the selection of one method could smooth income and increase taxes simultaneously. Another example of this is the timing of discretionary expenditures. Possibly a firm could spend more on discretionary items, such as advertising, when earnings are exceptionally high instead of when earnings are low. This smooths the earnings.

The issues of legality and availability are controlled in the experiment. There are no violations of generally accepted accounting principles by the subjects in the selection of the accounting decisions. Also, all variables are made explicitly available for smoothing purposes. The cash flow effects were partially controlled. All of the tax effects are eliminated. The only constraint remaining is the timing of the cash flows. This is usually associated with real smoothing. For this reason, there may be an association between cash flows and earnings per share for the real smoothing variables in this experiment. This could explain why there is significantly less smoothing in the use of real variables than in artificial variables. The subjects may have been reluctant to damage the cash position of their
companies in order to smooth earnings per share. However, it is inappropriate to conclude that smoothing is accomplished in practice through the use of artificial variables because the availability, legality, and tax effects of smoothing variables are controlled in the experiment. If the availability, legality, and tax consequences of the smoothing variables (real or artificial) are the same, businessmen prefer to smooth with artificial variables.

Hypothesis 3

The null (H₀₃) and alternative (Hₐ₃) form of the third hypothesis are given as follows:

H₀₃: The degree of smoothing of earnings per share is the same for closely held companies and widely held companies.

Hₐ₃: The degree of smoothing of earnings per share is not the same for closely held companies and widely held companies.

Hypothesis three corresponds to source C in Table 7. The null hypothesis (H₀₃) is rejected in favor of the alternative hypothesis (Hₐ₃). This is statistically significant beyond the 0.001 level. The degree of smoothing behavior displayed by the subjects is affected by the degree of manager control.

The results of recent studies by Smith [1976], Kamin, et al. [1976] and Amihud, et al. [1977] indicate that smoothing is more evident in managerially controlled firms than in
owner controlled firms. In this experiment, a managerially controlled firm is represented by the widely held company and an owner controlled firm is represented by the closely held company. The results are consistent with the conclusions of the other studies. There is more smoothing in the widely held company than in the closely held company. This is shown in Table 8 under the title "Companies."

Several reasons to smooth income are given in the first section of Chapter II. Most of the motivations for managers to smooth income are valid for both closely held companies and widely held companies. Some of the reasons for smoothing include tax advantages, improved labor relations, and improved creditor relations. However, there is additional incentive for managers to smooth income in a widely held company. Primarily, the manager desires to keep the owners of the company satisfied. By doing so, the manager maximizes his own position with the company. This may be accomplished by smoothing income. According to Biedleman [1973], income smoothing could raise the price of a security by reducing the systematic risk of that security. If a company is closely held and not traded on a stock exchange, reducing the systematic risk may not be appropriate. Therefore, managers of widely held companies may be more motivated to smooth than managers of closely held companies. This is consistent with the results of the experiment.
The over-all results of the experiment are summarized in Table 9. The cell means for each of the experimental conditions is given. Each one of the cell means are consistent with the discussion of the results.

Table 9
The Cell Means*

<table>
<thead>
<tr>
<th>ARTIFICIAL VARIABLE</th>
<th>No Trade-off</th>
<th>Medium Trade-off</th>
<th>High Trade-off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Widely Held</td>
<td>1.162</td>
<td>1.757</td>
<td>2.446</td>
</tr>
<tr>
<td>Closely Held</td>
<td>1.184</td>
<td>2.770</td>
<td>3.162</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REAL VARIABLE</th>
<th>No Trade-off</th>
<th>Medium Trade-off</th>
<th>High Trade-off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Widely Held</td>
<td>1.257</td>
<td>2.216</td>
<td>2.703</td>
</tr>
<tr>
<td>Closely Held</td>
<td>1.824</td>
<td>3.203</td>
<td>3.662</td>
</tr>
</tbody>
</table>

* The assignment of responses is as follows:

1 = High smoothing
2 = Medium smoothing
3 = Low smoothing
4 = No smoothing
The Interactions

There are four relevant interactions in this study. These are listed in Table 7 as ABC, AB, AC and BC. Significant interactions could affect the interpretation of the results of the treatment effects in an experiment. The effects of the interactions on the results of the study are discussed in this section.

The ABC interaction represents the interaction between the degree of trade-off, the smoothing variable, and the ownership structure. This over-all interaction is statistically insignificant ($p > 0.1$). This interaction has no effect upon the interpretation of the results of the treatment effects. The cell means of the ABC interaction are given in Table 9.

Another interaction is found between the degree of trade-off and the smoothing variable. The cell means for this AB interaction are given in Table 10. This interaction is statistically significant beyond the 0.025 level. The AB interaction could distort the interpretation of the A main effect and the B main effect. These are the degree of trade-off of total earnings per share for the reduction of the variability of the earnings per share stream and the use of real or artificial smoothing variables. Although this interaction is significant, it has no effect upon the interpretation of the results. This is demonstrated in Figure 6. The slopes of the lines for artificial variables and real
### Table 10

The Cell Means* for the Interactions

The interaction Between the Smoothing Variable and the Degree of Trade-off (AB)

<table>
<thead>
<tr>
<th></th>
<th>No Trade-off</th>
<th>Medium Trade-off</th>
<th>High Trade-off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artificial</td>
<td>1.500</td>
<td>2.264</td>
<td>2.804</td>
</tr>
<tr>
<td>Real</td>
<td>1.541</td>
<td>2.709</td>
<td>3.182</td>
</tr>
</tbody>
</table>

Significance level:  $p < .025$

The interaction Between the Ownership Structure and the Degree of Trade-off (AC)

<table>
<thead>
<tr>
<th></th>
<th>No Trade-off</th>
<th>Medium Trade-off</th>
<th>High Trade-off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Widely Held</td>
<td>1.209</td>
<td>1.986</td>
<td>2.574</td>
</tr>
<tr>
<td>Closely Held</td>
<td>1.831</td>
<td>2.986</td>
<td>3.412</td>
</tr>
</tbody>
</table>

Significance level:  $p < .05$
Table 10 (continued)

The Interaction Between the Smoothing Variable and the Ownership Structure (BC)

<table>
<thead>
<tr>
<th></th>
<th>Artificial</th>
<th>Real</th>
</tr>
</thead>
<tbody>
<tr>
<td>Widely Held</td>
<td>1.788</td>
<td>2.059</td>
</tr>
<tr>
<td>Closely Held</td>
<td>2.590</td>
<td>2.896</td>
</tr>
</tbody>
</table>

Significance level: $p > .05$

* Cell scores are assigned as follows:

1 = high smoothing
2 = medium smoothing
3 = low smoothing
4 = no smoothing
Figure 6. The Interaction Between the Smoothing Variable and the Degree of Trade-off
variables differ slightly, but at no point do they intersect. The means of the cells of the AB interaction all change in the same direction. This implies that the degree of trade-off affects the subjects' smoothing behavior in a similar manner for the real and artificial variables. The amount of smoothing decreases as the trade-off increases for both the real and the artificial variables. Therefore, the effect of this interaction is not relevant to the interpretation of the results. What differs is the rate of decrease in smoothing behavior. This explains why the interaction is statistically significant.

The AC interaction represents the interaction between the ownership structure and the degree of trade-off. Cell means for the AC interaction are given in Table 10. The interaction is statistically significant beyond the 0.05 level. This interaction could distort the interpretation of the A effect and the C effect. Analogous to the AB interaction, is the AC interaction, which has no effect upon the interpretation of the results. The AC interaction is depicted in Figure 7. The slopes are different for widely held and closely held companies, but the lines do not intersect. Decreases in the amount of smoothing as the trade-off increases are the same for the closely held companies and the widely held companies. The interaction is significant because the rate of decrease is different for manager controlled firms and owner controlled firms. This interaction
Figure 7. The Interaction Between the Ownership Structure and the Degree of Trade-off
is not relevant to the interpretation of the results of the experiment.

The BC interaction represents the interaction between the smoothing variable and the ownership structure. The over-all interaction is statistically insignificant (p>0.1). The interpretation of the results is not affected by this interaction. Cell means for the BC interaction are given in Table 10.
CHAPTER 6
SUMMARY AND CONCLUSIONS

Summary

Generally accepted accounting principles provide a variety of alternatives to account for a given set of financial occurrences. Management also has the capability of timing financial transactions (such as delaying a sale) and making discretionary expenditures. Due to this flexibility in the accounting alternatives available and the timing of transactions, management has the capability to reduce the fluctuations of reported income from year to year. The process of reducing the fluctuations of reported income from year to year by using accounting alternatives is known as artificial income smoothing. Timing financial transactions and making discretionary expenditures to reduce the variability of reported income is known as real income smoothing. Both types of income smoothing are examined in this dissertation.

This study consists of a laboratory experiment that examines the income smoothing process and an economic analysis of income smoothing. Since income smoothing research requires controllability as well as variable specification, 89.
the laboratory experiment has been selected as the appropriate methodology to use in this study.

The second chapter of this dissertation reviews the income smoothing literature and discusses some advantages of smoothing which are: (1) tax benefits, (2) the improvement of relation with creditors, investors, and workers, (3) the dampening of business cycles, (4) the reduction of the systematic risk of a security, and (5) the improvement of the prediction of cash flows of a company by users of the financial statements.

Four basic problems associated with most of the income smoothing research are as follows: (1) defining target income, (2) selecting appropriate smoothing variables, (3) obtaining the needed information about the use of these variables because this data is frequently not disclosed in financial statements and (4) selecting the appropriate sample firms. There are also difficulties inherent in the analytic techniques used to detect income smoothing. The use of the laboratory experiment eliminates many of these weaknesses.

An economic model of smoothing is developed in Chapter III. The proposed model is an initial attempt to create a useful presentation of income smoothing. Two separate cases are developed. The first case assumes that a weighting factor is only attached to last period's income. The second case assumes that a weighting factor is attached to the previous two period's income.
Examples are given in both cases to demonstrate how the model works. In all cases, the model results in a smoother income stream when a smoothing factor is used. This is reflected by a reduction in the sum of squares of the error term when a regression line is fitted to the predicted income stream.

There are three hypotheses in the study. The first hypothesis relates to the motivation to smooth earnings per share. A measure of motivation in this experiment is defined as the amount of total earnings per share, for six years, that a subject is willing to trade-off in order to reduce the variance of that earnings per share stream. The hypothesis is given as follows:

The degree of trade-off of earnings per share (no medium and high) has an effect upon smoothing behavior.

The second hypothesis involves the smoothing of the earnings per share stream using artificial variables (accounting decisions) and real variables (business decisions). This hypothesis is given as follows:

The degree of smoothing of earnings per share is not the same for real and artificial variables.

Hypothesis three is related to management control and smoothing earnings per share. The third hypothesis is given as follows:

The degree of smoothing of earnings per share is not the same for closely held companies and widely held companies.
The subjects consisted of seventy-four financial executives from thirty-one companies located in the state of Ohio. The participants in the experiment are listed in Table 5.

There are three independent variables in this experiment as follows: (1) the degree of trade-off, (2) the type of smoothing variable, and (3) the form of ownership. The design of the experiment is given in Figure 5. The three trade-off conditions are without trade-off (no trade-off), medium trade-off and high trade-off. These are given in Table 6. In the no trade-off condition, the variance of the earnings per share stream increases from choice to choice but the total earnings per share remains constant. The medium trade-off condition contains small decreases in total earnings per share associated with decreases in the variance in the earnings per share stream. In the high trade-off condition, there are larger decreases in earnings per share than there are in the medium trade-off condition. Also, there are larger differences in the variance of the earnings per share stream than there are in the medium trade-off condition.

Two types of smoothing variables are used in this study. These are (1) real variables represented by business decisions and (2) artificial variables represented by accounting decisions. The artificial variables consist of the selections of a depreciation method (straight-line or sum-of-years digits) and the selection of a method for the investment tax
credit (flow-through vs. deferred). Similarly, the business decisions consist of the selection of an advertising plan (Plan A vs. Plan B) and the selection of a research and development project (Prospect X vs. Prospect Y). The accounting decisions in no way affect the outcomes of business decisions and the business decisions in no way affect outcomes of accounting decisions.

The third independent variable is related to the degree of owner control. Corporation A in the experiment has diverse ownership and may be considered to be a manager controlled firm. Corporation B has few owners and may be considered to be an owner controlled firm. Subjects are asked to assume the role of controller for both Corporation A and Corporation B.

The dependent variable is represented by the earnings per share stream chosen for each of the twelve cases. The four choices available in each case are associated with the degree of smoothing. After completing the task, the subjects' responses were coded into one of four ordinal numbers. The number one represents the largest amount of variance reduction and the greatest amount of smoothing. The number four represents the least amount of variance reduction and the least amount of smoothing. The numbers two and three were assigned to a medium degree of smoothing and a small amount of smoothing, respectively.
Internal validity is crucial to the design of an experiment and the interpretation of the results. Four major steps were taken to promote a high degree of internal validity as follows: (1) conducting a pilot study, (2) randomizing the presentation, (3) controlling for intervening variables and (4) conducting manipulative checks.

Most laboratory studies, including this experiment, lack some external validity. The task was made as realistic as possible in order to overcome some of the shortcomings of external validity. Also, real businessmen were used as subjects. There is a need to be cautious in extrapolating the results of this experiment beyond the laboratory.

Analysis of variance was selected as the method of analysis for three reasons. First, the interaction effects are very important in interpreting the results of this study. Second, there are many ties in the data. A tie is defined as the number of identical responses across treatments by an individual subject. Too many ties weaken the conclusions that may be drawn from the Friedman test. Finally the literature cited in the Statistical Analysis section of Chapter IV indicates that the use of analysis of variance in conjunction with ordinal data is appropriate.

This experiment utilizes a randomization of order repeated measures design. A repeated measures design is defined as an experiment in which all subjects receive all treatments. The treatments are randomized for each subject.
Some advantages of this design are given by Gaito [1961] and Myers [1972]. They suggest that the repeated measures design is economical because it requires less subjects than a non-repeated measures design. Also, the variance due to different subjects assigned to different treatments is removed. This lower subject variation increases the precision of the analysis.

All three null hypotheses are rejected in favor of the alternative hypotheses at the $p < .001$ level. The results are summarized in Table 7. Two of the interactions are statistically significant. The AB interaction between the degree of trade-off and the type of smoothing variable is significant at the $p < .025$ level. The AC interaction between the degree of trade-off and the type of ownership structure is significant at the $p < .05$ level. Although the interactions are significant, they do not affect the interpretation of the results. This is demonstrated in Figure 6 and Figure 7.

Conclusions and Implications

The first hypothesis states that the degree of trade-off of earnings per share (no, medium and high) has an effect upon smoothing behavior. This hypothesis is statistically significant. The mean responses for the no, medium and high trade-off conditions indicate that the greater the trade-off of total earnings per share for variability in the earnings
per share stream, the less the subjects smoothed earnings per share. This relationship suggests that companies will not smooth earnings indiscriminantly if the cost of smoothing earnings is too expensive.

There is some smoothing behavior displayed by the subjects in the high-trade-off condition. The subjects are motivated to smooth earnings per share, at least to a minimal extent, even though there is a large decrease in total earnings per share. This implies that there is strong motivation to smooth earnings, but the extent of this smoothing behavior is affected by the related trade-off. Therefore, smoothing may be widespread in practice. What varies is how frequently and to what degree each company smooths income.

Hypothesis two relates to how the choice of a smoothing variable affects smoothing behavior. There is a statistically significant difference in the degree of smoothing of earnings per share using real and artificial variables. The results indicate that subjects smoothed earnings per share more with artificial variables than with real variables.

Many factors are relevant to the selection of smoothing variables. Most of these are eliminated in the design of the experiment. By making the decision to smooth earnings per share by using real or artificial variables equivalent with respect to availability, legality, and tax consequences, the smoothing preferences of the subjects are revealed. The
results indicate that the subjects preferred to smooth with artificial variables more than real variables. It is inappropriate to conclude from the results of the experiment that there is more artificial smoothing than real smoothing in practice.

The findings imply that given the choice, businessmen prefer to smooth with artificial variables. If accounting policy makers decide that smoothing earnings should not be practiced, the accounting profession should focus its efforts on artificial smoothing. However, the reduction or elimination of artificial smoothing could cause an increase in the practice of real smoothing. Since the subjects smoothed to some extent using both types of variables, both artificial and real smoothing are probably used in practice.

Hypothesis three relates to how the ownership structure affects smoothing behavior. There is a statistically significant difference in the degree of smoothing earnings per share for closely held and widely held companies. The results indicate that the subjects smoothed more for widely held companies than for closely held companies. This result is consistent with the existing research on this topic.

Several accounting researchers (see Chapter II) suggest that managers smooth income to gain tax advantages, improve labor relations, and improve creditor relations. These reasons to smooth income are applicable to both closely held companies and widely held companies. However, there are
additional reasons to smooth income that are more applicable to widely held companies. These include a reduction of the systematic risk of a security and the resultant increase in the security's price, and an improvement of the communication of management's expectation of future cash flows. These are additional incentives to smooth for widely held companies. The additional motivation to smooth income for widely held companies is consistent with the results of the experiment. If accountants desire to detect income smoothing, they should focus primarily on widely held companies.

Suggestions for Future Research

The Economic Model

The proposed income smoothing model is an initial attempt to create a useful presentation of the income smoothing process. There is a need to refine and expand this model. For example, risk preferences could be explicitly incorporated into the model.

Before this model can be used for classificatory purposes, it is necessary to test the model. The parameters of the model can be obtained for existing companies through their financial records. The parameter that is not derived in this manner ($\xi_i$) can be obtained by regressing reported income over time. Once all of the parameters of the model are obtained, it is not difficult to verify the predictive
accuracy of the model. The predictive accuracy of the model is verified by examining a number of years (twenty for example) of historical data. The first ten years are used to derive the parameters of the model, the next ten years are used to compare the model's forecasts of income each year to actual reported income each year. This is a measure of the predictive accuracy of the model. If the model's forecasts are reasonably accurate, predicted income can be used in the place of forecasted income. This allows the model to be solved for $\alpha_2$, the amount of smoothing in the current period. This enables the researcher to determine the degree of income smoothing for a particular company.

Sensitivity analysis can be performed on this model using a simulation technique. In this analysis, individual parameters or specified groups of parameters are varied while other parameters remain constant. The results of the sensitivity analysis explain how and to what extent certain parameters or groups of parameters change predicted income. The sensitivity analysis assists the researcher in understanding the internal characteristics of the model.

The Experiment

Experimental methodology is useful in the examination of income smoothing. This methodology may be applicable to other traditional accounting issues. The results of experimental research can be compared with the results of research
that use alternative methodologies. If the results coincide, the evidence for the underlying hypothesis is increased.

Several suggestions for future research resulted from performing the experiment and conducting post experimental interviews. These are as follows: (1) the elimination of some experimental controls, (2) the substitution of cash flow trade-offs for earnings per share trade-offs, (3) the examination of the communication aspects of income smoothing, (4) the investigation of the effect of institutional investment on income smoothing and (5) the study of income smoothing with respect to different risk preferences.

Several intervening variables are controlled in this experiment. A discussion of these is found in the Internal Validity section of Chapter IV. One of the control devices consists of maintaining a slope of zero for a trend line fitted to an earnings per share stream. If the slopes of the fitted trend lines are allowed to vary, the effect of different growth rates on income smoothing behavior is revealed. A subject may be willing to trade-off the reduction of variability in the earnings stream for growth. Another control device is the elimination of tax effects from the experiment. Tax consequences could have significant impact upon smoothing behavior. A study could be made of the effect of various tax structures and tax rates on the degree of income smoothing.
Many subjects suggested that the choice of a trade-off of cash for reducing the variability of the earnings per share stream is more difficult than the choice that they were confronted with in the experiment. Some subjects noted that the cash trade-off has a real effect upon the company while the earnings per share trade-off does not. By using cash instead of earnings per share, the subject places a monetary value on a specific amount of variability reduction of the earnings per share stream.

In many instances, the subjects stated that income smoothing is necessary because of the lack of communication between the manager and the owner. The manager cannot explain the reason for fluctuations in income smoothing from year to year to every individual stockholder. Due to these limitations, income should be smoothed in order to eliminate the need for detailed communication. The extent of smoothing should be examined with alternate communication networks, and with varying degrees of accessibility to the owners.

Some institutional investors, such as insurance companies and pension funds, have certain investment requirements. An example of this is the requirement for certain ratios to be maintained above some specific level. Since many ratios contain earnings, managers may desire to smooth earnings so that the ratios will not decline below the required level. The effect of institutional investors on income smoothing has not been investigated even though their
impact may be significant.

Finally, the risk preferences of a manager could effect his smoothing behavior. A risk averse manager may choose to smooth earnings per share instead of maximizing earnings per share. A risk seeking manager would follow the opposite strategy. The effect of risk on income smoothing could be tested using two different techniques. One technique is to measure a subject's risk preference independent of the determination of the subject's smoothing behavior. If risk averse subjects smooth more than risk seeking subjects, a direct relationship exists between risk aversion and smoothing behavior. Another method of testing the relationship between risk preferences and smoothing behavior is to experimentally manipulate the subject's risk preferences. This can be accomplished by verbally instructing the subject that his company and superiors are all risk averse, risk neutral, or risk seekers. To what extent a company is risk averse, risk neutral, or risk seeking can be demonstrated by example.
APPENDIX A

EXPERIMENTAL QUESTIONNAIRE ADMINISTERED TO FINANCIAL EXECUTIVES
DECISION MAKING AND ITS RELATIONSHIP TO EARNINGS PER SHARE

You are asked to assume the role of controller of two corporations (A and B). The two corporations are of equal size but are separate and independent of each other. The objective of both corporations is the maximization of stockholder wealth. Corporation A's stock is traded on a major stock exchange and has highly diverse ownership. Corporation B does not list its stock on an exchange and has a small group of owners. Your job security, salary, bonuses, and advancement will probably be affected by how satisfied the stockholders are with reported earnings.

In your role as controller, you will be making two accounting decisions and two business decisions. The accounting decisions consist of the selection of a depreciation method (straight-line vs. sum-of-years digits), and the selection of a method for the investment tax credit (flow-through vs. deferred). Similarly, the business decisions consist of the selection of an advertising plan (Plan A vs. Plan B), and the selection of a research and development project (Project X vs. Project Y). The accounting decisions in no way effect outcomes of business decisions and the business decisions in no way effect the outcomes of accounting decisions. The decisions you make should be 104.
based on information provided in this study.

You will be given twelve separate cases. An example of these cases is given below. The pre-decision E.P.S. is the E.P.S. for each year before any accounting or business decisions are made. The four choices given represent the effect upon E.P.S. of those particular choices. Total E.P.S. represents the sum of the pre-decision E.P.S. and the effect on E.P.S. of the choice made. This is to be filled in by you. This number is the total reported E.P.S. (ignoring taxes) for the year. In each case, once a choice is made, you must stay with this choice for all six years.

SAMPLE CASE - Company A

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-decision E.P.S.</td>
<td>$1.00</td>
<td>$1.00</td>
<td>$1.00</td>
<td>$1.00</td>
<td>$1.00</td>
<td>$1.00</td>
</tr>
<tr>
<td>1) straight-line and flow-through</td>
<td>0.10</td>
<td>0.20</td>
<td>0.30</td>
<td>0.40</td>
<td>0.50</td>
<td>0.60</td>
</tr>
<tr>
<td>2) straight-line and deferred</td>
<td>0.70</td>
<td>0.80</td>
<td>0.90</td>
<td>1.00</td>
<td>1.10</td>
<td>1.20</td>
</tr>
<tr>
<td>3) sum-of-years and flow-through</td>
<td>1.30</td>
<td>1.40</td>
<td>1.50</td>
<td>1.60</td>
<td>1.70</td>
<td>1.80</td>
</tr>
<tr>
<td>4) sum-of-years and deferred</td>
<td>1.90</td>
<td>2.00</td>
<td>2.10</td>
<td>2.20</td>
<td>2.30</td>
<td>2.40</td>
</tr>
</tbody>
</table>

Total E.P.S. $____ $____ $____ $____ $____ $____

*subsequent years (after year six) are unknown but are unaffected by choice made.

If choice one is selected, circle choice one. The total E.P.S. for Year 1 would be $1.00 (Pre-decision E.P.S.) plus 0.10 (Choice 1) or $1.10. Year 2 would be $1.00 plus 0.20 or $1.20. Therefore, you would insert these totals for all
six years as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total E.P.S.</td>
<td>$1.10</td>
<td>$1.20</td>
<td>$1.30</td>
<td>$1.40</td>
<td>$1.50</td>
<td>$1.60</td>
</tr>
</tbody>
</table>

If choice two is selected, circle choice two and fill in the blanks at the bottom of the page as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total E.P.S.</td>
<td>$1.70</td>
<td>$1.80</td>
<td>$1.90</td>
<td>$2.00</td>
<td>$2.10</td>
<td>$2.20</td>
</tr>
</tbody>
</table>

The same procedure would be followed if choice three or choice four were selected.

Although it should take about one half hour or less, there is no time limit to complete this task. Since there are no right or wrong selections; please do not think of this as a test. All results will be kept confidential. Thank you for your cooperation.
Company A (traded on major stock exchange; diverse ownership)

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-decision E.P.S.</td>
<td>$0.10</td>
<td>$0.30</td>
<td>$0.10</td>
<td>$0.20</td>
<td>$0.10</td>
<td>$0.20</td>
</tr>
<tr>
<td>1) straight-line and flow-through</td>
<td>$0.20</td>
<td>$0.10</td>
<td>$0.20</td>
<td>$0.20</td>
<td>$0.20</td>
<td>$0.20</td>
</tr>
<tr>
<td>2) straight-line and deferred</td>
<td>0.10</td>
<td>0.00</td>
<td>0.50</td>
<td>0.10</td>
<td>0.40</td>
<td>0.00</td>
</tr>
<tr>
<td>3) sum-of-years and flow-through</td>
<td>0.00</td>
<td>0.40</td>
<td>0.10</td>
<td>0.40</td>
<td>0.00</td>
<td>0.20</td>
</tr>
<tr>
<td>4) sum-of-years and deferred</td>
<td>0.10</td>
<td>0.20</td>
<td>0.30</td>
<td>0.00</td>
<td>0.40</td>
<td>0.10</td>
</tr>
<tr>
<td>Total E.P.S.</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
</tbody>
</table>

*subsequent years (after year six) are unknown but are unaffected by choice made.

REQUIRED: (1) Circle the one choice of the four selected.
(2) Fill in the blanks with the appropriate E.P.S.

Company B (not traded on stock exchange; few owners)

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-decision E.P.S.</td>
<td>$0.10</td>
<td>$0.30</td>
<td>$0.10</td>
<td>$0.20</td>
<td>$0.10</td>
<td>$0.20</td>
</tr>
<tr>
<td>1) straight-line and flow-through</td>
<td>$0.20</td>
<td>$0.10</td>
<td>$0.20</td>
<td>$0.20</td>
<td>$0.20</td>
<td>$0.20</td>
</tr>
<tr>
<td>2) straight-line and deferred</td>
<td>0.10</td>
<td>0.00</td>
<td>0.50</td>
<td>0.10</td>
<td>0.40</td>
<td>0.00</td>
</tr>
<tr>
<td>3) sum-of-years and flow-through</td>
<td>0.00</td>
<td>0.40</td>
<td>0.10</td>
<td>0.40</td>
<td>0.00</td>
<td>0.20</td>
</tr>
<tr>
<td>4) sum-of-years and deferred</td>
<td>0.10</td>
<td>0.20</td>
<td>0.30</td>
<td>0.00</td>
<td>0.40</td>
<td>0.10</td>
</tr>
<tr>
<td>Total E.P.S.</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
</tbody>
</table>

*subsequent years (after year six) are unknown but are unaffected by choice made.

REQUIRED: (1) Circle the one choice of the four selected.
(2) Fill in the blanks with the appropriate E.P.S.
### Company A (traded on major stock exchange; diverse ownership)

**Cell 2AX**

<table>
<thead>
<tr>
<th>Year</th>
<th>Pre-decision E.P.S.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6*</th>
</tr>
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1) straight-line and flow-through  
2) straight-line and deferred  
3) sum-of-years and flow-through  
4) sum-of-years and deferred  

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<th>Total E.P.S.</th>
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</table>

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2) Fill in the blanks with the appropriate E.P.S.

### Company B (not traded on stock exchange; few owners)

**Cell 2AY**

<table>
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<tr>
<th>Year</th>
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Company A (traded on major stock exchange; diverse ownership)

Cell 3AX

<table>
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Total E.P.S.  

$$_ $$ $$ $$ $$ $$ $$

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Company B (not traded on stock exchange; few owners)

Cell 3AX

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<td>$0.20</td>
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<tr>
<td>1) Plan A and Project X</td>
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Company B (not traded on stock exchange; few owners)

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<td>2) Plan A and Project Y</td>
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APPENDIX B

EXCERPTS FROM THE
POST EXPERIMENTAL INTERVIEWS

113.
This appendix contains paraphrased excerpts from the post experimental interviews. The subjects' comments are selected on the basis of interest and relevance. Repetitive statements are not included. The subjects' remarks are written as close to the original conversation as possible.

Subject 1: It is best to smooth with an upward trend. The accounting decisions are easy to make because there are no cash flow implications. The business decisions have cash flow implications.

Subject 2: A firm should smooth for the purpose of borrowing funds. Earnings per share should be maintained at a reasonable level in order to demonstrate to the creditors that the company is capable of repaying the debt.

Subject 3: There can be only one right way to reflect results of operations within the framework of GAAP. Therefore, Corporation A and Corporation B reflect each decision on the same bases.

Subject 4: If cash flows were used instead of earnings per share, I might have ignored extreme fluctuations and strictly maximized.

Subject 5: The executive is concerned with long range effects of their decisions. Many things influence decisions besides the smoothness of the earnings per share stream. Earnings doesn't have as much bearing on decisions as it did a few years ago because of the loss of glamor of the earnings ratios and their impact on the stock market. More emphasis
Management does not deliberately attempt to smooth but rather reacts to the environment. Management has a duty to perform for the stockholders, especially in today's legal environment.

Subject 6: Smoothing is convenient for potential investors in order to make decisions. Smoothing is important because the value of a stock is a function of expectations of future earnings.

Subject 7: I maximized for the closely held company and smoothed for the widely held company because I could communicate more openly with the owners of the closely held company. It is difficult to be candid with a large group of owners, even though that is what I desire.

Subject 8: I can't communicate with many owners but I can with a few owners.

Subject 9: If I was going to sell a closely held company, I would maximize earnings. Otherwise, I would smooth earnings.

Subject 10: Accounting decisions should not change the operations of a business. However, I would be willing to change the operation in order to show greater earnings.

Subject 11: We play a corporate game by making sub-optimal business decisions in order to manipulate earnings per share. However, we are seeing less of this practice recently.

Subject 12: It has been increasingly difficult to smooth income in the last five years. There is no where near the
flexibility we used to have. Also, we try to be consistent
from year to year because of our external auditors. Also,
we are more precise in making our quarterly reports.
Subject 13: In the real world we are able to optimize cash
flows without adversely affecting earnings per share. The
reason for this is that we make a large number of business
decisions. First we examine discounted cash flow. We worry
about earnings subsequently.
Subject 14: There is a need to close down accounting alter­
natives. Ninety-eight percent of the investors don't under­
stand what is going on. They just compare one company to
another on the basis of reported income. We need to stan­
dardize for comparative purposes.
Subject 15: A patterned predictable earnings trend is more
important in publicly held companies than in closely held
companies. Earnings should be predictable.
Subject 16: The stability of earnings per share enters into
our capital budgeting decisions.
Subject 17: Communication is important; we smooth because
we can't communicate to the market, just to a few stockholders.
Subject 18: Smoothing for closely held companies is important
because these companies need credit.
Subject 19: The ownership structure should not dictate
what is right or wrong in selecting accounting alternatives.
Subject 20: Businesses in general focus on earnings per
share. More attention should be paid to cash flows. Analysts
and investors need to be educated to orient themselves away from return on equity and toward cash flow. Dividends are also an important consideration.


