STRUCTURAL CHANGES IN SYSTEMATIC RISK AND INFLATION ACCOUNTING: A THEORETICAL AND EMPIRICAL EXAMINATION OF ASR190 AND FAS33

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PREFACE

This study is concerned with the effect of specific and general price changes on a firm's systematic risk. To capture this effect, a theoretical model based on capital asset pricing theory is developed. In the development of this theoretical model, it is shown that specific and general price changes can affect a firm's risk. Thus, disclosure of this information could be useful for risk assessment. It is further shown that even when there are no general price changes, disclosure of specific price information can be useful.

Three empirical tests are performed to test the theoretical model. The first and second tests address the usefulness of mandated inflation accounting disclosures. The third test examines systematic risk changes in periods characterized by different inflation rates. Results of the empirical tests indicate that mandated inflation accounting disclosures do not appear to significantly affect investors' risk assessments. Also, the number of risk changes in the three different inflation periods is not significantly different.

These results do not imply that mandated inflation accounting disclosures are not needed, or that inflation has no effect on risk. However, they may suggest that data currently being disclosed is not adequate or sufficient. In any case, by first developing a theoretical model and then empirically testing this model, the merits of disclosure of specific and general price information can be assessed more accurately.

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CHAPTER I

INTRODUCTION AND STATEMENT OF THE PROBLEM

The Financial Accounting Standards Board (FASB) issued Statement No. 33 (FAS33) in September, 1979, requiring public enterprises meeting certain size requirements to disclosed supplementary, inflation-adjusted information. This standard replaced Accounting Series Release 190 (ASR190), which the Securities and Exchange Commission (SEC) adopted in 1976 requiring disclosure of replacement cost data in corporate 10-K reports. ASR190 did not require the restatement of earnings or the disclosure of data adjusted for general price level changes. Consequently, ASR190 was subjected to a considerable amount of criticism, and the SEC indicated to the FASB that is would be withdrawn if the Board would issue a suitable statement, which resulted in FAS33.

By requiring the disclosure of inflation-adjusted numbers, the FASB hoped to supply users with information to more accurately assess the amount, timing, and uncertainty of prospective cash flows in accordance with the objectives of financial reporting (FASB, 1978). The FASB was optimistic that, at the individual firm level, creditors and investors (as well as other users) would be more informed for the purpose of assessing (1) future cash flows, (2) enterprise performance, (3) erosion of operating capability, and (4) erosion of general purchasing power. From a macroeconomic viewpoint, an inflation adjusted cost of capital would lead to a more efficient allocation of resources, and governmental policymakers would have more relevant information on which to base economic policy.

Several studies have been performed to determine whether the objectives of ASR190 and FAS33 have been met. A variety of methodologies have been employed, including tests of capital market reaction to the disclosures and tests of the predictive ability of systematic risk using inflation-adjusted accounting data. This dissertation is related to studies performed in these two specific areas.

Before discussing the studies in these areas and comparing them to the work performed in this study, however, a background of mandated inflation accounting disclosures is presented. Therefore, the first section of this chapter discusses the background and content of ASR190 and FAS33. The second section then describes the previous studies in these two areas that tested for usefulness of inflation disclosures. The third section includes a statement of the problem addressed in this study, while the last section contains a summary of the content of this study.

Background--ASR190 and FAS33

The issue of requiring inflation disclosures became a topic of major concern in 1973 because of the first oil crisis and double-digit inflation. Early in 1974, the FASB issued a discussion memorandum calling for the presentation of supplemental, general price level-adjusted statements. The SEC, however, desired disclosure of supplementary information with respect to specific price changes, not general price changes. The FASB argued that presenting both sets of information would be too burdensome for businesses. In August of 1975, the SEC proposed requiring replacement cost data, and the FASB postponed making an inflation decision. The result of the SEC's proposal was ASR190, which required that supplemental replacement cost information on inventory, cost of goods sold, property, plant, and equipment, and depreciation be included in corporate 10-K reports. This rule applied to all firms with (1) total inventory and gross property, plant, and equipment in excess of $100 million, and (2) total inventory and gross property, plant, and equipment representing more than 10 percent of total assets. ASR190 did not require the restatement of earnings, which the FASB felt users of information really needed and wanted.

ASR190 was soon subjected to a considerable amount of criticism, and the SEC indicated to the FASB that it would be withdrawn if the Board would issue a suitable statement. In December of 1978, the FASB issued a new Exposure Draft giving management the option to choose between constant-dollar (general price change) or current cost (specific price change) accounting (FASB, 1978). Eventually, FAS33 was issued in September, 1979, requiring both of the restatements for companies that had either:

1. Inventory and net property plant and equipment of at least $125 million, or

2. Total assets over $1 billion.

The dual-disclosure approach was selected because of the diversity of opinion expressed by the respondents to the Exposure Draft. The required general price change data was:

1. Information on income from continuing operations for the current fiscal year on a historical cost/constant dollar basis, and

2. The purchasing power gain or loss on net monetary items for the current fiscal year.

The required specific price change data was:

1. Information on income from continuing operations for the current fiscal year on a current cost basis,

2. The current cost amounts of inventory, property, plant, and equipment at the end of the current fiscal year, and

3. Increases or decreases for the current fiscal year in the current cost amounts of inventory and property, plant, and equipment, net of changes in the general price level.

The FASB stated that it intended to assess the usefulness of both types of information and to undertake a comprehensive review no later than five years after its implementation. This comprehensive review is still pending; however, the FASB recently eliminated the requirement for disclosure of historical cost/constant dollar information for those enterprises that present current cost/constant dollar information (FASB, 1984). In announcing this elimination, the FASB stated that a proposed statement is currently in process that will address current cost/ constant purchasing power disclosures and will combine all pronouncements related to FAS33.

Prior Research

In its Invitation to Comment on the Need for Research (1981), the FASB encouraged additional research to determine if its objectives were being met. A sample list of research questions was included as part of this Invitation to Comment, two of which included,

1. Are there any immediate effects on stock prices or trading volume at the time of disclosures?

2. Do the disclosures affect analysts' estimates of future cash flows or assessments of risk (emphasis added)?

Several studies have attempted to answer these questions by relying on capital market theory (Sharpe, 1963) and the related capital asset pricing model (CAPM) developed by Sharpe (1964), Linter (1965), and Mossin (1966). This theory provides a framework from which it is possible to draw implications concerning the role of accounting information in an efficient market. A brief review of this theory is warranted.

All investors are assumed to be risk averse and desire to maximize expected utility. Under uncertainty, each investor is faced with a set of probability distributions on market values of firms at the beginning of the period. Each probability distribution is characterized by two parameters, the mean and standard deviation, and it is assumed that investors can summarize their investment opportunities in terms of these parameters. The mean is viewed as a measure of the expected requrn of the investment, while the standard deviation is regarded as the measure of the riskiness of the investment. Hence, investment analysis is reduced to assessing the risk-return characteristics of return distributions that exist at the beginning of the period.

The related CAPM, discussed in more detail in Chapter II, yields a picture of market equilibrium that implies a relationship between a measure of risk for the individual assets and their expected return. Within the context of this model, the only variable that determines the differential riskiness among securities is the systematic risk, and therefore the role of accounting information focuses on systematic risk. Beaver (1972) states this explicitly:

> Moreover, in an efficient market, the only potential value of accounting information to the individual investor would be the assessment of the risk (and hence, expected return) associated with a given portfolio, which in turn would involve estimation of the systematic risk component for the individual securities that constitute the portfolio (p. 423).

Thus, one role of accounting information would be to improve predictions of risk and expected return.

Past empirical studies addressing the above-mentioned questions asked by the FASB have relied on estimates of systematic risk to test for the usefulness of inflation disclosures. Sharpe's (1963) market model has been used to estimate the statmetic risk component (beta) of an individual security return relative to the market return.[1] These studies can be broadly classified into two categories. The first category contains studies which tested for the information content of accounting disclosures by looking at security-returns behavior. The analysis of returns behavior, however, hinged on estimates of beta as derived from the market model. If "abnormal" returns were generated when the information was disclosed, then this was considered to be evidence that accounting information had an impact on the market. Similar studies correlated various accounting measures with security returns.

The second category contains studies which used beta as the dependent variable in a regression on several accounting risk measures (ARMs). If these ARMs could be used to form superior risk forecasts (as compared to the naive forecast model or technically-based forecast

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[1]This model is described in detail in Chapter II.

models), then it is argued that this leads to an improvement in decision making at the individual level.[2]

Information Content Studies

Many studies were performed testing for market reaction to ASR190 after it was promulgated in 1976. Tests included ASR190's initial proposal, its effective date, and the dates when the actual replacement cost information was filed with the SEC. These studies included Abdel-khalik and McKeown (1978), Beaver, Christie, and Griffin (1980), Gheyara and Boatsman (1980), and Ro (1980, 1981). They were unanimous in their failure to detect a price or volume reaction to the SEC regulation mandating the disclosure of replacement cost data. Although all the studies used basically the same set of data, the finding of no market reaction is strengthened by the fact that the studies used different methodological approaches.

Beaver, Griffin, and Landsman (1981) used a cross-sectional approach to assess the incremental value of ASR190 data using the period 1972-1978. They found that a historical cost measure of income correlated more closely with security returns than an ASR190 measure of income (preholding gain net income). Moreover, once historical cost income is known, a replacement cost measure of net income provides no additional useful information. The reverse was found not to be true. Clearly,

[2]Whereas this model assumes that the capital market is "efficient" at the aggregate level, it says nothing about information efficiency at the individual investor level. An investor can still earn an abnormal return, but not consistently over time.

the results of this study are consistent with the results of the market reaction studies above.

Because FASB33 has only been effective since 1979, few published studies have been able to use actual FAS33 data. However, this has not prevented researchers from testing the reaction to FASB deliberations on FAS33. Noreen and Sepe (1981) investigated the impact on the market of three events: (1) the addition of general price-level disclosures to the FASB's agenda in January, 1974; (2) the November, 1975, decision not to issue a report by year-end; and (3) the report in January, 1979, to propose a standard (which culminated, of course, in FAS33). Firms were partitioned into those that would be "affected" and those that would be "exempt." If an affected firm experienced a positive price reaction when events (1) and (3) occurred, then a "price reversal" for event (2) might be expected.

The results, based on correlations between events for affected firms, suggest there was a reaction. For 100 firms with the lowest prior-period variance of prices, the results were even more significant. These firms were chosen since they were the ones least likely to have a market reaction anyway.

A study by Beaver and Landsman (1984) used a two-stage regression to test for relationships between accounting data and security returns. Using actual FAS33 earnings data and historical cost earnings data, they found that historical cost was the only predominant variable explaining security returns. In other words, FAS33 disclosures had no incremental information content.

Another similar unpublished study by Elgers, Hogan, Mannino, and Murray (1983) used actual FAS33 data to test the degree of association between unexpected earnings (as computed using nominal dollars, constant dollars, and current dollars) and abnormal security returns. Their results indicated that after controlling for the information content of historical cost information, additional inflation disclosures do not substantially contribute toward explaining interfirm differences in security returns.

Systematic Risk Prediction Studies

ASR190's adoption resulted in several empirical studies testing for associations between inflation-adjusted ARMs and beta. Basu (1977) and Short (1978) used historical cost (HC) and general price level (GPL) ARMs as explanatory variables for beta. The results were conflicting. Basu concluded that HC and GPL ARMs are interchangeable, while Short found that GPL ARM's had a 34 percent increase in explanatory power. Baran, Lakonishok, and Ofer (1980) estimated GPL data using validated techniques and found that, over an 18 year period (1957-1974), GPL accounting beta had a higher association with the market beta than did HC accounting beta. This was true for three different definitions of earnings. The authors also analyzed two subperiods, noting no significant difference for the subperiod 1957-1965, while GPL data were superior for 1966-1974. They explained that this may have been due to a learning effect during the second, more inflationary subperiod.

The previously cited unpublished study by Elgers et al. (1983) also contained a test using several ARMs measured in nominal, constant, and current dollars. They found that a combined information set had the highest explanatory power. Interestingly, though, nothing was done to "correct" for betas mean regression tendencies or to allow for unstable ARMs.

Criticisms and Limitations

A wide variety of methodological approaches have been used in both of the above types of studies. When taken together, the conclusions reached provide little evidence of market reaction to price change disclosures, and conflicting evidence on predictability value of these disclosures. One reason for this, perhaps, is that none of the studies incorporated price changes into the theory on which the tests were based. If inflation or inflation disclosures has an effect on systematic risk, then the results of these studies may be erroneous. For example, if the returns calculated in information content studies were based on a parameter that was by itself affected by inflation (or inflation disclosure), then it may not have been possible to identify an "abnormal" return caused by the disclosure.

By the same token, the dependent variable (beta) used in the systematic risk prediction studies may have been affected by general and specific price changes. Moreover, most of the independent variables (ARMs) used in the studies were not theoretically linked to systematic risk.[3] Without a theory explaining which ARMs (whether historical or inflation-adjusted) to include in the tests, the differences in explanatory power between historical models and price level adjusted models could be due to a misspecification of the model.

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[3]While past analytical studies (Hamada, 1969, 1972; and Conine, 1980) have identified financial leverage as a determinant of risk, other variables identified as being theoretically linked to beta have not been put to empirical test. The reason for this is that these variables (e.g., ratio of fixed costs to variable costs, covariability of firm output level to market return) are extremely difficult to operationalize.

Lev and Ohlson (1983) commented on the need for such a theory:

> The 'positive' work has generally been disappointing, and there have been few, if any, serious 'normative' studies. Much of the 'positive' work is best described as 'fishing expeditions.' Consideration is seldom given to what determines systematic risk and why there ought to be a change in risk because the accounting and economic environments have changed (p. 65).

In addition to the lack of a theoretical foundation, a limitation common to all the studies reviewed in this section is that they either analyzed only a small amount of data or, in the case of studies such as Basu (1977), Short (1978), and Baran et al. (1980), had to estimate general price-level data using estimation techniques that were of questionable validity.[4] As more years of FAS33 data become available, tests based on time-series information are possible.

Statement of the Problem

Lev and Ohlson are but two of several researchers calling for the development of a theory linking systematic risk and accounting information. Revsine (1970), for example, was one of the first to recognize the need for such a theory in the replacement cost area:

> In summary, empirical evidence is an important component of the total research process. In the replacement cost area, however, there is no underlying theoretical base to guide empirical tests. Without this base, empirical tests are likely to be disjointed. Much effort would be

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[4]Walther (1982) has shown that two of the most widely-used models for estimating general price level data contain a great deal of measurement error. He showed that estimated purchasing power gains and losses overstated actual amounts by 70.11 percent and estimated general price level adjusted depreciation expense exceeded actual by about 14 percent for both the Davidson-Weil and Parker models. Cost of goods sold was very close to actual for both models.

> wasted in attempting to discover what might later prove to be irrelevant data. In the long run, it would seem to be far more efficient if the needed theoretical foundation were developed first. Then, with this foundation to guide later testing of the theory, empirical progress would be expedited (p. 3).

At present, an accurate assessment of the effects of inflation on an individual firm is unclear, if prices of specific goods and services change at a rate different than the general price change. As Beaver and Landsman (1984, p. 3) point out, "In a world where prices change at different rates, inflation is a subjective concept, and controversies arise as how best to measure it." Therefore, a theory which predicts the effects of price changes on future cash flows and riskiness of these flows would allow stronger implications to be drawn from empirical tests.

No theory currently exists which links the effects of price changes to systematic risk. The objective of this research is first to incorporate specific and general price changes into traditional capital market theory, and then to determine whether these variables affect systematic risk. If it can be shown that price change variables do affect systematic risk, then a logical question is whether ASR190 and/or FAS33 disclosures enabled investors to obtain more accurate measures of these variables. This question is addressed in the first two empirical tests. The third empirical test examines the effects of general price changes on systematic risk.

Summary of Content

Chapter I introduced the problem of disclosing inflation-adjusted accounting information. Several capital market studies testing for the information value of these disclosures were discussed. It was pointed out that one of the possible reasons these studies have not provided overwhelming evidence for or against ASR190 or FAS33 disclosures is that no theory currently exists which links the effects of price changes to systematic risk. By first developing a theoretical model incorporating price change variables, the effect of price changes on systematic risk can be assessed. Empirical tests can then be performed to see if the disclosures required by ASR190 and FAS33 contained information about these price change variables. If so, investors may have revised their systematic risk assessments based on this information.

Chapter II presents the analytical development of the model, which explicitly incorporates specific and general price changes. Chapter III explains the design and methodology of the three empirical tests to be performed, while Chapter IV provides an analysis of the results. Chapter V concludes with a summary of the findings of the study, a discussion of its limitations, and suggestions for future research.

CHAPTER II

PRICE CHANGES AND BETA: AN ANALYTICAL EVALUATION

The objective of this chapter is to explore analytically the effects of specific and general price changes on systematic risk. The first section presents a model linking beta to firm value in a non-inflationary environment. This model, which is based on capital market theory, is then expanded in the second section to reflect price changes, and it is examined to determine whether these price change parameters affect beta. The third section illustrates several different cases of price changes by means of numerical examples. The first set of cases involves only specific price changes, while the second set is expanded to include both specific and general price changes. The fourth section discusses some implications of the model which are useful in providing a basis on which to empirically test the relationships between systematic risk and price changes. Finally, the last section summarizes the chapter.

Review of the CAPM

The theoretical examination of the linkages between beta and price changes is done using the Capital Asset Pricing Model (CAPM) developed by Sharpe (1964), Lintner (1965), and Mossin (1966). According to the CAPM, the equilibrium expected return is:

$$\bar{r}_{jt} = i + \frac{\text{cov}(\tilde{r}_{jt}, \tilde{r}_{mt})[\bar{r}_{mt} - i]}{\text{var}(\tilde{r}_{mt})}$$

$$= i + \beta_j[\bar{r}_{mt} - i] \tag{1}$$

where $\tilde{r}_{jt}$ = the rate of return for period t on asset j,

$\tilde{r}_{mt}$ = the rate of return for period t on the market portfolio,

$\bar{r}_{jt}$ = the expected value of $\tilde{r}_{jt}$,

$\bar{r}_{mt}$ = the expected value of $\tilde{r}_{mt}$,

i = the riskless rate of return, and

$\beta_j = \text{cov}(\tilde{r}_{jt}, \tilde{r}_{mt})/\text{var}(\tilde{r}_{mt})$.

The only firm-specific determinant of $\bar{r}_{jt}$ is β_j, which is referred to as firm j's systematic risk, or beta.

The rates of return are defined as:

$$\tilde{r}_{jt} = \frac{\tilde{YY}_{jt+1}}{V_{jt}} - 1 \tag{2}$$

$$\tilde{r}_{mt} = \frac{\tilde{MM}_{t+1}}{X_t} - 1 \tag{3}$$

where: $\tilde{YY}_{jt+1}$ = the end-of-period cash income plus end-of-period market value of asset j,

V_{jt} = the current equilibrium value of asset j,

$\tilde{MM}_{t+1}$ = the end-of-period cash income plus end-of-period market value of the market portfolio, and

X_t = the current equilibrium value of the market portfolio.

To simplify the analysis, equations (2) and (3) are redefined as:

$$\tilde{r}_{jt} = \frac{\tilde{Y}_{jt+1}}{V_{jt}} \tag{2a}$$

$$\tilde{r}_{mt} = \frac{\tilde{M}_{t+1}}{X_t} \tag{3a}$$

where $\tilde{Y}_{jt+1}$ = the end-of-period net cash income for asset j and

$\tilde{M}_{t+1}$ = the end-of-period net cash income of the market portfolio.

Notice that end-of-period market value is not included in $\tilde{Y}_{jt+1}$ or $\tilde{M}_{t+1}$. Since end-of-period value is a deterministic component of $\tilde{Y}Y_{jt+1}$ or $\tilde{M}M_{t+1}$, excluding it in the definition of $\tilde{Y}_{jt+1}$ or $\tilde{M}_{t+1}$ will not affect the subsequent analysis (its inclusion would merely result in additional non-relevant terms). Exclusion of V_{jt+1} and X_{t+1}, therefore, allows the effects of price changes to be more readily observed.

Subsequent analysis is also facilitated using a cash-based version of the usual rate-of-return version described by equation (1). To achieve this cash-based version, equations (2a) and (3) are substituted into (1). Rearranging, we have:

$$V_{jt} = \frac{\bar{Y}_{jt+1} - \lambda \mathrm{cov}(\tilde{Y}_{jt+1}, \tilde{M}_{t+1})}{i} \tag{4}$$

where $$\lambda = \frac{\bar{M}_{t+1} - iX_t}{\mathrm{var}(\tilde{M}_{t+1})} \tag{5}$$

The parameter λ is the equilibrium price per unit of market risk. To make the following analysis less cumbersome, subscripts are omitted unless needed for clarity.

The CAPM in an Inflationary Environment

In order to incorporate general and specific price changes into the model, six assumptions in addition to the standard assumptions of the CAPM are made. This section will begin with a list of these assumptions, to be followed by (1) development of the model,

(2) statement of the central proposition, and (3) presentation of three corollaries resulting from the central proposition.

Additional Assumptions

Assumption 1: Two inputs are used to produce the output.

Assumption 2: Output price in a noninflationary environment equals input cost plus profit (where profit is a fixed percentage of inout cost).

Assumption 3: $\bar{r}^*_m = \bar{r}_m + g$, that is the expected market rate of return in the presence of inflation equals the expected market rate in the absence of inflation plus the inflation rage g (Fisher effect).[1]

Assumption 4: $i^* = i + g$, that is the risk-free rate of return in the presence of inflation equals the risk-free rate in the absence of inflation plus the inflation rate (Fisher effect).

Assumption 5: $\tilde{M}^* = (1 + g)\ \tilde{M}$, where $\tilde{M}^*$ is the end-of-period cash flow on the market portfolio in an inflationary environment.

Assumption 6: The firm experiences a specific rate of input price increases of k_e and passes along rate t_e to the consumer.

The Effect of Price Changes on the CAPM

Given Assumptions 1 and 2, the end-of-period cash income in a noninflationary environment can be expressed as:

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[1]Assumption 3 insures that if a change in systematic risk is experienced by a firm due to disclosure of price-level data, then the systematic risk of the rest of the market adjusts so as to maintain general equilibrium. Specifically, this assumption guarantees that $\beta = 1$ is the market risk.

$$\tilde{Y} = \pi(\tilde{c}_1 + \tilde{c}_2) = \pi c_1 + \pi c_2 = \tilde{Y}_1 + \tilde{Y}_2 \quad (6)$$

where c_e = cost of input e and

π = profit rate as a percentage of cost.

In an inflationary environment, the end-of-period income, $\tilde{Y}^*$, can be determined using Assumption 6. According to Assumption 6, if c_e is the cost of input e, then $t_e c_e$ is passed along to the consumer. If $t_e = k_e$, then all of the price increase is passed along to the consumer. It is also possible that $t_e \neq k_e$. This outcome is characterized as follows:

$$\tilde{Y}^* = \Sigma \pi c_e + \Sigma t_e c_e - \Sigma k_e c_e \quad (7)$$

From equation (6), $c_e = Y_e/\pi$. Substituting this expression for $\tilde{c}_e$ in equation (7), and rearranging:

$$\tilde{Y}^* = \phi_1 \tilde{Y}_1 + \phi_2 \tilde{Y}_2 \quad (8)$$

where $\phi_e = [(\pi + t_e - k_e)/\pi]$.

Clearly, ϕ_e is a function of specific price information. Thus, if it can be shown that ϕ_e is present in assessing systematic risk in an inflationary environment, then this implies that specific prices influence systematic risk. Proposition 1 below addresses this issue. To facilitate analysis of this proposition, however, four lemmas must first be developed.

Lemmas 1 and 2 analyze firm value in both noninflationary and inflationary environments. Lemmas 3 and 4 show the components of systematic risk in these environments.

Lemma 1: Firm value in a noninflationary environment can be expressed as:

$$V = V_1 + V_2$$

$$\text{where } V_e = \frac{[\bar{Y}_e - \lambda \mathrm{cov}(\tilde{Y}_e, \tilde{M})]}{i} \qquad i = 1, 2$$

Proof: Substitute equation (6) into equation (4) and rearrange.

Lemma 2: Firm value in an inflationary environment is expressed as:

$$V^* = \phi_1 V_1^* + \phi_2 V_2^*$$

$$\text{where } V^* = \frac{[Y_e - \lambda^* \mathrm{cov}(Y_e, M)]}{i^*}$$

$$\text{with } \lambda^* = \frac{\bar{M}(\bar{r}_m - i^*)}{\bar{r}_m^* \ \mathrm{var}(\tilde{M})}$$

Proof: Using Assumptions 3 and 5:

$$\bar{r}_m^* = \bar{r}_m + g$$

$$\frac{(1+g)\bar{M}}{X^*} = \bar{r}_m + g$$

$$X^* = \frac{(1 + g)\bar{M}}{\bar{r}_m^*} \qquad (9)$$

Furthermore, Assumption 5 also implies:

$$\mathrm{var}(\tilde{M}^*) = (1 + g)^2 \ \mathrm{var}(\tilde{M}) \qquad (10)$$

Using Assumption 4, and substituting equations (8), (9), and (10) into equation (4), the following outcome is produced:

$$V^* = \frac{\phi_1\bar{Y}_1 + \phi_2\bar{Y}_2 - (1+g)\left[\dfrac{\bar{M} - \dfrac{i^*\bar{M}}{\bar{r}^*_m}}{(1+g)^2 \ \mathrm{var}(\tilde{M})}\right]\mathrm{cov}(\tilde{Y}^*, (1+g)\tilde{M})}{i^*}$$

$$= \frac{\phi_1\bar{Y}_1 + \phi_2\bar{Y}_2 - \dfrac{\left[(1+g)^2 \ \bar{M} - \dfrac{i^*\bar{M}}{\bar{r}^*_m}\right]}{(1+g)^2 \ \mathrm{var}(\tilde{M})}\mathrm{cov}(\tilde{Y}^*, \tilde{M})}{i^*}$$

$$= \frac{\phi_1\bar{Y}_1 + \phi_2\bar{Y}_2 - \dfrac{\bar{M}\dfrac{\bar{r}_m}{\bar{r}^*_m} - \dfrac{i^*\bar{M}}{\bar{r}^*_m}}{\mathrm{var}(\tilde{M})}\mathrm{cov}(\tilde{Y}^*, \tilde{M})}{i^*}$$

$$= \frac{\phi_1\bar{Y}_1 + \phi_2\bar{Y}_2 - \dfrac{\bar{M}\bar{r}^*_m - i^*\bar{M}}{\bar{r}^*_m \ \mathrm{var} \ (\tilde{M})}\mathrm{cov}(\tilde{Y}^*, \tilde{M})}{i^*} \tag{11}$$

From equation (11), the desired results directly follow. Q.E.D.

Since V* depends on ϕ_e and ϕ_e in turn depends on k_e, specific price information is useful in assessing firm value. Similarly, V^*_e is affected by g, and so general price information is useful in assessing firm value. From Lemma 1, the return of a two input firm can be expressed as:

$$\tilde{r} = \frac{\tilde{Y}_1 + \tilde{Y}_2}{V_1 + V_2}$$

$$= \frac{\tilde{Y}_1}{V_1 + V_2} + \frac{\tilde{Y}_2}{V_1 + V_2}$$

$$= \tilde{r}_1 + \tilde{r}_2 \tag{12}$$

Given equation (12), the following lemma can now be stated:

Lemma 3: The systematic risk of a firm in a noninflationary environment equals

$$\beta = \beta_1 + \beta_2$$

where $\beta_e = \dfrac{\text{cov}(\tilde{r}_e, \tilde{r}_m)}{\text{var}(\tilde{r}_m)}$

Proof: Follows directly from the substitution of equation (12) and the definition of β found in equation (1).

Lemma 4: Firm return in an inflationary environment and firm return in a noninflationary environment are related in the following way:

$$\tilde{r}^* = a_1\tilde{r}_1 + a_2\tilde{r}_2$$

where $a_e = \dfrac{\phi_e(V_1 + V_2)}{V^*}$ $\qquad i = 1, 2$

Proof: From equation (8) and Lemma 2:

$$\tilde{r}^* = \frac{\phi_1\tilde{Y}_1 + \phi_2\tilde{Y}_2}{V^*}$$

From equation (12) it is possible to substitute $r_e(V_1 + V_2)$ for $\tilde{Y}_e$, yielding:

$$\tilde{r}^* = \frac{\phi_1(V_1 + V_2)\tilde{r}_1 + \phi_2(V_1 + V_2)\tilde{r}_2}{V^*}$$

$$= \frac{\phi_1(V_1 + V_2)}{V^*}\,\tilde{r}_1 + \frac{\phi_2(V_1 + V_2)}{V^*}\,\tilde{r}_2$$

Q.E.D.

The Effect of Price Changes on Systematic Risk

Given the analysis above, the central proposition can now be stated:

Proposition 1: Specific and general price changes can affect a firm's systematic risk. Thus, price information has risk assessment value.

Proof: From Lemma 4, $\tilde{r}^* = a_1\tilde{r}_1 + a_2\tilde{r}_2$

Accordingly:

$$\beta^* = \text{cov}[(a_1\tilde{r}_1 + a_2\tilde{r}_2), \tilde{r}^*_m] / \text{var}(\tilde{r}^*_m)$$

$$= \frac{a_1 \text{ cov}(\tilde{r}_1, \tilde{r}^*_m)}{\text{var}(\tilde{r}_m)} + \frac{a_2 \text{ cov}(\tilde{r}_2, \tilde{r}^*_m)}{\text{var}(\tilde{r}^*_m)} \tag{13}$$

Now,

$$\tilde{r}_m = \frac{\tilde{M}^*}{X^*}$$

$$= \frac{(1+g)\tilde{M}}{(1+g)\bar{M} / (\bar{r}^*_m)} \quad \text{(using equation (9) and Assumption 5)}$$

$$= \frac{(\bar{r}^*_m)\tilde{M}}{\bar{M}}$$

$$= \frac{\bar{r}^*_m}{r_m}\tilde{r}_m \quad \text{(since } M = \tilde{r}_m X\text{)}$$

Let $z = \dfrac{\bar{r}^*_m}{\bar{r}_m}$

Thus,

$$\tilde{r}^*_m = z\tilde{r}_m \tag{14}$$

and

$$\text{var}(r^*) = z^2 \text{ var}(\tilde{r}_m) \tag{15}$$

Next, substitute equations (14) and (15) into (13), and simplify:

$$= (a_1/z) \frac{\text{cov}(\tilde{r}_1, \tilde{r}_m)}{\text{var}(\tilde{r}_m)} + (a_2/z) \frac{\text{cov}(\tilde{r}_2, \tilde{r}_m)}{\text{var}(\tilde{r}_m)}$$

or $\beta^* = (a_1/z)\beta_1 + (a_2/z)\beta_2$.

Since a_e is a function of ϕ_e and ϕ_e is a function of k_e, specific price changes affect β (by Lemma 3, $\beta = \beta_1 + \beta_2$). Moreover, z contains g, and therefore g affects β. Thus, both g and k_e are useful in assessing the systematic risk of a firm in environment with price changes. Q.E.D.

Two corollaries stemming from Proposition 1 can now be presented.

Corollary 1: A sufficient condition for systematic risk to be unaffected by specific price changes is for the firm to pass the total specific price increases of each input to the consumer.

Proof: $\beta = \beta^*$ if $(a_1/z) = (a_2/z)$. But $(a_1/z) = (a_2/z)$ implies $\phi_1 = \phi_2$. Since $\phi_e = [(\pi + t_e - k_e)/\pi]$, setting $t_e = k_e$ is one way to achieve $\phi_1 = \phi_2$. Q.E.D.

From this corollary, it is seen that a firm's systematic risk can be affected by its ability to transfer input price increases to the consumer. Firms that can more easily shift these price increases to the consumer will be less affected, in terms of systematic risk, than firms that cannot do so as readily.

Corollary 2: If g = 0, specific price information is still useful in assessing a firm's systematic risk.

Proof: For g = 0, z = 1. Furthermore, for g = 0, Lemma 2 implies $V_e^* = V_e$. Thus, $\beta^* = [(V_1 + V_2)/V^*]\phi_1\beta_1 + [(V_1 + V_2)/V^*]\phi_2\beta_2$, where

$V^* = \phi_1 V_1 + \phi_2 V_2$. Assessment of β^* still requires knowledge of ϕ_e which is a function of k_e. Q.E.D.

The above corollary establishes the value of specific price information even when general price inflation is nonexistent. Accordingly, even though general inflation has declined from the levels being experienced when FAS33 was mandated, disclosure of specific price information can still be helpful in assessing systematic risk.

The Effect of Price Changes on Systematic Risk: A Numerical Example

In order to better illustrate the effects of specific and general price changes on systematric risk, a numerial example is presented. Table I lists cash flow distributions for both a two-input firm (Firm A) and the market, along with related statistics computed for these distributions. Similarly, Table II lists the return distributions and related statistics. This data serves as the basis for examining the effect on beta, using several different price change scenarios. Before examining these price change scenarios, however, Table III presents similar information for Firm B. Notice that Firm A and Firm B make up the entire market. Also note that each firm's beta, weighted by its value in relation to the market, sums to one.

Table IV describes seven cases involving specific price changes, while Table V provides a listing of the parameter values associated with each case. Finally, Table VI presents the parameter values for the same seven cases, except that general price changes are introduced. By first examining the effects of specific price changes in a particular case, and then introducing general price changes, it is possible to

TABLE I

CASH FLOW DISTRIBUTIONS: TWO-INPUT FIRM AND MARKET

Firm A Cash Flow Distribution						Market Cash Flow Distribution	
Input 1		Input 2		Total			
Prob.	Cash Flow	Prob.	Cash Flow	Prob.	Cash Flow	Prob.	Cash Flow
1/3	60	1/3	40	1/3	100	1/3	500
1/3	80	1/3	50	1/3	130	1/3	1,000
1/3	105	1/3	55	1/3	160	1/3	1,500
$\bar{Y}_{1,t+1}$ =	81.67	$\bar{Y}_{2,t+1}$ =	48.33	$\bar{Y}_{A,t+1}$ =	130	$\bar{M}_{t+1}$ =	1,000
						Assume X_t =	5,000
						i =	.08

$cov(\tilde{Y}_{1,t+1}, \tilde{M}_{t+1}) = 7,500$ $\quad$ $cov(\tilde{Y}_{2,t+1}, \tilde{M}_{t+1}) = 2,500$ $\quad$ $cov(\tilde{Y}_{A,t+1}, \tilde{M}_{t+1}) = 10,000$

$var(\tilde{M}_{t+1}) = 166,667$

$\lambda = .0036$

$V_{1,t} = 683.37$ $\quad$ $V_{2,t} = 491.63$

$V_{1,t} + V_{2,t} = V_{A,t} = 1,175$

TABLE II

RETURN DISTRIBUTIONS: TWO-INPUT FIRM AND MARKET

Firm A Return Distribution						Market Return Distribution	
Input 1		Input 2		Total			
Prob.	Return	Prob.	Return	Prob.	Return	Prob.	Return
1/3	.0511	1/3	.0340	1/3	.0851	1/3	.1
1/3	.0681	1/3	.0426	1/3	.1106	1/3	.2
1/3	.0894	1/3	.0468	1/3	.1362	1/3	.3
$\bar{r}_{1,t}$ =	.0695	$\bar{r}_{2,t}$ =	.0411	$\bar{r}_{A,t}$ =	.1106	$\bar{r}_m$ =	.2
$cov(\tilde{r}_{1,t}, \tilde{r}_m) = .0013$		$cov(\tilde{r}_{2,t}, \tilde{r}_m) = .0004$		$cov(\tilde{r}_{A,t}, \tilde{r}_m) = .0017$		$var(\tilde{r}_m) = .0067$	
$\beta_1 = \frac{.0013}{.0067} = .194$		$\beta_2 = \frac{.0004}{.0067} = .06$				$\beta = \frac{.0017}{.0067} = .254$	
β_1 +		β_2 =		$\beta_A = .254$			

TABLE III

FIRM B INFORMATION

Firm B Cash Flow Distribution		Firm B Return Distribution	
Prob.	Cash Flow	Prob.	Return
1/3	400	1/3	.1046
1/3	870	1/3	.2275
1/3	1,340	1/3	.3503
$\bar{Y}_{B,t+1}$ =	870	$\bar{r}_{B,t}$ =	.2275
$cov(\tilde{Y}_{B,t+1}, \tilde{M}_{t+1})$ =	156,667	$cov(\tilde{V}_{B,t}, \tilde{V}_M)$ =	.0082
$V_{B,t}$ =	3,825	β_B =	1.224

$$\frac{V_{A,t}}{X_t} \beta_A + \frac{V_{B,t}}{X_t} \beta_B = \beta$$

$$\frac{1,175}{5,000} .254 + \frac{3,825}{5,000} 1.224 = \beta$$

$$.06 + .94 = 1.00$$

TABLE IV

DESCRIPTION OF SEVEN CASES INVOLVING SPECIFIC PRICE CHANGES

	Price Change Parameters		Description
Case 1A	k_1 = .00 t_1 = .00	k_2 = .00 t_2 = .00	This represents a world of no price changes.
Case 2A	k_1 = .20 t_1 = .00	k_2 = .20 t_2 = .00	The firm experiences a .20 increase in both inputs, but cannot pass along any of this increase to consumers.
Case 3A	k_1 = .20 t_1 = .20	k_2 = .20 t_2 = .20	The firm passes along the total price increase for both inputs to the consumers.
Case 4A	k_1 = .20 t_1 = .10	k_2 = .10 t_2 = .00	Only half the increase in the first input's price is passed along to the consumer, while none of the second input's price increase is passed along to the consumer. This case can be viewed as the more general case for Cases 2A and 3A, whereby $k_e - t_e = C$ for all e.
Case 5A	k_1 = .20 t_1 = .05	k_2 = .10 t_2 = .05	This firm experiences different rates of input price increases but can only shift a portion of these increases to consumers. The portion passed along to consumers is equal for each input. (Note that $k_e - t_e \neq C$ for all e.)
Case 6A	k_1 = .10 t_1 = .15	k_2 = .05 t_2 = .15	This is the opposite of Case 5A. While the firm incurs different input price increases, if shifts higher rates to consumers. The rates passed along to consumers are equal.
Case 7A	k_1 = .05 t_1 = .15	k_2 = .10 t_2 = .15	This is exactly like Case 6A, except k_e and t_e are reversed for each input.

Note: In all cases, no general price changes occur (i.e., g = 0).

TABLE V

THE EFFECTS OF SPECIFIC PRICE CHANGES ON SYSTEMATIC RISK

	$\bar{r}_m$	i	λ	ϕ_1	ϕ_2	$\bar{M}$	V_1	V_2	V*	a_1	a_2	Z	β_1^*	β_2^*	β*
Case 1A ($g=0$; $k_1=0$, $k_2=0$; $t_1=0$, $t_2=0$)	.2	.08	.0036	1	1	1,0000	683.37	491.63	1,175.00	1	1	1	.194	.06	.254
Case 2A ($g=0$; $k_1=.20$, $k_2=.20$; $t_1=0$, $t_2= 0$	.2	.08	.0036	.333	.333	1,000	683.37	491.63	391.27	1	1	1	.194	.06	.254
Case 3A ($g=0$;$k_1=.20$, $k_2=.20$; $t_1=.20$, $t_2=.20$)	.2	.08	.0036	1	1	1,000	683.37	491.63	1,175.00	1	1	1	.194	.06	.254
Case 4A ($g=0$; $k_1=.2$, $k_2=.1$; $t_1=.10$, $t_2=0$)	.2	.08	.0036	.667	.667	1,000	683.37	491.63	783.73	1	1	1	.194	.06	.254
Case 5A ($g=0$; $k_1=.2$, $k_2=.1$; $t_1=.05$, $t_2=.05$)	.2	.08	.0036	.50	.833	1,000	683.37	491.63	751.21	.782	1.303	1	.152	.078	.230
Case 6A ($g=0$; $k_1=.1$, $k_2=.05$; $t_1=.15$, $t_2=.15$)	.2	.08	.0036	1.167	1.333	1,000	683.37	491.63	1,452.84	.944	1.078	1	.183	.065	.248
Case 7A ($g=0$; $k_1=.05$, $k_2=.1$; $t_1=.15$, $t_2=.15$)	.2	.08	.0036	1.333	1.167	1,000	683.37	491.63	1,484.66	1.055	.924	1	.205	.06	.265

TABLE VI

THE EFFECTS OF GENERAL AND SPECIFIC PRICE CHANGES ON SYSTEMATIC RISK

	r^*_m	i^*	λ^*	ϕ_1	ϕ_2	$\bar{M}$	V^*_1	V^*_2	V^*	a_1	a_2	Z	β^*_1	β^*_2	β^*
Case 1B (g=.10; k_1=0, k_2=0; t_1=0, t_2=0)	.3	.18	.0024	1	1	1,000	353.72	235.17	588.89	2.00	2.00	1.50	.256	.080	.336
Case 2B (g=.10; k_1=.20, k_2=.20; t_1=0, t_2=0)	.3	.18	.0024	.333	.333	1,000	353.72	235.17	196.10	2.00	2.00	1.50	.256	.080	.336
Case 3B (g=.10; k_1=.20, k_2=.20; t_1=.20, t_2=.20)	.3	.18	.0024	1	1	1,000	353.72	235.17	588.89	2.00	2.00	1.50	.256	.080	.336
Case 4B (g=.10; k_1=.2, k_2=.1; t_1=.10, t_2=0)	.3	.18	.0024	.667	.667	1,000	353.72	235.17	392.79	2.00	2.00	1.50	.256	.080	.336
Case 5B (g=.10; k_1=.2, k_2=.10; t_1=.05, t_2=.05)	.3	.18	.0024	.50	.833	1,000	353.72	235.17	372.76	1,576	2,626	1.50	.204	.105	.309
Case 6B (g=.10; k_1=.1, k_2=.05; t_1=.15, t_2=.15)	.3	.18	.0024	1.167	1.33	1,000	353.72	235.17	726.27	1.888	2.157	1.50	.244	.086	.330
Case 7B (g=.0; k_1=.05, k_2=.10; t_1=.15, t_2=.15)	.18	.18	.0024	1.333	1.167	1,000	353.72	235.17	745.95	2.100	1.838	1.50	2.72	.074	.346

determine the relative impact of each price change of systematic risk. Cases 1A-7A represent the specific price and general price change scenarios. Each case is discussed below.

Case 1A presents a world in which there is no price change. Input 1 and Input 2's portion of the total systematic risk of .254 is .194 and .06, respectively. The introduction of a general price increase of .10 in Case 1B, however, causes beta to increase to .336 (or 32 percent). Each input's portion of this total risk rises to .256 and .080.

Cases 2A and 3A are simplifications of the more general Case 4A, which demonstrates that systematic risk is unaffected when the differences between the rate of input price increase (k_e) and the amount of this rate passed along to consumers (t_e) are the same for each input (that is, $k_e - t_e = C$ for all e). Case 2A shows a firm with price increases of .20 for each input, none of which is passed along to the consumer. Case 3A, on the other hand, shows a firm that shifts all of its .20 increase for each input to the consumer. Case 3A is a direct illustration of Corollary 1. Notice that beta in Cases 2B, 3B, and 4B are the same as Case 1B.

Case 5A illustrates the case in which a smaller percentage of the dominant input's price increase is passed along to the consumer, compared to the less dominant input (the dominant input is defined to be the input contributing the most to the firm's systematic risk). For example, only 25 percent of input 1's price increase is passed along to the consumers as compared to 50 percent of inputs 2's price increase. It is interesting to note that input 1's beta drops from .194 to .152, while input 2's beta increases to .079 from .06, resulting in an overall decrease in firm beta to .230. Similar results obtain from Case 5B, whereby total beta falls from .336 to .309.

Cases 6A and 6B differ from Cases 5A and 5B in that more than the input price increases are passed along to consumers. Total beta decreases slightly in each of these cases (compared to Casea 1A and 1B). Note that 150 percent of the dominant input price increase is passed along to the consumer, while 300 percent of input 2's price increase is passed along to the consumer. Input 1's beta decreases, while input 2's beta increases.

Cases 7A and 7B are identical to Cases 6A and 6B, except the amount of specific price increases are reversed for each input. Now, 200 percent of input 1's price increase is passed along to the consumer, while only 150 percent of input 2's price increase is passed along to the consumer. As a result, input 1's beta increases and input 2's beta decreases. Cases 5A-7A and Cases 5B-7B demonstrate that specific price changes can affect a firm's systematic risk. Cases 1B-7B further demonstrate that general price changes can affect a firm's systematic risk. These cases are all consistent with Proposition 1. Cases 5A-7A, on the other hand, show that even when general price changes are zero, specific price information is still useful in assessing a firm's systematic risk. This was proven in Corollary 2. Finally, Corollary 1 is illustrated by Cases 3A and 3B (which are related to Cases 2A, 2B, 4A, and 4B), whereby a firm is not affected by specific price changes if it shifts the total price increase for each input to consumers.

Implications from the Analysis

The above cases more clearly illustrate the effects of price changes on systematic risk as developed in the second section. In addition, they serve as a basis on which to draw implications for accounting. For example, it was shown that a firm's systematic risk is affected by the rates of input price increases and the amount of these increases passed along to consumers. From the perspective of an investor, then, knowledge of this information would be helpful in assessing a firm's systematic risk. An accounting question stemming from this analysis includes whether ASR190 or FAS33 disclosures were helpful in estimating k_e or t_e.

The disclosures required by ASR190 and FAS33 were discussed in Chapter I. Neither required information about t_e, the rates of input price increases passed along to consumers. However, both required various types of information related to k_e, the rates of input price increases. Specifically, both ASR190 and FAS33 required current cost disclosure of inventory, cost of goods sold, property, plant, and equipment, and depreciation. Additionally, FAS33 required disclosure of income from continuing operations calculated by deducting replacement cost of goods sold and depreciation; also, it required disclosure of increases or decreases in current costs of inventory and property, plant, and equipment (otherwise known realized and unrealized holding gains).

Based on the above disclosures, it appears that investors would be unable to obtain direct measures of k_e. For example, an investor would not be able to determine each k_e for a firm with multiple inventory inputs, since these inputs are aggregated in FAS33. Similarly, the realized and unrealized holding gains reported in FAS33 are lumped together for inventory and property, plant, and equipment. Perhaps the inability to obtain a direct assessment of k_e is one reason why past empirical studies have concluded negatively about the usefulness of ASR190 and FAS33 disclosures.

It appears that the required disclosures may provide some indirect, imperfect, information about k_e. The model developed in this chapter showed that both k_e and t_e are essential to risk assessment. Since only part of the needed information about k_e is available, it is doubtful that beta will change due to revelation of this information. Perhaps, however, the market has some access to information regarding t_e, and disclosure of information related to k_e may lead to a change in beta. This is an empirical question, and the implications of information about k_e are explored in this study.

The empirical segment of this study provides additional evidence regarding the usefulness of ASR190 and FAS33 disclosures. These tests, however, are based on a theory which shows that knowledge of k_e and t_e are useful in assessing systematic risk. Specifically, the first test addresses the question of whether the disclosures contained information which led investors to revise their assessments of k_e and t_e. If so, then more beta changes may have occurred for disclosure firms than for non-disclosure firms. The second test, on the other hand, looks only at FAS33 disclosures. Firms reporting the largest differences between inflation-adjusted data and historical cost data were presumably affected the most by price changes. If disclosure of these large differences caused investors to revise their assessments of t_e and k_e, then more beta changes for these large-difference firms would be expected.

The price-change model developed in the second section also showed that general price changes affect systematic risk. Cases 1B-7B showed that systematic risk increased 32 percent when general prices changed from zero to 10 percent. The disclosures required by ASR190 did not include the effects of general price changes, while FAS33 disclosures did include them. It seems highly unlikely that these FAS33 disclosures contained any new information about general price changes, since this information is already available from several other sources (for example, the Consumer Price Index is released approximately the 20th of each month).[1] For this reason, it is not surprising that many previous tests on the usefulness of general price-change adjusted information have reached negative conclusions. An interesting test of the theory developed in this chapter, however, would be to compare measures of systematic risk in periods characterized by significantly different inflation rates. This question is addressed in the third empirical test conducted in this study.

Conclusion

The objective of this chapter was to analytically explore the effects of specific and general price changes on systematic risk. In so doing, the effects of these price changes on firm value could also be examined. First, the CAPM, a model of firm value in a non-inflationary

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[1]The FASB, by eliminating historical cost/constant dollar information, seems to indirectly concur with this. In explaining the basis for its conclusion, the FASB (1984, p. 3) stated that "the evidence has indicated that reporting effects of changing prices using two different methods may detract from the usefulness of the information and that the historical cost/constant dollar information is less useful than the current cost/constant purchasing power information."

environment, was reviewed. Next, this model was expanded to include both specific and general price change parameters. It was shown that a firm's end-of-period cash net income is dependent on the specific rate of input price increase, and also on the percentage of this price increase which is passed along to consumers. In addition, it was also shown that firm value is dependent on general price changes.

After analyzing the effects of price changes on a firm's end-of-period cash net income and firm value, the next task was to identify the impact of these price changes on systematic risk. Proposition 1 was then formally stated and proven. This proposition demonstrated that both types of price changes can affect systematic risk, and therefore this information can be useful for risk assessment.

Two corollaries directly followed from Proposition 1. Corollary 1 showed that a firm would not be affected by specific price changes if the firm passed along the entire price increase to the consumer. Corollary 3 indicated that specific price information is still useful in assessing a firm's systematic risk, even when general inflation is zero. These results support the position that specific price disclosures may have value even when general inflation is not unusually high.

Next, a numerical example was presented to better illustrate the effects of price changes on systematic risk. Several cases of differing price change scenarios were employed. From these cases, implications for accounting were discussed. The questions addressed by the three empirical tests in this study were included in this discussion. The next chapter presents the details and describes the design and methodology of these tests, while Chapter IV provides an analysis of the results.

CHAPTER III

EMPIRICAL DESIGN AND METHODOLOGY

The purpose of this chapter is to describe the design of the empirical study and the means by which this design was accomplished. The prior chapter's developments showed that systematic risk is affected by specific and general price changes. In this chapter, three tests based on this development are performed.

The first test addresses the question of whether the disclosures required by ASR190 and/or FAS33 allowed investors to obtain measures of k_e, one specific price change parameter shown to affect beta. The second test is restricted to examining FAS33 disclosures. The third test, on the other hand, examines the effects of general price changes on systematic risk.

The first section of this chapter explains how each test relates to the theoretical model and describes the questions each test addresses. The second section describes the overall sample selection process. The firms included in this overall sample make up the population of firms from which each test's sample is drawn. The third section includes an explanation of the statistical tests which are used to identify structural changes in a firm's systematic risk. The next three sections describe the design, methodology, and sample selection (from the overall sample) for each of the empirical tests. A final section consists of a brief summary.

Questions Suggested from the Analysis

One question suggested by the prior chapter's development is:

Were the disclosures required by ASR190 and/or FAS33 sufficient to allow investors to revise their assessments of the rates of input price increases (k_e)?

If ASR190 or FAS33 data were being used by investors to revise their measures of k_e, then more re-assessments of systematic risk would be observed for firms reporting this data. Test 1 explores the effects of price change disclosures on systematic risk. The period January 1, 1976 to December 31, 1982, which covers the effective dates of ASR190 and FAS33 disclosures, is examined. An additional test similar to Test 3 (to be explained below) is also performed for certain firms in the Test 1 sample. Narrowing the focus to FAS33 disclosures only, the following question is asked:

Were the disclosures required by FAS33 more informative for firms that were more affected by price changes?

Test 2 addresses this question. Presumably, firms reporting the largest differences between inflation-adjusted and historial cost data were affected the most by price changes. Since the theory shows that beta can be affected by specific price changes, it is possible that these firms experienced more beta changes than lesser affected firms.

While Test 1 and Test 2 deal with disclosure of specific price information, Test 3 involves general price changes. Since general price change information is readily available to the market, Test 3 addresses a different question, namely:

Do firms experience more systematic risk changes in periods of high inflation than in periods of low inflation?

The theory states that beta will change if general prices change. Ideally, this theory could be tested if systematic risk was examined in a period with no general price changes and compared to a period with general price changes. Since no periods can be identified where general inflation is zero, Test 3 identifies three periods of differing price changes. These periods are classified as low, medium, and high, with the low period acting as a surrogate for a noninflationary period. If more risk changes occurred in the high period vis-a-vis the lower periods, then there is evidence supporting the theory that general price changes affect beta. Since the theory predicts that beta will change if $g > 0$, negative empirical results cannot be used to provide evidence against the theory itself ($g > 0$ occurs for all three periods).

Overall Sample Selection

An initial overall sample of 334 firms was selected for this study based on Test 1. Two groups of firms were identified: (1) test group and (2) control group. The test group consisted of firms subject to FAS33, while the control group consisted of those firms not subject to FAS33. To be included as a test firm, the following selection criteria had to be satisfied:

1. Inclusion on the FASB Statement 33 DataBank tape,

2. Inclusion on the Center of Research in Security Prices (CRSP) monthly tape, and

3. Matched with a control firm satisfying (2) but not (1).

The FASB tape contains only information pertaining specifically to those firms required to report the mandated inflation disclosures. These firms include both financial and non-financial firms.

The CRSP tape was needed in order to calculate betas and changes in betas. Beta calculations are based on Sharpe's (1963) market model, which specifies the following relationships:

$$R_{jt} = \alpha_j + \beta_j R_{mt} + \varepsilon_{jt} \tag{16}$$

where $E(\varepsilon_{jt}) = 0,$

$\mathrm{cov}(\tilde{R}_{mt}, \varepsilon_{jt}) = 0,$

$\mathrm{cov}(\varepsilon_{jt}, \varepsilon_{kt}) = 0,$

R_{jt} = ex post return on security j,

R_{mt} = ex post return on all other capital assets ("market return")

ε_{jt} = error term, and

α_j, β_j = intercept and slope.

R_{mt} was computed using an equal-weighted index.[1]

The group of control firms, all of which were not required to disclose FAS33 data, was also selected from the CRSP tape and matched with the test firms based on the following two matching criteria: (i) systematic risk and (ii) industry.

Criterion (i) required that each pair of test and control firms have similar risk measures before the reporting of inflation data

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[1]Brown and Warner (1980) showed that use of the value-weighted index resulted in more Type I errors, vis-a-vis the equal-weighted index. Also, they found that the equal-weighted index was no less likely, and in fact slightly more likely, to pick up abnormal performance than the value-weighted index.

required by ASR190. To achieve this, firms were matched on betas, plus or minus .10 percent, computed over the 18-month period July 1, 1974 to December 31, 1975. The purpose of criterion (ii) was to control for any effects on firm behavior specifically unique to a particular industry. Industry membership was determined by the three-digit Standard Industrial Classification (SIC) number. Appendix A consists of a flowchart providing more detail on the selection process.

Statistical Tests for Identifying Risk Changes

A computer program called TIMVAR, written by Brown, Durbin, and Evans (1973), was used to identify structural changes in betas. Hansen (1977) employed this program to identify periods in which betas were stable and unstable. The following description of TIMVAR, as well as Appendix B, are adapted from his study. TIMVAR embodies a set of techniques for detecting departures from constancy of regression relationships over time when regression analysis is applied to time series data (Brown et al., 1973). More specifically, TIMVAR tests the hypothesis of constant regression coefficients over time,

$$H_0: \beta_1 = \beta_2 = \ . \ . \ . \ \beta_T = \beta$$

(β is used here to represent a vector of regression coefficients) where the subscript t = 1, ..., T is used to indicate that β_t may vary with time.

There are three techniques used to identify structural changes in beta, and one technique used to detect <u>when</u> the change occurred. First, the above hypothesis can be investigated by constructing forward and backward plots of cumulative sums and sums of squares of recursive residuals. These two tests, cusum and cusum of squares, involve a pair of significance lines, which if crossed by the sample path, results in the rejection of the null hypothesis of constant regression coefficients.

The third technique is a homogeneity test based on analysis of variance. Coefficients are obtained by fitting the model to a segment of n successive observations and moving this segment along the time series. The final TIMVAR technique is the plotting of Quandt's log-likelihood ratio which detects the single time point, if any, at which there is an abrupt change from one constant set of parameters to another (Quandt, 1958). A more detailed description of TIMVAR is given in Appendix B.

The TIMVAR program provided the results of the above tests and performed standard regression. Examination of the data using these techniques enabled identification of firms experiencing beta changes, provided a count of the number of risk changes for these firms, and pinpointed when the change(s) occurred.

In all three empirical tests, .10 was used as the critical value for alpha. Seven primary TIMVAR tests were run on each firm, as shown in Table VII. As Brown et al. (1973) mentioned, it should not be a cause for concern if the tests did not give identical results. Departures from constancy may have shown themselves in different ways, and the tests may not have been equally powerful against the particular departure encountered. The cusum of squares test, for example, is sensitive to residual variance changes, and significant results may have been obtained for this test when the cusum test did not.

Therefore, a firm was determined to have a beta change if any of the cusum tests or homogeneity tests were significant. If only one or

TABLE VII

TESTS USED TO DETECT STRUCTURAL CHANGES IN BETA

Primary TIMVAR Tests	Critical Value α = .10
1. Cusum - Forward	0.850
2. Cusum - Backward	0.850
3. Cusum of Squares - Forward	0.17215*
4. Cusum of Squares - Backward	0.17215*
5. Homogeneity - Moving Regression Length 12	1.650*
6. Homogeneity - Moving Regression Length 24	1.650*
7. Homogeneity - Moving Regression Length 36	1.760*

Secondary Test for Equality of Variance**

Secondary Test	Critical Value α = .05
1. n = 12, r = 7	6.75
2. n = 24, r = 3	2.81
3. n = 36, r = 2	2.00

*These critical values are illustrative of the case with 84 observations (12 x 7 years), as in Empirical Test 1. The values differ depending on the number of observations.

**This test was performed if one or both of the cusum of squares test was significant, and all other tests were not significant.

both of the cusum of squares tests was significant, then a secondary test was performed because of the sensitivity to residual variance factor described above. This test, called the Hartley test, tests for equality of variances when sample sizes are all equal (Neter and Wasserman, 1974). The hypothesis was:

H_0: $\sigma_1^2 = \sigma_2^2 = . . . = \sigma_r^2$

H_1: Not all σ_j^2 are equal.

The largest sample variance, denoted $\max(s_j^2)$, and the smallest sample variance, denoted $\min(s_j^2)$, were used to obtain the following test statistic:

$$H = \frac{\max(s_j^2)}{\min(s_j^2)}$$

Clearly, values of H near 1 supported H_0, and large values of H supported H_1. The distribution of H when H_0 held was tabulated and critical values were compared to this table to determine the level of significance. The distribution of H depended on the number of factor levels, r, and the sample size, n, and assumed a normal population.[2] Since three moving regressions were performed for each firm, three values of H were computed. H_0 was not rejected and a beta change was judged to have occurred if at least two of these values were less than their respective table values.

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[2] A factor level r depends on the length of the moving regression and the number of observations in each regression. For example, with a moving regression of length 12 (i.e., n=12) and 84 total observations, there are seven factor levels, corresponding to regressions computed over observations 1-12, 13-24, 25-36, 37-48, 49-60, 61-72, and 73-84.

Test 1

The objective of this test was to determine if evidence of significant risk assessment changes occurred in the presence of mandated inflation disclosures. The analytical model constructed in Chapter II showed that specific and general price changes had an effect on systematic risk. If disclosure of such information caused investors to revise their risk assessments, then this would indicate that such data had information value. One way to test this would be to compare the number of risk changes of firms required to make these disclosures with the number of risk changes of firms not required to do so. As Chapter I indicated, only the very largest corporations were subjected to ASR190 and FAS33. Therefore, a "control" set of firms for a test such as the one described above necessarily consists of smaller firms.

From the 167 pairs of matched firms initially identified, 87 pairs were kept for Test 1.[3] Notice that the numbers in the column, "ID No.", were preceded by either a "T" or "C". This denotes whether the firm is a test or control firm. For example, Firm No. 1 and Firm No. 58 are identified as test and control match No. 41. These two firms are classified under SIC industry 3540 (Machine tools, metal cutting types). TIMVAR was run for the period January 1, 1976 to December 31, 1982 for all 174 firms.

The process of identifying and classifying beta changes merits explanation. Figure 1 illustrates the procedure for identifying if and

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[3]Return data for the period 1969-1975 was originally calculated for all 334 firms with the intent of performing an alternative test. Since several firms did not have the necessary return data for this time period, they were eliminated, along with their related matches. This reduced sample of 87 firms was considered adequate to accomplish the desired objective of the test.

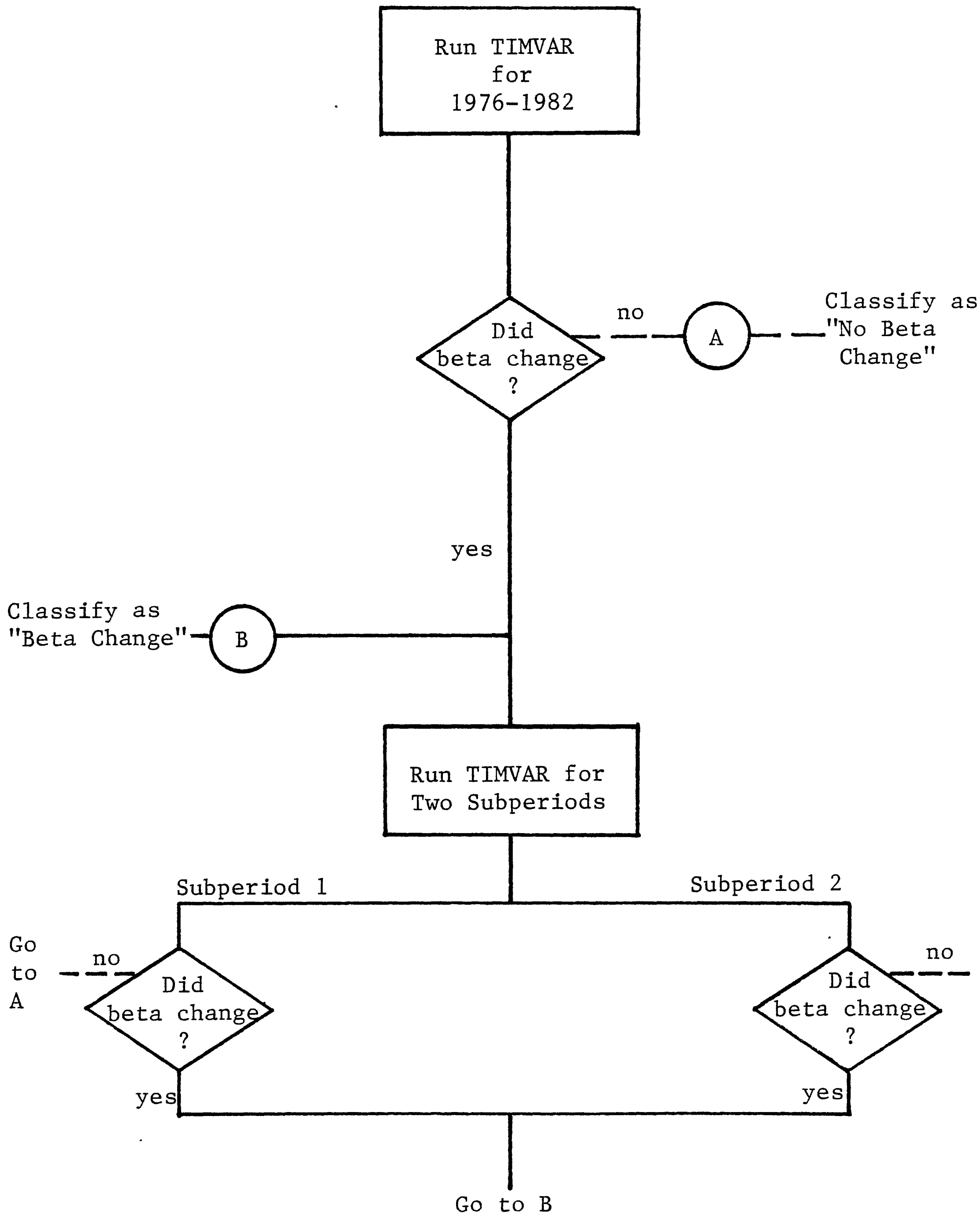

Figure 1. Procedure for Identifying Structural Changes in Beta

when a structural change occurred. The result of the process described in Figure 1 was a firm identified as either a "no beta change" or a "beta change" firm. If a change was detected, the period was divided into two segments, and TIMVAR was re-run over these two subperiods in order to detect additional beta changes. Finally, the total number of beta changes was counted.

Consideration was given to controlling for beta changes that corresponded to the occurrence of significant events, as reported in The Wall Street Journal Index (1976-1982), by eliminating those beta changes. Not eliminating beta changes due to major events, however, recognizes the possibility that some firms may engage in risk changing activities because of specific and general price changes. For example, a firm may issue more debt to buy assets now in order to avoid future specific price increases. By doing so, it would also perhaps be able to repay this debt with cheaper dollars, if prices continue to rise. If many of the beta changes corresponding to major events of this nature, then controlling for these events may have a confounding effect (in other words, the event corresponding to the beta change may have been caused, or partially caused, by inflation). For this reason, beta changes corresponding to major events were not eliminated.

For each of the 174 firms, the dates of beta change were noted, and categoried into the following subperiods: (1) ASR190 subperiod, from 1/1/76 to 12/31/78, and (2) FAS33 subperiod, from 1/1/79 to 12/31/82. In order to determine whether disclosures required by ASR190 and FAS33 were being used by investors to obtain more accurate assessments of specific price changes, two statistical tests were used. For the first test it was hypothesized that the proportion of ASR190 and FAS33 firms experiencing changes in beta was greater than the proportion of firms not required to report this data. The second test was a test of differences in beta changes experienced by test firms as compared to their matched control firms. This test covered the entire seven year period.

An additional test similar to Test 3 was performed for some of the firms in this sample. TIMVAR was used over the period January 1, 1966 to December 31, 1972, for the firms with available return data. This reduced the number of matched pairs to 43. Since the period 1976-1982 experienced a much higher inflation rate than 1966-1972 (see Test 3), the possibility exists that the beta changes noted in 1976-1982 may have been caused by general inflation. Therefore, it was hypothesized that the number of beta changes for the 86 firms during the 1976-1982 period was greater than the number of beta changes for the 86 firms during the 1966-1972 period. A test of differences for paired samples was employed.

Test 2

The objective of Test 2 was similar to Test 1, except attention was restricted to the usefulness of FAS33 disclosures in assessing the effects of specific and general price changes on a firm's systematic risk. It seems reasonable to surmise that firms with the largest differences between reported historial cost disclosures and inflation-adjusted disclosures were most affected by changing prices. Since it was shown that beta can be affected by specific and general price changes, then it is possible that these firms experienced more beta changes than lesser affected firms. The purpose of Test 3, therefore, was to examine firms required to report FAS33 data, and determine if firms with wide disparities in historical cost and inflation-adjusted measures experienced more beta changes than less disparate firms.

Sample Selection and Test Procedure

The original sample of 167 test firms was reduced to 83 firms because of data availability reasons.[4] These 83 firms are listed in Appendix D. The time period for this test was January 1, 1979 to December 31, 1981. The procedure to identify beta changes was similar to Test 1.

Details of the required disclosures of FAS33 were outlined in Chapter I, and Figure 2 provides an example of the form of these supplementary disclosures. Notice that six numbers are circled. Items 1, 2, and 4 represent net income from continuing operations (IFCO) under three methods: historical cost income from continuing operations (HCIFCO), general inflation-adjusted income from continuing operations (CDIFCO), and specific price-change adjusted income from continuing operations (CCIFCO). The purchasing power gain and loss is represented (PPGL) by items 3 and 5, while the holding gain (HG), net of increase in prices attributable to general inflation, is represented by item 6.

The FASB (1979, pp. 56-57) believed that presenting alternative measurements was desirable, since "a single measure may be insufficient to convey all the effects of changing prices on a business enterprise."

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[4]Most of the 84 firms dropped from the original sample elected to report only 1980 and 1981 current cost data, as allowed by FAS33. The remaining firms were financial firms, and were not listed on the Compustat Industrial Files.

SPECIFICATION OF VARIOUS ACCOUNTING INCOME MEASURES TO BE USED IN THIS STUDY

STATEMENT OF INCOME FROM CONTINUING OPERATIONS ADJUSTED FOR CHANGING PRICES
For the Year Ended December 31, 1980
(In (000s) of Dollars)

	As Reported in the Primary Statements	Adjusted for General Inflation	Adjusted for Changes in Specific Prices (Current Costs)
Net sales and other operating revenues	$253,000	$253,000	$253,000
Cost of goods sold	197,000	204,384	205,408
Depreciation and amortization expense	10,000	14,130	19,500
Other operating expense	20,835	20,835	20,835
Interest expense	7,165	7,165	7,165
Provision for income tax	9,000	9,000	9,000
	244,000	255,514	261,908
Income (loss) from continuing operations	$ 9,000[1]	$ (2,514)[2]	$ (8,908)[4]
Gain from decline in purchasing power of net amounts owed		$ 7,729[3]	$ 7,729[5]
Increase in specific prices (current cost) of inventories and property, plant, and equipment held during the year*			$ 24,608
Effect of increase in general price level			8,959
Excess of increase in specific prices over increase in the general price level			$ 5,649[6]

*At December 31, 1980 current cost of inventory was $65,700 and current cost of property, plant, and equipment, net of accumulated depreciation was $85,100.

Adapted from FASB, Appendix A, 1979.

Figure 2. Illustration of Supplementary Disclosure Form of FAS33

Therefore, six alternative measures were used for Test 3. These measures are defined as:

1. CDA = CDIFCO = Item 2
2. CDB = CDIFCO + PPGL = Item 2 + Item 3
3. CCA = CCIFCO = Item 4
4. CCB = CCIFCO + PPGL = Item 4 + Item 5
5. CCC = CCIFCO + HG = Item 4 + Item 6
6. CCD = CCIFCO + PPGL + HG = Item 4 + Item 5 + Item 6

Earnings data were obtained from two sources: (1) Standard and Poors Compustat Annual Industrial Files, for historical cost earnings, and (2) FASB Statement 33 DataBank tape, for inflation-adjusted earnings numbers. By using six measures, one may perhaps obtain some insight into which earnings numbers were being used more extensively by investors.

Each of the six measures above was subtracted from HCIFCO. It was hypothesized that firms with the largest differences would experience a higher number of risk changes, if the disclosures allowed investors to more effectively measure the impact of changing prices on these firms.

Test 3

The example presented in Chapter II consisted of seven cases, with each case examined in a non-inflationary and an inflationary world. In this example, it was shown that systematic risk increased 32 percent when general prices changed from zero to 10 percent. If general price changes have a similar effect on firms in the real world, it seems possible that a period experiencing a great deal of inflation would experience more risk changes than a less inflationary period. Table VIII presents the GNP Implicit Price Deflator for the period 1957-1982. This period was divided into three subperiods, each characterized by different inflation rates: (1) 1958-1964 (low), (2) 1966-1972 (medium), and (3) 1976-1982 (high). As one can see from the table, the GNP Implicit Price Deflator for the low subperiod increased at an average annual rate of 1.64 percent, with low and high rates of .92 percent and 2.36 percent. In the medium subperiod the annual average inflation rate was 4.33 percent, with low and high rates of 3.0 percent and 5.37 percent. Lastly, the high subperiod showed an average inflation rate of 6.02 percent, with low and high rates of 4.36 and 10.16 percent.

The objective of Test 3 was to determine if more risk changes occurred in higher inflationary periods vis-a-vis lower inflationary periods. A total of 117 firms, listed in Appendix D, had the necessary return data with which to identify beta changes. TIMVAR was initially run over all three subperiods for each firm.

It was hypothesized that there were more beta changes in the period with higher inflation. To test this, two types of statistical information sets were obtained. The first information set consisted of the same proportions test of firms experiencing beta changes as in Test 1, while the second information set consisted of a test of differences in the number of beta changes experienced by each firm across the three subperiods. Details of these information sets, along with results of the tests, are included in the next chapter.

Conclusion

This chapter has explained the empirical design and methodology

TABLE VIII

GNP IMPLICIT PRICE DEFLATOR, 1957-1982

Low Inflationary Period			Medium Inflationary Period			High Inflationary Period		
Year	Index	% Increase	Year	Index	% Increase	Year	Index	% Increase
(1972 = 100)								
1957	64.93	3.45	1966	76.76	3.23	1975	128.99	12.08
1958	66.04	1.71	1967	79.06	3.00	1976	134.99	4.65
1959	67.60	2.36	1968	82.54	4.40	1977	143.24	6.11
1960	68.70	1.63	1969	86.79	5.15	1978	155.38	8.15
1961	69.33	.92	1970	91.45	5.37	1979	168.05	10.16
1962	70.61	1.85	1971	96.01	4.99	1980	185.13	8.69
1963	71.67	1.50	1972	100.00	4.16	1981	201.22	4.36
1964	72.77	1.53	1973	105.75	5.75	1982	210.80	6.02
1965	74.37	2.18	1974	115.08	8.82			
Average Increase 1958-1964 = 1.64%			Average Increase 1966-1972 = 4.33%			Average Increase 1976-1982 = 6.02%		

Note: Years within brackets make up the period under study.

Source: U.S. Department of Commerce, Bureau of Economic Analysis (1983).

of the three empirical tests used to test the effects of price change disclosures, as well as the price changes themselves, on investors' assessments of systematic risk. These tests were based on the theoretical model developed in Chapter II, which showed that specific and general price changes affect systematic risk. The first section of this chapter explained how each test relates to the model and described the questions each test addresses.

The samples used in all three tests were drawn from an overall sample of 334 firms. Also, all three tests used TIMVAR, a set of statistical tests to identify structural changes in systematic risk. The second and third sections of this chapter described the sample selection process and explained the tests included in TIMVAR.

The next three sections described the details of each of the empirical tests. Test 1 explored the effect of price change disclosures on systematic risk (as well as providing a test similar to Test 3). Whereas Test 1 addressed both ASR190 and FAS33 disclosures, Test 2 focused only on FAS33 disclosures. Test 3 examined the effect of price changes in three periods characterized by significantly different inflation rates. The next chapter provides the results of these tests.

CHAPTER IV

ANALYSIS OF THE RESULTS

This chapter presents an analysis of the results of the empirical tests outlined in Chapter III. Test 1 consists of a primary test and a secondary test. The primary test examines the information value of specific price change disclosures required by ASR190 and FAS33, while the secondary test looks at the effects of general price changes as well. Test 2 is restricted to testing for the information value of FAS33 disclosures only. Test 3, on the other hand, is a test to determine if the predicted effects of general price changes are observed in the three periods characterized by different rates of price change. Four sections are presented in this chapter: one section for the results of each of the three tests, and a final section containing a discussion of the overall results of these tests.

Results of Test 1

Test of Specific Price Change Disclosures

Two statistical tests examining the usefulness of ASR190 and FAS33 disclosures were conducted on the 174 firms (87 matches) listed in Appendix C. Note that the number of beta changes for the period January 1, 1976 to December 31, 1982, are listed for each firm. For the first test, this period was divided into an ASR190 subperiod and an FAS33 subperiod. Looking first at ASR190, it was hypothesized that more ASR190 firms experienced one or more beta changes than the control firms, if the information value of these disclosures enabled users to more accurately measure the effects of specific price changes on systematic risk. Let:

n_t = number of test firms experiencing a beta change in the ASR190 period,

n_C = number of control firms experiencing a beta change in the ASR190 period, and

N = total number of matched firms (that is, 87).

Define

$$p_T = \frac{n_T}{N} \tag{18}$$

$$p_C = \frac{n_C}{N} \tag{19}$$

The hypothesis tested was:

$H_0 = p_T = p_C$

$H_1 = p_T > p_C$

If ASR190 had a significant effect, H_0 should be rejected.

The test statistic used is one which tests for differences between two population proportions (Daniel and Terrell, 1975, p. 177):

$$z = \frac{(\hat{p}_T - \hat{p}_C) - (p_T - p_C)}{\left[\frac{p_T(1 - p_T)}{n_T} + \frac{p_C(1 - p_C)}{n_C}\right]^{\frac{1}{2}}} \tag{20}$$

where the samples are independent simple random samples, z is normally distributed, and

p_T and p_C = the true population proportion,

$\hat{p}_T$ and $\hat{p}_C$ = estimates of p_T and p_C based on sample sizes n_T and n_C.

A test of the FAS33 subperiod was performed in a similar manner. Statistical results for both subperiods are presented in Table IX. Notice that the null hypothesis cannot be rejected for either subperiod, which indicates that the number of disclosure firms experiencing beta changes is not significantly different from the number of non-disclosure firms.

TABLE IX

STATISTICAL RESULTS OF PROPORTIONS TEST: TEST 1

Statistic	ASR190 Subperiod	FAS33 Subperiod
n_T	20	37
n_C	17	39
N	87	87
p_T	23.0%	42.5%
p_C	19.5%	44.8%
z_{calc}	0.563	-0.036
$z_{table,\ \alpha = .10}$	1.28	1.28
Conclusion	Do Not Reject H_0	Do Not Reject H_0

To obtain additional evidence, a second statistical test was employed, comparing the differences between the number of beta changes incurred by each test and control pair over the entire seven-year period. The hypothesis tested was:

H_0: $\mu_T = \mu_C$

H_1: $\mu_T > \mu_C$

where μ_T and μ_C are the population number of beta changes experienced by test and control firms. Let:

D_i = the difference between test firm i's number of beta changes and control firm i's number of beta changes.

The differences D_i in the individual pairs are assumed to be normally distributed about a mean μ_D, which represents the average difference in the effects of the two treatments over the population of which these pairs are a sample. The test statistic is:

$$t = \frac{(D - \mu_D)}{s_{\bar{D}}} \qquad (21)$$

where

$$s_D = \left[\frac{\Sigma(D_i - \bar{D})^2}{n-1}\right]^{1/2} \qquad (22)$$

The test statistic follows Student's t-distribution with n-1 degrees of freedom, where n is the number of pairs (Snedecor and Cochran, 1980).

Results of this test were similar to the proportions test. Specifically:

$\bar{D} = -0.057$

$s_D = 1.2138$

$t = -0.047$

$t_{table,\ \alpha\ =\ .10} = 1.29$

The hypothesis that the number of beta changes experienced by test firms is significantly different than the number of beta changes experienced by control firms cannot be rejected.

Test Incorporating General Price Changes

Table VIII in Chapter III showed that average inflation was 6.02 percent and 4.33 percent over the periods 1976-1982 and 1967-1973, respectively. The question addressed in this test is whether the number of beta changes in the 76-82 period was higher than the 67-73 period. The model developed in Chapter II indicated that beta is affected by general price changes.

The 87 matched firms in Appendix C were reduced to 43 matches because of availability of return data. The number of beta changes for each of the 43 firms was identified and listed in Appendix C. If the rate of inflation in the 76-82 period was different enough to significantly affect the general price change parameters, then more beta changes may be observed for both test and control firms.

Figure 3 serves as a basis on which to explain the hypotheses examined. The first hypothesis is:

H_0: $\mu_H = \mu_L$

H_1: $\mu_H > \mu_L$

where μ_H is the true number of beta changes in the 76-82 period (high) and μ_L is the true number of beta changes in the 67-73 period (low).

	LOW (1967-1973)	HIGH (1976-1982)
Test Firms	μ_{TL} n = 43	μ_{TH} n = 43
Control Firms	μ_{CL} n = 43	μ_{CH} n = 43

Hypotheses Tested:

1. H_1: $\mu_H = \mu_L$
2. H_2: $\mu_{TH} = \mu_{TL}$
3. H_3: $\mu_{CH} = \mu_{CL}$

Figure 3. Hypotheses Tested in Test 1: Examination of the Effects of General Price Change

This test can be divided into two subtests, where the test and control firms are analyzed separately. For the test firms, Hypothesis 2 is stated as:

H_0: $\mu_{TH} = \mu_{TL}$

H_1: $\mu_{TH} > \mu_{TL}$

where the subscripts indicate test (T) firms in the high (H) and low (L) periods. Hypothesis 3 is identical to Hypothesis 2, except control (C) firms are examined. If Hypothesis 2 yields significant results and Hypothesis 3 does not, ASR190 and FAS33 disclosures could explain the difference, since only test firms were subject to these disclosures. The same test of differences between paired samples described earlier is used for all three hypotheses in this test.

Results of these tests are presented in Table 10. In all three cases the null hypothesis was not rejected. Implications from these results are discussed after the results of Test 2 and Test 3 are presented.

TABLE X

STATISTICAL RESULTS OF TEST 1: INCLUSION OF THE EFFECTS OF GENERAL PRICE CHANGES

Hypothesis	n	$\bar{D}$	$s_{\bar{D}}$	t_{calc}	$t_{table,\alpha=.10}$	Conclusion
H_1	86	.198	1.176	.168	1.29	Do not reject
H_2	43	.186	1.277	.146	1.30	Do not reject
H_3	43	.209	1.094	.191	1.30	Do not reject

Results of Test 2

Test 2 narrows the focus of testing for the usefulness of mandated disclosures to the 83 firms subject to FAS33 listed in Appendix D.

TIMVAR was used to identify beta changes over the period January 1, 1979 to December 31, 1981. Then, for each of the six inflation-adjusted earnings measures, the following steps were taken:

1. The inflation-adjusted measure was subtracted from the historical cost measure.

2. The absolute value of each difference was calculated and ranked according to size.

3. A schedule of 28 firms with the largest differences was prepared (representing one-third of the 83 firms in the sample).

4. A list of the firms identified as "beta change" firms was compared to this schedule, and a count of firms appearing on both was taken.

Since the effects of specific and general price changes were presumably more dramatic for the "large difference" firms, then it is hypothesized that these firms will experience a proportionally higher number of risk changes than a random selection of firms. For example, a random sample of 30 firms drawn from the 83 firms should be expected to contain 10 firms (28/83 = x/30; x = 10) that were included in the schedule of 28 "large difference" firms. If the 30 firms are not random, however, but contain useful information about specific and general price changes, then more than 10 firms would be expected to be in the 28-firm schedule.

Table XI lists the 24 firms identified as beta change firms (these firms are also denoted with an '*' in Appendix D). Random selection of any 24 firms should result in inclusion of eight firms in the schedule of 28 "large difference" firms. Note that only one of the inflation-adjusted measures, CCD, meets this expected value.

TABLE XI

TEST 2 RESULTS

Appendix D Firm No.	Rank, Based on Inflation-Adjusted Less Historical Cost Earnings					
	CDA	CDB	CCA	CCB	CCC	CCD
2	–	–	–	–	–	–
5	28	4	–	7	–	11
6	–	25	–	–	–	–
15	–	–	–	–	–	–
23	1	1	1	1	4	2
24	–	–	–	–	–	–
25	–	–	–	–	–	–
27	–	–	–	–	21	–
28	–	9	21	20	–	16
29	–	–	–	–	–	–
30	–	–	–	–	–	–
33	27	–	23	27	–	–
35	–	–	–	–	–	–
39	3	6	4	–	1	1
46	–	–	–	–	–	–
49	–	15	–	14	–	21
50	–	–	–	–	–	–
55	–	–	–	–	26	25
57	21	–	19	–	12	19
66	–	–	–	–	–	–
68	20	3	11	4	14	5
69	–	–	–	–	–	–
74	–	–	–	–	–	–
75	–	–	–	–	–	–
Number of Firms Appearing of Both Schedules	6	7	6	6	6	6

The results of this test, like Test 1, provide no evidence that FAS33 disclosures had a significant impact of systematic risk of firms subject to these disclosures.

Results of Test 3

Appendix E contains a list of the 117 firms included in this test, along with the number of beta changes experienced by each firm during the low, medium, and high inflationary periods identified in Chapter III. As in Test 1, a proportions test and a test of differences between paired samples was used to test whether more beta changes occurred in periods of higher inflation. First, for the proportions test, let:

n_L = number of firms experiencing a beta change in the low inflationary period (1958-1964),

n_M = number of firms experiencing a beta change in the medium inflationary period (1966-1972),

n_H = number of firms experiencing a beta change in the high inflationary period (1976-1982), and

N_T = total number of firms (that is, 151).

Define

$$p_L = \frac{n_L}{N_T} \tag{23}$$

$$p_M = \frac{n_M}{N_T} \tag{24}$$

$$p_H = \frac{n_H}{N_T} \tag{25}$$

The three hypotheses tested were:

1. H_0: $p_H = p_L$ vs. H_1: $p_H > p_L$

2. H_0: $p_H = p_M$ vs. H_1: $p_H > p_M$

3. H_0: $p_M = p_L$ vs. H_1: $p_M > p_L$

If the firms in the higher inflationary periods experienced a significantly greater number of beta changes than in the lower inflationary periods, H_0 should be rejected. The test statistic is the same z-statistic used in Test 1 to test for differences between two population proportions. Table XII gives the results for this test. It is obvious that H_0 cannot be rejected in all cases.

A test of differences between paired samples was also performed. For each firm, the difference between the number of beta changes experienced in each period was computed. Let:

$\bar{D}_{H-L}$ = the average difference between the number of beta changes experienced by firms in the high and low inflationary periods.

Similarly, $\bar{D}_{H-M}$ and $\bar{D}_{M-L}$ are defined for the other periods. The hypotheses tested were similar to the proportions test, except the mean number of beta changes was examined rather than the number of firms experiencing one or more beta changes. Table XIII presents the results of this test, and once again it is noted that none of the null hypotheses can be rejected.

Comparative Discussion of the Overall Results

All three empirical tests failed to provide evidence that price change, or price change disclosures, has an impact on systematic risk. The following discussion provides an explanation of why this may have occurred. First, with respect to the tests of specific price disclosures in Test 1 and Test 2, it is very possible that the

TABLE XII

STATISTICAL RESULTS OF PROPORTIONS TEST: TEST 3

Statistic	Hypothesis 1: High vs. Low	Hypothesis 2: High vs. Medium	Hypothesis 3: Medium vs. Low
n_L	53	-	54
n_M	53	53	-
n_H	54	54	-
N_T	117	117	117
p_L	.453	-	.453
p_M	-	.453	.453
p_H	.462	.462	-
z_{calc}	.138	.138	.000
$z_{table,\alpha=.10}$	1.280	1.280	1.280
Conclusion	Do Not Reject	Do Not Reject	Do Not Reject

disclosures required by ASR190 and FAS33 were not sufficient to allow investors to revise their risk assessments. It was shown that knowledge of each input's price change, and the amount of this price change passed along to consumers, is required. It appears highly likely that neither ASR190 nor FAS33 provided this information, and therefore it is not surprising that these tests, as well as the majority of empirical tests conducted in prior studies, reached negative conclusions about the usefulness of these disclosures. Test 2's somewhat anomalous results are difficult to rationalize. The fact that less than one-third of the beta change firms were included in all but one of the ranked schedules is hard to explain. Ex post rationalization leads one to wonder if less specific price change information (if indeed there was any information at all) was inferred from firms reporting the largest differences between historical cost and inflation-adjusted measures. Perhaps the existence of such wide disparities caused investors to shy away from re-assessing the risk of a firm whose inflation-adjusted measures deviated so drastically from traditional historical cost.

TABLE XIII

STATISTICAL RESULTS OF TEST OF DIFFERENCES: TEST 3

Hypothesis	N_T	$\bar{D}$	$s_{\bar{D}}$	t_{calc}	$t_{table,\alpha=.10}$	Conclusion
H_1 (H vs. L)	117	.0513	1.238	0.04	1.66	Do not reject
H_2 (H vs. M)	117	.1111	1.165	0.01	1.66	Do not reject
H_3 (M vs. L)	117	-.0598	1.101	-0.05	1.66	Do not reject

The test of beta changes performed in Test 3, as well as the secondary test in Test 1, failed to provide any evidence of more beta changes in periods of higher inflation. This conclusion is also not surprising, in light of the fact that the extent of inflation's effect on risk is not known. While the numerical example supporting the theoretical model in Chapter II showed that beta increased when general inflation increased from zero to 10 percent, this example may not be externally valid. The example assumed the existence of a period of no general price changes. Test 3 attempted to use a low inflationary period as a surrogate for a non-inflationary period, but it may not have been an acceptable one. It is possible that different rates of inflation may not affect the frequency of structural changes in beta, or that the time periods used in the tests may not have been sophisticated enough to capture different inflation rates.

The fact that the tests in this study, as well as a majority of tests performed in prior studies, do not support FAS33 may suggest that the information currently being disclosed in not what should be disclosed. The theoretical model developed in this study indicates that each input's specific price increase and the amount of this increase passed to consumers is necessary in assessing a firm's systematic riak. The fact that this theoretical model drove the empirical tests may well be the major contribution of this study. Hopefully, future empirical studies may rely on this model, or one such as this. The next chapter, Chapter V, concludes this dissertation with a summary of the findings and suggestions for future research.

CHAPTER V

CONCLUSION

Chapter I, the introductory chapter, presented the objective of this study. It described the inflation disclosures currently being required by FAS33, as well as those required by ASR190. The FASB and SEC had hoped that these disclosures would be useful to users at both an individual firm level and a macroeconomic level. As a result, several studies were performed to determine if the objectives of ASR190 and FAS33 were being met.

One area of research which has attracted much interest is the potential effect these disclosures may have had on the capital market. Chapter I classified these studies as information content studies or systematic risk prediction studies. It was pointed out that both categories relied on an estimate of the systematic risk component (beta) of an individual security relative to the market return. None of these studies, however, considered the effect that inflation, or inflation disclosures, might have on beta itself. One reason for this is that no theory existed which linked the effects of inflation to systematic risk. Several researchers have recognized the need for such a theory (for example, Lev and Ohlson, 1983; Revsine, 1970). They contended that empirical tests would be more fruitful if a theoretical foundation was developed first.

A major objective of this research, therefore, was to provide a theory which demonstrated the effect of specific and general price changes on systematic risk. After developing this theory, three empirical tests predicated on this theory were performed. The first and second tests dealt with the effect of price change disclosures on systematic risk, while the third test explored the effect of general price changes on systematic risk.

Summary of the Findings of the Study

Theoretical Examination of Inflation's Effect on Systematic Risk

Chapter II analytically incorporated specific and general price change parameters into a non-inflationary model of firm value. This model of firm value was derived from the Capital Asset Pricing Model (CAPM), which shows that the only firm specific determinant of a firm's return is its systematic risk. In order to incorporate price change variables into the model, six assumptions were made. It was shown that firm value in an inflationary environment is affected by (1) the amount of each input's specific rate of price change, (2) the amount of each input's price change passed along to consumers, and (3) general price changes. Proposition 1 showed that specific and general price changes can also affect systematic risk. Thus, disclosure of this information can be useful for risk assessment.

In addition to Proposition 1, two corollaries were presented. Corollary 1 indicated that a sufficient condition for systematic risk to be unaffected by specific price changes was for the firm to pass along total specific input price increases to the consumer. Corollary 2 showed that disclosure of specific price information is still useful in assessing a firm's systematic risk even when general prices are unchanged.

These two corollaries yielded interesting implications. Firms that can more easily pass along input price increases to consumers should experience less risk volatility due to price changes than firms less able to do so, according to Corollary 1. Corollary 2, on the other hand, indicated that specific price disclosures may be useful even when general inflation is negligible. This is encouraging in light of the fact that historical cost/constant dollar information has so recently been eliminated. Also, this finding may have important implications for future policy, in that certain current cost information may be useful even without inflation. The FASB might consider this when it considers potential modification of the current cost disclosures now required.

Empirical Examination of the Effect of Inflation and Inflation Disclosures on Systematic Risk

Chapter III described the design of the three empirical tests conducted in this study, while Chapter IV presented an analysis of the results of these tests. All three tests were based on the theoretical model which showed that systematic risk can be affected by specific and general price changes.

The objective of Test 1 was to determine if evidence of significant risk assessment changes occurred in the presence of ASR190 and FAS33 disclosures. If these disclosures allowed investors to more accurately assess the impact of price changes on systematic risk, then more risk changes should be observed for these firms vis-a-vis non-reporting firms. A sample of 87 matched pairs of firms was selected. Each pair, consisting of a reporting and non-reporting firm, was subjected to a set of statistical tests of nonstationarity to identify significant beta changes. It was hypothesized that firms reporting inflation disclosures would undergo more risk changes than those not required to report these disclosures. Results indicated no evidence that disclosure of ASR190 or FAS33 data affected the betas of disclosure firms more than the betas of non-disclosure firms.

The second test was restricted to examination of FAS33 disclosures only. Differences between inflation-adjusted earnings measures and historical cost earnings measures were computed and ranked for a sample of 83 firms. It was hypothesized that firms with the largest differences would experience more beta changes, since the effects of specific and general price changes were more dramatic for these firms. The findings of this test were similar to Test 1, in that no evidence was provided supporting the hypothesis that FAS33 disclosures had a significant impact on systematic risk.

The third test involved selecting three time periods with significantly different inflation rates. The objective of this test was to determine if more changes in systematic risk occurred in a period in which specific and general price changes were more pronounced. Significant beta changes were identified for a sample of 117 firms for each time period. Results of the two statistical tests performed indicated no evidence that firms were affected more dramatically in higher inflationary periods.

Summarizing, none of the three empirical tests provided evidence that price change disclosures or price change itself impacted systematic risk. Potential explanations for these results were discussed at the end of Chapter IV. One reason is that ASR190 or FAS33 disclosures may not have been sufficient to allow investors to revise their risk assessments. If this is the case, then it is not surprising that a majority of past empirical studies reached negative conclusions about the usefulness of these disclosures. Another reason for the negative results is that the extent of the impact of price changes on systematic risk is not known.

Limitations of the Study

The findings of this study are necessarily dependent on capital market theory. The CAPM is a single period model, and whether or not it is sufficiently rich to answer questions about the role of accounting data, a multiperiod phenomenem, is not clear. Even so, the CAPM has been widely accepted as a model on which real-world implications for accounting and security analysis can be drawn.

Another limitation of this study is the potential restrictiveness of the six assumptions used to incorporate specific and general price changes into the model. The assumption of two inputs made the analysis much less complex, and adding additional inputs would not affect the results. The assumption that output price equals input cost plus a fixed percentage of input cost, however, may not hold for firms within industries characterized by strong competition. The pricing strategies of competitors may have a greater effect on output price than input cost. Assumptions 3, 4, and 5 do not appear to be very restrictive.

For Assumptions 3 and 4, the effects of inflation are simply added to the expected market rate of return and risk-free interest rate in the absence of inflation (Fisher effect). For Assumption 5, the end-of-period market cash flow is increased by general inflation. Finally, the last assumption, which stipulates that the firm experiences a specific rate of input price increase and passes along a portion of this increase to the consumer, is not at all restrictive.

The example presented in Chapter II shows that specific and general price changes have a significant effect on risk. This example, however, included a market with only two firms. A third limitation, perhaps, is that the real-world effects on systematic risk may not be significant (future research could attempt to identify these real-world effects--see the following section). Hence, the empirical tests would yield insignificant results even if the theoretically correct price change information was being disclosed.

Suggestions for Future Research

There are several areas of possible research in this area, some of which stem from this study's limitations. First, as mentioned in the limitations section, the CAPM is a single period model. It would be interesting to see how the price change parameters included in this study would be incorporated into richer, multiperiod models.

Another area of possible research includes identification of firms with differing abilities to pass along input price increases to consumers (this relates to the third limitation above). Corollary 2 indicated that the systematic risk of firms that could more readily pass along input price increases to consumers should be less affected by price changes. Results of such a test could aid in assessing the validity of the model developed in this study.

This study reviewed systematic risk prediction studies, which examined the relationship between accounting risk measures (ARMs) and systematic risk. Most of these ARMs were not, however, theoretically linked to risk. Although this dissertation does not specifically address the relationship between various ARMs and risk, it does yield some insight as to how specific and general price changes affect beta. Therefore, future studies examining this relationship might well be advised at least to attempt to incorporate price change effects into the ARMs. If the data being disclosed is not sufficient to obtain accurate price-change adjusted ARMs, then an argument can be made calling for such information, if it exists.

TIMVAR, the set of statistical tests used to identify structural changes in beta, was used in this study. Perhaps the association between several of the ARMs and systematic risk can better be explored empirically by using TIMVAR. For example, dividend payout has been used as an ARM in most of these studies, but its relationship to beta is not very certain. If changes in dividend payout correspond to changes in risk, as identified by TIMVAR, then more confidence could be placed in the validity of using this ARM in the risk prediction model. Also, by adjusting these ARMs for the effects of price changes, more powerful conclusions could perhaps be reached.

In any case, the above suggestions support the contention that a theoretical foundation should be constructed first in order to lend credence to future empirical tests. Irrespective of the results of the empirical tests in this study, it is hoped that this dissertation has contributed to the theoretical base that has thus far been so seriously lacking in the inflation accounting area.

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APPENDIX A

FLOWCHART--SAMPLE SELECTION

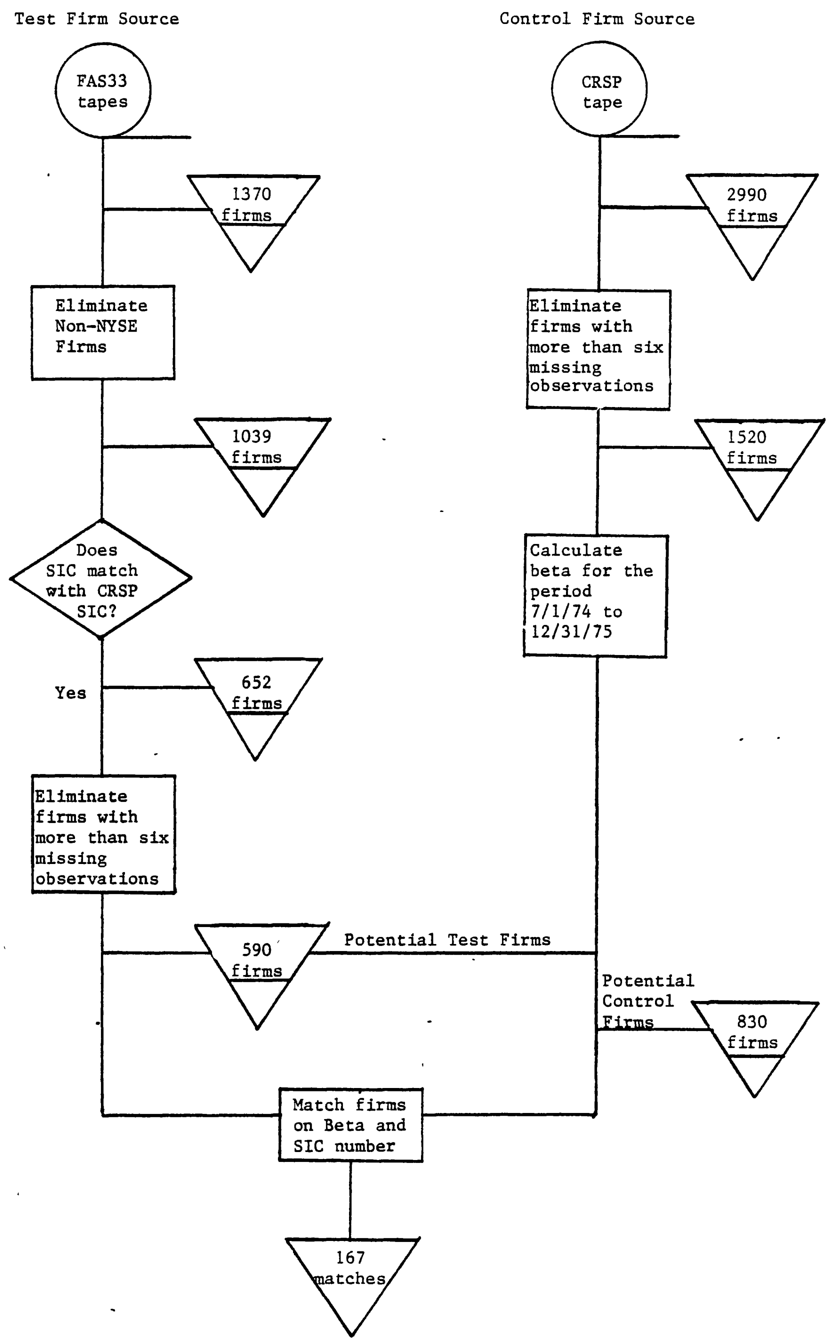

Figure 4. Flowchart--Sample Selection

APPENDIX B

NONSTATIONARITY TESTS

The description of the TIMVAR tests is based on the paper written by Brown et al. (1973). The basic regression model in this study is:

$$Y_t = \alpha_t + \beta_t X_t + U_t \qquad t = 1, \ldots, T,$$

where Y_t is the observation of the dependent variable at time t and X_t is the observation of the independent variable at time t. The error terms, U_t, are assumed to be independent and normally distributed with means of zero and variances, Var_t, t = 1, ..., T. The hypothesis of constancy over time is investigated by four tests--cusum test, cusum of squares test, homogeneity tests of moving regressions and Quandt's log-likelihood ratio test. This hypothesis is formally expressed as:

$$H: \begin{pmatrix} \alpha_1 \\ \beta_1 \end{pmatrix} = \begin{pmatrix} \alpha_2 \\ \beta_2 \end{pmatrix} = \ldots \begin{pmatrix} \alpha_T \\ \beta_T \end{pmatrix}.$$

Cusum Test

The cusum test is based upon the use of recursive residuals. Recursive residuals are standardized residuals which are calculated by inserting X in the regression equation calculated from the first t-1 observations, and then subtracting this predicted value from the actual value, Y_t. That is, assuming H_0 to be true, let $\hat{\alpha}_{r-1}$ and $\hat{\beta}_{t-1}$. be the OLS estimates obtained from the first r-1 observations. The forward recursive residual is thus defined as:

$$w_r = [Y_r - (\hat{\alpha}_{r-1} + \hat{\beta}_{r-1} X)] / \left[\frac{1 + 1/r + (X_r - \bar{X}^2)}{\Sigma(X_i - \bar{X}^2)} \right]^{1/2}$$

r = 3, ..., T.

Under H_0 it can be shown that w_{k+1}, ..., w_r are independent, N(0, Var) (where k = number of regressors). If the coefficients alpha and beta are constant up to a certain point and then change, the w_r's will have zero means up to the disturbance point and non-zero thereafter. The cusum test examines plots of the cusum quantity,

$$w_r = (1/S) \sum_{k+1}^{r} w_j, \qquad r = 3, \ldots, T$$

against r for r = k+1, ..., T, where S is the estimate of the standard deviation of the residuals using all T observations.

Since the w_r's are N(0, Var) the W_r's are approximately normal such that:

$$E(W_r) = 0, \ Var(W_r) = r-2, \text{ and } Covar(W_r, W_s) = \min(r,s) - 2.$$

Next, a pair of symmetrical lines, above and below, the mean value line $E(W_r) = 0$ are constructed such that the probability of the sample path crossing one of the lines is alpha, the level of significance. The method of construction is based upon known results in Brownian motion theory. A backward recursion process is also performed to assist in locating the disturbance point. Critical values for alpha = .01, .05, and .1 are, respectively, 1.143, .948, .85 (these critical values apply, of course, to the cusum test). If a computed W is greater than the critical value selected, the null hypothesis is rejected.

Cusum of Squares Test

The cusum of squares test is based upon the squared recursive residuals and examines the plot of the quantities:

$$s_r = \left(\sum_{k+1}^{r} w_j^2 \right) / \left(\sum_{k+1}^{T} w_j^2 \right) \qquad r = 3, \ldots, T$$

The test is more sensitive to haphazard changes in coefficients than is the cusum test. It is also sensitive to changes in the residual variance. Under H_0, s_r can be shown to have a beta distribution with mean (r-2)/(T-2). A pair of lines, (r-2)/(T-2) plus or minus c_0,[1] are drawn parallel to the mean value line such that the probability that the sample path of s crosses a line is alpha.

Homogeneity Tests

Another means for investigating beta instability is the use of moving regressions. A regression is fit on a short segment of n observations which is then moved along the series. That is, for T observations, regressions are fit on the segments, (1, n), (2, n+1), ..., (T-n-1, T). A significance test for constancy of regression coefficients, the homogeneity test, is utilized. It is based on the use of regressions on nonoverlapping time segments using analysis of variance. The nonoverlapping time segments for a moving regression of length n, are (1, n), (n+1, 2n), ..., [(p-1)n+1, T], where p is the integral part of T/N. The homogeneity statistic for b nonoverlapping segments is:

$$F = [(T-2p)/(2p-2)] \left[\frac{(SSE_T - SSE_1 - SSE_2 - \ldots - SSE_b)}{\left(\sum_{1}^{b} SSE_i \right)} \right]$$

where SSE_T is the residual sum of squares for the regression on the

[1]For the derivation of c_0, see Brown et al. (1973), pp. 154-155.

entire T observations and SSE_i, i = 1, ..., b is the residual sum of squares for the regression on each of the nonoverlapping segments.

Quandt's Log-Likelihood Test

This test is used to detect the point in time in which the regression relationship changed from one constant relationship to another constant relationship. Quandt (1958) describes the development of the techniques. For each r from r = 3 to T - 3 the ratio Q_r = $\log_{10}$[(max likelihood of observations given H_0)/(max likelihood of observations given H_1)] is computed, where H_1 is the hypothesis that observations in the time segments (1, ..., r) and (r+1, ..., T) come from two different regressions. The minimum value of Q_r is the estimate of the point at which the switch from one relationship to another has occurred. It can be shown that $Q_r = (r \log S_1^2)/2 + ((T-r)/2)\log S_2^2 - (T \log S^2)/2$, where S_1^2, S_2^2, and S^2 are the residual sum of squares divided by the number of observations in each of the subintervals and the entire interval, respectively.

APPENDIX C

LIST OF TEST 1 FIRMS

	Firm	SIC No.	ID No.	Number of Beta Changes 1966–1972	1976–1982
1	Acme Cleveland Corp	3540	T 41	2	0
2	Air Prods & Chems Inc	2810	T 14	0	0
3	Alagasco Inc	4920	T 72	0	0
4	Alberto Culver Co	2844	C 22		0
5	Allegheny Intl Inc	3310	C 35	1	2
6	Allied Corp	2810	C 14	1	0
7	American Home Prods Corp	2830	T 13	1	0
8	American Sterilizer Co	3842	C 46		0
9	Ameron Inc	3272	C 28		1
10	Amp Inc	3690	T 52	1	0
11	Amrep Corp	6552	C 84		2
12	Amsted Inds Inc	3310	C 30		1
13	Apache Corp	1311	T 4		2
14	Arkla Inc	1321	T 5		1
15	Aro Corp	3580	C 47	0	2
16	Arvin Inds Inc	3710	T 54	1	0
17	Axia Corp	3310	C 34	0	0
18	Ball Corp	3221	C 26		1
19	Baxter Travenol Labs Inc	2830	C 19	0	1
20	Belco Petroleum	1310	T 2		1
21	Bethlehem Steel	3310	T 30		0
22	Black & Decker Mfg Co	3540	T 42		2
23	Bristol Myers Co	2630	T 19	0	0
24	Brockway Inc	3221	T 26		0
25	Brush Wellman Inc	3359	T 37		1
26	CCX Inc	3310	C 31		0
27	CPC Intl Inc	2040	C 9	0	1
28	CP Natl Corp	4931	T 76		2
29	CTS Corp	3660	T 50		0
30	Campbell Soup Co	2030	C 7	0	0
31	Carolina Fght Carrier	4213	C 62		0
32	Carpenter Technology Corp	3310	T 34	1	0
33	Carter Wallace Inc	2830	C 18	1	0
34	Cascade Nat Gas Corp	4923	C 75		0
35	Castle & Cooke Inc	2033	C 8	2	1
36	Central Ill Lt Co	4930	T 78		1
37	Cessna Aircraft Co	3720	C 57	0	0
38	Champion Spark Plug Co	3690	T 53	1	0
39	Chrysler Corp	3710	T 55	0	1
40	Cleveland Cliffs Iron Co	1000	T 1	1	1
41	Colgate Polmolive	2840	T 21		2
42	Columbia Gas Sys Inc	4930	C 76		2
43	Commonwealth Energy System	4931	C 77		2
44	Conagra Inc	2041	T 10		1
45	Consolidated Freightways Inc	4213	T 62		0
46	Cooper Inds Inc	3510	C 39	0	1
47	Cooper Labs Inc	2834	C 20		0
48	Dana Corp	3710	C 54	1	1
49	Deltona Corp	6552	T 84		0

	Firm	SIC No.	ID No.	Number of Beta Changes 1966-1972	1976-1982
50	Digital Equip Corp	3573	T 46		0
51	De Soto Inc	2850	T 23	0	2
52	Easco Corp	3310	C 58	1	0
53	Eastman Kodak Co	3830	T 60		1
54	Edison Bros Stores Inc	5660	T 81	0	0
55	Empire Inc	5984	C 82		3
56	Enserch Corp	4920	T 74	0	3
57	Equifax Inc	7392	C 85		1
58	Ex Cell O Corp	3540	C 41	0	1
59	Fairchild Inds Inc	3720	T 57	0	2
60	Federal Paper Brd Inc	2640	C 12	0	0
61	Fleet Finl Group Inc	6025	C 83		1
62	Flexi Van Corp	7394	T 85		0
63	General Mis Inc C 15	2040	C 11		0
64	General Signal Corp	3660	C 51	1	0
65	Genstar Corp	3241	C 27		2
66	Gerber Prods Co	2030	T 7	1	0
67	Gleason Wks	3541	T 43		1
68	Global Marine Inc	1381	C 6		2
69	Golden West Finl Corp Del	6711	T 86		2
70	Gould Inc	3690	C 53	1	0
71	Great Atlantic and Pac Tea Inc	5510	C 80	0	2
72	Gulf Res & Chem Corp	3332	C137		0
73	Harris Corp Del	3550	T 44		2
74	Harsco Corp	3310	T 29		0
75	Harte Hanks Communications Inc	2711	C 13		0
76	Hawaiian Elec Inc	4911	T 67	0	0
77	Helmerich & Payne Inc	1311	C 3	1	1
78	Hercules Inc	2890	T 24	0	0
79	Hesston Corp	3523	T 40		0
80	Hoover Unvl Inc	3560	C 56	0	0
81	Houston Inds Inc	4910	T 65	1	0
82	Houston Hat Gas Crop	4923	T 75		1
83	Hunt Philip A Chem Corp	3861	C 60		1
84	I C Inds Inc	6711	C 86		0
85	I U Intl Corp	4920	C 72	0	0
86	Illinois Pwr Co	4910	C 64	0	0
87	Indianapolis Pwr & Lt Co	4910	T 68	1	2
88	Inland Stl Corp	3310	C 32		0
89	Interlake Inc	3310	T 31		1
90	International Harvestor Co	3520	C 30		0
91	International Multifoods Corp	2041	T 11		1
92	International Tel & Teleg Corp	3660	T 51	1	1
93	Interstate Pwr Co	4910	C 65	0	0
94	Iowa Elec Lt & Pwr Co	4910	C 66	1	2
95	Iowa Pub Svc Co	4811	C 69	0	0
96	Keystone Cons Inds Inc	3310	T 32		2
97	Knight Ridder Newspapers Inc	2711	T 13		0
98	Kroger Co	5410	T 79		1

	Firm	SIC No.	ID No.	Number of Beta Changes 1966-1972	1976-1982
99	L T V Corp	3720	T 59	0	0
100	Lilly Eli & Co	2834	T 15		0
101	Lockheed Corp	3720	C 59	1	1
102	Lone Star Inds Inc	3240	T 27		0
193	Louisiana Ld and Expl Co	1311	C 2		2
104	Lukens Inc	3310	T 35	1	0
105	Magic Chef Inc	3631	T 49		1
106	Mapco Inc	4925	C 5		0
107	Marion Labs Inc	2834	C 17		2
108	McDonnell Douglas Corp	3720	T 59	2	0
109	Michigan Energy Resources Co	4924	T 73	0	2
110	Midland Ross Corp	3710	T 56	0	2
111	Minnesota Mng & Mfg Co	2640	T 12	0	0
112	Monarch Machine Tool Co	3540	C 42		0
113	Morton Thiokol Inc	2830	C 15		0
114	NCH Corp	2842	C 21		2
115	NBD Bancorp Inc	6025	T 83		2
116	N L Inds Inc	2850	C 23	0	2
117	National Gypsum Co	3270	T 28		1
118	National Std Co	3310	T 33	0	0
119	National Std Corp	3310	T 36	0	1
120	Natomas Co	1000	C 1	0	1
121	Nevada Pwr Co	4911	T 64	2	1
122	Niagara Mohawk Pwr Corp	4910	C 67	0	2
123	Northeast Utils	4911	T 70		1
124	Northern Ind Pub Svc Co	4911	C 71	1	0
125	Oklahoma Gas & Elec Co	4910	T 71	0	1
126	Oneida Ltd	3914	T 61		1
127	Oneok Inc	4920	C 73	0	2
128	Orange and Rockland Utils Inc	4930	T 77		0
129	Outboard Marine Inc	3510	T 39	0	3
130	Overnite Transn Co	4214	T 63		2
131	Pacific Ltg Corp	4920	T 87	0	0
132	Pacific Pwr & Lt Co	4911	C 70		1
133	Parker Hannifin Corp	3429	T 38	0	0
134	Pepsico Inc	5410	C 79		2
135	Pfizer Inc	2830	T 20		0
136	Pillsbury Co	2040	C 10		1
137	Portec Inc	3310	C 33	2	2
138	Procter & Gamble Co	2840	T 22	1	2
139	Proler Intl Corp	3341	C 29		2
140	Public Svc Co N Mex	4931	C 78		0
141	Purolator Inc	3714	C 55	2	1
142	Quanex Corp	3317	C 36	1	1
143	Ralston Purina Co	2040	T 9	0	2
144	Reece Corp	3636	C494		1
145	Ronson Corp	3910	C 61	2	1
146	Safeway Stores Inc	5410	T 80	1	1

	Firm	SIC No.	ID No.	Number of Beta Changes 1966-1972	1976-1982
147	Schlumberger Ltd	3570	T 45		1
148	Scoa Inds Inc	5661	C 81	0	1
149	Scott & Fetzer Co	3635	C 48		2
150	Sedco Inc	1351	T 6		0
151	South Carolina Elec & Gas Co	4910	C 68	0	0
152	Southern Ind Gas & Elec Co	4910	T 69	0	0
153	Starrett L S Co	3420	C 38	0	1
154	Sterling Drug Inc	2830	T 16		0
155	Stokely Van Camp Inc	2030	T 8	2	0
156	Stride Rite Corp	3140	C 25	1	1
157	Suburban Propane Gas Corp	5980	T 85		1
158	Sun Chem Corp	2850	C 24	0	3
159	Sunstrand Corp	3540	C 43		1
160	Superior Oil Co	1310	T 3	0	2
161	Teco Energy Inc	4911	T 66	0	1
162	Teledyne Inc	3602	C 44		1
163	Tenneco Inc	4920	C 74	0	0
164	Texas Oil & Gas Corp	1311	C 4		0
165	Thomas & Betts Corp	3644	C 52	1	0
166	Transcon Inc Cal	4213	C 63		2
167	Tyco Labs Inc	3679	C 50		0
168	U M C Inds Inc	3580	T 47	1	0
169	United Sts Shoe Corp	3140	T 25	0	0
170	Univar Corp	2833	C 16		2
171	Warner Lambert Co	2830	T 17		2
172	Westcoast Transmission Ltd	4923	C 87	0	0
173	Whirlpool Corp	3630	T 48		2
174	Zapata Corp	1381	C 45		1

APPENDIX D

LIST OF TEST 2 FIRMS

	Firm Name	SIC No.
1	ACF Inds Inc	3740
2	AMF Inc	3550*
3	Abbott Labs	2830
4	Amerada Hess Corp	2910
5	American Home Prods Corp	2830*
6	Amp Inc	3690*
7	Arkla Inc	1321
8	Armco Inc	3310
9	Arvin Inds Inc	3710
10	Bethlehem Steel Corp	3310
11	Borg Warner Corp	3710
12	Brockway Inc	3221
13	Brush Wellman Inc	3359
14	CP Natl Corp	4931
15	Certainteed Corp	2990*
16	Chrysler Corp	3710
17	Cleveland Cliffs Iron Co	1000
18	Colgate Palmolive	2840
19	Dun & Bradstreet	7392
20	Eaton Corp	3710
21	Edison Bros Stores Inc	5660
22	El Paso Co	4920
23	Exxon Corp	2910*
24	Fairchild Inds Inc	3720*
25	Federal Mogul Corp	3560*
26	Figgie Intl Inc	3569
27	Fruehauf Corp	3710*
28	GATX Corp	3740*
29	Grumman Corp	3720*
30	Harcourt Brace Jovanovich Inc	2710*
31	Harsco Corp	3310
32	Hawaiian Elec Inc	4911
33	Hercules Inc	2890*
34	Hershey Foods Corp	2070
35	Hesston Corp	3523*
36	Houston Inds Inc	4910
37	Ideal Basic Inds Inc	3240
38	Indianapolis Pwr & Lt Co	4910
39	International Tel & Teleg Corp	3660*
40	Johnson & Johnson	3840
41	Kaiser Cement Corp	3240
42	Knight Ridder Newspaper Inc	2711
43	Koppers Inc	2810
44	Kroger Co	5410
45	L T V Corp	3720

*Indicates that this firm experienced a beta change during 1/1/79 to 12/31/81.

	Firm Name	SIC No.
46	Lone Star Inds Inc	3240*
47	Longs Drug Stores Inc	5912
48	Lukens Inc	3310
49	McDonnell Douglas Corp	3720*
50	McGraw Hill Co	2710*
51	Midland Ross Corp	3710
52	Motorola Inc	3660
53	Murphy G C & Co	5330
54	N C R Corp	3570
55	National Distillers & Chm Corp	2080*
56	National Gypsum Co	3270
57	National Stl Corp	3310*
58	Nevada Pwr Co	4911
59	Northeast Utils	4911
60	Occidental Pete Corp	1311
61	Oklahoma Gas & Elec Co	4910
62	Orange & Rockland Utils Inc	4930
63	Pacific Ltg Corp	4920
64	Panhandle Eastn Corp	4922
65	Pfizer Inc	2830
66	Revere Copper & Brass Co	3350*
67	Safeway Stores Inc	5410
68	Schlumberger Ltd	3570*
69	Scovill Inc	3350*
70	Smith A O Corp	3710
71	Southern Ind Gas & Elec Co	4910
72	Standard Oil Co Ind	2910
73	Sterling Drug Inc	2830
74	Stop & Shop Cos Inc	5411*
75	Supermarkets Gen Corp	5411*
76	Sybron Crop	3840
77	Teco Energy Inc	4911
78	T R W Inc	3710
79	U M C Inds Inc	3580
80	Warner Lambert Co	2830
81	Washington Gas Lt Co	4920
82	Weis Mkts Inc	5411
83	Whirlpool Corp	3630

APPENDIX E

LIST OF TEST 3 FIRMS

Firm Number and Name		Number of Beta Changes 1958-1964	1966-1972	1976-1982
1	ACF Inds Inc	2	0	0
2	AMF Inc	1	1	1
3	Abbott Labs	0	2	0
4	Acme Cleveland Corp	1	2	0
5	Alagasco Inc	2	0	0
6	Allegheny Intl Inc	1	1	2
7	Allied Corp	1	1	0
8	American Home Prods Corp	0	1	0
9	Amsted Inds Inc	0	1	1
10	Armco Inc	0	1	2
11	Arvin Inds Inc	1	1	0
12	Axia Corp	0	0	0
13	Bendix Corp	1	0	0
14	Bethlehem Steel Corp	0	1	0
15	Black & Decker Mfg Co	0	0	2
16	Borg Warner Corp	2	0	0
17	Bristol Myers Co	0	0	0
18	Brooklyn Union Gas Co	2	0	0
19	CCX Inc	1	1	0
20	CPC Intl Inc	1	0	1
21	Campbell Soup Co	1	0	0
22	Carling Okeefe Ltd	0	0	0
23	Carolina Fght Carrier Corp	0	0	0
24	Carpenter Technology Corp	0	1	0
25	Carter Wallace Inc	2	1	0
26	Colgate Palmolive	2	1	2
27	Columbia Gas Sys Inc	0	0	2
28	Cooper Inds Inc	1	0	1
29	Dana Corp	2	1	1
30	De Soto Inc	0	0	2
31	Disney Walt Prodtns Inc	0	1	0
32	Easco Corp	0	1	0
33	Eastman Kodak Co	2	0	1
34	Eaton Corp	0	0	0
35	Edison Bros Stores Inc	1	0	0
36	El Paso Co	0	1	0
37	Enserch Corp	1	0	3
38	Ex Cell O Corp	0	0	1
39	Exxon Corp	1	0	0
40	Fairchild Inds Inc	0	0	2
41	Federal Mogul Corp	0	1	1
42	Federal Paper Brd Inc	2	0	0
43	General Instr Corp	1	1	1
44	General Mls Inc C 15	0	0	0
45	General Signal Corp	1	1	0
46	Gerber Prods Co	1	1	0
47	Gould Inc	0	1	0
48	Grumman Corp	0	0	0
49	Harris Corp Del	0	0	1

Firm Number	and Name	Number of Beta Changes 958-964	1966-1972	1976-1982
50	Harsco Corp	1	0	0
51	Hayes Albion Corp	2	0	2
52	Heinz H J Co	1	0	0
53	Hercules Inc	1	0	0
54	Hershey Foods Corp	1	0	0
55	Homestake Mining Co	0	2	1
56	Houston Inds Inc	0	1	0
57	I U Intl Corp	0	0	0
58	Indianapolis Pwr & Lt Co	0	1	2
59	Inland Stl Corp	0	1	0
60	Insilco Corp	1	0	0
61	Interlake Inc	0	2	1
62	International Harvester Co	0	0	1
63	International Tel & Teleg Corp	0	1	1
64	Interstate Pwr Co	0	0	0
65	Jewel Cos Inc	0	2	0
66	Johnson & Johnson	0	2	1
67	Keystone Cons Inds Inc	0	0	2
68	Koppers Inc	2	1	0
69	Kroger Co	0	2	1
70	L T V Corp	1	0	0
71	Lockheed Corp	0	2	0
72	Lone Star Inds Inc	0	0	0
73	Lukens Inc	2	1	0
74	McGraw Hill Co	1	0	0
75	Midland Ross Corp	1	0	2
76	Minnesota Mng & Mfg Co	1	0	0
77	Monarch Mach Tool Co	0	1	0
78	Morton Thiokol Inc	0	0	0
79	Motorola Inc	2	0	0
80	Murphy G C & Co	2	1	1
81	N C R Corp	2	1	2
82	N L Inds Inc	0	0	2
83	National Distillers & Chm Corp	0	0	2
84	National Gypsum Co	0	1	1
85	National Stl Corp	0	0	1
86	Natomas Co	1	0	1
87	Niagara Mohawk Pwr Corp	0	0	2
88	Oklahoma Gas & Elec Co	0	0	1
89	Oneok Inc	1	0	1
90	Outboard Marine Inc	0	0	3
91	Pacific Lrg Corp	0	0	0
92	Pepsico Inc	0	0	2
93	Pfizer Inc	2	2	0
94	Pillsbury Co	0	1	1
95	Portec Inc	1	2	2
96	Procter & Gamble Co	1	1	2

Firm Number and Name		Number of Beta Changes 1958-1964	1966-1972	1976-1982
97	Revere Copper & Brass Co	0	3	0
98	Rexnord Inc	1	0	0
99	Reynolds Metals Co	0	0	1
100	Ronson Corp	1	0	0
101	Safeway Stores Inc	0	1	1
102	Schlumberger Ltd	0	2	1
103	Scovill Inc	3	1	0
104	Smith A O Corp	2	1	1
105	South Carolina Elec & Gas Co	0	0	0
106	Southern Ind Gas & Elec Co	0	0	0
107	Standard Oil Co Ind	2	1	0
108	Starrett L S Co	0	0	1
109	Sterling Drug Inc	0	1	0
110	Stokely Van Camp Inc	0	1	0
111	Sun Chem Corp	0	0	3
112	Sunstrand Corp	0	2	1
113	Superior Oil Co	0	0	2
114	Sybron Corp	1	0	1
115	United Sts Shoe Corp	2	0	0
116	Warner Lambert Co	2	1	2
117	Whirlpool Corp	0	0	2

VITA 2

Curtis Lynn DeBerg

Candidate for the Degree of

Doctor of Philosophy

Thesis: STRUCTURAL CHANGES IN SYSTEMATIC RISK AND INFLATION ACCOUNTING: A THEORETICAL AND EMPIRICAL EXAMINATION OF ASR190 ADN FAS33

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