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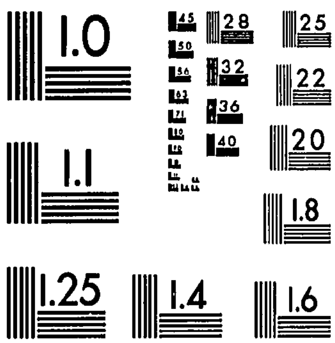

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INTRA-INDUSTRY INFORMATION TRANSFERS ASSOCIATED WITH
MANAGEMENT EARNINGS FORECASTS

University of Illinois at Urbana-Champaign PH.D. 1986

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INTRA-INDUSTRY INFORMATION
TRANSFERS ASSOCIATED WITH MANAGEMENT
EARNINGS FORECASTS

BY

STEPHEN PAUL BAGINSKI

B.S., Illinois State University, 1979
M.S., Illinois State University, 1980

THESIS

Submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy in Accountancy
in the Graduate College of the
University of Illinois at Urbana-Champaign, 1986

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ABSTRACT

INTRA-INDUSTRY INFORMATION TRANSFERS ASSOCIATED WITH MANAGEMENT EARNINGS FORECASTS

Stephen Paul Baginski
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University of Illinois at Urbana-Champaign, 1986

This research provides a theoretical basis for expecting a stock price impact of a firm's disclosure of changes in expected earnings on other non-disclosing firms in its industry (an information transfer) and proposes tests of the proposition that management forecasts of earnings generate such transfers. Cluster analysis procedures are used to construct homogeneous industries for which the transfer effect is hypothesized. Parametric tests are proposed that mitigate the effects of cross-sectional correlation of market model residuals within the industry. In addition, a model is formulated that seeks to explain cross-sectional differences in the magnitude of observed information transfers by economic relationships between the disclosing firm and non-disclosing industry co-members. The magnitude of the information transfer is expressed as a function of the magnitude of changes in earnings expectations of the disclosing firm, the market share variability of the reporter, and a measure of the relative diversification (homogeneity) of industry co-members. The results of empirical tests of these models fail to reject the null hypotheses for information transfer existence and relationship to the sign and magnitude of changes in earnings expectations conveyed by management forecasts (for homogenous industries as defined by cluster analysis). At the 4-digit SIC code level, the results support the hypothesis that the magnitude of information transfers is positively related to the sign and magnitude of changes in earnings expectations conveyed by management forecasts. In addition, the results support the hypothesis that the magnitude of information transfer is inversely related to the relative diversification of industry co-members. The results do not support market share variability as a determinant of the magnitude of information transfers.

DEDICATION

This work is dedicated to my parents whose personal example has always been the best teacher, to my son Andrew, and to my wife, Lynn, whose patience, encouragement, and understanding were the key ingredients to its completion.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The alleged economic consequences of various disclosure rules concerning management forecasts have spawned a great deal of debate.[1] As indicated by Gonedes, Dopuch, and Penman (GDP) [1976], two fundamental questions arise from the forecast debate:

> First, to what extent do the required forecast disclosures convey information pertinent to establishing firms' equilibrium values?... Second, to what extent are the disclosure rules consistent with optimal allocations of resources? (p. 90)

Empirical studies addressing the first question (reviewed in Section 1.3) include Foster [1973], Patell [1976], GDP [1976], Nichols and Tsay [1979], Penman [1980], Ajinkya and Gift [1984], and Waymire [1984]. The results of these studies support the hypothesis that a management earnings forecast conveys information for equity valuation for the firm making the forecast.

Although the information content hypothesis is supported, the usefulness (gross benefit) of management forecasts in determining equity values may be understated since research has ignored the effects of forecast disclosure on non-disclosing firms (an information transfer). This information transfer effect is possible in cases where the profit functions of firms are related by commonality of inputs or simultaneous determination of the demand for the firms' outputs. A transfer effect might also exist for situations in which the outputs of one firm become the inputs of other firms such as in a supplier/ retailer relationship.

The concept of information transfer associated with accounting disclosures was introduced by Foster [1980, 1981] who hypothesized an intra-industry information transfer effect for releases of accounting earnings reports. The hypothesis was tested for a large number of earnings releases during the 1963 to 1978 period. He found that information transfers occurred and that the sign of the effect on firm j's stock price was consistent with the sign of the effect on firm i's stock price (firm i being the "releaser" of the information). The greatest effects were found when the earnings release generated the largest stock price revision of the releaser. In addition, evidence was provided supporting narrowness of industry definition as a determinant of the magnitude of information transfer.

Research on non-U.S. firms is contradictory. Firth [1976] documented information transfers for the 1973 to 1974 period for a sample of eighty-seven earnings releases by U.K. companies. Morris [1980] failed to document such transfers for 165 earnings release observations of

Australian companies for the 1964-1972 period. Clinch and Sinclair [1985] present preliminary results in favor of information transfers for Australian firms for the 1977-1981 period.

Intra-industry information transfers associated with a number of other information events have also been studied. Olsen and Dietrich [1985] examined vertical information transfers between retail chain stores and their suppliers. They documented a significant change in suppliers' stock prices for releases of monthly sales announcements by retailers. Larger price changes were found for suppliers with a relatively larger portion of sales to the announcing retailer. Studies of information transfer associated with other events include Bowen, Castanias and Daley [1983] and Hill and Schneeweis [1983] (news of a nuclear accident), Eckbo [1983] and Stillman [1983] (horizontal merger announcements), and Boim [1977] (the announcement of a dividend omission).

Currently, the information transfer research is plagued by several deficiencies. The most significant deficiency is the lack of a theoretical model from which to generate the information transfer hypothesis and to specify conditions which affect its magnitude. This weakness has precluded the development of more powerful directional tests of the existence of information transfer.[2] In addition, it has rendered existing nondirectional tests difficult to interpret.

In this research, two models are derived as a basis for the hypothesis. Both models rely on the similarities of production functions of firms within the same industry to investigate the transferability of changes in earnings expectations. The first is a simple "risk class" model which specifies a conditional distribution of changes in firms' expected profits. The variance of the distribution is zero since the ratio of changes in firms' expected earnings is a constant proportion. As a result, the transferability of changes in expected earnings is perfect (no forecast error). This permits a directional test of the information transfer hypothesis for certain groupings of firms. The second model extends the simple "risk class" model from a "zero-variance" conditional distribution of changes in expected profits of firms to a conditional distribution in the traditional sense (non-zero variance) where the parameters of the distribution are described by economic relationships between firms in the same industry. Due to the non-zero variance, a forecast error may be specified. This will identify factors which determine the magnitude of information transfers.

In addition, empirical tests of the models are performed for the case of management earnings forecasts.

The research design for the empirical tests refines prior method in four respects. First, parametric tests of the hypothesis are justified by forming non-forecasting firms into portfolios to mitigate the effects of cross-sectional residual correlation. Prior research has ignored the problem of many non-releasers in event time (e.g., Firth [1976]) or has mitigated the effects of the problem through less powerful nonparametric tests (e.g., Foster [1981]). Second, prior research has ignored the effects of contemporaneous disclosures during the event period. This research partially controls for this problem by excluding sample and control firms with known disclosures in the event period. Third, direct measures of changes in earnings expectations are calculated in this research (management forecast less previously issued composite analyst forecast). Prior research has relied on indirect measures (abnormal returns of forecaster) as proxies for changes in earnings expectations. Finally, this research utilizes an industry-matched control group design to combat the criticism that the event time abnormal returns of non-forecasters are driven by industry level events whose effects are not extracted by a single-factor market model. These empirical tests are the first tests of the information transfer hypothesis for forecast data.

1.2 Importance of Information Transfer Research

The results of information transfer research have implications for policy formation, research design and investment strategy as discussed below.

1.2.1 Policy Formulation

Since the existence of a stock price reaction to an accounting disclosure is a necessary but not a sufficient condition for an increase in social welfare (Gonedes and Dopuch [1974]), the "information content" methodology is relegated to the role of determining the somewhat weaker notion of disclosure effect. If information transfers occur when forecasts are disclosed by management, then a number of interrelated effects are indicated. The first relates to utility effects on shareholders of non-disclosing firms for which the disclosure has implications. As shown by Trueman [1983], the release of new information causes three utility effects on individuals. A "price effect" is caused by changes in prices resulting from the disclosure of the information. The "shareholding effect" is the shareholder's change in utility from revising his portfolio and the "production effect" is a change in utility caused by the firm selecting a different set of production alternatives due to the information revelation. If we abstract from the price effect and assume homogeneous beliefs (positive production effect), Trueman shows that the release of information in a production-exchange economy results in a Pareto indifferent or Pareto superior solution since individuals, at the least, lose no utility from having additional information available from which to choose alternative consumption/investment streams. Therefore, the documentation of a price reaction to the release of a management forecast indicates three effects on individuals:

1. A price effect which is positive or negative depending on the "content" of the news.
2. A production effect which is positive when homogeneous beliefs obtain (see Arrow [1978] and Hirshleifer [1971]) and can be either positive or negative for individual shareholders when heterogeneous beliefs obtain, and
3. A non-negative shareholding effect.

In an information transfer context, the set of individuals affected by the disclosure is expanded to include those who wish to assess the return distribution of other non-disclosing firms. If shareholders of non-disclosing firms are able to revise their expectations based on the disclosures of another firm, they will experience similar utility effects less the portion of the price effect associated with information production.

A second effect of information transfer relates directly to the fact that the shareholders of the non-disclosing firm do not bear the costs of information production. The voluntary production of information that causes information transfers involves private financing of a public good. The disclosure of a management earnings forecast involves costs of production, verification, dissemination and litigation among others. These costs reduce the utility of the current shareholder group but not the utility of shareholders of non-forecasting firms for which the forecast has implications for equity valuation (a cross-subsidy to shareholders of other firms).

As indicated by Gonedes [1980], the existence of cross-subsidies in a system where every firm discloses implies no systematic or important wealth redistributions. However, the purpose of this research is to document effects of the present system of voluntary disclosure. Under the present system, the existence of information transfers associated with management forecasts implies a wealth redistribution from shareholders of the producing firm to shareholders of other firms.

A final effect of information transfer relates to the fact that the marginal benefits to these "free riders" may not be considered by individual firms when making information production decisions. Gonedes [1975] utilizes a game-theoretic approach to study the problem of information production. A basic conclusion of his analysis is that, under appropriate conditions, the competitive information production equilibrium obtained through coalition contracting is a Pareto optimal state.[3] Demsetz [1970] provides a market specification leading to a competitive pricing mechanism for the output of the information production process which also leads to Pareto optimal information production. Although both papers consider the public goods aspects of accounting information, the market settings that they specify allow the exclusion of non-purchasers. In the case of a public good, if non-purchasers are not excluded, the resulting information production decisions are non-Pareto optimal (see GDP [1976], p. 99). To obtain Pareto optimality, the firm causing the external economies should increase information production. In the absence of a pricing mechanism which compensates firms for producing information (to the point at which marginal costs equal marginal benefits after consideration of the marginal benefits to free riders), the increase will not occur. In this study, the term "externality" will be used to designate the situation in which information transfers occur and no pricing mechanism is in effect to "price-out" the transfers. This definition is consistent with definitions provided by Foster [1980] and Beaver [1981]. Examples of proposed solutions to the externality problem may be found in Foster [1980]. They include the creation of markets for trading forecasts, the combination of firms' information rights, tax subsidy and direct regulation.

The costly solutions to the externality problem render the documentation of information transfer as only a necessary condition for market failure (see Leftwich [1980]). In order to document market failure, Foster [1980] indicates that empirical evidence must take several forms:

> (a) evidence on the sub-set of logically possible information transfers that are empirically significant.
> (b) evidence on the sub-set of logically possible information transfers that are priced out by the market mechanism, and
> (c) evidence on the cost of alternative institutional mechanisms for internalizing the impact of information transfers into the disclosure decisions of firms. (p. 224)

Evidence of the existence of information transfers associated with management earnings forecasts is directed at (a) above. In addition, this research is designed to document the existence of economic factors which determine the magnitude of the transfers.

1.2.2 Research Design Implications

Many of the test statistics used in capital market studies assume that residuals calculated from the market model are cross-sectionally independent. If this assumption is violated, the residual variance calculated by ordinary least squares procedures will be biased (downward in the case of positive correlation). Of interest to this study is the effect on cross-sectional residual correlation of omission of the industry index. Beaver [1981] indicates the statistical bias which will result if the index is significant in explaining individual security returns and is omitted from the market model.

Given the documented significance of the industry index (King [1966] and others cited in section 2.3), it is surprising that, to date, there is a lack of evidence as to what specific items cause the industry effect on security returns. Ball and Brown [1967], Gonedes [1973], and Magee [1974] document the significance of the industry factor in explaining movements in accounting earnings but do not consider any individual accounting disclosures as a determinant of security price co-movement within the industry. If such a relationship is documented empirically, a guide will be provided to researchers who wish to avoid the cross-sectional correlation problem. For example, if intra-industry information transfers are documented for a specific type of information release, a signal is provided to researchers who wish to assess the information content of a specific item in periods in which the information transfer causing releases are plentiful. In these cases, the use of methods to combat cross-sectional correlation are indicated.[4]

Another implication of information transfer for research design relates to information transfer as a confounding effect. Recently, a great deal of research has concentrated on the effects of certain variables on the stock price reaction to earnings announcements on or around the dates of those announcements. Givoly and Palmon [1982], Chambers and Penman [1984], Kross [1982], Kross and Schroeder [1984], and Whittred [1980] investigate timing of the announcement as a determinant of stock price reaction at earnings announcement dates. It is recognized in these studies that a number of factors may be driving the explanatory power of "timing". One of these factors is the potential for early industry releasers to convey a significant portion of the content of a late releaser's report.

At this point, it is difficult for timing studies to control for information transfer effects. This may be necessary if the research is to concentrate on other factors for which "timing" is a proxy (missing expected disclosure date, etc.). Additional research on information transfer existence and magnitude is necessary to provide a basis for such control.

1.2.3 Investment Strategy

A growing amount of firm valuation research has suggested that analysis of industry groupings can be valuable in portfolio construction. This assertion is based on the empirical finding that industry effects are significant in explaining the "extra-market" components of security return (security residual returns after removing the market component).[5]

Additional evidence on this issue may be provided by empirical results which document disclosures causing co-movement in industry security prices. Also, the formation of risk class industries and the concern for factors which determine the magnitude of information transfers may lead to techniques for explicit consideration of the industry factor in portfolio construction models.

1.3 Management Forecasts and Earnings Expectations

As noted in Section 1.1, the forecast disclosure debate partially rests on the notion that disclosure of management earnings forecasts has some benefit (information content). This notion is a result of the assertion of substantive differences in information sets between managers and non-managers. Managers are argued to have superior knowledge of the consequences to their firms of various states of the world and also of their planned actions to mitigate or encourage the realizations of those consequences. If we abstract from the motivation of managers to disclose the forecast (accurately), the disclosure should benefit the capital market by enabling the assessment of stock price to be based on a finer information set.[6]

This section reviews prior research on management forecasts as a method of conveying changes in earnings expectations. The discussion is limited to management forecasts for two reasons. First, as argued in Section 1.1, a policy debate exists concerning management forecasts. This debate is not related to other types of forecasts (analyst, time series, etc.). Second, only analyst forecasts have a specific release date and are, therefore testable under an "event-study" methodology. But, a given analyst tends to revise forecasts simultaneously for firms in the same industry, a situation which would confound the measurement of transfer effects with "own effects."

The degree to which a management forecast leads to stock price revision is ultimately an empirical question. Fortunately, a great deal of empirical work has already been performed in this area. In addition to research concerned with the accuracy of the forecasts,[7] a number of studies have employed the familiar two-parameter asset pricing model (Sharpe [1964], Lintner [1965]) as a basis for inference. Foster [1973] examined the stock market reaction to sixty-eight management disclosures of preliminary estimates of earnings per share (EPS) for the 1968-1970 period. Most of the estimates preceded preliminary earnings announcements by less than one calendar month. Foster created trading strategies based on the prior knowledge of the unexpected earnings conveyed by the manager's forecast. The unexpected earnings component was computed by comparing the forecast with a variety of naive annual and quarterly earnings models.

The trading strategy, based on the sign of the unexpected earnings component, yielded a five-day pre-forecast average abnormal return of 1.61 percent for annual and 1.48 percent for quarterly models. Post-forecast abnormal returns were significantly lower leading Foster to conclude that the estimates of EPS possess information content.

Gonedes, Dopuch and Penman (GDP) [1976] provide evidence that the scaled forecasts of earnings per share (EPS) by company officials have implications for security valuation. Using a sample of 148 firms for the 1967-68 period, GDP examined analysts forecasts as a proxy for management forecasts.[8] Firms were ranked at each forecast date by scaled EPS into one of four portfolios of thirty-seven securities each. A portfolio was formed by ranking its members in order of systematic risk and dividing the group into a high-risk and a low-risk portfolio. These two portfolios were then combined in a manner that yielded systematic risk equal to one. Hotellings T^2 test was used to test the null hypothesis that no linear combination of the four return differences between a given portfolio and the control portfolio would yield a value significantly different from zero. The null was rejected with a probability significantly below .05. Further analysis indicated that the results were driven by the low scaled forecasts. Other linear combinations did not cause rejection of the null hypothesis.

Patell [1976] examined 336 management earnings forecasts provided by 258 firms during the 1963-68 period.[9] A variety of parametric and non-parametric tests were provided for the testing of stock price reaction. Also, announcements were classified as "good" or "bad" news by utilizing various naive proxies for market expectations. Patell's results are as follows:

> (1) There was a statistically significant upward price change during the week of forecast disclosure, beyond that explained by movement of the market as a whole. (2) When using a measurement technique which includes sign, the price adjustment was, on average, of the same sign and magnitude as that which accompanied the subsequent announcement of realized annual earnings. Using an unsigned measurement technique similar to Beaver [1968] produced a forecast price adjustment smaller than the earnings announcement adjustment. (3) During the two months preceding the disclosure of the forecast, price adjustment was in the same direction as the change in "naive"

> expectations embodied in the forecast. Forecasts which exceeded estimates of market expectations were preceded by positive price adjustments, and forecasts which fell short of market expectations were preceded by negative price adjustments. (4) Regardless of the sign of the estimated change in market expectations of future earnings, on average, the immediate forecast week was the occasion of upward price revision. Subsequent price behavior was relatively level for the positive forecast group and continued to decline for the negative forecast group (p. 273).

Nichols and Tsay [1979] examined 83 long-range executive forecasts during the years 1968 to 1973 and found that for the entire sample, the null hypothesis of no information content could not be rejected at a low significance level. If the sample was partitioned on the basis of the magnitude by which forecasts exceeded a proxy for market expectations, a significant market reaction to highly favorable forecasts was found.

Penman [1980] conducted two tests for information content of management earnings forecasts for the 1968 to 1973 period. The first test, similar to GDP [1976], examined 737 forecasts, while an unexpected returns test examined 1188 forecasts. Both tests indicated that management forecasts contained information relevant for firm valuation.

The aforementioned studies document a significant positive abnormal stock return (on average) associated with management earnings forecasts which exceed expected earnings. However, the Patell [1976], Nichols and Tsay

[1979] and Penman [1980] studies fail to document a negative price effect for forecasts which fall short of expected earnings. Waymire [1984] investigated this phenomenon by controlling for contemporaneous disclosures and by utilizing analyst forecasts issued prior to management forecasts as proxies for expected earnings. Point projections published in the Wall Street Journal from 1969-1973 were used in the study. Of the 479 forecasts used, only 94 (19.6%) were issued in isolation.

Abnormal returns tests for the full sample and the "isolation" sample were consistent. Positive (negative) abnormal returns were associated with good (bad) news forecasts. Rank correlation tests on the magnitude of unexpected earnings and the magnitude of abnormal returns for both samples "suggest that abnormal returns are positively associated with the unexpected component of management forecasts (i.e., forecast deviations) in terms of both sign and magnitude" (p. 717).

Results similar to those of Waymire are reported by Ajinkya and Gift [1984] for abnormal returns measured from the forecast month through the earnings release month, and Beshara [1981] for weekly return data.[10] Based on these empirical results, a positive association between the unexpected earnings conveyed by the management forecast and unexpected returns will be assumed for the model development in Chapter 2.

1.4 Organization of the Study

Chapter 1 has provided the motivation for examining information transfers associated with management forecasts. Prior management forecast research has ignored the information transfer issue and prior information transfer studies have preceded the development of a formal model with which to generate the hypothesis.

In addition, Chapter 1 has reviewed prior research documenting the information content of management forecasts as indicators of changes in earnings expectations, a necessary condition for information transfer within the context of the theory of information transfers provided in Chapter 2.

In Chapter 3, a research design is developed to test theoretical hypotheses generated in Chapter 2. Chapter 4 presents the results of the empirical tests. Chapter 5 provides a summary and discusses conclusions and limitations of the study.

CHAPTER 1

ENDNOTES

[1]Recent disclosure rules are found in Securities and Exchange Commission [1973, 1975 and 1979]. The debate is limited to management rather than analyst or time series forecasts. Whether or not someone should provide the latter two forecasts does not appear to be a policy issue at this time.

[2]Foster does not test the significance of the directionally determined unexpected return for the non-releasing firms at the earnings announcement date of the releases.

[3]An allocation of resources to production is considered Pareto optimal if it cannot be reorganized in a manner which increases the utility of one or more individuals without decreasing the utility of other individuals. See Henderson and Quandt [1980], pp. 286-291.

[4]See Jaffe [1974], Hong, Kaplan, and Mandelker [1978], and Collins and Dent [1984] for methods to combat cross-sectional correlation.

[5]Research efforts which document this finding include Cohen and Pogue [1967], King [1966], Meyers [1973], Simkowitz and Logue [1973], Rosenberg [1974], Livingstone [1977], and Lee and Zumwalt [1981].

[6]This discussion abstracts from the incentives of management to make accurate forecasts available to all market participants (see Verrecchia [1983]).

[7]See Lorek, McDonald and Patz [1976], Basi, Carey and Twark [1976], Imhoff and Pare [1982], McDonald [1973], and Copeland and Maroni [1972].

[8]They argued that the proxy approach was necessary due to measurement error in management forecasts and to satisfy the requirement of an uninterrupted time series of data for their experiment.

[9]First and second quarter results accompanied approximately 46 percent of the forecasts. 204 of the forecasts were point or convertible to point estimates and 132 were of form of "greater (less) than X dollars."

[10]Both studies used forecasts gathered from the *Wall Street Journal Index* for 1970-1977.

CHAPTER 2

THEORY DEVELOPMENT

2.1 Model Development

An information transfer occurs whenever new firm-specific information about firm i causes capital market participants to reassess the distribution of returns of firm j. Formally,

$$f(P_j | n_j) \neq f(P_j | n_i, n_j, n_k, \ldots, n_z)$$

where, f(P) = unconditional distribution function of the price of firm j's common stock,

n_j = the financial reporting system of firm j (including management earnings forecasts),

and n_i, n_k, ..., n_z are the financial reporting systems of firms i, k, ..., z (including management earnings forecasts).

This implies a conditional distribution $f(P_j | n_i)$, where n_i includes a management earnings forecast of firm i. The firm valuation literature normally relates the stock price of firm j to the expected earnings of firm j. However, if one can relate the management earnings forecast of firm i to the stock price of firm j, then the information transfer hypothesis has theoretical content. This study will seek to relate changes in expected earnings of firm i to changes in expected earnings of firm j, thus relating the management forecast from system n_i (a possible signal of changes in expected earnings) to a recognized determinant of P_j.

The remainder of this chapter presents a partial equilibrium model which specifies the relationship between changes in expected profits of firms which operate within a given industry. The industry level is chosen for two reasons, both related to the associated empirical research design. First, modelling at the industry level ignores across-industry (intra-market) relationships. This is consistent with an empirical market model which removes market-wide effects in the calculation of unexpected return. Second, practically defined "industries" (SIC codes) provide a preliminary arena for the examination of intra-industry relationships. Across-industry groupings of firms have not been defined (although determinable as evidenced by Olsen and Dietrich [1985]).

A "relationship" between expected profits implies a conditional distribution of changes in expected profits for firms within the same industry. In Section 2.2, invoking a symmetry argument will lead to a conditional distribution with zero variance. This, in essence, is a risk class model. Upon observing a change in expected profits for one firm, one need only multiply by a scalar to calculate the change in expected profits for another firm. There is no uncertainty in this estimation procedure.

Sections 2.3 and 2.4 extend the risk class model by moving from symmetric to asymmetric equilibrium. Two asymmetries are introduced. Section 2.3 relaxes the assumption that firms in homogeneous goods industries produce and sell equal amounts. The model of Flaherty [1980] is reviewed. Under this model, only industry structures in which firms have different market shares can be locally steady stable states.[1] In Section 2.4, the identical products assumption is relaxed by allowing for corporate diversification. The effect of these asymmetries is to introduce uncertainty into the prediction of one firm's change in expected profit from the signal of another firm (a traditional conditional distribution).

2.2 Risk Class Model

Consider the following n-firm, non-cooperative game.[2] Firms producing a homogeneous product q face the following market conditions:

(1) Linear demand : $p = a - bQ$,

(2) Linear cost: $C = \sum_{k=1}^{m} w_k x_k$,

(3) $Q = \sum_{i=1}^{n} q_i$, where $q_i = f(x_k)$

where, p = market-clearing price,

a = demand intercept,

b = slope of demand curve,

Q = quantity produced by the industry,

w_k = cost of production factor k, k = 1, 2,..., m,

x_k = production factor (input) k, k = 1, 2,..., m,

q_i = the output of the i'th firm, and

$f(x_k)$ is the production function.

For simplicity, assume a constant returns to scale economy. A solution to the non-cooperative game is an equilibrium characterized by production choices $q^* = \{q_i^*, q_j^*, \ldots, q_n^*\}$ which simultaneously solve the profit maximization problem for the N firms. More formally, this equilibrium, referred to as the Nash solution, requires that firm i choose q_i^* such that:

$$V_i(q_1^*, q_2^*, \ldots, q_i^*, \ldots, q_n^*) > V_i(q_1^*, q_2^*, \ldots, q_i, \ldots, q_n^*)$$

where, $V_i(.)$ represents firm i's value function. Assuming that such an equilibrium exists, the profit function for an arbitrarily chosen firm i may be expressed as follows:

$$(4)\quad \pi_i = (a^E - b^o Q)q_i^* - \sum_{k=1}^{m} w_k^E x_k^*(\underline{w}^E, q_i^*)$$

where, π_i = expected profit for firm i,

q_i^* = the production choice in equilibrium for firm i,

a^E = expected intercept of the demand curve,

b^o = non-stochastic slope of the demand curve,

w_k^E = expected cost of factor k,

$\underline{w}^E$ = a vector of expected factor costs for k factors of production, and

x_k* = the demand for factor k at production level q_i* and wage vector $\underline{w}^E$.

In equation (4), a^E, b^0, and $\underline{w}^E$ are determined outside of the partial equilibrium model. Since the purpose of this section is to derive a relationship between firms' changes in expected profits in equilibrium, we will investigate changes in profit with respect to these exogenous variables.[3]

Proposition 1: If we assume constant returns to scale, then equation (4) may be written as follows:

$$(5) \quad \pi_i = q_i^* \, [(a^E - b^o Q) - \sum_{k=1}^{m} w_k^E x_k^*(\underline{w}^E)]$$

where, $x_k^*(\underline{w}^E)$ is interpreted as the demand per unit of production given $\underline{w}^E$.

Proof: (See Varian [1984, pp. 27-28])

If we invoke the condition that the firms are symmetric, we can relate the changes in expected profits for any two firms i the industry as follows:

Proposition 2: Under conditions of symmetry, the changes in expected profits of firm i and an arbitrary industry co-member, firm j, may be related as follows:

$$(6) \quad d\pi_j = (q_j^*/q_i^*) \, d\pi_i$$

where, $d\pi_j$ = the total differential of firm j's profit.

Proof: (See Appendix A.)

Also, from the symmetry condition, $q_j* = q_i*$ so that $d\pi_j = d\pi_i$. Even if we allow for the possibility that industry-wide random shocks occur so that firms' output decisions vary, the ratio of their outputs will equal one from the symmetry condition.

Equation (6) is a form of the "risk class" conditional distribution of changes in profits used by Foster [1981]. The relationship is driven by the symmetry conditions. The following two sections will introduce asymmetries which are sufficient to provide an empirically testable extension of the risk class model.

2.3 Asymmetric Equilibrium

It was asserted in the previous section that even if firms' outputs vary through time in response to random shocks, the ratio of their outputs would not vary, and in fact, would be equal to one. This is a direct result of the symmetry condition. Assuming that firms' outputs vary through time in response to random shocks (along any equilibrium path), it is sufficient to show that asymmetric equilibria exist to guarantee that the ratio of firms' outputs varies through time. Flaherty [1980] demonstrates the existence of the asymmetric equilibria.

Prior to the Flaherty paper, the empirical reality of differential market shares in homogeneous goods industries was assumed rather than explained in analytical oligopoly theory. The results of Flaherty's dynamic oligopoly models provide an explanation of how an industry structure could converge to a state in which firms have unequal market shares.

Flaherty illustrates a dynamic non-cooperative game in which firms choose a sequence of outputs and cost-reducing investments in order to maximize the present value of periodic profit. Firms within a given industry produce a non-storable homogeneous good for which there is a stationary inverse demand. Cost-reducing investment is defined as follows:

$$(7) \quad x_{it} = g(c_{it}, c_{i,t+1})$$

where, x_{it} = investment by firm i in period t, and

c_{it} = constant marginal cost for firm i in period t.

Equation (7) indicates that firms are able to choose next period's marginal cost, $c_{i,t+1}$, by choosing a level of expenditure, x_{it}, in period t. Flaherty imposes the additional conditions that the expenditure required for a cost reduction increases more than proportionately as c_{it} increases or $c_{i,t+1}$ decreases (for a cost decrease between periods), that the required x_{it} is a positive, decreasing convex function of $c_{i,t+1}$ (for cost maintenance), and that the required x_{it} is convex and increasing in current and decreasing in subsequent periods:

(8) $g(c_{it},c_{i,t+1}) > 0;\ g(c,c) > 0;\ g_1 > 0;\ g_2 < 0;\ g_{11} > 0;\ g_{22} > 0;\ g_{12} < 0;\ \text{and}\ g_{11}g_{22} - g_{12}^2 > 0,$

where subscripts denote partial derivatives. Firms must choose a sequence of outputs and investments, Q_i and X_i, to maximize:

(9) $$\max \sum_{t=0}^{\infty} \beta^t[(p(q_t) - c_{it})q_{it} - x_{it}]$$

where, β = the firm's discount rate,

x_{it} = $g(c_{it},\ c_{i,t+1})$, and

$p(q_t{*})$ = the inverse demand function.

Although firms face initial symmetric conditions, except for possibly different marginal costs at time zero, Flaherty shows that the only locally stable steady-state equilibrium is asymmetric. Define $\tilde{\phi} = (q_j{*}/q_i{*})$ where the tilde denotes a random variable. As argued in the beginning of this section, the existence of asymmetric equilibria justifies the specification of the ratio of firms' outputs as a random variable. Given these fairly general conditions, then, we may substitute this relationship into equation (6) to obtain:

(10) $d\pi_j = \tilde{\phi}\ d\pi_i.$

2.4 Effects of Diversification

First, rewrite equation (10) to include additional subscripts on $d\pi_j$ and $d\pi_i$ to indicate that these profit changes relate only to production of industry R products.

$$(11) \quad d\pi_{jR} = \tilde{\phi}_R d\pi_{iR}.$$

In addition, assume that changes in a given firm's profits for each industry are independent and that firm i operates in industries R and S so that:

$$(12) \quad d\pi_i = d\pi_{iR} + d\pi_{iS}.$$ [4]

We will assume that $d\pi_j$ is determined by industry R operations.[5]

That is:

$$(13) \quad d\pi_j = d\pi_{jR}.$$

The capital market receives signal $d\pi_i$ attributable to industry R production in order to calculate $d\pi_j$. Define this proportion, γ, as follows:

$$(14) \quad d\pi_{iR} = \tilde{\gamma}\, d\pi_i, \; \tilde{\gamma} \sim (\bar{\gamma}, \sigma_\gamma^2), \; \bar{\gamma} > 0.$$ [6]

Substituting (14) and (13) into (11) yields the following forecasting function:

$$(15) \quad d\pi_j = \tilde{\phi}_R \tilde{\gamma} d\pi_i + \tilde{e}, \; \tilde{e} \sim (0, \sigma_e^2), \; \mathrm{cov}(\tilde{e}, \tilde{\phi}_R \tilde{\gamma}) = 0.$$

Equation (15) is a conditional distribution of $d\pi_j$ on $d\pi_i$. It represents a simple extension of the risk class model to incorporate variable market share and product diversification. Equation (15) collapses to the simple risk class model for $\tilde{\gamma}$ equal to one in equation (14) (no diversification) and for nonstochastic ϕ_R

(symmetry).

The use of equation (15) as a forecasting tool will generate a forecast error, σ^2_{FE}, with the following variance:

$$(16) \quad \sigma^2_{FE} = (d\pi_i)^2\sigma^2(\tilde{\phi}_R\tilde{\gamma}) + \sigma^2_e.$$ [7]

The following section will examine equations (6), (15) and (16) to provide testable implications of the model.

2.5 Statement of Theoretical Hypotheses

As previously mentioned, it is assumed that certain management forecasts convey changes in earnings expectations and that such changes in earnings expectations are positively related to unexpected returns. The implication of this assumption is that if we have a hypothesized effect of a factor in our model on changes in earnings expectations of a non-disclosing firm, then the factor is hypothesized to have an effect of the same sign on unexpected returns of non-disclosing firms.

Examination of equations (6) and (15) indicates a positive relationship between the sign and magnitude of the change in earnings expectations conveyed by a management earnings forecast for firm i and the sign and magnitude of changes in earnings expectations for firm j. This relationship leads to the following null hypothesis:

H_{01}: There is no relationship between the sign and magnitude of changes in earnings expectations conveyed by a management forecast of firm i and unexpected returns for firm j, when firms i and j are members of a "risk class" industry grouping.

The second and third hypotheses are generated from examination of equation (16). Assuming that individuals who use (15) as a forecasting tool have a preference for certainty, the utility gained from the forecasting process is inversely related to the potential for earnings forecast error dispersion.[8] A potentially significant source of forecast error variance are the variances associated with estimation of ϕ and γ.

In the presence of stochastic market share, the variance of ϕ is nonzero. If firm i is undiversified relative to the industry, γ is equal to one in equation (16). In the presence of diversification of firm i, γ is a random variable. It is therefore hypothesized that the magnitude of firm j's unexpected returns observed at the time of firm i's management forecast is positively related to the precision achievable when forecasting firm j's changes in earnings expectations from firm i's changes in earnings expectations. This is, the magnitude of unexpected returns is inversely related to the sources of forecast error variance. If we expand (16), these sources will become apparent. Assuming independence of ϕ and γ, we have:

(17) $$\sigma^2_{FE} = (d\pi_i)^2[\sigma^2(\phi)\sigma^2(\gamma) + \mu_\phi\sigma^2(\gamma) + \mu_\gamma\sigma^2(\phi)] + \sigma^2_e.$$

Partials with respect to $\sigma^2(\phi)$ and $\sigma^2(\gamma)$ are as follows: (denoted $\Delta(\phi)$ and $\Delta(\gamma)$ respectively)

(18) $$\Delta(\phi) = (d\pi_i)^2(\sigma^2(\gamma) + \mu_\gamma) > 0$$

(19) $$\Delta(\gamma) = (d\pi_i)^2(\sigma^2(\phi) + \mu_\phi) > 0.$$

The null forms of the hypotheses relating to these results are as follows:

H_{02}: Ceteris paribus, the magnitude of unexpected returns for firm j observed at the date of firm i's management forecast is unrelated to the variance of the ratio of their outputs when firms i and j are members of a defined industry grouping, and

H_{03}: Ceteris paribus, the magnitude of unexpected returns for firm j is unrelated to the diversification level of the reporting firm, firm i, when firms i and j are members of a defined industry grouping.

2.6 Summary of Chapter 2

In Chapter 2, a theory of information transfers was provided. For the case of symmetric firms, the model suggests the existence of information transfer associated with disclosures that convey changes in expected earnings of firms. It also suggests a positive relationship between the sign and magnitude of changes in earnings expectations and the magnitude of information transfers.

For the case of asymmetric firms, the magnitude of information transfer is a function of market share uncertainty and the relative diversification of disclosing and non-disclosing firms.

These relationships were derived in the context of an industry-level model of non-coopertive equilibrium. The model is one of partial equilibrium, taking changes in other markets as exogenous. Chapter 3 provides a research design for testing these relationships.

CHAPTER 2

ENDNOTES

[1]A steady state industry structure is an equilibrium path on which all firms' outputs and investments do not change. A locally stable steady state occurs when an equilibrium path is close to a steady state and tends to converge to the steady state (Flaherty [1980]).

[2]Co-operation among firms is not assumed in the determination of production plans. For a summary of the development of non-cooperative game theory, see Friedman [1977].

[3]Allowing either a or b or be stochastic is sufficient to generate an exogeneously-determined price change with no change in the resulting proposition.

[4]This formulation ignores economics of scope and, as a result, avoids the issue of conditions necessary for the existence of multi-product firms. For an excellent discussion of this issue, see Baumol, Panzar and Willig [1982].

[5]Later, in the empirical tests, firm j will correspond to a portfolio of industry members and, in a sense, will proxy for a "representative" industry member and, by definition, will be undiversified relative to the industry.

[6]The expected value of gamma is assumed to be greater than zero. This is the same as asserting that $d\pi_{1R} > d\pi_{1S}$ in equation (12) which is a reasonable assumption given that R is the dominant industry for firm 1.

[7]See Pindyck and Rubinfeld [1981, pp. 208-109].

[8]The idea that a signal's effect on price is positively related to the precision with which it signals an object of interest is formally developed by Holthausen and Verrecchia [1982].

CHAPTER 3

RESEARCH DESIGN

3.1 Operationalizing the Industry Concept

Three hypotheses were stated in section 2.5. The testing of the first hypothesis requires "risk class" industry groupings while the testing of hypotheses two and three requires an industry definition which allows for firm dissimilarities. Operationalization of the industry concept is problematic. A number of potential methods for practical definition of "industry" have been employed. Standard Industrial Classification (SIC) codes define various levels of "industry" in terms of homogeneity of end product. It is well known, however, due to corporate diversification, that the SIC codes contain groupings of firms with imperfect product homogeneity. This is not a significant problem for tests of hypotheses two and three since the theoretical model which generates these hypotheses admits diversification. It is a problem for tests of hypothesis one since the model specification leading to hypothesis one does not admit diversification or, at the least, would be robust for significant departures from perfect product homogeneity only under highly restrictive conditions. Empirical evidence of multiple risk classes within SIC codes is provided by Martin, Scott and Vandell [1979], Gonedes [1969], and Boness and

Frankfurter [1977]. This evidence points to the limitations of SIC codes as a proxy for risk class in tests of hypothesis one.

Other methods have applied classification schemes based on a variety of firm-specific characteristics. Foster [1981] reduces the heterogeneity of SIC code firms by examining 10K reports and deleting firms from the industry if they had less than 50% of their revenue derived from the activity defining the 4-digit industry. The remaining firms, however, are still diversified and heterogeneous. They may or may not belong to the same risk class (constantly proportional changes in earnings expectations). Kruger [1975] uses several characteristics (end-product similarity, size similarity, and geographic location similarity) to characterize classes of freight carriers in order to determine industry norms. Although this yields groupings for which the calculation of industry norms appears reasonable, it does not yield groupings that encompass all of the intra-industry information transfers that may occur in the industry. The theory of Chapter 2 does not preclude information transfers between small and large firms and between firms in different locations. The following two sections discuss the operationalization of the industry concept employed in this research.

3.1.1 Construction of Risk Class Industries

The use of the risk class specification (i.e., the assumption of conditions sufficient to generate equation (6)) as a motivation for the information transfer hypothesis requires the construction of industry groupings for which equation (6) would be expected to hold. Equation (6) requires that industry members belong to the same "risk class" in the sense that their economic profits are proportional. Since the interest of this research is in determining the effect of a management forecast of earnings on the value of equity claims (stock price reaction of non-disclosing firms), we will define a "risk class" in the context of proportional earnings available for equity shareholders. Therefore, we may discuss the variability of earnings available to the residual equity interest via the determinants of such variability, that is, business risk and financial risk (see Van Horne [1974, pp. 220-221] for a discussion of this dichotomy).

As indicated by Martin, Scott, and Vandell (MSV) [1979], the determination of a business risk class is a multidimensional undertaking which must attempt to determine the similarity of firms with regard to items such as cost structure, product demand characteristics, intra-industry competitive position, and managerial talent. In testing the first theoretical hypothesis, this research will not accept the notion that Standard Industrial Classification (SIC) codes provide effective groupings of firms which are in the same risk class.

Risk class industries are constructed using cluster analysis. Cluster analysis is essentially an attempt to empirically define a given classification when analytical techniques are unavailable or extremely complex. Examples of the use of cluster analysis in a variety of business and economic contexts may be found in Jensen [1971], Lee and Zumwalt [1981], Farrell [1975], Frecka [1982], Lee and Lloyd [1978], Elton and Gruber [1971], and Gupta and Huefner [1972].

After collecting the management forecasts, the cluster analysis is performed on each 4-digit SIC code for which at least one forecast was found. The use of 4-digit codes to define the subset of firms from which to form the risk classes (rather than the set of all firms) minimizes risk classes in which co-members have completely unrelated production activities in an economic sense. The cluster analysis is performed over the 60 months preceding each forecast year to minimize the effect of structural change on the effectiveness of the procedure.

Ward's hierarchical clustering technique is used in this study (Ward [1963], see Appendix B). Ward's method has been shown to be one of the best clustering algorithms currently available in terms of robustness to departures from assumptions about cluster characteristics (Milligan [1980]).

In order to perform the analysis, it is necessary to define variables which capture the desired dimensions of firm similarity. Several approaches to defining a proper set of variables have been used in the literature. Basically, these approaches may be summarized by studies defining firm similarity in terms of accounting variables (e.g., MSV [1979]) or in terms of market-based and accounting variables (e.g., Frecka [1982]). After reviewing these cluster analysis studies, it was apparent that no single set of variables has been demonstrated as superior in differentiating among risk classes. Therefore, the following variables are chosen based on their association with the elements of the aforementioned business risk and financial risk dichotomy:

Business Risk

The market model is estimated for each 4-digit industry co-member using 60 monthly returns preceding each forecast year. As in Frecka [1982], estimates of α, β, and the variance of the error term from the following model are used as three input variables into the cluster analysis:

(1) $r_{it} = \alpha_i + \beta_i(R_{mt}) + e_{it}$, where

r_{it} = continuously compounded monthly return for firm i in period t,

α_i = intercept for firm i,

β_i = slope for firm i,

R_{it} = equally-weighted market return for all New York and American Stock Exchange Firms, and

e_{it} = error term satisfying standard assumptions of the classical linear regression model.

The estimates of β_i and residual variance are utilized as proxies for diversifiable and undiversifiable business risks (financial structure held constant). The intercept, α, is interpreted as a third statistic which, together with β_i and the residual variance, characterize the market's assessment of the return generating process of the firm. Clustering the firms on the basis of "similarity of return generating process" captures the market's assessment of the homogeneity of firms. As information reaches the market, similar firms will experience similar reactions to that information.

Financial Risk

Firm valuation literature indicates that β is not independent of financial leverage. In this sense, financial risk is captured by the first three cluster input variables generated by the estimation of equation

(1). In addition, a fourth variable is calculated as the five-year average of the sum of current liabilities, long-term debt and preferred stock divided by the common equity of the firm. Values of this ratio greater than five are truncated at five since the sensitivity of cluster analysis to outliers has been well documented.

The three market variables and the debt/equity variable are computed for each firm. As indicated by Elton and Gruber [1970], performing cluster analysis on correlated variables may lead to results which overweigh factors measured by more than one variable. In addition, the effect of a clustering ratio on the classification obtained may be a function of the scale on which it is measured. The correlated variable problems is normally handled via principal components analysis (see Harman [1964]). Given that only four variables are being used in this study, principal components analysis is not performed. The variables, however, are standardized to mean equal to zero and variance equal to one prior to performing the cluster analysis in order to reduce the effects of the scale problem.

At this point, it is important to note that a stopping rule is necessary to define the optimum number of clusters. It is generally recognized that no satisfactory method exists for determining the number of clusters for any type of cluster analysis (Everitt [1980]). Prior studies have either adopted one of the unsatisfactory methods as a "guide" or have employed arbitrary rules based on predetermined research design considerations.

In this study, cluster analysis is used for dissection, that is, to reclassify heterogeneous groups into more homogeneous groups. An appropriate heuristic for this dissection procedure is plotting R^2 against the number of clusters.[1] Plots may be examined to determine a point of diminishing increases in R^2 with increases in the number of clusters. This method, similar in spirit to determining the number of factors in factor analysis, is used in this study to determine the number of clusters.

3.1.2 Industry Definition For Tests of Hypotheses Two and Three

Hypotheses two and three are generated from the extended model and, therefore, do not require the creation of risk class industries. To test for the effects of market share stability of the reporter and diversification of the industry on information transfer, nonhomogeneous industry groupings are required. For the purpose of this research, 4-digit SIC codes are assumed to constitute a nonhomogeneous industry grouping. The use of the SIC code as a proxy for an industry appears to be a standard procedure in the literature.[2] The assumption that the industries are somewhat nonhomogeneous is reasonable given researchers' attempts to redefine SIC industries to reduce such diversification (see Foster [1981] and the cluster analysis studies cited earlier). Industries defined by 4-digit SIC codes are selected from the Compustat Manual for the testing of hypotheses two and three.

3.2 Operationalized Variables

3.2.1 Information Transfer

Information transfer is defined as the ability to earn abnormal returns on a portfolio of stocks of fellow industry members from foreknowledge of a management earnings forecast by one firm in the industry. Define the return, r_{pt}, on an equally-weighted portfolio of non-reporting industry co-members for week t as:

$$(2) \quad r_{pt} = \frac{1}{n} \sum_{i=1}^{n} R_{it}$$

where, R_{it} = the return on stock i for week t,[3] and

n = the number of stocks in portfolio p (consisting of non-reporting industry co-members).

Weekly rates of return for each portfolio are used to estimate the market model:

$$(3) \quad \tilde{r}_{pt} = \alpha_p + \beta_p \tilde{r}_{mt} + \tilde{\mu}_{pt}$$

where, $\tilde{r}_{pt}$ = weekly return on an equally-weighted portfolio of industry non-reporters,

$\tilde{r}_{mt}$ = equally-weighted index of market return,[4]

α_p = intercept,

β_p = systematic risk of portfolio p,

$\tilde{\mu}_{pt}$ = abnormal return on portfolio p for week t, and

t = one weekly period for the estimation period, t = 1, 2,..., T (60 weeks preceding the test period for each portfolio will be used as the estimation period, t = 60).

The test period consists of the three weeks surrounding the management forecast. The following prediction error, μ_{pk}, is estimated:

(4) $\mu_{pk} = r_{pk} - (\alpha_p - \beta_p r_{mk})$ k = -1, 0, 1.

Since the μ_{pk} are prediction errors rather than true residuals, the variance of the regression prediction error, S^2, is computed as follows:

(5) $$S^2 = 1 + \frac{1}{T} + [(r_{mk_T} - \bar{r}_m)^2 / \sum_{t=1}^{T} (r_{mt} - \bar{r}_m)^2] \sum_{k=1} \mu_{pt}^2 / (T-2)$$

where, $\bar{r}_m$ is the average market return over period T = 60 weeks. The standardized error statistic for each portfolio, V_{pk}, for each week during the test period is as follows (see Hong, Kaplan, and Mandelker [1978]):

(6) $V_{pk} = \mu_{pk} / S$.

Patell [1976] indicates that the V_{pk} can be normalized as follows:

(7) $$Z_{Vk} = \sum_{p=1}^{N} V_{pk} / X_t$$

where, $X_t = \{ \sum_{p=1}^{N} [(T_p - 2) / (T_p - 4)]\}^{1/2}$

The portfolio approach is used to reduce the problem of cross-sectional correlation of residual returns across industry members. The test statistic formed in equation (7) (Z_{Vk}) requires the independence of prediction errors (u_{pk}). Prediction errors formed on an individual firm rather than on a portfolio basis would not be independent since they would be measured in the same calendar time within the same industry. The portfolio prediction errors, however, are measured for different weeks and for different industries. The portfolio approach is similar in spirit to procedures employed by Jaffe [1974], Hong, Kaplan, and Mandelker [1978], and Abdel-khalik and Ajinkya [1982].

An important consideration is that the Z_{Vk} provide a cross-sectional average of the information transfer associated with the management forecast alone. Two phenomena exist which confound the ability of Z_{Vk} to separate the information transfer from other effects: contemporaneous disclosures made by the non-disclosing industry co-members which have an effect on their own price, and other industry-level information (interest rate changes, etc.) released during the test period.

To mitigate the effect of the former, non-forecasting firms that released announcements during the test period are not included in the non-forecasting sample portfolio.

To mitigate the effects of the latter, a control portfolio is selected for each sample portfolio from the sub-set of firms within each industry not selected as a cluster co-member of the disclosing firm. The control firms are matched to the sample portfolio on the basis of systematic risk.[5] In addition, the control firms have not made disclosures during the test period.

Control firms share two-digit industry membership with the sample firms. They are selected from outside the four-digit code, if possible. The purpose of the control portfolio is to capture significant industry-level announcements (e.g., interest rate changes) occurring at the same time as the management forecast. The control should not capture the effects of the independent variable. Selecting control firms from the four-digit level would reduce the power of the tests since information transfer at the four-digit level has been documented. However, this is done if an insufficient number of candidates exist at the two-digit level since industry matching is critical.

Subtracting the control group prediction error from the sample prediction error should increase the internal validity of the Z_{Vk} measure as an indication of the information transfer effect associated with the management forecast.

3.2.2 Changes in Expectations

The theoretical analysis indicates that the forecast of earnings must represent a change in expectations regarding accounting earnings. The change in expectations is designated as follows:

$$(8) \quad \Delta E_m = (MF_m - AF_m)/AF_m$$

where, ΔE_m = change in earnings expectations caused by the m'th forecast.

MF_m = the m'th management forecast of earnings, and

AF_m = the composite analyst forecast for the firm preceding the m'th forecast by management.

3.2.3 Market Share Variability

Since we are investigating information transfer for a portfolio of industry co-members, define ϕ as the ratio of firm i sales to the sales of all industry members in firm i's 4-digit SIC code. The variance of ϕ is calculated over the 32 quarters preceding the year of the forecast.

3.2.4 Relative Diversification

The model presented in Chapter 2 describes the effect on information transfer of situations where the reporting firm is diversified relative to the non-disclosing firm for which the information transfer is hypothesized. One approach to measuring relative diversification (heterogeneity of firms' operations) would be to compute some diversification metric for each disclosing firm and each non-disclosing portfolio of firms. Several measures of diversification are possible. Berry [1971] and McVey [1972] derive a measure of diversification using the weighting system of the Herfindahl Summary Index of Concentration (see Adelman [1969]). Other measurements include the number of nonprimary industries in which an enterprise operates, the ratio of nonprimary to total output, and combinations of the two (Gort [1962]). Gorecki [1974] discusses problems associated with each of these measures. This research employs a measurement technique that is simpler to apply and that is theoretically justifiable. It can be argued that regardless of the level of diversification of the reporter (assuming that the reporter is randomly drawn from the industry population), information transfer will be inversely related to the heterogeneity of operations of the industry members. Consider the two extremes. If the operations of industry members are identical, the information transfer should be great for a portfolio of industry firms. If the operations of many of the industry members are nearly unrelated, information transfer may be great for a given non-disclosing firm if, by chance, it has the same operations as the disclosing firm. But, for a portfolio of all non-disclosing firms, information transfer would be low.

A market-based measure of firm diversification is employed. The coefficient of determination (R^2) is calculated from the market model for each firm for the 60-month period preceding the test period. As argued by Barnea and Logue [1973], given the assumption of relatively perfect capital markets, R^2 contains elements of both product and market diversification which no physical diversification measure is able to do. The higher the R^2, the closer the correspondence between a given firm's operations and the operations of a highly diversified market portfolio. Since each firm is compared with the same market portfolio and R^2 is bounded by zero and one, comparability across firms is achieved. For an example of the use of R^2 as a measure of corporate diversification, see Amihud and Lev [1981].

The mean R^2 is also calculated for each industry. This is a statistical measure of the importance of the market portfolio in explaining individual security returns. A high mean R^2 would indicate the relative unimportance of the industry effect for a given industry. As an additional test, the average standardized unexpected return calculated from (6) is computed over all forecasts within a given industry. Industry portfolio returns are then ranked on this measure and on mean R^2. The Spearman correlation is used to test for association.

A significant negative association is expected.

3.3 Tests of Hypothesis One

H_{01} is divided into two parts for statistical testing purposes:

H_{01S}: There is no relationship between the sign of changes in earnings expectations conveyed by a management earnings forecast of firm i and unexpected returns for firm j when firms i and j are members of a "risk class" industry grouping (the "sign" hypothesis).

H_{01SM}: There is no relationship between the sign and magnitude of changes in earnings expectations conveyed by a management forecast of firm i and unexpected returns for firm j when firms i and j are members of a "risk class" industry grouping (the "sign and magnitude" hypothesis).

The alternative hypotheses are:

H_{A1S}: There is a positive relationship between the sign of changes in earnings expectations conveyed by a management earnings forecast of firm i and unexpected returns for firm j when firms i and j are members of a "risk class" industry grouping.

H_{A1SM}: There is a positive relationship between the sign and magnitude of changes in earnings expectations conveyed by a management forecast of firm i and unexpected returns for firm j when firms i and j are members of a "risk class" industry grouping.

The alternative hypotheses are one-sided since the theory of Chapter 2 indicates strictly positive relationships. For tests of H_{01S} (the "sign" hypotheses), a trading strategy is formed to earn positive abnormal returns. A significant statistic in the left tail of a two-tailed test would not be evidence consistent with the theory. Therefore, a one-sided alternative is stated since rejection of the null in the right tail of the distribution would be the only finding consistent with the theory. The argument is similar for H_{A1SM} as a one-sided alternative.

The following procedure is used to test theoretical hypothesis H_{01S}:

1. Form risk class industries via cluster analysis.
2. Identify forecast date from WSJI. Designate the week in which the forecast appeared as time zero.
3. Form a sample portfolio for each forecast from non-reporting risk class co-members satisfying the aforementioned selection criterion.
4. Select and form a control portfolio for each sample portfolio.
5. Calculate V_{pk} for the non-forecasting sample and the control sample from a trading strategy which takes long (short) positions in each portfolio with non-negative (negative) changes in earnings expectations as measured by equation (8).

The difference in returns is computed as follows:

(9) $D_{pk} = V_{pk}$ (non-forecast sample) $- V_{pk}$(control)

The following statistical hypotheses are tested via a matched-pair t-test:

SH_{01S}: $D_k = 0.$ $k = -1,0,1$

SH_{A1S}: $D_k > 0.$ $k = -1,0,1$

The D_k are cross-sectional means of D_{pk} for each week.

Hypothesis H_{01SM} is tested by ranking each portfolio on its earnings expectation change and on V_{pk} from equation (6). The following statistical hypotheses are tested by computing Spearman's rank order correlation between ranks:

SH_{01SM}: $\rho_k = 0$, $\quad k = -1,0,1$

SH_{A1SM}: $\rho_k > 0$, $\quad k = -1,0,1$

3.4 Tests of Hypotheses Two and Three

Theoretical hypotheses two and three are tested simultaneously via regression analysis. The following regression model is estimated at time zero:

$$(10) \qquad V_{pk} = a_0 + b_1(\Delta E_i) + b_2(MS_i) + b_3(D_I) + \varepsilon_{pk}$$

where, V_{pk} = standardized prediction error for the p'th portfolio corresponding to the p'th management earnings forecast,

ΔE_i = change in earnings expectations for firm i,

MS_i = market share variability of the forecast releaser,

D_I = relative diversification level (heterogeneity) of firms within industry I (industry I contains firm i),

a_0 = intercept, ε = error term, and

b_i = regression coefficients, i = 1, 2, 3.

The model presented in Chapter 2 predicts $b_1 > 0$ and b_2, $b_3 < 0$. Although the change in earnings expectations is included primarily as a control, the sign and level of significance of b_1 is of interest since it measures the effect for 4-digit industry classifications.

The following statistical hypotheses are of primary research interest:

SH_{02}: $b_2 = 0$.

SH_{A2}: $b_2 < 0$.

SH_{03}: $b_3 = 0$.

SH_{A3} $b_3 < 0$.

Again, the null is tested against the one-sided alternative since rejection of SH_{02} and SH_{03} in the right tail of the null distribution is inconsistent with the theory.

CHAPTER 3

ENDNOTES

[1] R^2 is equal to the sum of squares between the means of all clusters divided by the corrected total sum of squares. In the context of cluster analysis, it is an indication of the ability to predict the value of a clustering variable from knowledge of its cluster membership.

[2] See Lee and Zumwalt [1981], Foster [1981], Eichenseher and Danos [1981], Lev [1969], and Frecka and Lee [1983] for examples of the use of SIC code as a proxy for industry. Note, however, that certain of these studies recognize the diversification within industries.

[3] To maximize the number of firms with available data, returns are constructed from daily returns taken from the CRSP Daily Return Tape. The daily returns are continuously compounded to form the monthly returns for the cluster analysis and the weekly returns for the hypothesis testing.

[4] The equally-weighted index of market returns is used for three reasons. First, portfolios of industry co-members are formed in equation (2) on an equally-weighted basis to protect against the effects of large firms on the information transfer effect. Use of the equally-weighted market returns is consistent with equally-weighted portfolios. Second, to the extent that an industry is large enough to significantly affect the computation of the market return, we will be using independent and dependent variables in equation (3) which measure a similar return. Finally, Brown and Warner [1980] provide simulation results which favor use of the equally-weighted index.

[5] See Beaver, Clarke and Wright [1979] for empirical evidence of association between systematic risk and residual return. Also, see Miller and Scholes [1972, p. 62] for evidence on the association between systematic risk and variance of residual return.

CHAPTER 4

RESULTS

4.1 Sample Characteristics

Copies of the Wall Street Journal Index (WSJI), are examined for the 1978-1983 period to document dates of the management earnings forecasts. The following criteria are satisfied for each forecast:

(i) it is the first forecast of annual results.

This criterion is necessary to increase the power of the test. Later forecasts of annual earnings will be for a shorter forecast horizon. By later in the year, market expectations will be refined due to the existence of quarterly reports. As a result, later forecasts by management are likely to have less impact on stock price. Also, forecast revisions and reiterations are eliminated using this criterion.

(ii) it occurs within the first eleven months of the company's fiscal year.

This omits forecasts of essentially "actual" results.

(iii) it is not accompanied by earnings reports, dividends or other significant announcements.

Foster [1981] documents information transfers for earnings reports. If this criterion is not used, the rival hypothesis that earnings report releases are causing the transfer could be offered as an explanation for the results.

(iv) it is attributed to a company official.

(v) it is a point or interval estimate or convertible to a point estimate.

Interval estimates are converted to point estimates by calculating the average of the endpoints.

(vi) it is preceded by an analyst forecast issued within a five-week period preceding the date of the management forecast (as determined by reference to Standard and Poor's Earnings Forecaster).

This criterion is necessary to ensure data for calculating the change in earnings expectations conveyed by the forecast.

The search of the WSJI provides 411 forecasts by company officials which are either point forecasts or convertible to point forecasts. A total of 139 firms (34%) issued forecasts in isolation.[1]

Data availability reduces the number of forecasts to sixty-two. The two most significant causes of the unavailable data arise from the fact that the original 411 forecasts are gathered without concern for exchange listing. As a result, a significant number of small firms have either a lack of return data contained on the Center for Research on Security Prices (CRSP) tape (39), or unavailable analyst forecasts (38). Due to additional data requirements imposed by the individual tests (available quarterly market share data, available industry co-members without contemporaneous disclosures, etc.), the final samples are fifty-nine for tests of the first hypothesis and fifty-seven for tests of the second and third hypotheses.

Table 4.1 shows the distribution of forecasts by sample year. Earlier years provide a larger portion of the sample. The impact of the sample selection criterion on sample size is clear. Table 4.2 provides a further breakdown of the management forecast samples by industry. The largest industry concentration is found in 4-digit SIC code 3210. The five forecasts were made by Guardian Industries, the only firm with more than one forecast in the sample. Rarely did more than one forecast appear within an industry during a given year. Therefore, the problem of having more than one observation (portfolio of non-forecasters) in calendar time is virtually non-existant. This is important given the results of Collins and Dent [1984] pointing to cross-sectional standard deviation underestimation for positively correlated portfolio returns when the portfolios were formed within the same industry.

Finally, Table 4.3 provides the distribution of sample by fiscal year-end. As expected the majority of the sample firms have a calendar year-end.

TABLE 4.1
DISTRIBUTION OF FORECASTS BY YEAR
(Initial and Final Sample)

Year	Initial Sample *	Sample for Tests of H_{01}	Sample for Tests of H_{02} and H_{03}
1978	79	18	18
1979	100	10	9
1980	62	7	7
1981	56	9	9
1982	57	10	9
1983	57	5	5
Total	411	59	57

*Sample prior to implementation of criterion (iii) and (vi).

TABLE 4.2

DISTRIBUTION OF FORECASTS BY INDUSTRY

4-DIGIT SIC CODE	H_{01}	$H_{02,03}$	4-DIGIT SIC CODE	H_{01}	$H_{02,03}$
1211	1	1	3550	2	1
1311	1	1	3570	1	1
1381	1	1	3573	1	1
1600	0	1	3610	1	1
2085	1	1	3662	1	1
2086	1	1	3679	1	1
2200	2	2	3825	1	1
2270	1	1	3940	2	2
2300	1	1	3950	1	1
2600	1	1	4911	1	1
2700	1	0	4923	1	1
2711	1	1	5140	2	2
2731	1	1	5211	2	2
2800	2	2	5311	2	2
2830	1	1	5331	1	1
2844	1	1	5812	1	1
3210	5	5	5912	2	2
3221	1	1	6024	1	1
3290	1	1	7011	1	1
3310	1	1	7370	1	1
3390	1	1	7500	1	1
3449	1	1	8060	2	1
3533	1	1			
3540	2	2	Total	59	57

H_{01} = sample for tests of H_{01}

$H_{02,03}$ = sample for tests of H_{02} and H_{03}

TABLE 4.3
DISTRIBUTION OF SAMPLE
BY FISCAL YEAR-END

Fiscal Year-End	Sample for Tests of H_{01}	Sample for Tests of H_{02}, H_{03}
January	3	3
February	1	1
March	1	0
April	0	0
May	0	0
June	8	8
July	0	0
August	2	2
September	2	2
October	2	2
November	1	1
December	39	38
Total	59	57

4.2 Identification of Industry Co-members

This section provides results on the identification of industry co-members. Section 4.2.1 presents the results of the cluster analysis procedure which is designed to identify risk class co-members for tests of theoretical hypothesis one. In addition, the reduction of sample size due to elimination of co-members with disclosures during the test period is documented. Section 4.2.2 provides a similar analysis using 4-digit SIC codes as the definition of an industry.

4.2.1 Risk Class Co-members

Ward's hierarchical clustering algorithm is run for each 4-digit SIC code for which at least one forecast is found. Table 4.4 presents the results of the procedure. Panel A of Table 4.4 indicates that the number of clusters formed within each 4-digit code range from one to eight clusters. The clustering algorithm is halted when an increase in the number of clusters results in a minimal increase in the ratio of between to within cluster variance. To implement this stopping rule, plots of R^2 against the number of clusters are made. Visual inspection of the plots yield a small range of acceptable stopping points. To increase the objectivity of the final stopping decision, the algorithm is stopped when creating a new cluster results in a less than five percent increase in R^2. Without exception, this procedure yields a stopping point within the range of acceptable stopping points identified via the visual inspection of the plots.

This stopping rule is strictly adhered to unless the cluster so defined contains no co-members without simultaneous disclosures. On fourteen occasions the algorithm is stopped early to ensure a cluster co-member. On thirteen of the fourteen occasions, the number of clusters formed is two or more. Even though the early stopping of the algorithm ignores information on firm dissimilarity provided by the clustering procedure, the formation of more than one cluster decreases the likelihood of groupings of highly heterogeneous firms into risk class portfolios.

The information in Panel A is derived from data after all stopping-rules have been implemented. The median number of clusters within each 4-digit code is five.

Panel B provides an indication of the achieved values of the ratio of between to within cluster variance for forty-six clustering procedures. The majority of clusters exhibit ratios greater than four. On average the between cluster variance is eight times larger than the within cluster variance. This is a relatively large ratio when it is taken into account that the starting point for the analysis was the 4-digit level.

TABLE 4.4

CLUSTER ANALYSIS DESCRIPTIVE STATISTICS

PANEL A
FREQUENCY OF NUMBER OF CLUSTERS FORMED PER 4-DIGIT INDUSTRY

Number of clusters	1	2	3	4	5	6	7	8
Frequency	10	6	5	3	7	11	10	4

Mean number of clusters 4.50

Median number of clusters 5.00

PANEL B
FREQUENCY OF ACHIEVED VALUES OF THE RATIO OF BETWEEN CLUSTER VARIANCE TO WITHIN CLUSTER VARIANCE

Range of Ratio	Frequency
Less than 1.00	4
1.00 - 4.00	14
4.01 - 7.00	13
7.01 - 10.00	4
10.01 - 13.00	3
13.01 - 16.00	5
Greater than 16.00	3
	46*

*The ratio was not calculated for 10 single-firm clusters and calculated only once for 3 cases in which two forecasts appeared within one 4-digit SIC code.

Mean ratio 8.00

Table 4.5 presents information on the size of the clusters obtained from the cluster analysis. Recall that each cluster is formed into an industry portfolio to calculate the prediction error used in the empirical tests. Panel A reports the various sizes of the portfolios as identified by the cluster analysis. Panel B reports the actual distribution of portfolio sizes after non-forecasters with contemporaneous disclosures are eliminated.

Panel A shows that single-firm, two-firm, three-firm, and four-firm portfolios are identified most often by the cluster analysis. The median number of firms per portfolio is three while the mean is slightly over four. A total of 251 firms are identified as cluster co-members.

Panel B indicates that only 134 (53.4%) of the firms have no contemporaneous disclosures during the test period. Restricting the sample to these firms results in single-firm and two-firm portfolios dominating the sample. Also, the median number of firms per portfolio is reduced to one and the mean is reduced to slightly over two.

The results of Panel B indicate that for this particular sample, it may be reasonable to perform the cross-sectional statistical tests on a single-firm basis

TABLE 4.5

SAMPLE OF NON-FORECASTING

CLUSTER CO-MEMBERS

FOR TESTS OF THE FIRST HYPOTHESIS

PANEL A
DISTRIBUTION OF PORTFOLIO SIZES
AS IDENTIFIED BY CLUSTER ANALYSIS

Number of Firms in Portfolio	1	2	3	4	5	6	7	8 or more	Total
Frequency	11	11	10	9	4	4	3	7	59

Total Number of Firms 251

Mean Firms per Portfolio 4.25

PANEL B
ACTUAL DISTRIBUTION OF PORTFOLIO SIZES
FOR FIRMS WITHOUT CONTEMPORANEOUS DISCLOSURES

Number of Firms in Portfolio	1	2	3	4	5	6	7	8 or more	Total
Frequency	30	14	4	3	4	1	0	3	59

Total Number of Firms 134

Mean Firms per Portfolio 2.23

rather than on a portfolio basis. Recall that the problem associated with the single-firm analysis is one of violation of certain independence assumptions necessary for proper cross-sectional parametric tests. If firms are clustered in calendar time (e.g., ten non-forecasters for a single forecast date) their prediction errors will not be independent. While there are eleven portfolios with clusters of four or more firms, there are forty-eight portfolios with clusters of three or less. Although the cross-sectional correlation problem exists, it does not appear to be as significant as originally expected. As a result, several of the tests performed at the portfolio level are repeated at the individual firm level for purposes of comparison. These results are not reported however, since they yield the same conclusions relative to the null hypotheses as those reported in the following discussion.

4.2.2 Standard Industrial Classification Code Co-members

Table 4.6 provides similar information for the 4-digit SIC code industry definition. Panel A presents the distribution of industry sizes prior to the implementation of the contemporaneous disclosure criterion. The majority of the industries contain twenty firms or less with the

TABLE 4.6

SAMPLE OF NON-FORECASTING FOUR-DIGIT

SIC CODE CO-MEMBERS

FOR TESTS OF THE SECOND AND THIRD HYPOTHESES

PANEL A
DISTRIBUTION OF INDUSTRY SIZES

Number of Firms In The Industry	1-10	11-20	21-30	31-40	41-50	Total
Frequency	26	18	6	6	1	57

Total Number of Firms	771
Mean Firms per Portfolio	13.53

PANEL B
DISTRIBUTION OF PORTFOLIO SIZES
FOR FIRMS WITHOUT CONTEMPORANEOUS DISCLOSURES

Number of Firms in Portfolio	1-10	11-20	21-30	31-40	41-50	Total
Frequency	46	7	4	0	0	57

Total Number of Firms	401
Mean Firms per Portfolio	7.04

average industry size of 13.53 firms. A total of 771 firms are examined for contemporaneous disclosures.

Panel B of Table 4.6 shows that 401 (52%) of the firms satisfy the contemporaneous disclosure criterion. The majority of the portfolios actually formed for the empirical tests contain from one to ten firms with an average of 7.04 firms per portfolio.

4.3 Results of Tests of Theoretical Hypothesis One

Table 4.7 presents summary statistics for the portfolios formed from the risk class sample. The mean for ΔE is positive. However, the "good news" bias reported by Patell [1976] and others is not apparent for this sample. Thirty-three (55.9%) of the forecasts are less than the previously issued analyst forecast.

The average forecaster weekly beta is 1.17. The non-forecaster average portfolio beta and the average portfolio beta of the control group are nearly identical at 1.04 indicating a good matching of sample to control firms on average. Table 4.8 presents the distribution of differences in the sample and pair-matched portfolio betas. The large majority (78%) of the differences are less than .4. The extreme beta differences arise from cases where industries contain a relatively small number of firms that yield few candidates for matching.

Another important aspect of Table 4.7 is the skewness measure calculated for the weekly portfolio prediction errors for the forecasters, non-forecasters, and control groups. As discussed by Marais [1984], normal theory tests on V_{it} are sensitive to skewness in the disturbance distribution. A number of the skewness coefficients presented are different from the normal theory value of zero by a substantial amount. One-tailed hypothesis tests based on the normal theory will reject the null too often in the presence of significant skewness in the same direction as the alternative. The data summarized in Table 4.7 will be transformed via the trading strategy formulated in Chapter 3. Therefore, tests for departure from normality will be discussed with respect to the cross-sectional distributions of prediction errors generated by the trading strategy (for each week and each group).

4.3.1 Portfolio Test of Sign Hypothesis

As indicated in Chapter 3, theoretical hypothesis H_{01} suggests tests based on the sign of the change in earnings expectations and tests based on the sign and magnitude of changes in earnings expectations.[2] For tests relating to the sign only, the trading strategy is based on changes in earnings expectations calculated as the difference between

TABLE 4.7

PORTFOLIO SUMMARY STATISTICS

FOR TESTS OF SIGN AND SIGN AND MAGNITUDE HYPOTHESES

(RISK CLASS GROUPINGS)

Variable	Mean	Variance	Skewness	Kurtosis
ΔE	.010	.019	3.436	15.333
Forecaster:				
Beta	1.172	.185	.369	-.674
V_{-1}	.095	.897	.737	.099
V_0	-.038	1.037	.558	.805
V_1	-.038	.978	.297	.468
Non-forecaster:				
Beta	1.045	.193	1.413	2.559
V_{-1}	.096	1.130	.509	.250
V_0	-.123	.724	-.314	-.701
V_1	-.116	1.301	-1.564	6.093
Control:				
Beta	1.040	.141	.438	-.092
V_{-1}	-.345	1.822	3.687	22.341
V_0	.064	1.215	.801	.889
V_1	.024	.825	-.084	.004

TABLE 4.8

DISTRIBUTION OF BETA DIFFERENCES
OF SAMPLE AND PAIR-MATCHED CONTROL
PORTFOLIOS

Absolute Value of Differences	Frequency
Less than .2	25
.2 - .399	21
.4 - .599	5
.6 - .799	5
.8 - .999	1
Greater than 1.0	2

the management forecast and the composite analyst forecast preceding it.

Table 4.9 presents the results of the portfolio test of the sign hypothesis (H_{01S}). The results are inconsistent with prior literature with respect to the forecaster's prediction error. The hypothesis of zero abnormal return is not rejected for week zero. A number of reasons are possible. First, the relatively small sample size reduces the power of the test. Second, the small sample size precludes further partitions of the sample into "good news" and "bad news" sub-samples. Studies by Patell [1976], Penman [1980] and Waymire [1984] find weaker results for negative as opposed to positive forecasts. The combination of the two groups may be weakening the results. The most significant reason, however, may be the fact that 32 (54.2%) of the forecasts involve a revision from analyst forecasts of less than four percent in either direction and are not eliminated due to sample size considerations.

In addition, the null hypothesis of no information transfer is not rejected for the week of the management forecast. Although test statistics are provided for the non-forecast sample and control portfolios seperately, the statistic of interest is the one calculated for the pair-matched difference (D_K = .068) which is not significantly different from zero (t = .354).

TABLE 4.9
PORTFOLIO TEST OF SIGN HYPOTHESIS
(H_{01S})

Group	Week	V_k	Z_{vk}	p(one-tailed test)[1]
	-1	.078	.589	
Forecaster	0	.201	1.514	.0655
	1	.090	.682	
	-1	.119	.128	
Non-fore-casters	0	.204	1.542	.0618
	1	.211	1.593	.0559
	-1	.147	1.112	
Control	0	.136	1.031	
	1	-.103	-.782	
	Week	**D_k**	**t (matched-pair)**	
	-1	-.028	.133	
Difference	0	.068	.354	
	1	.314	1.766**	

D_k = V_k (non-forecasters) - V_k (control)

V_k = cross-sectional mean of standardized prediction errors

Z_{vk} = normalized score

p = $p(z > Z_{vk})$

[1]Reported only if less than .10.

**Significant at .05 level (one-tailed test), d.f.= 57.

This result is not consistent with the results of Foster [1981] relating to earnings releases. A number of explanations are possible for the lack of significance. First, recall the inability to reject the null hypothesis of information content of the management forecast for the forecasting firm. The three reasons offered as possible explanations for this result remain valid as explanations of the inability to reject the null hypothesis for the non-forecasters.

In addition to the above, a possible explanation is the relative strength of this study's research design relating to the internal validity of the measure of the information transfer effect. Specifically, this study combines the elimination of firms with contemporaneous disclosures, the use of industry-matched control groups, and direct calculation of changes in earnings expectations to mitigate the effects of other information on the internal validity of the Z_{Vk} measure. Prior studies have not employed these approaches.

There is one other result of interest in Table 4.9. A significant positive D_k for week +1 is documented. The detection of post-announcement abnormal returns is not unusual in the management forecast literature, (see Penman [1980] - fourth day following positive forecasts, Patell [1976], and Marais [1984] - replication of Patell's results using the "bootstrap" methodology), or in the capital market literature in general (Ball [1978], Joy and Jones [1979], Latane and Jones [1979], Bidwell and Riddle [1981], Rendleman, Jones and Latane [1982], and Foster, Olsen and Shevlin [1984]).

There are a number of possible explanations for the post-announcement abnormal returns. Aside from the notion of capital market inefficiency, explanations have included a criticism of the descriptive validity of the Capital Asset Pricing Model (CAPM) (Sharpe [1982], Banz [1981], Reinganum [1981] and Keim [1983]), the recognition that measures used in estimates of the CAPM may be biased (determination of the market return, etc.), use of hindsight information in the experiment, time period phenomenon (Beaver and Landsman [1981] and Watts [1978]), use of an improper unexpected earnings model (Foster, Olsen and Shevlin [1984]), and specific to the methodology used in this research, violation of normality of the prediction error distribution due to skewness (Marais [1984]).

The use of hindsight information is not an explanation for the results of this research. All trading rules, grouping procedures, and sample selections are based on information available up to and including the forecast week. The time period phenomenon is probably not a good explanation either since similar results have been documented for management forecasts from other time periods.

The other possible explanations remain valid. Of particular interest to this research are the unexpected earnings model and the skewness explanations. Foster, Olsen and Shevlin [1984] (FOS) found that unexpected earnings calculated as the standardized residual of the disclosing firm did not exhibit the post-announcement period abnormal returns associated with other unexpected earnings models. To examine this issue, the sign test is replicated using the sign of the forecaster's prediction error as a measure of changes in earnings expectations. Table 4.10 reports results consistent with Table 4.9 and FOS. The D_t for each week is not significantly different from zero at the .05 level.

The skewness explanation also has merit. The skewness coefficient calculated for the cross-sectional distributrion of V_{pk} for the post-announcement week of the non-forecasting cluster co-members is equal to 1.60 (n=59). This far exceeds the 1% upper limit of the distribution of skewness coefficients under the null hypothesis that the data was generated from a normal disturbance distribution. The skewness coefficient for the

TABLE 4.10

PORTFOLIO TEST OF SIGN HYPOTHESIS

USING FORECASTER'S PREDICTION ERROR

AS THE MEASURE OF CHANGES IN EXPECTATIONS

(H_{01S})

Group	Week	V_k	Z_{vk}	p(one-tailed test)[1]
	-1	.022	.165	
Non-fore-casters	0	.313	2.364	.0091
	1	.237	1.786	.0375
	-1	-.081	-.609	
Control	0	.058	.440	
	1	.032	.239	

	Week	D_k	t(matched-pair)
	-1	.103	.489
Difference	0	.255	1.352*
	1	.205	1.133

D_k = V_k (non-forecasters) - V_k (control)

V_k = cross-sectional mean of standardized prediction errors

Z_{vk} = normalized score

p = $p(z > Z_{vk})$

[1]Reported only if less than .10.

*Significant at .10 level (one-tailed test), d.f.=57.

announcement week difference is .78 (n=59) which also exceeds the 1% upper limit. This is expected since the difference measure is calculated from the non-forecasting cluster co-member V_{pk}. The result of the positive skewness is that the probability associated with the right-tail of the distribution is understated.

4.3.2 Portfolio Test of Sign and Magnitude Hypothesis

Tables 4.11 and 4.12 present the results of tests of the sign and magnitude hypothesis (H_{01SM}). Spearman rank correlation coefficients and associated t-statistics are reported for tests of the associations between rankings of changes in earnings expectations and rankings of V_{pk} for each group and for the sample/control differences. However, none are significantly different from zero. The correlation coefficient of the non-forecasting group and the control group are nearly identical suggesting the possibility that the control group was similarly affected by the forecast (information transfer at the 2-digit level) or similarly affected by other industry-level disclosures conveying information positively associated with the sign and magnitude of the change in earnings expectations.

To further investigate the insignificance of the rank order coefficients two additional tests are performed.

TABLE 4.11

PORTFOLIO TEST OF SIGN AND

MAGNITUDE HYPOTHESIS

(H_{01SM})

Group	Week	r_s	$t(r_s)$
	-1	.055	.413
Forecaster	0	.151	1.154
	1	.001	.077
	-1	.131	.999
Non-Fore-casters	0	.158	1.211
	1	.068	.517
	-1	-.107	-.811
Control	0	.160	1.225
	1	-.105	-.796
	-1	.135	1.032
Difference	0	-.038	-.289
	1	.167	1.281

r_s = Spearman Rank Order Correlation

$t(r_s)$ = t-statistic for correlation coefficient

TABLE 4.12

PORTFOLIO TEST OF SIGN AND MAGNITUDE HYPOTHESIS (H_{01SM})

		DECILES OF ΔE		NON-CONFLICTING RANGES	
Group	Week	r_s	$t(r_s)$	r_s	$t(r_s)$
	-1	.115	.327	-.009	-.061
Forecaster	0	.430	1.348	.214	1.439*
	1	.079	.223	-.059	-.390
	-1	.152	.433	.073	.483
Non-fore-casters	0	.394	1.212	.212	1.420*
	1	.333	1.000	.116	.764
	-1	.091	.258	-.194	-1.300
Control	0	.297	.879	.175	1.167
	1	-.394	-1.212	-.062	-.409
	-1	.067	.189	.170	1.134
Difference	0	-.176	-.505	.011	.073
	+1	.612	2.189**	.182	1.217

*Significant at .10 level (one-tailed test), d.f. = 43

**Significant at .05 level (one-tailed test), d.f. = 8

First the ΔE are ranked and combined into deciles. The mean V_{pk} for each group is computed for each decile and ranked. Spearman rank-order correlations are computed for each group for each week. This is a weaker test of association since the hypothesized relationship is for groups of observations "on average" rather than for individual observations.

The second test concentrates on measurement error in the management forecasts. The sign and magnitude of the change in expected earnings is a function of the relationship between management and analyst's forecasts. Fourteen of the range forecasts included in the sample are "conflicting" in the sense that the endpoints of the range fall on either side of the composite analyst forecast. Averaging of the endpoints assumes similar behavior by traders. To investigate the possible effect of the averaging procedure on the results of the Spearman rank order correlation test, the fourteen observations are dropped and the analysis is performed on the remaining fourty-five.

Table 4.12 provides the results of the two tests. The deciles test yields similar results to the individual observations test in one regard. The correlation coefficients are largest but insignificant at week zero for the forecasters and non-forecast cluster co-members.

However, the correlation of the difference measure with the changes in earnings expectations is significantly different from zero for week +1. This is consistent with the significant post-announcement prediction error associated with the sign of the change in earnings expectations documented in Table 4.9 and discussed thereafter.

The non-conflicting range tests are consistent with the individual observations tests. None of the correlation coefficients are significantly different from zero at the .05 level.

4.3.3 Summary of Section 4.3

In summary, it appears that the tests performed provide no evidence in support of the information transfer theory for management forecasts of earnings. The sign and the sign and magnitude null hypotheses are not rejected at week zero. Weaker tests performed on the deciles of changes in expectations and on non-conflicting ranges of forecasts yield similar results.

4.4 Results of Tests of Theoretical Hypotheses Two and Three

Table 4.13 presents summary statistics for the variables used in the regression tests of hypotheses two and three. The dependent variable for the regression is the week zero prediction error of the non-forecaster portfolio, V_0-non-forecaster. The next variable is the change in earnings expectations, ΔE. The purpose of including the change in earnings expectations in the regression model is two-fold. First, theoretical hypotheses two and three posit relationships with earnings held constant. Second, a test for a significant coefficient on the earnings change term is a test of hypothesis one for intra-industry information transfers at the four-digit level related to the sign and magnitude of changes in earnings expectations.

PVRS is the variance of the market model R^2 calculated across 4-digit code co-members of the forecaster with no contemporaneous disclosures during the test period. The calculation of PVRS in this manner reduces the effect of the sample selection criteria on the results obtained. For example, assume a ten firm industry (including the forecaster) in which five firms (including the forecaster) are very similar and the other five are very dissimilar both among themselves and with the five firm group which includes the forecaster. Suppose that the five firm group which included the forecaster were the only firms in the industry which had no contemporaneous disclosures for the test period. The inclusion of all firms in the calculation of PVRS would indicate a heterogenous group while it is clear that the sample

TABLE 4.13

PORTFOLIO SUMMARY STATISTICS

FOR TESTS OF HYPOTHESES TWO AND THREE*

Variable	Mean	Variance	Maximum	Minimum
V_0-Non-Forecasters	.119	.874	2.851	-1.641
ΔE	.011	.019	.775	-.219
PVRS	4.421[1]	.145[1]	23.762[1]	.045[1]
PVMS	.380[1]	.017[2]	1.827[1]	.016[1]

[1]Equals value X 100

[2]Equals value X 1000

ΔE = change in earnings expectations

PVRS = variance of market model R^2 calculated across industry co-members as a percentage of the mean

PVMS = variance of forecaster's market share as a percentage of the mean

*Hypothesis two posits a negative relationship between PVMS and V_0 - Non-forecasters. Hypothesis three posits a negative relationship between PVRS and V_0.

obtained for the test is homogeneous. Inclusion of only sample firms in the calculation of PVRS would correctly indicate the characteristics of the non-disclosures for which the information transfer is hypothesized.

PVMS is the variance of the market share of the forecaster. Both PVRS and PVMS are standardized by their respective means, since, all else held constant, the variance of a variable is a positive function of its relative magnitude.

The regression test is, essentially, a test of differential impact across forecasts. The ability to detect differential impact is influenced by whether or not the forecasts have any impact at all. Since the sample used in the regression test is slightly different than the sample used to test H_{01} (both in terms of the forecasters and the non-forecaster portfolios), the sign test is repeated.

Table 4.14 presents the results of the sign test. The average cross-sectional prediction errors of the forecaster and the non-forecaster portfolios are significantly different from zero at week zero only. These results indicate an information transfer impact at the 4-digit level. Therefore, conducting differential impact tests is reasonable[3].

TABLE 4.14

SIGN TEST FOR SIC SAMPLE

Group	Week	V_k	Z_{Vk}	p(one-tailed test)
	-1	.098	.732	
Forecaster	0	.268	1.988	.0239
	1	.081	.602	
	-1	.083	.616	
Non-Forecasters	0	.230	1.704	.0446
	1	-.026	-.193	

V_k = cross-sectional mean of standardized prediction errors

Z_{Vk} = normalized scores

p = $P(z > Z_{Vk})$

According to equation (17) (Chapter 2), there are three potential determinants of forecast error variance and therefore, three potential independent variables to be included in the regression (in addition to ΔE). The cross-product of σ^2(PVMS) AND σ^2(PVRS) (cross-product of $\sigma^2(\phi)$ and $\sigma^2(\gamma)$ in the theoretical development) was not included in the regression for reasons which will be discussed after analysis of Table 4.15.

Table 4.15 presents the results of the regression test. The F-value for the entire regression (5.639) is large and significantly different from zero. The results for the individual independent variables reject the sign and magnitude null for ΔE (4-digit level) and reject theoretical hypothesis three which posits diversification as a deterent to information transfer. The parameter estimate for ΔE is positive and significantly different from zero. The parameter estimate for PVRS is negative and significantly different from zero. The parameter estimate for PVMS is positive and insignificant. Theoretical hypothesis two posits a negative relationship between the variance of the market share of the forecaster and information transfer. Therefore, the estimate of PVMS is of the wrong sign.

Tables 4.16 and 4.17 report the correlation matrix of the coefficient estimates and the raw variables respectively.

TABLE 4.15

RESULTS ON TESTS OF HYPOTHESES

TWO AND THREE*

Dependent variable: V_0 of non-forecaster

F value for model	5.639
p(F(null) > F)	.002
R^2	.242
Adjusted R^2	.199

Variable	Parameter Estimate	Standard Error	t	p(one-tailed test)
Intercept	.258	.199	1.29	
ΔE	2.891	.800	3.613	.000
PVMS	19.923	27.330	.729	
PVRS	-5.598	2.937	-1.906	.031

*Hypothesis two and three posit negative signs for PVMS and PVRS respectively.

From examination of Table 4.16, it is clear that multicollinearity is not a problem in interpreting the estimates for the coefficients presented in Table 4.15. The correlations among ΔE, PVMS and PVRS are very low. In Table 4.17, it is interesting to note that the correlations between V_0 and two of the independent variables, ΔE and PVRS are substantial and of the same sign as predicted by the theory.

As discussed earlier, the entire potential design matrix is not utilized in the Table 4.15 regression. Instead, a subset of the matrix is used which excludes the cross-product of the variance terms. There are a prior reasons for excluding the term. First, the cross-product term is small as evidenced by multiplying the means of PVRS and PVMS reported in Table 4.13. Second, it contains redundant information which is likely to result in multicollinearity and the resulting problems of coefficient interpretation. However, if the term is relevant and removed from the equation, the efficiency gained may be more than offset by the resulting bias of the remaining regression coefficients (Kennedy [1981], p. 133). The simultaneous consideration of bias and efficiency suggests that the decision on dropping the variable from the design matrix should be made with respect to a criterion based on mean squared error. Such a criterion has been developed

TABLE 4.16

CORRELATION OF ESTIMATES

REPORTED IN TABLE 4.15

	Intercept	ΔE	PVMS	PVRS
Intercept	1.000			
ΔE	-.011	1.000		
PVMS	-.515	-.024	1.000	
PVRS	-.646	-.030	-.0008	1.000

TABLE 4.17

CORRELATION OF RAW VARIABLES

USED IN TABLE 4.15 REGRESSION

	V_0 of non-forecasters	ΔE	PVMS	PVRS
V_0 of non-fore casters	1.000			
ΔE	.427	1.000		
PVMS	.096	.024	1.000	
PVRS	-.214	.031	.009	1.000

by Amemiya [1980] and will be used in this research.[4] The criterion involves minimizing the following metric:

(1) $APC = [(T + K_1)/(T-K_1)](1 - R^2)$

where, T = sample size, and

K_1 = variables included in the design matrix.

Minimizing APC is similar in spirit to maximization of adjusted R^2 (see Theil [1961] for a discussion of adjusted R^2). However, the APC criterion and the adjusted R^2 criterion differ in two respects. First, the R^2 criterion makes no assumption regarding the loss associated with choosing an incorrect model (it is not a mean square error based criterion). Second, the APC has a higher penalty for adding variables than the adjusted R^2 criterion.

To apply the APC rule, the regression is reestimated including the product term. As anticipated the correlation of PVRS and PVMS with the product term is quite high, -.82 and -.78 respectively.

Table 4.18 presents the values for APC, adjusted R^2 and R^2 for the regression excluding and including the product term. APC is minimized and adjusted R^2 is maximized for the regression excluding the product term Therefore, support exists for restricting the design matrix to the subset of variables used in the Table 4.15 regressions. At worst, the restricted model estimator of the variance will be biased upward (Judge, et. al. [1982],

TABLE 4.18

MODEL SPECIFICATION TEST*

	Excluding Product Term	Including Product Term
Direct Method:		
APC	.268	.280
R^2	.242	.243
Adjusted R^2	.199	.185
Indirect Method:		
APC	.325	.339
R^2	.293	.295
Adjusted R^2	.253	.241

*This test is performed to determine the appropriateness of excluding the theoretically posited product term from the Table 4.15 regression.

APC = Amemiya Prediction Criterion

p. 598) and will reduce the chance of rejecting the null.

4.4.1 Summary of Section 4.4

Evidence from the regression test supports the rejection of hypothesis one (for 4-digit non-forecasters) and hypothesis three. Hypothesis two is not rejected. This suggests that changes in earnings expectations and industry diversification may be used to explain the differential impact of management earnings forecast on the abnormal returns of non-forecasting industry members. The variance of the market share of the forecaster does not appear to be significant in explaining differential impact.

4.5 Additional Tests

As indicated in Chapter 3, intuition suggests an additional test of the ability to explain cross-sectional differences in V_{pk}. The industry mean R^2 is an indicator of the association of industry return with the market return. It was hypothesized that the higher the association with the market, the lower the effect of information transfer at the industry level would be. The Spearman rank order correlation between the V_{pk} and the mean R^2 for the industry is equal to $-.19$. The t-value of -1.44 is significant at the .10 level (one-tailed test), evidence consistent with the hypothesis.

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[1]Waymire [1984] reports 19.6% of forecasts issued without contemporaneous disclosure during a three-day period for data gathered from 1969 to 1973. The WSJI provides dates of disclosures by firms.

[2]The latter is a much stronger test than the former.

[3]These tests should be interpreted with caution, however, due to the absence of a control group in the design.

[4]Judge, et. al. [1982] note that the sampling properties of estimators developed in papers such as Amemiyas are generally unknown and should be used with caution.

CHAPTER 5

SUMMARY, CONCLUSIONS AND LIMITATIONS

5.1 Summary and Conclusions

The alleged economic consequences of proposed disclosure rules concerning management earnings forecasts have spawned a great deal of debate. A question arising from the forecast debate that has received considerable research attention is whether or not management forecasts convey information pertinent to establishing firm's equilibrium values. Although the information content hypothesis has been supported empirically, the usefulness of forecasts in determining equity values may be understated. This is due to the fact that research efforts to date have estimated only the effects of forecast disclosure on the stock price of the firm making the disclosure. It has ignored the effects of forecast disclosure on non-forecasting firms for which the forecast may have implications for equity valuation (an information transfer).

Information transfer research is important for three reasons. First, documentation of information transfer provides evidence on changes in individual's utility, on wealth redistribution, and on the potential non-Pareto optimality of firms' information production decisions.

Second, the phenomenon of information transfer is directly related to the residual return cross-sectional correlation problem in a research design context. Third, the documentation of disclosures which cause co-movement in industry security prices provides additional evidence on the usefulness of analysis of industry groupings in investment strategy.

This research is motivated by the lack of theoretical and empirical work in the information transfer area. Chapter 2 provides the development of a theory of information transfers. A partial equilibrium model is provided which specifies the relationship between changes in expected profits of two firms which operate within a given industry. Two variants of the model are derived. A risk class specification results when a symmetry argument is invoked. For firms within the same risk class, this specification serves as a basis for hypothesizing a positive relationship between the sign and magnitude of changes in earnings expectations of the forecaster and the abnormal returns of non-forecasting firms. A second specification relies on the results of Flaherty [1980] relating to asymmetric equilibrium and allows for product diversification. This specification serves as a basis for hypothesizing an inverse relationship of the market share variability of the forecaster and the relative diversification of the industry with the abnormal returns of nonforecasting industry co-members.

The following null forms of the theoretical hypotheses were tested:

H_{01}: There is no relationship between the sign and magnitude of changes in earnings expectations conveyed by a management forecast of firm i and unexpected returns of firm j, when firms i and j are members of a "risk class" industry grouping.

H_{02}: Ceteris paribus, the magnitude of unexpected returns for firm j observed at the date of firm i's management forecast is unrelated to the variance of the ratio of their outputs when firms i and j are members of a defined industry grouping.

H_{03}: Ceteris paribus, the magnitude of unexpected returns for firm j is unrelated to the diversification level of the reporting firm, firm i, when firms i and j are members of a defined industry grouping.

The empirical evidence provided in Chapter 4 fails to reject H_{02}, a hypothesis which has not been tested in prior research. H_{03} is rejected in favor of the alternative. This result is consistent with prior research. Foster [1981] presents some evidence that highly diversified industries experience a lower degree of information transfer (documented for high positive prediction error portfolios only).

H_{01} is rejected or not rejected based on the definition of industry. When based on risk class industry groupings (derived from cluster analysis), the tests employed fail to reject the null. When non-forecasters are defined as members of the forecasters 4-digit SIC code, H_{01} is rejected as indicated by the significant "change in earnings expectation" coefficient in the regression test.

Interpretation of these results must be made with reference to the models from which the testable hypothesis are generated. The first model results in a "risk class" specification. Tests of this hypothesis are, in reality, joint tests of the ability to construct risk class groupings of firms and of the information transfer effect for management forecasts. Failure to reject the null of no information transfer points to the necessity to develop more powerful tests of the hypothesis (i.e., develop better clustering procedures).

The second model admits heterogeneity of firms but requires measures of heterogeneity (market share variability and industry diversification). Tests of this model rely less on the ability to identify industry co-members since practically defined industries exist (4-digit SIC). Three specific conclusions are supported by the tests using SIC code industries. First, there are specific accounting related disclosures which cause co-movement in security prices. The co-movement of security prices is documented at the 4-digit SIC code industry level. Event studies which address industry-specific regulations and assume cross-sectional independence of residual returns yield results which are suspect during periods in which the accounting related disclosures are plentiful. The effects are weaker for diversified industries.

Second, the co-movement in security prices is above and beyond that which is explainable by the relationship between individual and market returns (extra-market component of security returns). Therefore, analysis of industry groupings is potentially relevent to investment strategy.

Third, intra-industry information transfers associated with management earnings forecasts exist. As explained in Chapter 1, this provides evidence of effects on individual's utility for shareholders and potential shareholders of non-disclosing firms that result from the forecast disclosure decision. Stronger social welfare statements may not be made since, by nature, they require socially determined rules by which to choose between alternative configurations of individual's utility. However, this does not deter from the relevance of documenting the existence of the effect as in input into the choice process of accounting policy makers.

5.2 Limitations

There are a number of potential limitations of this research. First, the model presented in the paper is a partial equilibrium model which does not consider the relationships among multiple products of diversified firms. However, it is not clear that a more complex model would yield testable hypotheses different or more intuitively pleasing than the hypotheses generated by the simple model.

Second, many of the constructs of importance to the information transfer theory are unobservable and must be proxied. The power of the empirical tests may be reduced to the extent that measurement error is present in the proxy calculations. This limitation is apparent in the clustering procedures. After the initial choice between the use of market or accounting variables, a significant number of decisions must be made on which variables to choose and how to measure them.

A third limitation of the analysis is that mandatory forecasts are unavailable. It is not certain that empirical evidence of information transfers for voluntary forecasts is generalizable to forecasts produced under a mandatory system (see Imhoff [1978]). Also costs of disclosure are ignored and, as a result, policy recommendations are not made. Related to the generalizability issue is the effect of including only forecasts issued without contemporaneous disclosures in the sample. The representativeness of the sample forecasts may be questioned if there are systematic differences between forecasts issued in isolation and those issued as a part of a disclosure package.[1]

Another question exists as to whether or not the clustering procedure yielded homogeneous firms. Failure to reject the null for the "risk class" industries (H_{01}) may be caused by poor clusterings rather than a lack of intra-industry relationships. Rejection of H_{01} for SIC code industries (regression tests) increases the likelihood that this is the case. It is possible that other clustering procedures or variables would yield different results for the "risk class" industries.

Finally, the theory of information transfers is not well specified. As a result, it is difficult to interpret results such as the effect of the forecast on the control group. It is possible that the abnormal return of the control group was affected by the forecast (information transfer at the 2-digit level). Recall that the intent of the research design was to select a control group which was affected only by industry-level information (change in interest rates, etc.). Lack of theory as to the extent of information transfers makes selection of a proper control group difficult.

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[1]See Waymire [1984] for a further analysis of this issue.

APPENDIX A

Proof of Proposition (2):

Consider equation (5):

(A1) $\pi_i = q_i^* [a^E - b^o Q] - \sum_{k=1}^{m} w_k^E x_k^*(\underline{w}^E)]$

Write a similar equation for firm j (assuming symmetry).

(A2) $\pi_j = q_j^* [a^E - b^o Q] - \sum_{k=1}^{m} w_k^E x_k^*(\underline{w}^E)]$

The total change in expected profits for each firm may be found by taking the partial derivatives of (A1) and (A2) with respect to a^E and each w_k^E ($k = 1, \ldots, m$).

(A3) $\partial \pi_i / \partial a^E = q_i^*$

(A4) $\partial \pi_j / \partial a^E = q_j^*$

(A5) $\partial \pi_i / \partial w_k^E = -q_i^* \; x_k^*(\underline{w}) \quad k = 1, \ldots, m.$

(A6) $\partial \pi_j / \partial w_k^E = -q_j^* \; x_k^*(\underline{w}) \quad k = 1, \ldots, m.$

Dividing (A4) by (A3) and (A6) by (A5) and rearranging yields:

(A7) $\partial \pi_j / \partial a^E = (q_j^* / q_i^*)(\partial \pi_i / a^E)$

(A8) $\partial \pi_j / \partial w_k^E = (q_j^* / q_i^*)(\partial \pi_i / \partial w_k^E) \quad k = 1, \ldots, m.$

The total change in expected profits for all changes in a^E and w_k^E, $d\pi_j$, may be found by summing (A7) weighted by da^E and (A8) for all $k = 1, \ldots, m$ weighted by dw_k^E (assuming cross-effects of da^E and dw_k^E are zero):

(A9) $d\pi_j = (q_j^* / q_i^*)[(\partial \pi_i / \partial a^E) da^E + \sum_{k=1}^{m} (\partial \pi_i / \partial w_k^E) dw_k^E].$

which from the definition of the total differential yields:

(6) $d\pi_j = (q_j{*}/q_i{*})d\pi_i$.

APPENDIX B

Description of Cluster Analysis

The cluster analysis algorithm is designed to help identify groups of observations that have similar attributes. In this study, the attribute of interest is risk class membership. This hierarchical technique begins by forming m clusters where m equals the number of observations (firms). Each observation is described by an n-dimensional vector where n is equal to the number of clustering variables (ratios). The two closest clusters are then combined to form m-1 clusters.

Closeness is computed as a Euclidean distance matrix. Letting x_i denote i'th observation vector, the distance between two observations can be written as:

(B1) $d(x_i, x_j) = (x_i - x_j)' (x_i - x_j).$

The procedure continues by combining the closest clusters as defined by (B1) until all firms have been placed in a single cluster. At any stage of the analysis, the loss of information which results from the grouping of individuals into clusters can be measured by the total sum of squared deviations of every point from the mean of the cluster to which it belongs (Ward [1963]). Combination of clusters occurs after consideration of the union of every possible pair of clusters. The two cluster union resulting in the minimum increase in the error sum of squares is selected. The error sum of squares is given by:

(B2) $$\sum_{i=1}^{n} x_i^2 - \frac{1}{n} (\Sigma x_i)^2.$$

See Everitt [1980] for an excellent discussion of cluster analysis.

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