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Comments are welcome. Please do not quote.

ABSTRACT

This study develops a structural equation model linking both abnormal stock returns and abnormal trading volume to unexpected changes in accounting ratios which result from the issuance of annual accounting data. A measurement model is constructed to aggregate the unexpected changes in accounting ratios into the unexpected changes in four financial dimensions, liquidity, leverage, profitability, and activity. The model is estimated and the hypothesized model configuration recreates 66% of the generalized variance in the observed data.

The individual parameter estimates show that the major source of variation in abnormal returns is the unexpected changes in profitability. Unexpected changes in liquidity and activity are linked to abnormal returns at a fairly low level of significance. None of the unexpected changes in the financial dimensions are found to be significantly linked directly to abnormal trading volume. Instead, the link is indirect through the relationship between abnormal returns and abnormal volume.

1.0 Purpose of the Study

Numerous researchers have investigated the reaction of the financial market to the issuance of corporate financial data and they have found that the market reacts to earnings data. Few researchers have investigated the reactions of the market to both earnings and financial position data. This project fills this void by studying the market reaction to the issuance of both earnings announcements and the complete financial statements. The intent is to assess the marginal contribution of non-earnings financial data simultaneously with the impact of the earnings announcement.

This study has three research thrusts. First, it simultaneously investigates both price and volume reactions. Rather than examining the price and volume reactions individually, both of the market reactions are linked to accounting data and modeled using simultaneous equations. This provides insight into the relationship between the two reactions and allows both direct and indirect relationships to be measured. The second research thrust is that a measurement model is employed to combine various financial accounting information into four fundamental firm dimensions. Instead of trying to link the market reactions to various financial ratios the reactions are linked to four underlying financial dimensions of the firm; liquidity, leverage, profitability, and activity. Each of these dimensions is measured by a group of financial ratios and the covariance structure among the ratios is used to formulate the magnitudes of the unobservable financial dimensions. The third thrust of this study is that it goes beyond simple statistical analysis of covariation and develops a hypothesized causal model structure. The variations in the price and volume rections of the market are decomposed into the components attributable to the variation in the unexpected changes in the liquidity, leverage, profitability, and activity financial dimensions. The significance of the hypothesized links between the market reactions and the financial dimensions is tested. Additionally, through over-identification of the hypothesized model structure, the model configuration itself is tested.

The next section of this paper presents the hypothesized model configuration linking the market reactions to the financial dimensions (structural model) and the financial dimensions to the financial ratios (measurement model). The third section summarizes the parameter estimation and model testing techniques. The data analysis is presented in section four and the final section provides the conclusions and implications of the results.

2.0 Hypothesized Model

The overall model developed and tested in this paper is made up of two components. The measurement model links the accounting data to four underlying financial dimensions and the structural model links the financial dimensions to the market reactions.

The structural model is based on an arbitrage pricing model approach in which the factors are the four financial dimensions. Ohlsen (1979) provides an analytic model relating accounting information to security valuation. His study examines security valuation relative to the stochastic behavior of accounting numbers. The model developed is the following:

$$P_t = A + \sum_{i=1}^{N} B_i X_{it} + CD_t$$

where: P_t is the price of the security at time t.

$\underline{X}_t = (X_{it}, X_{2t}, \ldots, X_{nt}, D_t)$ is a vector of datum concerning the economic attributes of the firm at time t.

X_{it} denotes financial accounting numbers that represent the economic attributes of the firm at time t.

D_t is dividends paid at time t.

$A, B_i, B_2, \ldots, B_n, C$ are the valuation parameters obtained by solving a system of simultaneous equations.

Olhsen does not stipulate the accounting numbers to be used in the model but asserts (p. 318), "the fundamental characteristics of financial variables are their (joint) stochastic time-series behavior . . . information variables in this mode of analysis can be any type of variable that affects investors' expectations about future events." The model in this study is based on four financial dimensions or attributes of the firm; liquidity, leverage, profitability, and activity.

Each of these four financial dimensions is an unobservable construct representing the financial and operating aspects of a firm and accounting data provides measures of these dimensions. Each of the financial dimensions has multiple ratios which are considered to be measures of the underlying dimension. The four financial dimensions and the measures (ratios) used in this study are:

<u>Liquidity</u>
- current ratio
- quick ratio
- defensive ratio

Leverage
- total debt to equity ratio
- long-term debt to equity ratio
- times interest earned

Profitability
- return on assets
- earnings to sales ratio
- primary earnings per share
- return on common stockholders' equity

Activity
- asset turnover
- receivable turnover
- inventory turnover

These ratios and the financial dimensions they measure constitute the components of the measurement model. Mock (1976) suggested the use of accounting information as observable measures of unobservable constructs. The basic model of this approach depicts the observable measure (accounting data or ratio) as a function of the underlying financial dimension and a measurement error term. Let x represent the measure (financial ratio), ξ represent the underlying dimension, and δ represent the measurement error. The measurement model for each ratio can be depicted as:

$$X_t = \xi_t + \delta_t$$

Since this paper is investigating the impact of accounting information on the market, the actual variables studied are the unexpected changes in the accounting ratios and the underlying financial dimensions which result from the issuance of the financial statements.

The components of the measurement model are defined as follows:

ξ_1 = expectation error regarding the liquidity dimension

ξ_2 = expectation error regarding the leverage dimension

ξ_3 = expectation error regarding the profitability dimension

ξ_4 = expectation error regarding the activity dimension

x_1 = expectation error of the current ratio

x_2 = expectation error of the quick ratio

x_3 = expectation error of the defensive interval

x_4 = expectation error of the long term debt to equity ratio

x_5 = expectation error of the total debt to equity ratio

x_6 = expectation error of the times interest earned ratio

x_7 = expectation error of the return on total assets

x_8 = expectation error of the earnings to sales ratio

x_9 = expectation error or primary earnings per share

x_{10} = expectation error of the return on equity

x_{11} = expectation error of the total asset turnover

x_{12} = expectation error of the accounts receivable turnover

x_{13} = expectation error of the turnover ratio

λ = measurement coefficient between the observable measure and the underlying/unobservable financial dimension expectation error

δ_1 to δ_{13} = the associated measurement error

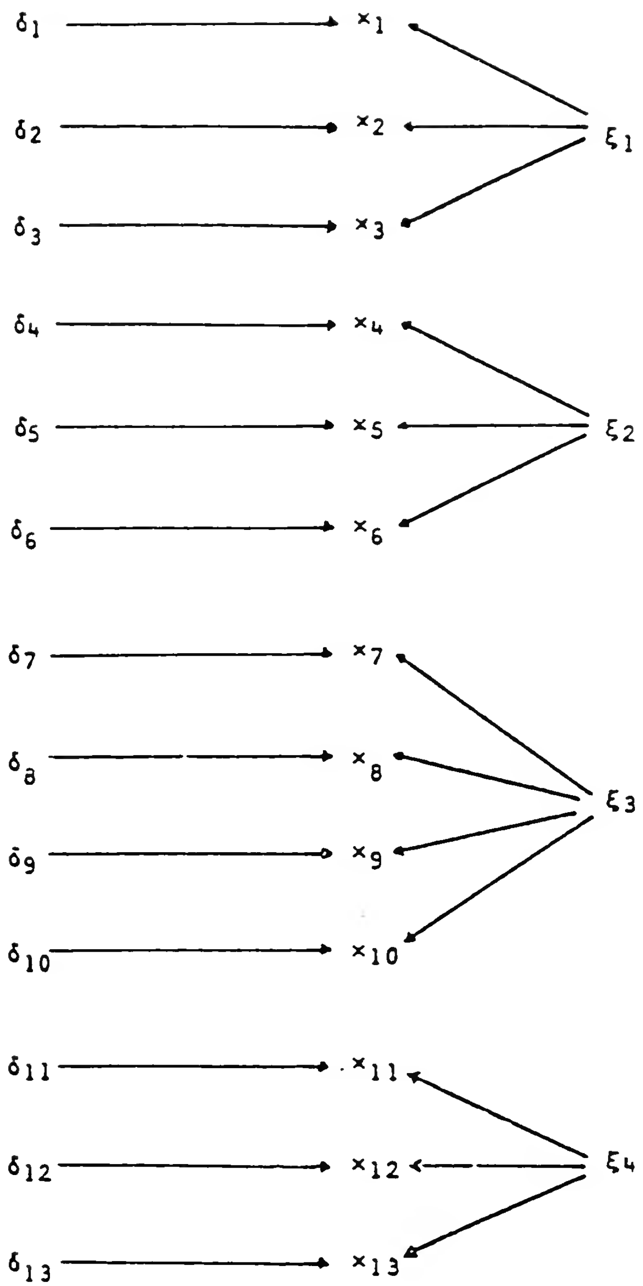
The overall measurement model relating the four financial dimensions to the observable accounting ratios is comprised of thirteen equations. Each equation represents a single accounting ratio as a measure of a single underlying financial dimension. The liquidity, leverage, and activity dimensions each have three ratios as measures of the underlying dimension. The profitability dimension is measured by four ratios. Each of the thirteen ratios is an imperfect measure of the appropriate underlying financial dimension and, therefore, each measurement model equation contains an error term. The thirteen equations comprising the hypothesized measurement model of this study are:

$$x_1 = \lambda_{11} \xi_1 + \delta_1 \qquad x_8 = \lambda_{32} \xi_3 + \delta_8$$
$$x_2 = \lambda_{12} \xi_1 + \delta_2 \qquad x_9 = \lambda_{33} \xi_3 + \delta_9$$
$$x_3 = \lambda_{13} \xi_1 + \delta_3 \qquad x_{10} = \lambda_{34} \xi_3 + \delta_{10}$$
$$x_4 = \lambda_{21} \xi_2 + \delta_4 \qquad x_{11} = \lambda_{41} \xi_4 + \delta_{11}$$
$$x_5 = \lambda_{22} \xi_2 + \delta_5 \qquad x_{12} = \lambda_{42} \xi_4 + \delta_{12}$$
$$x_6 = \lambda_{23} \xi_2 + \delta_6 \qquad x_{13} = \lambda_{43} \xi_4 + \delta_{13}$$
$$x_7 = \lambda_{31} \xi_3 + \delta_7$$

Figure 1 is a diagram of the hypothesized measurement model. Recall that the x's represent the observed expectation errors (unexpected changes) of the various accounting ratios and the ξ's represent the expectation errors (unexpected changes) in the underlying financial dimensions. The δ's represent the measurement errors since each ratio is an imperfect measure of the underlying dimension. Since the financial dimensions are interrelated they are modeled as covarying and they are not constrained to be orthogonal.

INSERT FIGURE 1

The hypothesized structural model links the unexpected changes in the financial dimensions to both types of market reaction, abnormal returns and abnormal trading volume. This allows the effect of the accounting information release on both the aggregate market and the individual investor level to be modeled. Beaver (1968) introduced the use of both changes in the equilibrium value of current market prices



where it is assumed that the ξ's are not orthogonal and may covary.

Figure 1. Hypothesized Measurement Model

(abnormal returns) and shifts in portfolio positions (abnormal trading activity) to research information content.

An arbitrage approach using annual accounting data in the pricing scheme leads to hypothesized links between each of the unexpected changes in the financial dimensions and the market reactions. Both of the market reactions, price and volume, are simultaneously investigated.

Beaver (1968) stated that the price reaction denotes the use of accounting information by the market in aggregate while a volume reaction is indicative of investors altering their portfolios. This implies that the market would not adjust prices due to individual investors making shifts in their portfolios, but individual investors may make shifts in their portfolios due to changes in the price of the security. This is the basis for a hypothesized unidirectional linkage between the abnormal returns and abnormal trading activity. The two equations which comprise the hypothesized structural model are:

$$\eta_1 = \gamma_{11}\ \xi_1 + \gamma_{12}\ \xi_2 + \gamma_{13}\ \xi_3 + \gamma_{14}\ \xi_4 + \zeta_1$$

$$\eta_2 = \gamma_{21}\ \xi_1 + \gamma_{22}\ \xi_2 + \gamma_{23}\ \xi_3 + \gamma_{24}\ \xi_4 - \beta_{21}\ \eta_1 + \zeta_2$$

where: η_1 = market's price reaction as measured by the cumulative abnormal return (CAR)

η_2 = market's volume reaction as measured by the cumulative abnormal volume (CAV)

ξ_1 = expectation error regarding the liquidity dimension

ξ_2 = expectation error regarding the leverage dimension

ξ_3 = expectation error regarding the profitability dimension

ξ_4 = expectation error regarding the activity dimension

γ = causal path coefficient between expectation error regarding the financial position dimension and the market's reaction measure

β = causal path coefficient between the market reaction measures

ζ_1 = prediction error of price reaction

ζ_2 = prediction error of volume reaction

Figure 2 is a diagram of the hypothesized structural model.

INSERT FIGURE 2

The total model hypothesized in this study is a combination of the measurement model and the related structural model. A diagram of the total model (measurement model and structural model) is presented in Figure 3.

INSERT FIGURE 3

The model can be summarized as follows:

$$\eta_1 = \gamma_{11} \xi_1 + \gamma_{12} \xi_2 + \gamma_{13} \xi_3 + \gamma_{14} \xi_4 + \gamma_1$$

$$\eta_2 = \gamma_{21} \xi_1 + \gamma_{22} \xi_2 + \gamma_{23} \xi_3 + \gamma_{24} \xi_4 - \beta_{21} \eta_1 + \xi_1$$

$$x_1 = \lambda_{11} \xi_1 + \delta_1 \qquad x_8 = \lambda_{32} \xi_3 + \delta_8$$

$$x_2 = \lambda_{12} \xi_1 + \delta_2 \qquad x_9 = \lambda_{33} \xi_3 + \delta_9$$

$$x_3 = \lambda_{13} \xi_1 + \delta_3 \qquad x_{10} = \lambda_{34} \xi_3 + \delta_{10}$$

$$x_4 = \lambda_{21} \xi_2 + \delta_4 \qquad x_{11} = \lambda_{41} \xi_4 + \delta_{11}$$

$$x_5 = \lambda_{22} \xi_2 + \delta_5 \qquad x_{12} = \lambda_{42} \xi_4 + \delta_{12}$$

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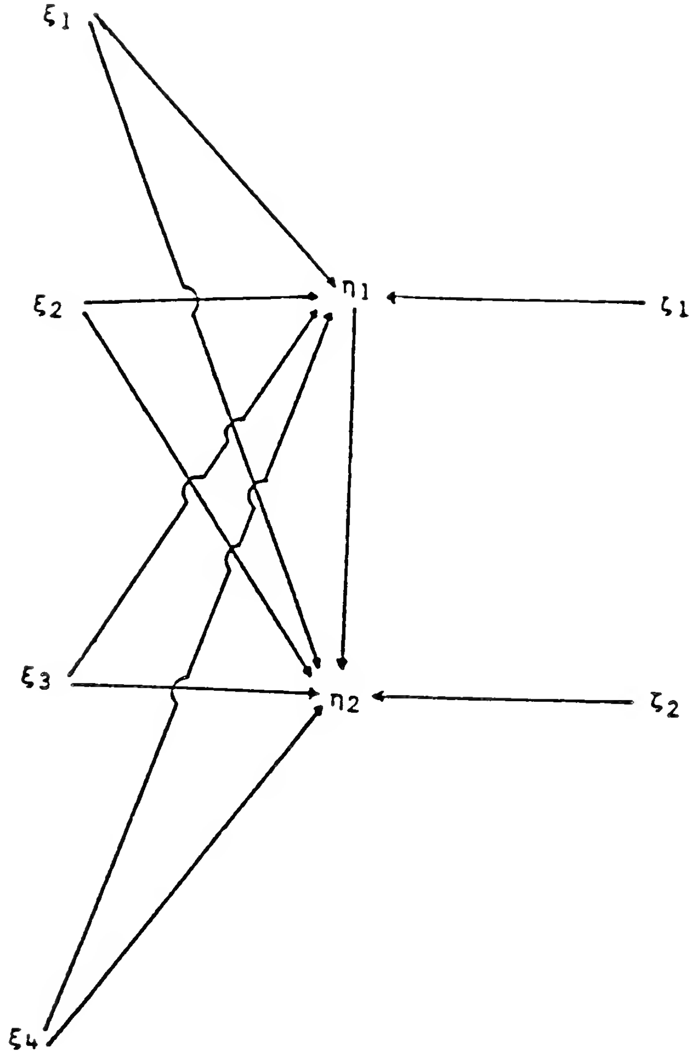

Figure 2. Hypothesized Structural Model

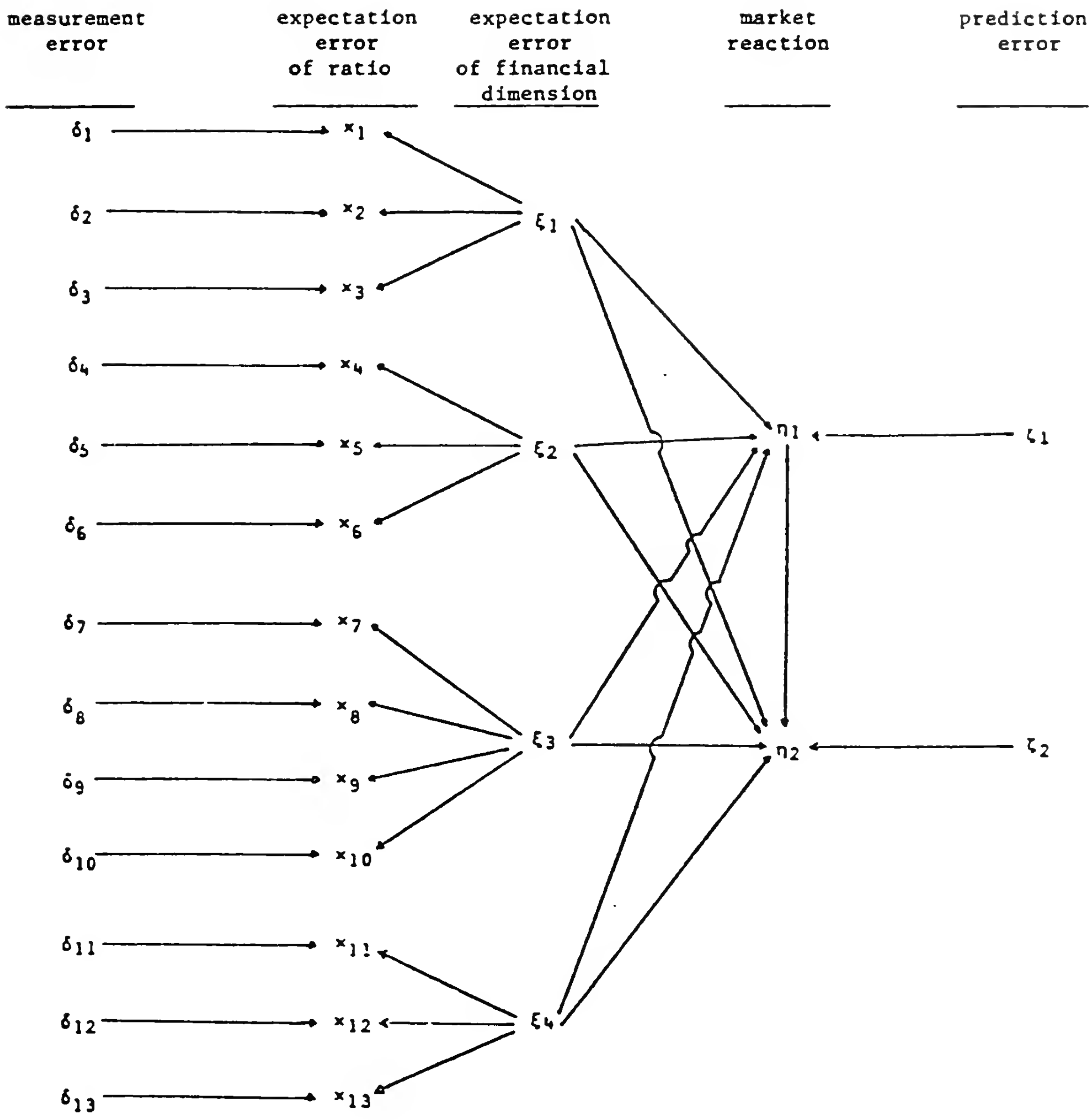

Figure 3. Total Hypothesized Model

The model hypothesizes that abnormal returns and abnormal trading volume are linked to unexpected changes in four financial dimensions which result from the issuance of annual accounting statements. Each of the unexpected changes in the financial dimensions is portrayed as being measured by unexpected changes in a group of financial ratios. The abnormal trading volume is also hypothesized to be driven by abnormal returns.

3.0 Statistical Techniques

All of the parameters of the model (both measurement and structural) are estimated simultaneously. However, to explain what is occurring, the estimation of the measurement model and the structural model will be described individually.

The measurement model is a factor analytic approach to the estimation of a set of underlying dimensions from the accounting ratios. The unexpected changes in the financial dimensions are estimated from the observed unexpected changes in the financial ratios which result from the issuance of the financial statements. A factor analysis is conducted on the unexpected changes in the financial ratios with the loadings of the variables constrained to certain dimensions. The expectation errors regarding the current ratio, quick ratio, and defensive interval are constrained to load on the liquidity dimension and are not allowed to load on any of the other three dimensions. Likewise, the accounting ratios hypothesized to be measures of other dimensions are constrained to load only on the dimension they are to measure. Using information regarding the theoretical measurement structure, the factor analysis is constrained to the hypothesized model configuration and the factor analysis is an oblique solution since the underlying dimensions are allowed to covary.

The structural model of the hypothesized configuration can be thought of as two regressions. The first regression relates abnormal returns to the unexpected changes in the four financial dimensions. The abnormal returns are regressed on the factor analytic derived underlying dimensions of the measurement model. The second regression relates abnormal trading volume to the unexpected changes in the underlying dimensions and the abnormal returns. This involves regressing abnormal trading volume on the unexpected changes in the financial dimensions and the abnormal returns modeled in the first regression. These regressions should be estimated simultaneously so that all effects, direct and indirect, can be considered in the parameter estimation.

The estimation of the model is accomplished using <u>LISREL</u>: <u>Analysis of Linear Structural Relationships by the Method of Maximum Likelihood</u> by Joreskog and Sorbom (1978). Appendix A contains a glossary and a description of the notation used in LISREL and adopted in this paper.

The hypothesized model of this project,

$$\eta_1 = \gamma_{11} \xi_1 + \gamma_{12} \xi_2 + \gamma_{13} \xi_3 + \gamma_{14} \xi_4 + \gamma_1$$
$$\eta_2 = \gamma_{21} \xi_1 + \gamma_{22} \xi_2 + \gamma_{23} \xi_3 + \gamma_{24} \xi_4 - \beta_{21} \eta_1 + \xi_1$$

$$x_1 = \lambda_{11} \xi_1 + \delta_1 \qquad x_8 = \lambda_{32} \xi_3 + \delta_8$$

$$x_2 = \lambda_{12} \xi_1 + \delta_2 \qquad x_9 = \lambda_{33} \xi_3 + \delta_9$$

$$x_3 = \lambda_{13} \xi_1 + \delta_3 \qquad x_{10} = \lambda_{34} \xi_3 + \delta_{10}$$

$$x_4 = \lambda_{21} \xi_2 + \delta_4 \qquad x_{11} = \lambda_{41} \xi_4 + \delta_{11}$$

$$x_5 = \lambda_{22} \xi_2 + \delta_5 \qquad x_{12} = \lambda_{42} \xi_4 + \delta_{12}$$

$$x_6 = \lambda_{23} \xi_2 + \delta_6 \qquad x_{13} = \lambda_{43} \xi_4 + \delta_{13}$$

$$x_7 = \lambda_{31} \xi_3 + \delta_7$$

is a specified form of the following general model (Joreskog and Sorbom, 1978, pp. 4-7)

$$\underline{\beta}\ \underline{\eta} = \underline{\Gamma}\ \underline{\xi} + \underline{\zeta} \qquad (1)$$

where: $\underline{\eta}$ (mxl) is a vector of the latent (underlying/unobservable) endogenous variables

$\underline{\xi}$ (nxl) is a vector of the latent (underlying/unobservable) exogenous variables

$\underline{\beta}$ (mxm) is the matrix of causal coefficients relating the endogenous variables to each other

$\underline{\Gamma}$ (mxn) is the matrix of causal coefficients relating the endogenous variables to the exogenous variables

$\underline{\zeta}$ (mxl) is a vector of random residuals or prediction errors

$$\underline{Y} = \underline{\Lambda}_y\ \underline{\eta} + \underline{\varepsilon} \qquad (2)$$

$$\underline{X} = \underline{\Lambda}_x\ \underline{\xi} + \underline{\delta} \qquad (3)$$

where: $\underline{Y}$ (pxl) are observations/indicators/measures of the latent endogenous variables $\underline{\eta}$

$\underline{X}$ (qxl) are observations/indicators/measures of the latent exogenous variables $\underline{\xi}$

$\underline{\Lambda}_y$ (pxm) is a matrix of regression coefficients of $\underline{Y}$ on $\underline{\eta}$

$\underline{\Lambda}_x$ (qxn) is a matrix of regression coefficients of $\underline{X}$ on $\underline{\xi}$

$\underline{\varepsilon}$ is a vector of measurement errors for $\underline{Y}$ as measures of $\underline{\eta}$

$\underline{\delta}$ is a vector of measurement errors for $\underline{X}$ as measures of $\underline{\xi}$

Let: $\underline{\Phi}$ (n x n) = covariance matrix of the exogenous variables, $\underline{\xi}$

$\underline{\Psi}$ (m x m) = covariance matrix of the prediction errors, $\underline{\zeta}$

$\underline{\Theta}_\varepsilon$ = covariance matrix of the measurement errors of the endogenous variables

$\underline{\Theta}_\delta$ = covariance matrix of the measurement errors of the exogenous variables

The variance-covariance matrix of the x and y variables created by the specified model is (Joreskog and Sorbom, 1978, p. 5):

$$\underline{\Sigma}\ ((p + q) \times (p + q)) =$$

$$\begin{bmatrix} \underline{\Lambda}_y (\underline{\beta}^{-1} \underline{\Gamma}\, \underline{\Phi}\, \underline{\Gamma}'\underline{\beta}'^{-1} + \underline{\beta}^{-1} \underline{\Psi}\, \underline{\beta}'^{-1}) \underline{\Lambda}'_y + \underline{\Theta}_\varepsilon & \underline{\Lambda}_y \underline{\beta}^{-1} \underline{\Gamma}\, \underline{\Phi}\, \underline{\Lambda}'_x \\ \underline{\Lambda}_x \underline{\Phi}\, \underline{\Gamma}'\underline{\beta}'^{-1} \underline{\Lambda}'_y & \underline{\Lambda}_x \underline{\Phi}\, \underline{\Lambda}'_x + \underline{\Theta}_\delta \end{bmatrix} \qquad (4)$$

The elements of the matrices, $\underline{\Lambda}_x$, $\underline{\Lambda}_y$, $\underline{\beta}$, $\underline{\Gamma}$, $\underline{\Phi}$, $\underline{\Psi}$, $\underline{\Theta}_\varepsilon$, and $\underline{\Theta}_\delta$ are specified according to the hypothesized model to be free, constrained, or fixed. The measurement model, equations (2) and (3), written in factor analytic form are:

$$\underline{Z} = \underline{\Lambda}\, \underline{f} + \underline{e}$$

$$\underline{Z} = (\underline{y}, \underline{x})$$

$$\underline{f} = (\underline{\eta}, \underline{\xi})$$

$$\underline{e} = (\underline{\varepsilon}, \underline{\delta})$$

$$\Lambda = \begin{bmatrix} \underline{\Lambda}_y & \underline{0} \\ \underline{0} & \underline{\Lambda}_x \end{bmatrix}$$

As such, the measurement model is a restricted factor analysis where the factors $\underline{\eta}$ and $\underline{\xi}$ satisfy a linear structural equation system of the following form:

$$\underline{\beta}\ \underline{\eta} = \underline{\Gamma}\ \underline{\xi} + \underline{\zeta}$$

Through specification of $\underline{\Phi}$ (the covariance matrix of the exogenous variables) to be full rank, an oblique solution is obtained. For additional references on the use of factor analytic techniques in structural equation modeling see Jackson and Borgotta (1981, pp. 179-281), Judge, Griffiths, Hill and Lee (1980, pp. 550-554), and Hanushek and Jackson (1977, pp. 302-324).

For estimation and testing of the model it is assumed that the distribution of the observed variables can be described by the first two moments, a mean vector and a variance-covariance matrix. The estimation process comprises fitting the covariance matrix constructed by the hypothesized model specifications ($\underline{\Sigma}$) to the observed covariance matrix ($\underline{S}$).

$$\underline{S}\ (p + q) \times (p + q) = \begin{bmatrix} \underline{S}_{yy}\ (p \times p) & \underline{S}_{yx}\ (p \times q) \\ \underline{S}_{xy}\ (q \times p) & \underline{S}_{xx}\ (q \times p) \end{bmatrix}$$

The fitting function employed,

$$F = \log |\underline{\Sigma}| + \mathrm{tr}\ (\underline{S}\ \underline{\Sigma}^{-1}) - \log |\underline{S}| - (p + q)$$

is minimized with respect to $\underline{K}$; where $\underline{K}$ is the set of free, constrained, or equivalent parameters designated by the hypothesized model structure. In minimizing the fitting function one minimizes the difference between the generalized variance of the model created covariance matrix and the generalized variance of the observed covariance matrix. Maximum likelihood estimates, efficient for large samples, result if the distribution of the observed variables (x and y) is multinormal (Joreskog and Sorbom, 1978, p. 3 and Hanushek and Jackson, 1977, pp. 314-316). The estimation procedure selects estimates of the parameters that minimize the F function by taking the derivatives of the F function, with regard to each parameter estimated, and solving this set of simultaneous equations for the values that equate the derivatives to zero.

Once the maximum likelihood estimates of the parameters have been obtained the hypothesized model can be tested for goodness of fit since the hypothesized model structure is over-identified. The total hypothesized model configuration is tested to determine its ability to create a covariance matrix ($\underline{\Sigma}$) that replicates the covariance matrix ($\underline{S}$) of the observed variables. Let H_o be the null hypothesis representing the total model as hypothesized. The alternative H_1 is that the created covariance matrix ($\underline{\Sigma}$) is any positive definite matrix. The test statistic NF_o is minus twice the logarithm of the likelihood ratio (where F_o is the minimum value of F and N is the sample size). NF_o is asymptotically distributed as χ^2 with degrees of freedom d {d = 1/2 [(p + q) * (p + q + 1) - t] where t is the total number of independent parameters estimated under H_o (Joreskog and Sorbom, 1978, p. 14)}. Appendix B contains a more complete discussion of the overall goodness of fit test.

4.0 Data Analysis

The firms included in the sample are calendar year firms (financial institutions and utilities are not included) listed on the New York Stock Exchange which announced annual earnings of 1979 during February, 1980. A sample of 204 firms meeting the following criteria is randomly chosen:

1. A firm must have complete requisite data on the CRSP monthly return data base for the period January 1, 1975 through March, 1980.

2. A firm must have complete requisite trading volume data on the Rapidquote data base for the period January, 1975 through March, 1980.

3. A firm must have complete requisite accounting data on the Compustat yearly data base for 1978 and 1979.

4. A firm must have filed third quarter, 1978 and 1979 10-Q reports with the Securities and Exchange Commission and the reports must be accessable at the Securities and Exchange Commission Reading Room in Chicago, Illinois.

Appendix C contains a list of the two hundred and four firms in the sample.

Hypotheses are tested using measures of the unexpected changes in the financial ratios and the two observed types of market reaction, abnormal returns and abnormal volume. The unexpected change in each of the financial ratios is the difference between the expectation of the ratio prior to the release of the accounting information and the realization of that ratio which results from the release of the accounting data. For the expectations of the 1979 year-end ratios, the market has realized the data contained in the quarterly earnings announcements and quarterly 10-Q reports for the first three quarters. Therefore, the expectations of the yearly accounting data used in this study is a composite of the actual quarterly results for the first three quarters of 1979 and an estimate of the fourth quarter. This estimate of the fourth quarter results for 1979 is a naive model based on the results of the fourth quarter of 1978. The expected year end value for 1979 is the sum of the results for the previous four quarters. The unexpected change in each financial ratio is the difference between the expected ratio for year end 1979 and the actual result.

The market reactions are computed by controlling for market-wide effects and are based on a four month test period, December 1979 through March 1980. This test period includes the earnings announcement in February and the public release of the audited financial statements by the end of March. A market model is estimated for each firm by regressing the security's monthly returns on the monthly returns of the market for 59 months, January 1975 through November 1979. The estimated parameters are used to predict the monthly returns for the four month test period and the abnormal return is computed as the difference between this predicted return and the actual observed return. The abnormal returns for each of the four months are summed to yield the cumulative abnormal return, CAR. The cumulative abnormal trading volume, CAV, is computed in a similar manner by regressing the monthly percentage of shares traded for each firm on the monthly percentage of shares traded by the market for the 59 months January 1975 through November 1979. The abnormal trading volume for each month is computed as the difference between the actual trading volume and the predicted trading volume based on the regression parameters. The abnormal trading volume for each month is cumulated for the four month test period to produce the cumulative abnormal volume, CAV.

Table 1 presents the lower left triangle of the correlation matrix for the variables used in this analysis.

INSERT TABLE 1

Appendix D provides the hypothesized model parameter specifications for the matrices of the LISREL model and each estimated parameter is numbered. The overall test of model fit, $\chi^2 = 443.3769$ with 77 degrees of freedom, implies a poor fit. However, Bentler and Bonett (1980) point out that the overall chi-square goodness of fit test for a comparison of a hypothesized model structure against a general alternative model structure is insufficient when the sample size or degrees of freedom are large. An alternative is to compare the hypothesized model structure against a null model that specifies independence among all the variables. The null measurement model specifies no common factors by setting all the factor loadings equal to zero. The null structural model sets to zero the links between the market reactions and the unexpected changes in the financial dimensions. It also provides no interdependence between cumulative abnormal returns and cumulative abnormal volume.

The χ^2 value for the null model is 1312.9024 with 105 degrees of freedom. Let C_1 represent the hypothesized model structure and C_0 the null model. The test of model equivalence can be tested by comparing the observed χ^2 values for the two models since the difference in the

Table 1. Lower Left Triangle of the Correlation Matrix of the Variables of Analysis

	Market Reactions		Liquidity			Leverage			Profitability				Activity		
	Y_1	Y_2	X_1	X_2'	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}
Y_1	1.000														
Y_2	.402	1.000													
X_1	-.129	-.110	1.000												
X_2	-.058	-.051	.844	1.000											
X_3	.137	.104	.045	.253	1.000										
X_4	.110	.084	-.323	-.181	.222	1.000									
X_5	-.071	-.050	.314	.315	.008	.465	1.000								
X_6	.027	.127	.101	.060	.089	-.077	-.007	1.000							
X_7	.130	.061	-.040	-.083	-.075	-.242	-.102	.207	1.000						
X_8	.133	.110	-.147	-.201	.081	-.117	-.125	.069	.795	1.000					
X_9	.223	.260	-.034	-.012	-.009	-.099	-.224	.133	.581	.497	1.000				
X_{10}	-.004	-.001	-.057	-.069	-.042	-.114	-.035	.055	.581	.446	.295	1.000			
X_{11}	-.077	-.069	.090	-.001	-.661	-.084	.049	.006	.171	-.085	.094	.090	1.000		
X_{12}	-.051	-.091	.052	-.098	-.216	-.109	.042	-.008	.284	.100	.144	.109	.323	1.000	
X_{13}	-.044	.002	.087	.206	-.181	-.065	.046	-.079	.086	-.156	.046	-.040	.478	.170	1.000

χ^2 values of the two models is asymptotically distributed as a chi-square variate with degrees of freedom equal to the difference in the number of parameters estimated for each of the two models. Since the χ^2 for C_0 is 1312.9024 (d.f. = 105) and the χ^2 for C_1 is 443.3769 (d.f. = 77) the χ^2 variate for the test of model equivalence is 869.5255 with 28 degrees of freedom. The hypothesis of model equivalence between the null and hypothesized configurations is rejected at the α = .001 level.

A measure of the explanatory power of the hypothesized model configuration can be computed (Bentler and Bonett, 1980). This fit index provides a measure of the proportion of the generalized variance in the observed data matrix explained by the hypothesized model structure. The normed fit index is computed as:

$$\Delta_{C_0 C_1} = \left[\frac{\chi^2_{C_0}}{N} - \frac{\chi^2_{C_0}}{N} \right] \div \left[\frac{\chi^2_{C_0}}{N} \right] = .66$$

since χ^2 = [(-2 logarithm of the likelihood ratio) - NF] where N is sample size and F is the minimum fit.

The hypothesized model configuration is a significant improvement over the null model since it recreates 66% of the generalized variance for the observed data matrix. This implies that only 34% of the generalized variance is not explained by the hypothesized model configuration.

The Full Information Maximum Likelihood (FIML) estimates and the corresponding t-values for the parameters of the hypothesized model configuration are presented in Table 2.

INSERT TABLE 2

Table 2. Parameter Estimates and t-Statistics

Parameter		Estimate	t-Statistic
1	(λ_{11})	1.007	17.146
2	(λ_{12})	.838	13.349
3	(λ_{13})	.038	.545
4	(λ_{24})	.072	.121
5	(λ_{25})	9.362	.122
6	(λ_{26})	-.003	-.117
7	(λ_{37})	1.051	19.493
8	(λ_{38})	.755	12.106
9	(λ_{39})	.540	8.268
10	($\lambda_{3\ 10}$)	.550	8.431
11	($\lambda_{4\ 11}$)	.806	8.129
12	($\lambda_{4\ 12}$)	.413	4.981
13	($\lambda_{4\ 13}$)	.569	6.519
14	(β_{21})	-.392	-5.917
15	(γ_{11})	-.114	-1.611
16	(γ_{12})	-.008	-.120
17	(γ_{13})	.143	2.034
18	(γ_{14})	-.122	-1.385
19	(γ_{21})	-.056	-.850
20	(γ_{22})	-.001	-.108
21	(γ_{23})	-.006	-.096
22	(γ_{24})	-.034	-.415
23	($\sigma_{\xi_1 \xi_2}$)	.057	.121

Table 2. continued

Parameter	Estimate	t-Statistic
24 $(\sigma_{\xi_1 \xi_3})$	-.007	-.112
25 $(\sigma_{\xi_2 \xi_3})$	.010	.121
26 $(\sigma_{\xi_1 \xi_4})$	.122	1.483
27 $(\sigma_{\xi_2 \xi_4})$	.016	.121
28 $(\sigma_{\xi_3 \xi_4})$	.289	3.851
29 $(\sigma^2 \zeta_1)$	.958	9.938
30 $(\sigma^2 \zeta_1)$	.834	9.970
31 $(\sigma^2 \delta_1)$	-.015	-.236
32 $(\sigma^2 \delta_2)$	.298	5.647
33 $(\sigma^2 \delta_3)$	.999	9.975
34 $(\sigma^2 \delta_4)$	.997	7.573
35 $(\sigma^2 \delta_5)$	-86.366	-.060
36 $(\sigma^2 \delta_6)$	1.000	9.975
37 $(\sigma^2 \delta_7)$	-.104	-1.897
38 $(\sigma^2 \delta_8)$	.430	8.546
39 $(\sigma^2 \delta_9)$	.708	10.005
40 $(\sigma^2 \delta_{10})$	.697	9.985
41 $(\sigma^2 \delta_{11})$	.351	2.621
42 $(\sigma^2 \delta_{12})$	.830	9.017
43 $(\sigma^2 \delta_{13})$	.677	7.135

An analysis of the individual estimates for the hypothesized model parameters indicates some problems with the hypothesized measurement model configuration. The unexpected changes in the current ratio and the quick ratio load significantly ($\alpha < .01$ and $\alpha < .01$, respectively) on the unexpected change in the liquidity dimension but the factor loading of the defensive interval is insignificant ($\alpha > .50$). None of the measures of the unexpected change in the leverage dimension significantly load ($t = .121$, $t = .122$, and $t = -.117$). The measures of the unexpected change in the profitability dimension load significantly with significance levels of .01, .01, .01, and .01. The factor loadings of the measures of the unexpected change in activity are also significant at levels of .01, .01, and .01.

The links between the unexpected changes in the financial dimensions and the abnormal returns provide mixed results. Only the profitability dimension link is highly significant ($\alpha < .05$) while the liquidity and activity dimension links are somewhat significant ($\alpha < .15$ and $\alpha < .20$, respectively) for a two-tailed test. The unexpected change in the leverage dimension seems to have no impact on abnormal returns.

None of the direct links between the unexpected changes in the financial dimensions and abnormal trading volume are significant at a reasonable level. However, the link relating abnormal volume to abnormal returns is highly significant ($\alpha < .005$) in the expected direction (the negative sign of the estimated coefficient and the negative sign of the parameter in the model equal a positive relationship). Abnormal trading volume is positively linked to abnormal returns. Given this relationship the unexpected changes in the financial dimensions impact abnormal trading volume only via an indirect path through abnormal returns.

Conclusions and Implications

A model linking unexpected changes in accounting variables is hypothesized, estimated, and tested using structural equation modeling techniques. Four financial dimensions are hypothesized and the observable ratios are constrained to load on the dimensions they are expected to measure. The results indicate that the hypothesized model configuration explains 66% of the generalized variance in the variance-covariance matrix of the observed variables. This approach demonstrates the usefulness of hypothesizing a measurement model to aggregate accounting information into four basic financial dimensions. Also, this study simultaneously models both price and volume reactions to the issuance of accounting data. This allows assessment of both direct and indirect links between the unexpected changes in the financial dimensions and the market reactions.

An analysis of the individual model coefficients indicates that the impact of the issuance of accounting data is portrayed in the market price reactions with the volume reactions being linked only to the price reactions. Only the unexpected change in the profitability dimension is found to impact the price reaction at a reasonably significant level. The liquidity and activity dimension links are only slightly significant. Given the highly significant coefficient between the volume reaction and the price reaction, and the significant links only between the unexpected changes in the financial dimensions and the price reaction, this study suggests that the trading volume reaction may be just an indirect artifact resulting from the impact of the accounting information on prices.

Additional modeling efforts are warranted to determine the degree of reciprocality between the price and volume reactions. Further research should investigate the causal relationships existing between the two types of market reactions. In studies involving numerous accounting data items, the use of a measurement model is warranted when multicollinearity is expected. Instead of trying to eliminate the collinearity among the accounting variables, a measurement model approach uses the collinearity among the variables to estimate an underlying construct as the source of systematic covariation.

Replication of this study using alternative expectation models to determine the unexpected changes in the accounting ratios could ascertain the extent to which the results of this study are dependent on the expectation model employed. In addition, replication on a different set of firms and a different time period would enhance the generalizability of the results.

References

Beaver, W. "The Information Content of Annual Earnings Announcements" Empirical Research in Accounting: Selected Studies 1968 supplement to the Journal of Accounting Research (1968) pp. 67-92.

______. Financial Reporting: An Accounting Revolution (Prentice-Hall, 1981a).

Bentler, P. M. and Bonett, D. G. "Significance Tests and Goodness of Fit in the Analysis of Covariance Structure" Psychological Bulletin (1980, Volume 68 No. 3) pp. 588-606.

Foster, G. Financial Statement Analysis (Prentice-Hall, 1978).

Hanushek, E. A. and Jackson, J. E. Statistical Methods for Social Scientists (Academic Press, 1977).

Heise, D. R. Causal Analysis (John Wiley & Sons, 1975).

Jackson, D. J. and Borgatta, E. F. Factor Analysis and Measurement in Sociological Research (Sage Publications, 1981).

Joreskog, K. G. and Sorbom, D. LISREL IV - Analysis of Linear Structural Relationships by the Method of Maximum Likelihood (National Education Resources, Inc., 1978).

Judge, G., Griffiths, W., Hill, R., and Lee, T. The Theory and Practice of Econometrics (John Wiley & Sons, 1980) pp. 550-555, 785.

Kiger, J. E. "An Empirical Investigation of NYSE Volume and Price Reactions to the Announcement of Quarterly Earnings" Journal of Accounting Research (Spring 1972) pp. 113-128.

Lev, B. Financial Statement Analysis (Prentice-Hall, Inc., 1974).

Mock, T. E. Measurement and Accounting Information Criteria - Studies in Accounting Research #13 (American Accounting Association, 1976).

Ohlson, J. A. "Risk, Return, Security-Valuation and the Stochastic Behavior of Accounting Numbers" Journal of Financial and Quantitative Analysis (June 1979) pp. 317-336.

Van Horne, J. C. Financial Management and Policy (Prentice-Hall, Inc., 1980).

Verrecchia, R. E. "On the Relationship Between Volume Reaction and Consensus of Investors: Implications for Interpreting Tests of Information Content" Journal of Accounting Research (Spring 1981) pp. 271-283.

Weston, J. F. and Brigham, E. F. Managerial Finance (The Dryden Press, 1972).

Appendix A

LISREL terminology

Types of Variables

η (eta)	Dependent (endogenous) variable: true (i.e., unobserved)
ξ (xi)	Independent (exogenous) variable: true (i.e., unobserved)
y	Indicator of dependent variable (observed)
x	Indicator of independent variable (observed)
ε	Measurement error in observed dependent variable
δ	Measurement error in observed independent variable
ζ	Sources of variance in η not included among the ξ's

Counts

m	Number of true dependent variables
n	Number of true independent variables
p	Number of observed dependent variables
q	Number of observed independent variables

Data-oriented Matrices

$\underline{S}$	(p+q x p+q), Variance-covariance matrix among the observed independent and dependent variables (or correlation matrix)
$\underline{\Sigma}$ (sigma)	(p+q x p+q), Model-generated estimates of variances and covariances among observed independent and dependent variables

Basic Parameter Matrices

$\underline{\Lambda}_y$ (lambda)	(p x m), Matrix of regression coefficients (λ's) relating true dependent variables to observed dependent variables
$\underline{\Lambda}_x$ (lambda)	(q x n), Matrix of regression coefficients (λ's) relating true independent variables to observed independent variables

$\underline{B}$ (beta)	(m x m), Matrix of regression coefficients interrelating true dependent variables
$\underline{\Gamma}$ (gamma)	(m x n), Matrix of regression coefficients (γ's) relating true independent variables to true dependent variables; indicates direct effect
$\underline{\Phi}$ (phi)	(n x n), Variance-covariance matrix among true independent variables (or correlation matrix)
$\underline{\Psi}$ (psi)	(m x m), Variance-covariance matrix among zeta variables (or correlation matrix)
$\underline{\Theta}_{\epsilon}$ (theta)	(p x p), Variance-covariance matrix among epsilon variables (or correlation matrix)
$\underline{\Theta}_{\delta}$ (theta)	(q x q), Variance-covariance matrix among delta variables (or correlation matrix)

Supplementary Parameter Matrices

$\underline{C}$	(m x m), Variance-covariance matrix among true dependent variables
$\underline{D}$	(m x n), Matrix of regression coefficients for reduced form of structural equations--i.e., coefficients which relate each true dependent variables to true independent variables, giving direct and indirect effects combined

Appendix B

χ^2 test in the analysis of covariance structures (Bentler and Bonett, 1980)

Let M_k be a more restrictive model than M_t. In general, the function $L(\Theta)$ is related to the logarithm of the likelihood function of the observations via

$$L^*(\Theta) = -n\,L(\Theta)/2 + c$$

where c is independent of Θ. (See Joreskog: Psychometrica, 1967, 32, 443-482).

Let $L^*(\Theta_k)$ be the maximum of $L^*(\Theta)$ under M_k; let $L^*(\Theta_t)$ be the maximum of $L^*(\Theta)$ under M_t. Thus

$$L^*(\Theta_k) \leq L^*(\Theta_t)$$

since the maximum under a space of restricted range cannot exceed the maximum under a space of less restricted range.

Consequently,

$$\log \lambda = L^*(\Theta_k) - L^*(\Theta_t)$$

is negative, with $0 < \lambda \leq 1$.

To test the null hypothesis of model equivalence (H_o: $\Theta_k = \Theta_t$), ($-2 \log \lambda$) is asymptotically distributed as a chi square variate. The degrees of freedom is the difference in the number of parameters estimated under M_t and M_k. This test is a test of the equality of the parameters under the two models. Since the free parameters in Θ_k are a subset of the free parameters in Θ_t, various applications of the test can be constructed.

The null hypothesis associated with model comparisons has an alternative form. The alternative is that the covariance matrices generated by the parameter vectors are equivalent under the M_k and M_t structural models. The significance test is the same as previously described.

Appendix C

Sample Firms

ACF Industries
Alaska Interstate
Alpha Portland
Allen Group
Amax
Amerada Hess
American Cyanamid
American District Telephone
American Water Works
AMETEX
AMF
Ampco Pittsburgh
Armada Corp.
Asarco
Avon
Ball Corp
Baxnes Group
Becker Industries
Bell & Howell
Bemis
B.F. Goodrich
Big Three Inds.
Blair, John
Bliss Laughlin
Boeing
Borg Warner
Baxter Travenol Labs.
Braniff
Brockway Glass
Brunswick
Burndy
Codence Industries
Carlisle
Callahan Mining
Capital Cities Communications
CBS
Charter
Cheseborough Pond
Chrysler
Cluett Peabody
Coca Cola, NY
Colgate Palmolive
Combustion Engineering
Conrac
Continental Group
Conwood
Cooper Industries
Cordura
CPC Industries
Crouse Hinds
Crown Cork and Seal
Cummins
Curtis Wright
Dennison Dentsply
DeSoto
Dexter
Diamond International
Drehold
DiGiorgio
Donnelly
Dorsey
Dow Chemicals
Eaton
Easco
EG&G
Emhart
Fairchild Industries
Federal Mogul
Federal Signal
Fieldcrest Mills
Fischer Scientific
FMC
Ford Motor
Fort Howard Paper
Foster Wheeler
Fruehauf
GATX
Gateway Industries
General Dynamics
General Motors
Genearl Signal
Genstar
G.F. Business Equipment
Giddings Lewis
Gifford Hill
Gillette
Ginas
Gleason Works
Goodyear Tire
Greyhound
Grumman
Gulf Research and Chemical
Hanna Mining
Harcourt Brace & Jovanovich
Hazeltine
Heileman Brewing
Hershey
Hesston
Homestake Mining
Host

Hospital Corp. of America
Hudson Bay Mining
I.C. Industries
Illinois Tool Works
Inexco Oil
Ingredient Technology
International Flavors
I.U. International Corp.
Johnson & Johnson
Jorgensen, Earle
Kane Miller
Kellogg
Kerr McGee
Kennecott Copper
Knight Ridder
Lamson Sessions
Lenox Lilly, Eli
Lionel
LTV Corp.
Lynch Communications
Masco
McNeil Corp.
MEI Corp.
Melville
Mesta Machine
Mirro
Mohasco
Mohawk Rubber
Monarch Machine Tool
Moore McCormack
Morrison Knudson
Munsingwear
Myers
Nashua
National Can
National City Lines
National Gypsum
North American Coal
North American Phillips
Northrop
Norton
Nucor
Oak Industries
Oakite Products
Occidental Petroleum
Ogden
Phelps Dodge
Pitney Bowes
Porter
Potlatch
Reichhold Chemical
Revere Copper & Brass
Revlon
Robertson, H.H.
Robins, A.H.
Rubbermaid
Ryder System
Saint Joe Minerals
Schaefer, F.M.
Scheving Plough
Schlitz
Sealed Power
Searle, G.D.
Sherwin Williams
Signal
Signode
Simmonds Precision
Smith International
Southland
Southwest Industries
SPS Technologies
Standard Brands
Stanley Works
Stone Container
Sun Chemical
Sunstrand
Swank
Sybron
Teleprompter
Thiokol
Thomas & Betts
Thomas Industries
Time, Inc.
Times Mirror
Transway International
TRW
Tyler Corp.
UMC Industries
United Refining
United Technologies
Upjohn
U.S. Industries
VF Corporation
Wallace Murray
Warner Communications
Warner Lambert
Wayne Gossard
Wean Limited
Wheelabrator Frye
Whirlpool
White Motor
Witco Chemical
Wrigley
WR Grace

Appendix D

Parameter specifications for hypothesized model

$\underline{\Lambda}_x$

	ξ_1	ξ_2	ξ_3	ξ_4
x_1	1	0	0	0
x_2	2	0	0	0
x_3	3	0	0	0
x_4	0	4	0	0
x_5	0	5	0	0
x_6	0	6	0	0
x_7	0	0	7	0
x_8	0	0	8	0
x_9	0	0	9	0
x_{10}	0	0	10	0
x_{11}	0	0	0	11
x_{12}	0	0	0	12
x_{13}	0	0	0	13

$\underline{B}$

$$\begin{bmatrix} 0 & 0 \\ 14 & 0 \end{bmatrix}$$

$\underline{\Gamma}$

$$\begin{bmatrix} 15 & 16 & 17 & 18 \\ 19 & 20 & 21 & 22 \end{bmatrix}$$

$\underline{\Phi}$

	ξ_1	ξ_2	ξ_3	ξ_4
ξ_1	0			
ξ_2	23	0		
ξ_3	24	25	0	
ξ_4	26	27	28	0

$\underline{\Psi}$

	29	
	0	30

$\underline{\Theta}_\delta$

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}
x_1	31												
x_2	0	32											
x_3	0	0	33										
x_4	0	0	0	34									
x_5	0	0	0	0	35								
x_6	0	0	0	0	0	36							
x_7	0	0	0	0	0	0	37						
x_8	0	0	0	0	0	0	0	38					
x_9	0	0	0	0	0	0	0	0	39				
x_{10}	0	0	0	0	0	0	0	0	0	40			
x_{11}	0	0	0	0	0	0	0	0	0	0	41		
x_{12}	0	0	0	0	0	0	0	0	0	0	0	42	
x_{13}	0	0	0	0	0	0	0	0	0	0	0	0	43