Faculty Working Papers

CONTRIBUTIONS OF QUARTERLY TIME SERIES COMPONENTS ANALYSIS TO CORPORATE FINANCE THEORY AND PLANNING

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Summary

Decomposing quarterly time series accounting data into seasonal, trend-cycle and irregular components provides unique insight concerning the future direction of corporate finance and planning models. The transitory and permanent components of the data change dramatically over a four quarter period. The change in the composition of the data highlights the problem of short-run financial forecasting and demonstrates the need for a new level of corporate finance theory. This theoretical development would be devoted to intermediate-term financial planning and take into account time and firm effects.

CONTRIBUTIONS OF QUARTERLY TIME SERIES COMPONENTS ANALYSES TO CORPORATE FINANCE THEORY AND PLANNING

There is a substantial gap between the academic theory of corporate finance and the current practice of financial management at the corporate level. Two leading theoretical developments in corporate finance--the Modigliani and Miller (M&M) theory on capital structure and dividend policy [27, 28, 29, 30] and the capital asset pricing model (CAPM) [2, 22, 23, 31, 36, 37, 39]--have focused on strategic decisions related to investment and long-run financing. These models have assumed financial markets operate in a state of static equilibrium with perfect competition and that a few variables provide the necessary information for long-run financial planning. Although these theories have been seriously criticized, they have provided a foundation for a rigorous conceptual development of corporate finance theory. However, conversations with corporate finance executives reveals they also have short- and intermediate-term financial planning tasks that are of primary importance in the accomplishment of overall corporate objectives.

One of these tasks is planning to meet corporate liquidity needs through the management of short-run cash inflows and outflows. A second major task involves preparing an intermediate-term financial forecast for a 12 to 24 month time period. These plans are prepared on a monthly or quarterly basis. The objectives of the intermediate-term financial forecast are to integrate marketing, production and purchasing plans into a total financial plan of the firm and to create flexible financial plans that will accomodate unexpected cash flow shortfalls.

In designing financial planning models Carlton [6], Francis and Rowell [7], Gentry and Phyrr [14], Gentry [15], Krouse [17], Myers and Pogue [33], Warren and Shelton [40, 41], and Carter [7] assumed a long-run time horizon which encompasses the cash flow stream related to investment and financing decision. Annual data are used as the basic input for each of these planning models. Although long-run financial planning models have provided substantive insight, they do not provide management the tools for intermediate-term planning and diagnosis. In the preparation of intermediate-term financial forecasts and plans, long-term trends of annual data are of limited value. There are many seasonal, trend-cycle and irregular forces at work in the short-run that create instability in financial and economic variables. There is a need to design an intermediate-term model that utilizes quarterly time series data that will capture the trend-cyclical, seasonal and irregular components in short-run financial plans.

In developing a theory that focuses on the intermediate time horizon and encompasses the dynamics of the process, theorists have been searching for a semi-quantitative approach that allows qualitative inputs. The ideal system would correctly integrate the key variables that are interacting over time in an uncertain environment and are experiencing continuous change. To bridge the gap between theory and practice there is a need for a statistical methodology that captures the similarity between accounting measures of income and the concept of economic profit.

The objectives sf this article are to review briefly the dimension of time horizon as it relates to portfolio theory and financial planning models; to develop the linkage between accounting profit measures and economic profit; to present the theory of the X-11 Model and develop the methodology for measuring the relative contribution of seasonal (S), trend-cycle (C), and irregular (I) components to changes in an original time series of quarterly balance sheet and income statement variables; to analyze and interpret the results of the X-11 empirical findings; and to provide a series of contributions emanating from the analysis.

TIME HORIZON

Time horizon is a complex problem for portfolio management and corporate financial management and planning. Traditional finance theories of M&M and CAPM have left the time horizon planning problem undefined as indicated by several authors, e.g., Jensen [16], Black [2] and Merton [25]. In expanding on this time horizon quandary of a portfolio manager, Merton suggested three time horizons: decision, planning and observation [26]. However, the decision or planning horizon of a portfolio manager does not necessarily equal the length of the observation horizon, e.g., daily, weekly, monthly, quarterly or annual. In portfolio decision making these calendar measurement units are used to replace the true investment decision horizon. The problem associated with this calendar issue has been extensively examined by Jensen [16], Cheng and Deets [9] and Lee [18]. In portfolio theory the time horizon problem is unresolved.

Although corporate financial planning models have relied on annual data, management has available monthly and quarterly financial information for corporate financial planning. However, the degree of stationarity of monthly or quarterly data is smaller than that of annual data. Therefore, it is useful to analyze the contributions of time series components of quarterly data to financial theory and planning. In 1972 Fama [11] developed the concept of components of investment performance. One component was classified as manager's timing, which is one part of investor's risk [11, p. 458-459]. The time series components of quarterly data developed in this paper will provide some complementary empirical information concerning managers timing from a corporate finance perspective.

RELATIONSHIP BETWEEN ACCOUNTING AND MARKET INFORMATION

Theoretically, market information should be used in determining the value of a firm, performing financial analysis, and planning and decision making. However, accounting information is generally used as a proxy for market information in financial analysis, planning and decision making. Therefore, analyzing the components of a quarterly time series of accounting information can be as insightful to management as market information. It is well-known that accounting information generally contains a major portion of market information. Therefore, accounting information is a respectable proxy for market information in quantitative financial analysis and planning. It should be realized that proxy errors exist when accounting information is used to replace the market information. By using the errors-in-variables (proxy errors) concept the relationship between market and accounting information can be specified as

$$\tilde{A}_t = \tau + \tilde{\mu}_t + \tilde{v}_t \tag{1}$$

where $\tilde{A}_t$ is accounting information in period t; τ is a constant measurement error associated with $\tilde{A}_t$; $\tilde{\mu}_t$ is the market information in period t; and $\tilde{v}_t$ is a random measurement error associated with $\tilde{A}_t$. $\tilde{v}_t$ is normally distributed with mean zero and variance σ_v^2. Scapens [35], Ohlson [19] and others have mathematically and theoretically shown that accounting earnings can be used as a proxy of economic (or market) profit. Lee and Primeaux [19] and Brown, et. al. [5] have proposed econometric methods to reduce (or remove) the random measurement errors, $\tilde{v}_t$. The technique used is similar to Friedman's permanent income hypothesis [13] and involves the decomposition of current income into permanent and transitory components.

The leverage ratio in terms of accounting information has been used extensively to replace the leverage ratio in terms of market information in financial analysis. The main reason for using an accounting leverage ratio instead of a market leverage ratio is that market information for both assets and debt is difficult to obtain. In the context of evaluating the market value of a firm, M&M [30] have used current earning as a proxy to replace expected earnings. An instrumentable variable approach is used to remove the random errors as defined in equation (1). The instrumentable variable method was used by M&M to remove the transitory component of annual accounting data. From the concept of time-series analysis the transitory segment of annual data is called the irregular component; the transitory component of quarterly data can be further classified into seasonal and irregular components. It is well-know that the X-11 program can be used to remove the seasonal and the irregular components from either quarterly or monthly data [3, 38]. In the following section the X-11 method is discussed.

X-11 MODEL AND ITS APPLICATIONS

Chambers, et. al. [8] have argued that the X-11 routine of the Bureau of the Census is an extremely effective tool for analyzing historical time series data to determine seasonal adjustment and growth trends. The X-11 program provides detailed information on three alternative components as defined in equations (2A) and (2B).

$$O = S + C + I \tag{2A}$$

$$O = S \cdot C \cdot I \tag{2B}$$

where O, S, C and I represent the original series and the seasonal, trend-cycle and irregular factors, respectively. (2A) represents an additive time series relationship among components and (2B) reflects a multiplicative relationship. Based upon the program developed by Shiskin, et. al., [38], the final C, I, and S can be obtained. In addition, the seasonal adjusted series can also be calculated. The X-11 program also supplies the relative contribution of the S, C and I components to the percentage changes in a monthly or quarterly time series. An explanation of the computation of the relative contribution of each component for each time span is presented in Appendix I.

The C component represents a more permanent type of information in the time series, while S and I, reflect a temporary or transitory phenomenon present in the data. Based upon the relationship between economic profit and accounting profit, that was developed in previous section, the C component of accounting profits can be regarded as economic profits. Therefore, the C component provides management, investors and regulatory agencies better information for decision making than the original accounting profit series. The relative contribution of the C component of accounting profits from different firms provides an opportunity to investigate empirically if a company's quarterly accounting variable serves as a good proxy of an economic variable.

EMPIRICAL ANALYSES

Although there are many reasons corporate finance theory has focused on long-run planning strategies, one technical reason is the stability and the availability of annual accounting data. Smoothed accounting data have provided the basis for testing financial theories that are related to the economic profitability of the firm. Theorists have not used audited quarterly balance sheet data because they are not available in large data systems. Furthermore, quarterly balance sheet and income statement data are frequently quite erratic. The instability of a company's quarterly financial statements reflects the effects of seasonal and random events on its cash inflows and outflows. Theoretical relationships among operating financial variables have not been developed because seasonal and random occurrences cloud the interpretation of the economic contribution of the accounting data. The X-11 routine provides a tool for clarifying the basis of the economic contribution of key financial variables through the measurement of the relative contributions of the (S), (C) and (I) components to percentage changes in the original times series of specific financial variables. If the relative contribution of the S, C and I components are reasonably stable in a cross-section of periods for key financial variables, there is an opportunity to develop a new level of corporate finance theory. The focus of a new theoretical level would be on a cross-sectional relationship among key variables involved in intermediate-term financial planning.

Objectives

The objectives of the empirical study are to analyze the stability of the relative contribution of S, C and I components for . . .

1. key financial variables over a one, two, three and four quarter time span;

2. a set of income statement variables and a set of working capital variables;

3. a set of income statement variables for a cross-section of quarters over several years and a set of working capital variables for a cross-section of quarters.

Data and Methodology

The study utilizes quarterly data from two separate sources. First, sales, operating income, depreciation, earnings-before-interest and taxes (EBIT) and net income were selected from the industrial Compustat files for 68 companies that had continuous data for all five variables for the period 1970-1978. Another data file contained 21 companies with continuous data for all five variables for the period 1962-1978. All 21 companies were included in the set of 68 companies.

The second data source had both balance sheet and income statement data for nine large industrial companies. The data were collected for the period IQ 1969 to IVQ 1977. In acquiring these data, 200 large and intermediate size companies were asked to send complete quarterly financial statements. There were 32 companies that provided the requested information. However, the data for 23 companies were incomplete. The nine companies included in the study are: Amsted, Caterpillar, Eastman Kodak, Ford, General Motors, Georgia Pacific, International Paper, Monsanto and Proctor and Gamble. Substantial effort was involved in verifying and testing the accuracy of these quarterly data.

One- and two-way analyses of variance tests were used to test the proposed hypotheses. The results are reported in the following section.

<u>Time Dimension</u>

The distributions of the relative contribution of the I, C and S components for the five income statement variables are presented in Exhibits 1 and 2. The mean and standard deviation (S.D.) of each variable for the 68 companies and the 21 companies are presented in Exhibits 1 and 2, respectively. The mean and S.D. of the relative contributions are reported according to quarterly times spans that cover one, two, three and four quarters.

A brief explanation will aid in the interpretation of the data reported in Exhibit 1. The average relative contributions of the I, C and S components for each time span equal 100 percent. For example, the mean relative contribution of the I, C and S components for sales in a one quarter time span are 17.71, 32.42 and 49.87 percent, respectively. The respective standard deviations are $\pm$ 11.82, $\pm$ 18.76 and $\pm$ 22.76 percent. For a time span of three quarters the means of the three components for sales are 4.35, 72.65 an 23.00 percent, and the

S.D.'s are plus or minus 3.94, 20.09 and 19.58 percent respectively. The data in Exhibit 2 follow the same format.

In Exhibits 1 and 2 the means and standard deviations of the relative contributions of each component have unique and stable patterns for each time span. The relative contribution of the seasonal components are always highest in a one-quarter time span for all five of the income statement variables. The seasonal component accounts for 40 to 50 percent of the percentage changes in sales, operating income, EBIT and net income, and 30-37 percent of the percentage change in depreciation. For a two-quarter time span the relative contribution of the seasonal component declines to a range of 23-40 percent and for a three-quarter time span it ranges from 20-33 percent. The seasonal component is equal to zero in a four-quarter time period. Therefore, the annual data does not contain seasonal information.

The relative contribution of the trend-cycle component increases with the length of the time span. The mean of the trend-cycle accounts for 20 to 32 percent of the total contribution in a one-quarter time span and it represents 83 to 95 percent of the total when all four quarters are included. In general, the mean relative contribution of the trend-cycle component is consistently larger than the I and S components for time spans of two, three and four quarters.

The pattern of the relative contribution of the irregular component oscillates over the length of the time spans. With the exception of the one quarter time span, the contribution of the I component is always smaller than the means of S and C. There is a significant drop in the relative information of the I component in one, two and three quarter time spans and a slight increase when all four quarters are included. Finally, the mean relative contribution of the irregular component varies widely among the five variables, e.g., it is high for depreciation and net income and low for sales. These findings imply that both depreciation and net income have been generally subject to more artificial manipulation, i.e., depreciation is subject to the change of depreciation methods and the net income is subject to the change of operating and financing policies. A one-way analysis of variance test examined the stability of the S, C and I components of the five income statement variables across the four time periods. In every ANOV test the F-ratio was statistically significant at the .05 level. This finding indicates the size of the relative contribution of the S, C and I components changed significantly as the quarterly time span increased.

An overview of the relative contribution of the components between a one-quarter and a four-quarter time highlights the vast difference in the composition of data used by management for decision making. Exhibit 3 presents a distribution of the relative contribution of the S, C and I components for the five income statement variables for a one-quarter and a four-quarter time span. The variable data are averages from the 68 and 21 company samples. A few observations will aid in the interpretation of the graphic presentation in Exhibit 3. In the first circle imagine you are viewing the end of a pipeline that is carrying information on the components of percentage changes in sales data in a one-quarter time span. The S and I components are signaling large quantities of transitory information, i.e., S is 50 percent and I is 17 percent. The trend-cycle component is carrying permanent information that represents only 33 percent of the percentage change in the sales trend. The composition of one-quarter sales data is heavily loaded with temporary signals which is the information available to management for intermediate-term financial planning. In contrasts when annual data are decomposed a vastly different structure emerges with a telescopic expansion and contraction of the C and S components, respectively. The C component represents 95 percent of the percentage changes in annual sales data and only 5 percent is related to the I component. There is no seasonal component in annual data. Corporate finance theory and planning models utilize annual data that contains mostly permanent type information.

Exhibit 3 highlights the vast differences between S, C and I components generated from a one-quarter term span and a four-quarter term span. The composition of the information in a pipeline with quarterly data is heavily weighted with temporary signals from the S and I components, while the pipeline with annual data is almost filled with permanent type signals from the C component.

There are three major propositions that evolve from this component analysis. First, short-run forecasting errors observed by Donaldson [10, p. 184-192] are most likely a result of the preponderance of temporary signals contained in the quarterly or short-run data. The change in the components overtime may be a cause of timing errors by management [11]. Second, the long-run random behavior of growth rates in earnings, i.e., long-run forecasting errors, as observed by I. M. D. Little [20], Little and Rayner [21], Murphy [32], Lintner and Glauber [24] and Brealey [4] are related to the I component in annual data.

Finally, the component analysis indicates the need to expand corporate finance theory and planning models to include intermediate-term financial planning, because current traditional theory does not address this important dimension in planning.

Company and Variable Dimensions

Although there is a significant difference in the S, C and I components as the time horizon is expanded, are these components similar or different among the companies or among the five income statement variables? A two-way ANOV test found there was a significant difference at the .05 level in the S, C and I components among the 68 companies and also among the 21 companies. Also there was a significant difference in the components over the four time periods. The F test results are presented in Exhibit 4. A second two-way ANOV test found a significant difference in the components among the five income statement variables. The interaction between the variables and time and the company and time were also all significant with one exception. These results are presented in Exhibit 4. However, when the 68 companies were subdivided into industry classes and into large and small groups the statistical results were quite different.

The objective of subdividing the 68 companies into industry classifications was to discover if the components are similar among the companies in the same industry. The industries and the number of companies in the industry are paper 5, chemical 5, petroleum refining 8, and steel 7. There were 23 companies in the Fortune second 500 which are classified as small, and 45 companies in The Fortune 500 that are defined as large.

In two-way ANOV tests the S, C and I components were similar among the variables in the paper and chemical industry and among small companies. Additionally, the C component was similar among the varibles of the steel companies; and the I component was similar among the variables of the steel companies and the petroleum refining companies. The F-ratios for thee ANOV tests are found in Exhibit 5.

The F-ratios in Exhibit 5 show there is no significant difference in the interaction between the variables and the time span for the paper, chemical and steel companies and for the small companies. Furthermore, the components for the income statement variables are significantly different for oil refining companies and for large Fortune 500 companies. Finally, Exhibit 5 reemphasizes the significant difference in the income statement variables over a one, two, three and four quarter time horizon.

The industry results provide unique insight into similarities and differences among companies. There are several industries in which the relative contribution of the S, C and I components of the income statement variables are similar which is opposite the earlier results when the aggregate data for the 68 or 21 companies were evaluated. From a model building perspective, the stability of S, C and I components among the income statement variables suggests the potential of developing a new level of corporate finance theory that focuses on an intermediate-term time horizon. This intermediate-term corporate finance theory would extend beyond the traditional investment and long-term financing dimension and include operating variables from the income statement.

When the relationship among the components are not similar, e.g., petroleum refining and large Fortune 500 companies, there is a need to have a theory that takes firm differences into account. The mixture of stable and unstable S, C and I components suggests the need to design an intermediate-term financial planning model with a dynamic adjustment process as suggested by Andrews [1].

The preceding tests have relied on five quarterly income statement variables. To present additional evidence concerning intermediate-term financial theory, a two-way ANOV test examined for differences in the components among companies and among the variables using four working capital variables--receivables, inventory, accounts payable and notes payable. The data are a new source of quarterly balance sheet information and provide additional information on the stability of the components among the nine companies. Exhibit 6 shows there is a similarity in the components among the companies. However, there is a significant difference in the S and C components for the working capital variables, but the I component of the working capital variables are similar. Although the size of the sample is too small to allow generalization, the components of the working capital variables are supportive of the industry finding that were based on income statement data.

Cross Section Tests

The time series dimension was important in the preceding analysis. The objective of this section is to utilize cross-section data to determine if the components for a set of balance sheet and income statement variables are similar among companies. The results of these tests are mixed. First, although not reported, the components of the income statement variables are significantly different for both sets of companies for each cross-section time period. For example, the five variables within a one quarter time horizon were significantly different among the 68 companies for the seasonal component. There were 12 tests for each data set (4 time periods x 3 components) or a grand total of 24 tests for the two data sets. The F test statistic was significant at the .01 level for each of the 24 tests. Although not reported, the same finding emerged when the income statement variable of the sample of nine companies were examined. However, the results were opposite when the working capital variables of the nine companies were tested. The F test statistics were not significant at the .10 level for the S, C and I component in any of the four cross-section time periods.

When the 68 companies were subdivided into industry categories there was a mixed pattern of differences and similarities among the S, C and I components of the income statement variables for many of the industries. In two-thirds of the tests the components were significantly different within an industry or a size category. The F test results are found in Exhibit 7. There was a similarity in the components among the steel companies for each time period. Also, with one exception, the I component of the chemical companies were similar. Finally, the S, C and I components of most industries were similar when annual data were used in the test. In summary, the disaggregation of the data indicates only modest similarity of the components from a cross-section of industry and size data.

CONCLUSIONS

Decomposing time series accounting data into seasonal, trend-cycle and irregular components provides unique insight concerning the future directions of corporate finance theory and planning models. The seasonal and irregular components reflect transitory developments in the data and the trend-cycle component captures the permanent features from the decomposition analysis. Two significant observations related to corporate finance theory and planning have evolved.

Seasonal and irregular components dominate the composition of one-quarter income statement variables. When analyzing four quarters of a data series, the trend cycle component represents 85-90 percent of the percentage change from the original series. The remainder is attributable to the irregular component. The change in the composition can be likened to the progressive changes that occur to impure water as it flows through a filter purification pipeline. The impurities (temporary information) are gradually removed as the water flows through the pipeline. At the end of the pipe only natural chemicals (permanent information) remain in the outflow. Financial theory and decision models have only utilized information from the end of the pipeline where permanent trends prevail. However, in practice management must use information from every stage along the pipeline for operating decision making and planning. The dominance of the transitory components in the short-run time horizon creates interpretative uncertainty for management and accounts for short-run forecasting errors. The analysis indicates the need for the development of corporate finance theory and planning models that focus on shorter- and intermediate-run decision issues. The analogy of the rate of flow of cash through a pipeline may serve as a model for developing dynamic intermediate-term corporate finance theory.

A two way analysis of variance of the aggregate data across companies and variables resulted in no stability in the components. However, by disaggregating into industry categories we discovered a similarity in the components among companies and across variables. The components are unstable as the time period is lengthened from one-quarter to four-quarters. Thus financial theory needs a dynamic adjustment process to account for changes in the components over time, however, the stability among companies within industry classes highlights the need for corporate finance theory to take into account both time and firm effects.

EXHIBIT 1

MEANS AND STANDARD DEVIATIONS OF THE RELATIVE CONTRIBUTIONS OF THE IRREGULAR, CYCLICAL AND SEASONAL COMPONENTS OF FIVE INCOME STATEMENT VARIABLES FOR 68 COMPANIES, 1970-1978
(in percent)

Time Span in Quarters	Irregular		Trend-Cycle		Seasonal	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Sales						
1	17.71	11.82	32.42	18.76	49.87	22.76
2	6.59	5.80	60.15	23.52	33.26	23.69
3	4.35	3.94	72.65	20.09	23.00	19.58
4	4.71	4.83	95.11	4.99	.18	.33
Operating Income						
1	26.21	15.59	23.55	16.88	50.24	23.50
2	12.49	9.12	48.53	21.43	38.97	23.88
3	8.49	6.27	60.39	22.65	31.12	22.94
4	11.78	7.66	87.92	7.74	.30	.25
Depreciation						
1	36.13	18.35	25.59	15.09	36.80	23.58
2	15.66	10.97	51.10	22.31	31.77	23.32
3	11.77	9.30	65.92	21.69	20.84	19.06
4	13.46	11.47	84.87	15.48	.20	.27
EBIT						
1	27.04	15.59	21.95	15.50	51.01	23.09
2	12.70	8.62	46.95	20.98	40.34	23.90
3	9.08	5.99	58.30	21.77	32.62	22.76
4	13.11	7.28	86.54	7.35	.35	.31
Net Income						
1	30.63	19.09	21.41	14.64	47.96	25.27
2	15.17	11.23	47.10	21.50	37.73	24.02
3	11.33	10.19	57.35	22.88	31.33	24.04
4	15.80	12.49	83.83	12.55	.37	.49

EXHIBIT 2

MEANS AND STANDARD DEVIATIONS OF THE RELATIVE CONTRIBUTIONS OF THE IRREGULAR, CYCLICAL AND SEASONAL COMPONENTS OF FIVE INCOME STATEMENT VARIABLES FOR 21 COMPANIES, 1962-1978
(in percent)

Time Span in Quarters	Irregular		Trend Cycle		Seasonal	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Sales						
1	16.35	8.17	32.90	14.25	50.75	17.37
2	6.98	3.49	64.76	16.88	28.26	15.29
3	4.14	2.57	73.90	17.10	21.96	16.13
4	4.76	3.55	95.06	3.76	.17	.35
Operating Income						
1	28.22	13.56	24.42	9.78	47.36	17.37
2	12.96	7.18	52.29	14.83	34.75	16.82
3	8.70	4.66	66.20	16.71	25.28	16.77
4	11.77	6.39	87.98	6.46	.25	.16
Depreciation						
1	41.99	13.38	27.52	10.50	30.48	13.65
2	17.67	9.82	58.48	14.97	23.85	13.80
3	13.37	8.89	72.50	13.25	14.13	7.97
4	12.70	9.89	87.10	9.97	.20	.17
E.B.I.T.						
1	28.08	13.18	23.74	9.39	48.18	16.54
2	12.72	7.23	50.84	15.16	26.44	17.09
3	9.01	4.45	64.52	16.04	26.47	16.21
4	12.95	7.23	86.76	7.30	.29	.21
Net Income						
1	33.51	17.84	24.83	11.46	41.66	20.51
2	15.65	11.40	55.26	17.12	28.99	18.65
3	11.90	9.44	64.83	18.43	23.27	18.63
4	14.67	9.99	85.09	10.02	.24	.12

EXHIBIT 3

SEASONAL, TREND-CYCLE AND IRREGULAR COMPONENTS

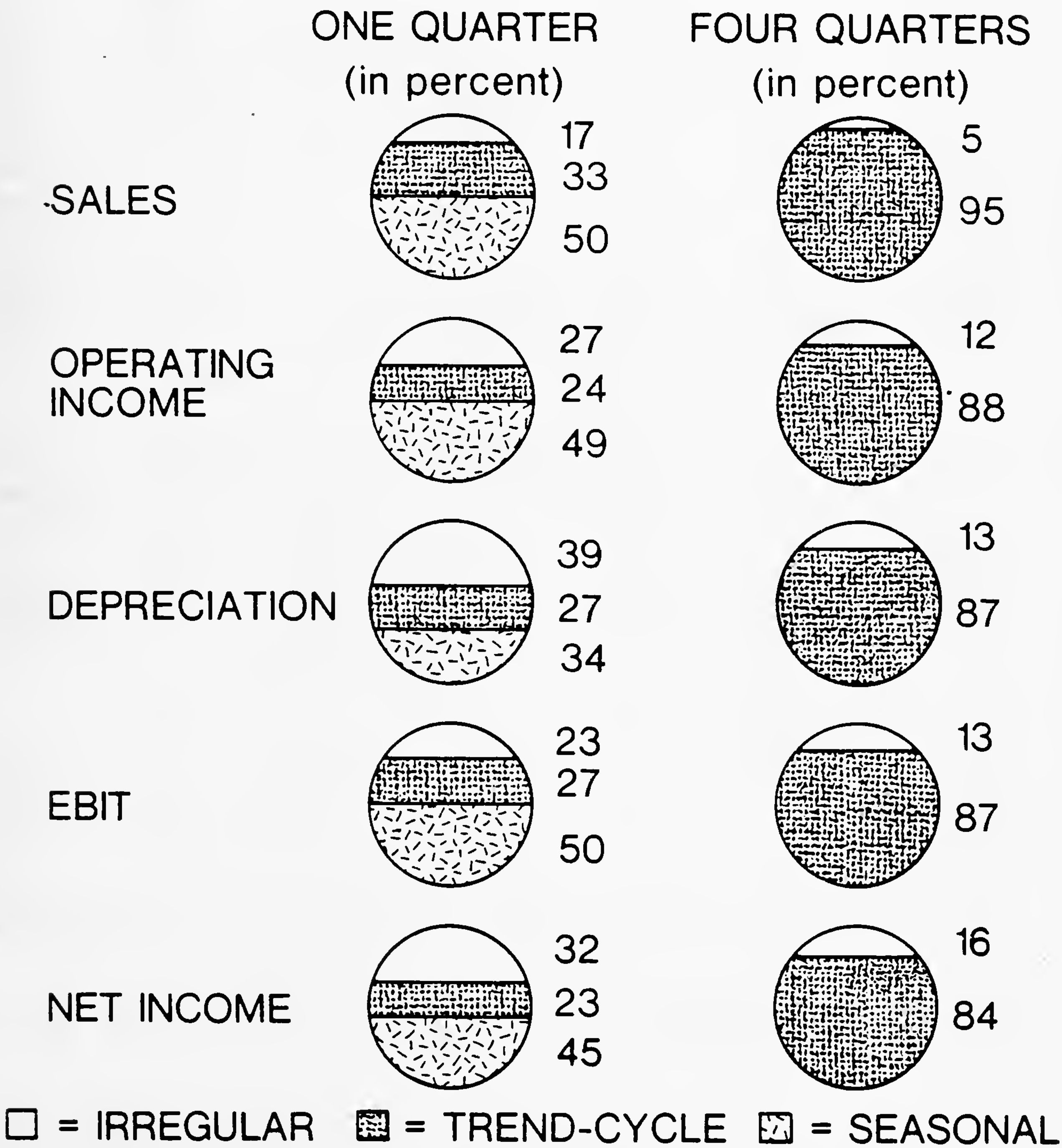

EXHIBIT 4

F RATIOS FOR TWO-WAY ANALYSIS OF VARIANCE TESTS MEASURING THE SIGNIFICANCE OF SEASONAL, CYCLICAL TREND AND IRREGULAR COMPONENTS AMONG FIVE INCOME STATEMENT VARIABLES, 68 COMPANIES AND 21 COMPANIES FOR TIME SPANS OF 1, 2, 3 AND 4 QUARTERS

	68 Company Sample	21 Company Sample
	SEASONAL COMPONENTS	
Variables [a]	3.17*	2.75*
Time Span	725.92**	246.92**
Variable-Time Span	2.48**	3.02**
Company [b]	6.83**	4.65**
Time Span	1449.50**	530.74**
Company-Time Span	6.23**	4.37**
	CYCLICAL TREND COMPONENTS	
Variables [a]	7.15**	2.63*
Time Span	1810.85**	1148.67**
Variable-Time Span	1.58	1.12
Company [b]	4.52**	5.31**
Time Span	3624.71**	1816.02**
Company-Time Span	6.13**	4.06**
	IRREGULAR COMPONENTS	
Variables [a]	13.45**	7.34**
Time Span	539.76**	322.87**
Variable-Time Span	6.15**	7.28**
Company [b]	3.40**	2.58**
Time Span	411.83**	394.95**
Company-Time Span	5.00**	3.70**

[a] Two way ANOV TEST measuring differences between five variables and time span.
[b] Two way ANOV TEST measuring differences between companies and time span.

*significant at .05 level.
**significant at .01 level.

EXHIBIT 5

F RATIOS FOR TWO-WAY ANALYSIS OF VARIANCE TESTS MEASURING THE SIGNIFICANCE OF SEASONAL, CYCLICAL TREND AND IRREGULAR COMPONENTS AMONG FIVE INCOME STATEMENT VARIABLES, SELECTED INDUSTRY AND SIZE CATEGORIES FOR TIME SPANS OF 1, 2, 3 AND 4 QUARTERS (1970-1978)

	Paper Industry (6 Co.)	Chemical Industry (5 Co.)	Petroleum Refining Industry (8 Co.)	Steel Industry (7 Co.)	Small Companies (23 Co.)	Large Companie (45 Co.)
SEASONAL COMPONENT						
Variable[a]	0.122	0.58	1.28	0.24	1.07	2.58*
Time Span	28.95**	56.45**	107.94**	95.14**	203.84**	538.14*
Variable-Time Span	0.35	0.57	1.83	0.89	9.99	3.02
Company[b]	9.41**	10.03**	4.24**	1.80	9.98**	5.05*
Time Span	149.96**	136.06**	148.58**	112.06	485.84**	969.30*
Company-Time Span	8.64**	8.44**	3.74**	1.92**	8.16**	5.40*
CYCLICAL TREND COMPONENT						
Variable	1.21	0.42	6.45**	1.54**	0.63	9.57
Time Span	180.56**	109.41**	399.10**	343.30**	454.72**	1449.04*
Variable-Time Span	0.33	0.57	2.27	1.46	0.52	1.70
Company	4.63**	11.16**	2.12	1.91	4.72**	4.45*
Time Span	384.70**	222.08**	484.91**	370.16**	1099.89**	2550.24*
Company-Time Span	6.42	6.31**	3.68**	1.77	8.14**	4.98*
IRREGULAR COMPONENT						
Variable	1.63	1.44	3.70*	3.53*	2.07	12.75
Time Span	36.80**	32.42**	138.82**	78.26**	152.78**	378.88*
Variable-Time Span	0.97	1.30	2.29*	0.70	1.72	4.64*
Company	5.36**	1.60	2.54*	1.52	5.18**	2.71*
Time Span	99.39**	45.50**	174.15**	94.36**	328.78**	585.05*
Company-Time Span	9.50**	3.84**	3.34**	1.92	7.25**	4.09*

[a] Two way ANOV TEST measuring differences between five variables and time span.
[b] Two way ANOV TEST measuring differences between companies and time span.

*significant at .05 level.
**significant at .01 level

EXHIBIT 6

F RATIO FOR TWO-WAY ANALYSIS OF VARIANCE MEASURING THE SIGNIFICANCE OF SEASONAL, CYCLICAL TREND AND IRREGULAR COMPONENTS FOR FOUR WORKING CAPITAL VARIABLES AND FIVE INCOME STATEMENT VARIABLES FOR NINE COMPANIES FOR THE TIME SPANS FOR 1, 2, 3 AND 4 QUARTERS (I-Q 1969 - IV-Q 1977)

	Working Capital Variables	Income Statement Variables
	SEASONAL COMPONENTS	
Variables[a]	9.45**	0.60
Time Span	82.54**	151.95**
Variables-Time Span	6.46**	0.88
Company[b]	1.29	8.90**
Time Span	60.68**	325.46**
Company-Time Span	1.35	7.15**
	CYCLICAL TREND COMPONENTS	
Variable[a]	8.48**	2.18
Time Span	189.88**	249.67**
Variables-Time Span	7.82**	0.66
Company[b]	0.50	5.27**
Time Span	120.42**	455.06**
Company-Time Span	1.02	5.21**
	IRREGULAR COMPONENTS	
Variable[a]	2.26	1.37
Time Span	56.54**	28.96**
Variables-Time Span	3.35**	1.22
Company[b]	1.47	3.39**
Time Span	44.76*	55.64**
Company-Time Span	0.78	6.27**

[a]Two way ANOV TEST measuring differences between five variables and time span.
[b]Two way ANOV TEST measuring differences between companies and time span.

*significant at .05 level.
**significant at .01 level.

EXHIBIT 7

F RATIOS FOR ONE WAY ANOV TESTS MEASURING THE SIGNIFICANCE OF IRREGULAR, CYCLICAL TREND AND SEASONAL COMPONENTS AMONG FIVE INCOME STATEMENT VARIABLES, SELECTED INDUSTRY AND SIZE CATEGORIES WITHIN A CROSS SECTION OF TIME OF 1, 2, 3, AND 4 QUARTERS

ONE QUARTER

	Paper Industry (6 Co.)	Chemical Industry (5 Co.)	Petroleum Refining Industry (8 Co.)	Steel Industry (7 Co.)	Small Companies (23 Co.)	Large Companies (45 Co.)
I	10.48*	1.24	3.04*	1.52	8.06**	3.49**
C	5.37**	9.73**	2.03-	2.10	5.59**	4.75**
S	15.42**	6.28**	3.86**	2.02	9.21**	5.13**

TWO QUARTERS

I	3.46*	3.34*	2.88*	0.83	4.42**	2.62**
C	2.71*	10.98**	2.35*	1.71	6.06**	4.40*
S	3.86**	10.97**	4.25**	1.23	8.41**	4.65*

THREE QUARTERS

I	4.04**	2.05	2.09	2.17	4.02**	2.43**
C	12.76**	11.53**	2.85*	1.83	6.39**	5.54**
S	16.88**	11.89**	4.06**	2.46*	10.78**	5.95**

FOUR QUARTERS

I	1.85	2.17	1.77	2.16	3.08**	2.43**
C	1.86	2.28	1.76	2.13	1.36	2.42**
S	1.39	9.37*	0.56	3.75**	4.06**	2.34**

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APPENDIX I

The X-11 routine computes the relative contribution of components to percent changes in the original series over each time span of one, two, three and four quarters using the following relationship [38, p. 18-19].

$$\overline{O}_t^{\,2} = \overline{I}_t^{\,2} + \overline{C}_t^{\,2} + \overline{S}_t^{\,2} + \overline{P}_t^{\,2} + \overline{TD}_t^{\,2}$$

where:

$\overline{O}_t$ = original series;

$\overline{I}_t$ = final irregular series;

$\overline{C}_t$ = final trend cycle;

$\overline{S}_t$ = final seasonal factors

$\overline{P}_t$ = prior montly adjustment factors, (not applicable to the quarterly model);

$\overline{TD}_t^{\,2}$ = Final trading day adjustment factors (not applicable to the quarterly model).

Since the sum of squares of the percent changes does not exactly equal $\overline{O}_t^{\,2}$, $(\overline{O}_t{}')^2$ is substituted, where $(\overline{O}_t{}')^2 = \overline{I}_t^{\,2} + \overline{C}_t^{\,2} + \overline{S}_t^{\,2}$. The relative contribution of the changes in each component for each time span is the ratio $\overline{I}_t^{\,2}/(\overline{O}_t{}')^2$, $\overline{C}_t^{\,2}/(\overline{O}_t{}')^2$ or $\overline{S}_t^{\,2}/(\overline{O}_t{}')^2$. [38, p. 19].