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Evidence Regarding Divergence of Analysts' Forecasts of Annual Earnings Per Share: Does Consensus Increase As the Forecast Horizon Declines?

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Preliminary draft: Comments welcome but please do not quote.

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Abstract

Intuitively one expects that the consensus of analysts regarding their forecasts of annual earnings per share should increase as the end of the year draws near. The empirical research to date regarding this notion has been mixed. The motivation for this study is twofold: (1) provide additional evidence using a different set of data based on a more recent period of time; and (2) call attention to and control for a number of potential problems inherent in the previous research. The results of this study indicate that the conclusion drawn by Brown, Foster, and Noreen [1985] which states "as the time to the announcement of actual earnings is reduced, security analysts agree more on EPS that each firm will announce" is incorrect. There is no systematic pattern of an increase in consensus over time for the firms studied.

1.0 Introduction

A widely held presumption regarding analysts' forecasts of earnings per share is that consensus increases (discordance decreases) as the time to the announcement of the actual accounting data declines. In effect, it is commonly believed that analysts' forecasts of annual earnings per share made at the beginning of the year should display less consensus (more discordance) than forecasts made at the end of the year. The current empirical evidence regarding this property of analysts' forecasts is mixed and inconclusive. Therefore, the motivation for this study is twofold: (1) provide additional evidence using a different data source than previously studied; and, (2) call attention to and control for a number of potential problems which may impact the interpretation of the evidence.

The use of a different set of data and a more recent time period for analysis provides additional insight since most of the previous research is rather out-dated (Brown, Foster, and Noreen [1985] use forecast data from the period of January, 1976 through December, 1980). The results of this study are based on forecasts for the years 1980, 1981, and 1982. In addition, the previous work has used monthly forecasts whereas this study is based on weekly forecasts.

Previous research by Crichfield, Dyckman, and Lakonishok [1978] and Elton, Gruber, and Gultekin [1982] reports mixed results based on the average level of consensus for fairly large groups of firms. Brown, Foster, and Noreen [1985] note this inconclusive evidence and investigate the change in the standard deviation of the distribution of analysts' forecasts for a sample of about 1500 firms. Their conclusion (pg. 52) is that "as the time to the announcement of actual earnings is reduced, security analysts agree more on EPS that each firm will announce" (emphasis added).

The conclusion drawn from these results by Brown et al. [1985] may be flawed in three ways. (1) Previous evidence has been based on the average aggregate level of consensus for a large group of firms rather than individual firms. The conclusion drawn is for the pattern of discordance over time at the individual firm level yet the analyses conducted are in the aggregate. (2) The metric employed in previous research is the standard deviation of the distribution of analysts' forecasts for an individual firm at a particular time. Absolute discordance (the standard deviation of the distribution) rather than relative discordance (the coefficient of variability of the distribution) has been used. (3) The group of firms analyzed contains varying numbers of analysts both across time and firms.[1]

The impact of the first potential problem on the interpretation of previous results is critical. Discordance of analysts' forecasts in the aggregate may decline over time but the same pattern may not hold when individual firms are scrutinized. The results reported in this study indicate that when individual firms are analyzed the discordance does not follow a systematic pattern of decline and in many cases is larger at the end of the year than at the beginning of the year.

By using the standard deviation rather than the coefficient of variation the interpretation and usefulness of this measure of consensus is limited. It is quite difficult to compare dispersions of different populations both across firms and across time unless the are scale invariant. For comparative purposes, both across time within the same firm and across firms for the same time, the measure of discordance should be standardized. One of the two most appropriate methods is to divide the standard deviation of the distribution by the mean. This produces the coefficient of variation.

As an example of the propriety of standardizing the measure of consensus, assume that for firm XYZ the mean consensus forecast of annual EPS is $5.00 at the beginning of the year with a standard deviation of $1.00. Also assume that later in the year the revised mean forecast is $2.00 with a standard deviation of $1.00. Is the level of discordance the same for both points in time? From an absolute point of view the answer is yes, however, from a relative sense the answer is no. Although the standard deviation has remained the same the coefficient of variation has increased from 20% to 50%. It seems apparent that the uncertainty has increased and standardization by the mean must be employed if one desires a measure that is comparable over time and across firms.

For comparative purposes, discordance is measured using both approaches in many parts of this paper. The results are very similar although there are cases in which the metric employed significantly affects the observed pattern of discordance over time. For the analysis in this study of discordance on the individual firm level, the metric employed is the coefficient of variation. Results based on the standard deviation are very similar and can be obtained from the author.

The third potential problem is the failure to control for the effect of more analysts entering the forecast distribution as the year end approaches. For many firms, the number of analysts following that particular firm increases as the year end gets closer. This can impact the standard deviation significantly when the number of analysts is small. For example, assume that early in the year the mean forecast is $5.00 with a standard deviation of $1.00 and the number of analysts is 2. Subsequently, another analyst enters the distribution with a forecast that is equal to the mean. Accordingly, the standard deviation will now be $.50. The range of the forecasts and the mean have remained the same but the standard deviation has declined significantly. To control for this effect one should keep the number of analysts constant or analyze firms in which the number of analysts following the firm is large enough to mitigate the problem. Brown, Foster, and Noreen attempt to control for this potential problem by using firms in which the number of analysts is at least six. A more stringent control is employed in this study; only firms with at least 10 analysts providing forecasts are used in this study.

The structure of this paper is as follows. The data used in this study along with the sample firms analyzed are described in the next section. Section 3.0 presents the results of an aggregate analysis on a sample of twenty-eight firms along with a comparison to the results of Crichfield et al. [1978], and Brown et al. [1985]. The fourth section discusses the graphic patterns of discordance across time at the individual firm level. In the fifth section the results of statistical tests regarding a systematic decline in discordance over time are provided. A summary and interpretation of the results are provided in Section 6.0.

2.0 Data Source and Sample

The source of the financial analysts' forecast data used in this study is the Icarus Service of Zacks Investment Research, Incorporated. This data base contains weekly consensus (mean of the distribution) forecasts of annual EPS (both current year and one year ahead) and the standard deviation of the distribution for about 2,400 companies. The average number of analysts providing a forecast for a firm is about twelve. Hassell and Jennings [1986] provide a detailed description of the data and discuss the issues regarding "out-of-date" forecasts and "reporting lags."

A sample of 38 New York Stock Exchange listed calendar year-end firms having at least 10 forecasts (of the current year EPS) for each week of the years 1980, 1981, or 1982 is randomly chosen. This results in 82 yearly periods of analysis since some firms have ten analysts for each of the three years while others only meet the criteria in one or two of the years. For each of the 82 firm/years there are 52 weekly observations of the consensus (mean) forecast and the standard deviation of the distribution. Table 1 contains a list of the 38 firms, the years of analysis, and descriptive statistics regarding the number of analysts in the forecast distribution for each firm/year.

INSERT TABLE 1

An analysis of the coefficients of variation (standard deviation divided by the mean forecast) indicates that discordance changes significantly during the calendar year for most of the firms/years. The average number of changes during the year is 29. For some firms discordance changes as many as 47 times while for other firms it changes only 5 times. The changes in the coefficient of variation are positive in more cases than negative.

3.0 Aggregate Level Results

Generally, the notion, supported by the aggregate evidence of Brown et al., that analyst discordance declines as the forecast horizon shrinks is upheld when the analysis is conducted at the aggregate level (a fairly large sample). However, as the number of firms in the aggregate declines the trend becomes much less systematic and discordance is much more volatile over time.

The results of previous research which have portrayed the smoothest trend and least volatility are those of Brown et al. [1985]. Their results which are based on a sample of around 1500 firms are displayed graphically in Figure 1.

INSERT FIGURE 1

The trend is quite systematic and for the year prior to the actual month of announcement the mean standard deviation declines to about half of the beginning of the year amount. It is not surprising that this result is obtained given that the sample size is quite large. As the sample size increases, the individual changes in discordance become much less important and the effect of a large change for an individual firm has little impact on a mean based on 1500 observations. One would expect that as the sample size decreases the pattern of discordance over time should be much more erratic.

Figure 2 is a graph of the combined results obtained by Crichfield et al. [1978] for a sample of about 50 firms over a ten year period. It depicts a much less systematic pattern than that found by Brown et al. [1985]. Indeed, the volatility is greatly increased and the pattern supports their observation that there is a tendency for a decline in discordance but that decline is very uneven and discordance often increases during the middle months.

INSERT FIGURE 2

When one graphs the individual years analyzed by Crichfield, et al the results are even unsettling. As noted by the authors, four of the ten years analyzed either show no decline or it is insignificant. Graphs for each of the ten years are provided in Figure 3.

INSERT FIGURE 3

Note that in the six years in which Crichfield et al find a statistically significant decline (1967, 1968, 1970, 1972, 1975, and 1976) the decline from the beginning of the period to the end is quite small for four of the six years (-.03, -.01, -.03, -.05, -.48, and -.24, respectively). Even in periods in which a decline is found the pattern is quite unsystematic. For instance, in years 1967 and 1968 the Cox-Stuart Trend Test results (as reported by Crichfield et al.) support the hypothesis of a downward trend at a .02 probability level but graphically the pattern is quite varied. During 1968 there is a downward trend during the year but at the end of the year discordance increases significantly to a level almost equal to that at the beginning of the year.

For a comparison to the studies previously discussed, Figure 4 provides graphs of the mean (over the sample of firms) standard deviation of the analysts' forecasts for the 34 firms of this study which are analyzed for the 1982 year. Graph 4a is based on weekly observations while graph 4b uses quadriweekly observations. Overall, both of the graphs depict a decline over the 52 week period but the decline in discordance does not seem to be smooth or systematic.

INSERT FIGURE 4

The inferences are quite different when the coefficient of variation is graphed rather than the standard deviation. Figure 5 presents the mean quadriweekly observations of the coefficient of variation that correspond to the weeks graphed in 4b. Notice that average discordance, measured as the mean coefficient of variation for the sample of 34 firms, is quite volatile and it actually increases at the end of the year.

INSERT FIGURE 5

One plausible explanation for the observed pattern could be that the denominator in the computation of the coefficient of variation (mean forecast) is driving the results. However, a plot of the average consensus (mean of the distribution) forecast, Figure 6, indicates a fairly systematic decline in the average estimate. It does not seem that the changes in the average consensus forecast are driving the results based on the coefficient of variability.

INSERT FIGURE 6

On the aggregate level, these results seem to indicate that the pattern of discordance over time is dependent upon the metric used and the number of observations in the analysis. As the number of firms in the analysis increases the pattern of decline becomes much more systematic and pronounced. However, when the sample size is relatively small (n=34 or n=50) the pattern shows a decline but it is much more erratic. When the standard deviation is scaled by the mean to produce the coefficient of variation, the pattern does not depict a systematic decline in discordance. Indeed, a comparison of the standard deviation pattern (Figure 4b) to the coefficient of variation pattern (Figure 5) indicates a very large differenc in the time series properties of the two metrics.

4.0 Individual Firm Patterns

To more fully depict the change in discordance over time at the individual firm level for the 83 observation periods of this study, the coefficient of variation is graphed over time for each of the periods. These graphs are provided in Figure 7. A comparison of the coefficient of variation patterns to those of the standard deviation indicates the patterns to be similar in most instances. The differences among the two metrics at the individual firm level is much less pronounced than that implied in the previous section. The graphs of the coefficient of variation over time are provided in Figure 7. Copies of the graphs for the standard deviation measure may be obtained from the author.

INSERT FIGURE 7

Given that the earnings volatility of a firm may impact the discordance metric one might expect the patterns for an individual firm to be similar across different calendar years. A visual inspection of the graphs does not seem to indicate that the patterns are consistent across time for the same firm. Note the patterns across the firms with three years of forecasts. In almost all cases the patterns are quite different; in some years there is an overall decline and then the following year the pattern shows an increase as the year end approaches.

Another plausible factor impacting the observed patterns might be the overall economic climate; patterns should be similar across firms for the same year. Again, this does not seem to be the case for the discernable patterns. During 1980 there are 10 overall patterns of decline and 4 patterns of increases. There are 13 declining and 17 increasing patterns for 1981. During 1982 17 decreasing patterns with 10 rising patterns are observed.

Overall, the graphical results do not consistently support the notion that discordance decreases (consensus increases) as the forecast horizon shrinks. The results seem to indicate that the patterns are quite varied and that neither long run firm characteristics nor general economic conditions are driving the patterns.

5.0 Statistical Analyses of Individual Firm Patterns

In order to statistically assess the trend in the patterns of discordance over time, regression models regressing the current week discordance on a prior observation of discordance are estimated for each of the 82 periods. The first model regresses the current observation of the coefficient of variation on the observation of the coefficient of variation for the previous week:

$$\tilde{D}_{it} = \hat{a}_i + \hat{b}_i \tilde{D}_{it-1} + \tilde{e}_{it}$$

where: $\tilde{D}_{it}$ is the current observation (week t) of the coefficient of variation for firm i,

$\tilde{D}_{it-1}$ is the previous observation (week t-1) of the coefficient of variation for firm i,

$\hat{a}_i$ and $\hat{b}_i$ are the regression estimates for the intercept and the coefficient, respectively,

$\tilde{e}_{it}$ is an error term.

To test for a significant decline in discordance over time the regression coefficient is first tested to determine if it is significant different from zero. If it is, the coefficient is then tested to determine if it is significantly less than one. If discordance does decline over time then the null hypothesis that the regression coefficient equals 1 should be rejected for the alternative that the coefficient is less than 1.

A potential problem in this sort of analysis is that the regression errors ($\tilde{e}_{it}$) may be correlated. In that case the use of ordinary least squares to estimate and test the coefficient is inappropriate. An autoregressive model should be employed when significant autocorrelation is present. The regression coefficient, the standard errors, and the coefficient of determination are provided in Table 2 for the OLS results as well as the results using a maximum likelihood autoregressive approach.

INSERT TABLE 2

The Durbin-Watson statistic is employed to determine if autocorrelation is a problem in the OLS regressions. Instances in which autocorrelation are a problem are denoted and the maximum likelihood estimates should be used.

To exemplify the effect of autocorrelation on the estimates refer back to the individual graphs in Figure 7 for Amax during 1982. The OLS estimate (reported in Table 2) is .4247 with a standard error of .1294. The autocorrelation has caused the error term to be under-estimated. This biases the standard error and results in an estimate of the regression coefficient which is significantly different than zero and significantly less than one. However, a visual analysis of the graph indicates that there is little, if any, relationship between the previous observation and the current observation. The Durbin-Watson statistic for the residual of the OLS estimation is 1.16 and it indicates significant auto-correlation among the residuals. When the autocorrelation is included in the regression the standard errors become much larger and the regression coefficient is statistically insignificant. Autocorrelation is problematic in nine of the 82 firm/years.

The test of the regression coefficient ($\hat{b} < 1.00$) indicates that there is a statistically significant decline in discordance over time in 32 of the 83 firm/years analyzed. However, this evidence does not support the notion that discordance declines over time for most firms. Indeed, it is not apparent that the instances in which a systematic decline is observed are either consistent over time for the same firms or consistent across firms for the same time period.

The inability to pick up a statistically significant decline over time in discordance may be that the lagged time interval utilized is too small. The changes from week to week may be quite small but changes using a 4, 8, or 12 week interval may signify a decline. In order to investigate this possibility, the following three models are estimated and the regression coefficients are tested:

(1) $\tilde{D}_{it} = \hat{a}_i + \hat{b}_i \tilde{D}_{it-4} + \tilde{e}_{it}$

(2) $\tilde{D}_{it} = \hat{a}_i + \hat{b}_i \tilde{D}_{it-8} + \tilde{e}_{it}$

(3) $\tilde{D}_{it} = \hat{a}_i + \hat{b}_i \tilde{D}_{it-12} + \tilde{e}_{it}$

where: $\tilde{D}_{it}$ is the current observation (week t) of the coefficient of variation for firm i,

$\tilde{D}_{it-4}$ is the observation of the coefficient of variation for four weeks earlier (t-4) for firm i,

$\tilde{D}_{it-8}$ is the observation of the coefficient of variation for eight weeks earlier (t-8) for firm i,

$\tilde{D}_{it-12}$ is the observation of the coefficient of variation for twelve weeks earlier (t-12) for firm i,

$\hat{a}_i$ and $\hat{b}_i$ are the regression estimates for the intercept and the coefficient, respectively,

$\tilde{e}_{it}$ is an error term.

In almost all instances significant autocorrelation exists among the OLS residuals and the maximum likelihood autoregressive model is employed. The results for all three sets of regressions (using the appropriate method, OLS or ML) are provided in Table 3.

INSERT TABLE 3

In most instances the regression coefficient is not significantly different than zero. Overall, these results do not support the notion that discordance declines over time.

6.0 Summary and Conclusions

This study has reexamined the evidence regarding the notion that consensus (discordance) of analysts' forecasts on annual EPS increases (decreases) as the forecast horizon declines. A graphical analysis indicates that a pattern of systematic decline is observed when the analysis is conducted on the aggregate level. However, when the size of the size of the sample being studied declines the pattern becomes much more erratic and in many cases it increases over time. Graphs of individual firm/years indicate that the patterns are not systematic across time or firms. The individual firm graphs do not support the notion that discordance declines over time.

Simple statistical tests, using a regression approach, are employed to determine if the regression coefficient linking the current observation of the coefficient of variation to a previous observation is significantly less than one. Again, the results do not support the notion of a systematic decline. In summary, the results of this study indicate that the conclusion by Brown, Foster, and Noreen [1985] (pg. 52) which states "as the time to the announcement of actual earnings is reduced, security analysts agree more on EPS that each firm will announce" (emphasis added) is incorrect.

Endnotes

1. Brown, Foster, and Noreen [1985] attempt to control for this problem by using only firms which have at least six analysts providing forecasts.

References

Brown, P., Foster, G., and E. Noreen, Security Analyst Multi-Year Earnings Forecasts and the Capital Market (Sarasota, Florida: American Accounting Association, 1985).

Crichfield, T., T. Dyckman, and J. Lakonishok, "An Evaluation of Security Analysts' Forecasts," The Accounting Review (July 1978), pp. 651-668.

Elton, E., M. Gruber, and M. Gultekin, "Professional Expectations: Accuracy and Diagnosis of Errors," Working Paper, New York University, 1982.

Hassell, J., and R. Jennings, "Relative Forecast Accuracy and the Timing of Earnings Forecast Announcements," The Accounting Review (January 1986), pp. 58-75.

Table 1. Sample Firms, Years, and Characteristics of Analysts

Firm	Year	Number of Analysts Maximum	Number of Analysts Minimum	Number of Changes in the Number of Analysts During the Year
Amax	1980	13	10	8
	1981	16	14	8
	1982	14	12	6
Amerada Hess	1981	14	12	5
	1982	16	13	4
Ampco Pittsburgh	1982	14	11	10
Avon	1980	14	11	5
	1981	16	12	7
	1982	12	10	7
Baxter Travenol Labs.	1980	15	11	7
	1981	18	15	5
	1982	22	16	10
Big Three	1981	13	10	5
	1982	12	11	4
Braniff	1981	13	10	4
Burndy	1982	11	10	1
Capital Cities Communications	1980	13	10	3
	1981	13	11	4
	1982	16	12	9
Colgate Palmolive	1981	13	10	5
	1982	12	11	5
Combustion Engineering	1981	14	10	6
	1982	13	11	6
Cooper Industries	1980	14	10	3
	1981	15	13	4
	1982	15	14	5
CPC	1981	15	14	2
	1982	13	11	4
Dow	1980	15	12	4
	1981	18	13	5

Table 1. Continued

Fairchild	1982	16	13	4
Ford	1981	13	11	6
	1982	14	12	5
Foster Wheeler	1981	13	11	6
Gillette	1981	18	15	8
	1982	15	14	2
General Motors	1980	13	12	8
	1981	14	13	4
	1982	15	13	4
Gulf Research and Chemical	1980	19	13	13
	1981	21	14	10
	1982	22	19	10
International Flavors and Fragrances	1981	14	12	6
	1982	13	11	3
Johnson and Johnson	1980	16	14	4
	1981	18	15	5
	1982	21	17	9
Lilly, Eli.	1980	22	17	7
	1981	25	20	6
	1982	25	21	8
Masco	1981	12	10	3
Melville	1982	13	11	5
Northrop	1981	13	9	6
	1982	16	13	5
Phelps Dodge	1981	16	14	5
	1982	16	13	9
Potlatch	1980	15	12	3
	1981	15	14	4
	1982	16	13	6
Revlon	1980	15	12	5
	1981	17	15	6
Schering Plough	1980	21	17	4
	1981	25	21	6
	1982	26	22	10

Table 1. Continued

Searle, G.D.	1980	17	14	4
	1981	24	20	10
	1982	24	20	6
Smith International	1980	16	13	6
	1981	17	15	3
	1982	21	15	10
Thomas and Betts	1982	11	10	2
Times Mirror	1982	15	13	4
TRW	1981	12	11	5
	1982	14	12	3
Upjohn	1980	21	17	4
	1981	24	22	6
	1982	24	21	5
Warner Communications	1981	19	15	10
	1982	23	16	9
Warner Lambert	1980	21	16	6
	1981	23	20	5
	1982	23	21	6

Figure 1. Graph of Results by Brown, Foster, and Noreen [1985]

Vertical Axis: Mean Standard Deviation (n≅1500)
Minimum .166 Maximum .272
Horizontal Axis: Time

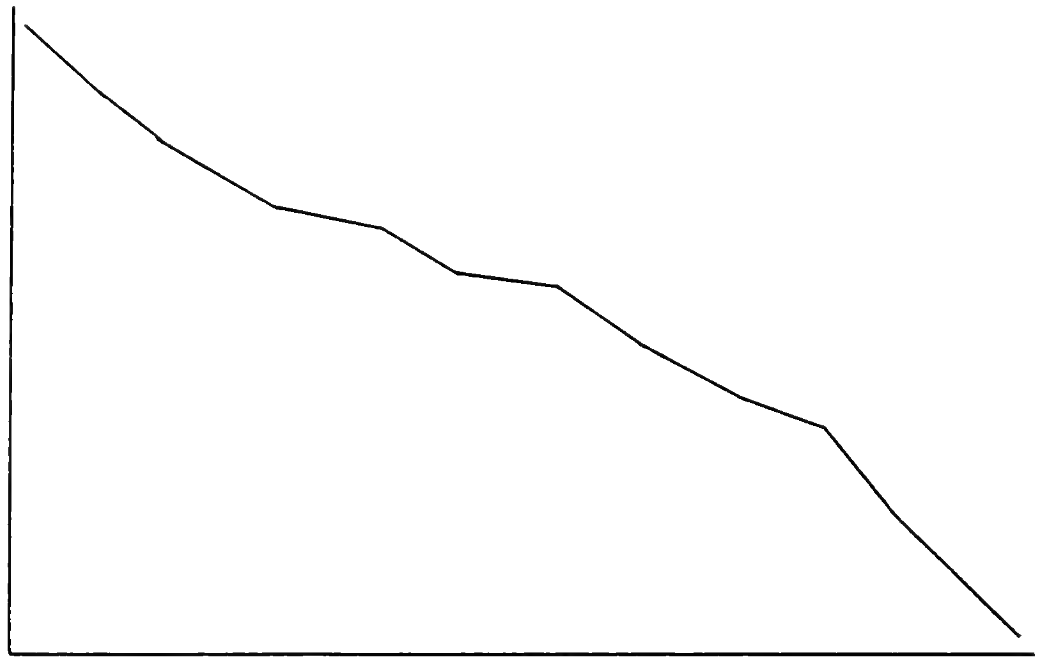


Figure 2. Graph of Results by Crichfield, Dyckman, and Lakonishok [1978]

Vertical Axis: Mean Standard Deviation (n≈50, 10 years)
Minimum .192 Maximum .279
Horizontal Axis: Time

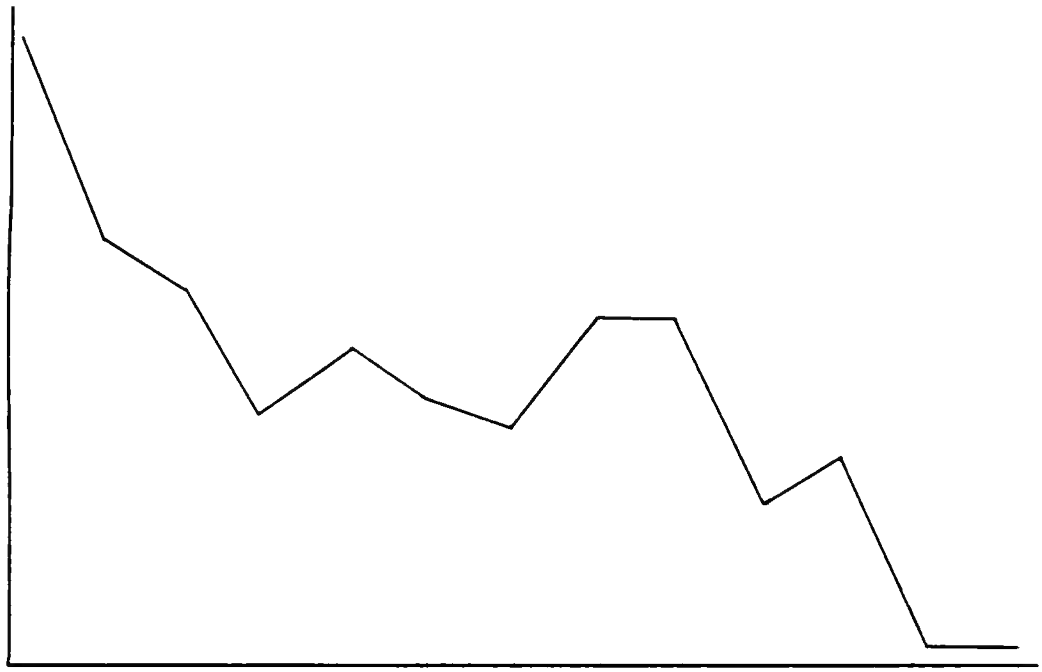
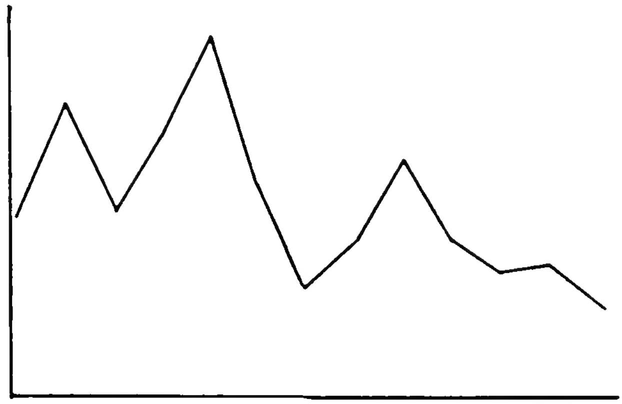


Figure 3. Graph of Individual Year Results by Crichfield, Dyckman, and Lakonishok [1978]

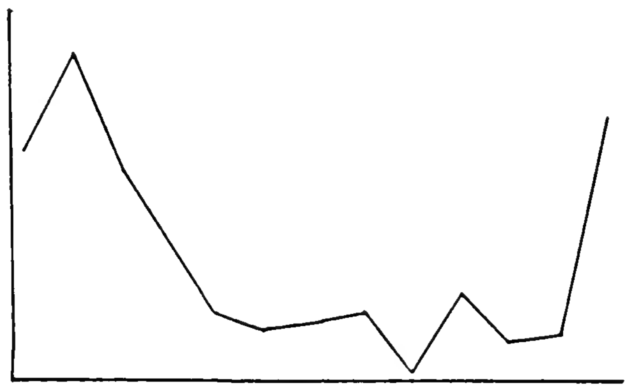
Vertical Axis: Mean Standard Deviation (n≅50)

Horizontal Axis: Time

1967 (Vertical Axis - Minimum=.09 Maximum=.21)



1968 (Vertical Axis - Minimum=.16 Maximum=.27)



1969 (Vertical Axis - Minimum=.12 Maximum=.25

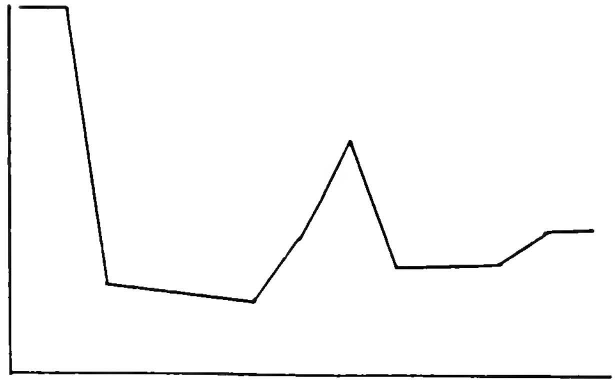
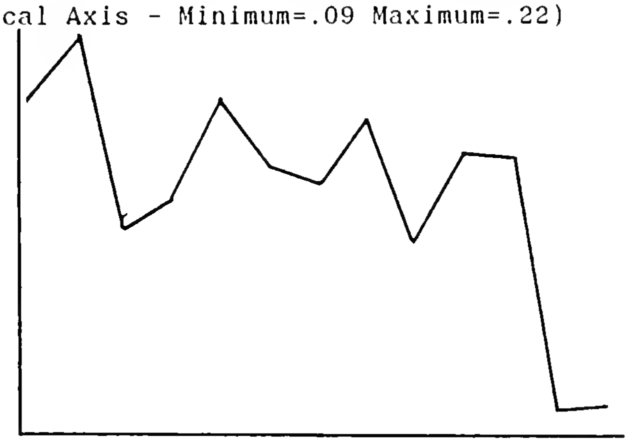


Figure 3. Continued

1970 (Vertical Axis - Minimum=.09 Maximum=.22)

1971 (Vertical Axis - Minimum=.09 Maximum=.22)



1972 (Vertical Axis - Minimum=.11 Maximum=.24)

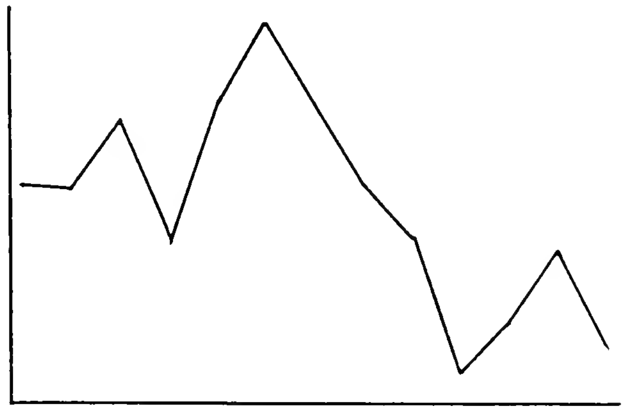
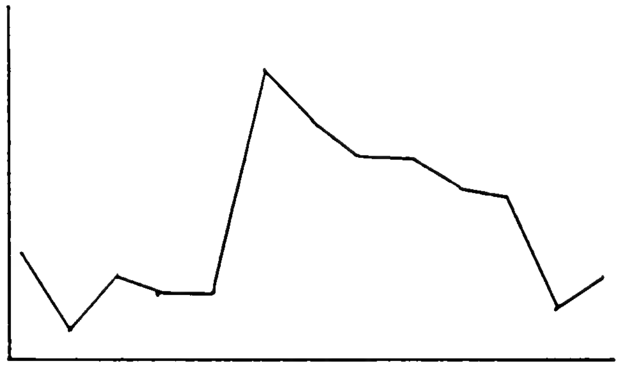
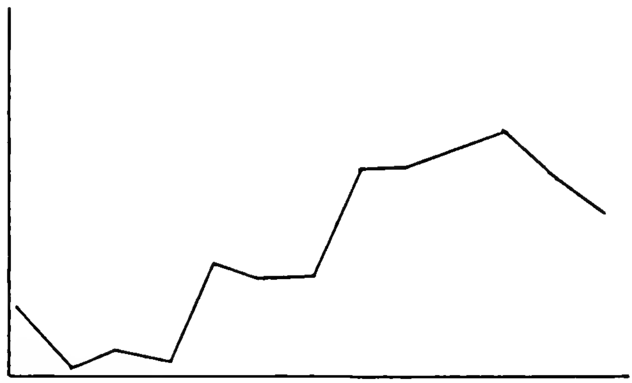


Figure 3. Continued

1973 (Vertical Axis - Minimum=.14 Maximum=.24)



1974 (Vertical Axis - Minimum=.20 Maximum=.50)



1975 (Vertical Axis - Minimum=.20 Maximum=.80)

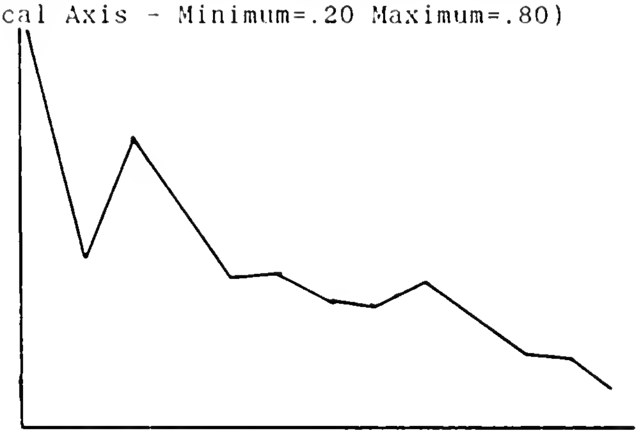


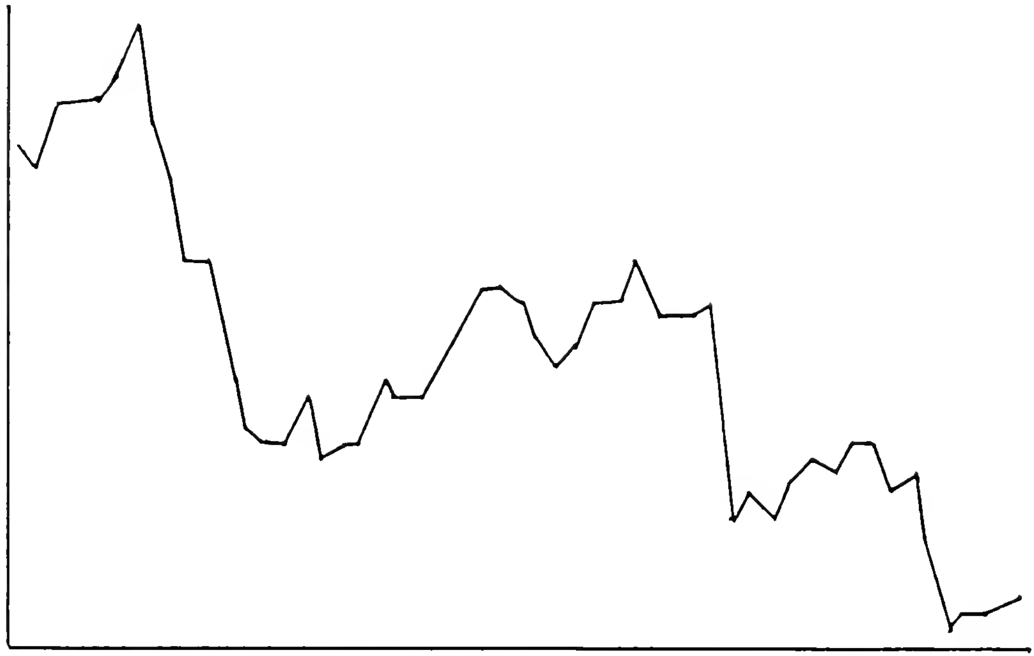
Figure 3. Continued

1976 (Vertical Axis - Minimum=.10 Maximum=.50)

Figure 4. Graph of Average Standard Deviation over Time for 1982

Vertical Axis: Mean Standard Deviation (n=34)
Minimum .334 Maximum .484
Horizontal Axis: Time

a. Weekly Observations



b. Quadri-weekly Observations

Figure 5. Graph of Average Coefficient of Variation over Time for 1982

Vertical Axis: Mean Coefficient of Variation (n=34; quadri-weekly observations)

Minimum .134 Maximum .791

Horizontal Axis: Time

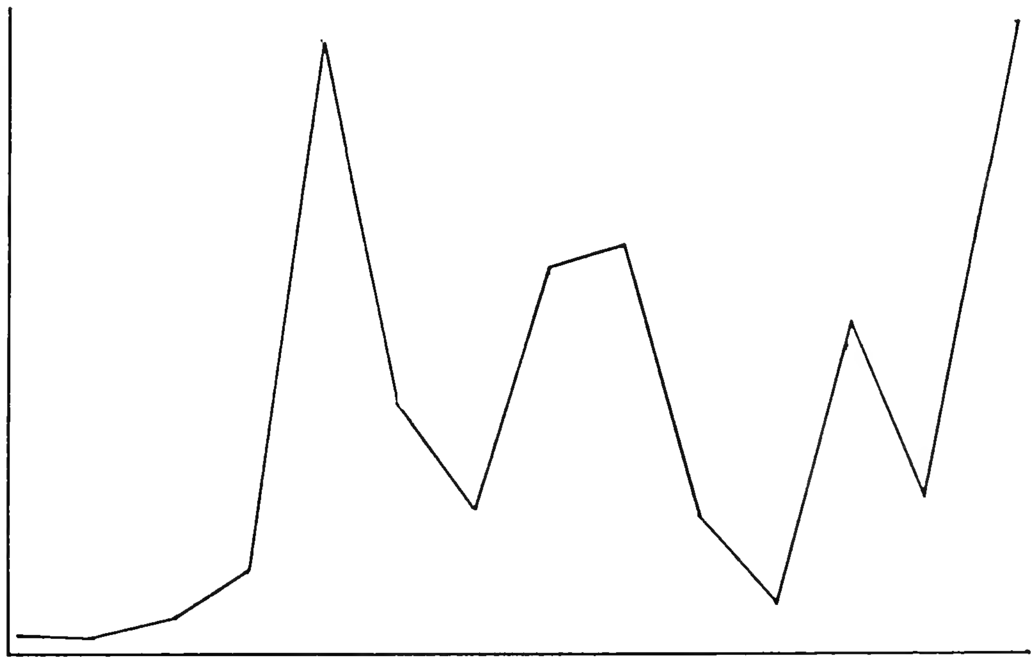


Figure 6. Graph of Average Consensus Forecast over Time for 1982

Vertical Axis: Mean Consensus Forecast (n=34; quadri-weekly observations)
Minimum $3.38 Maximum $4.51
Horizontal Axis: Time

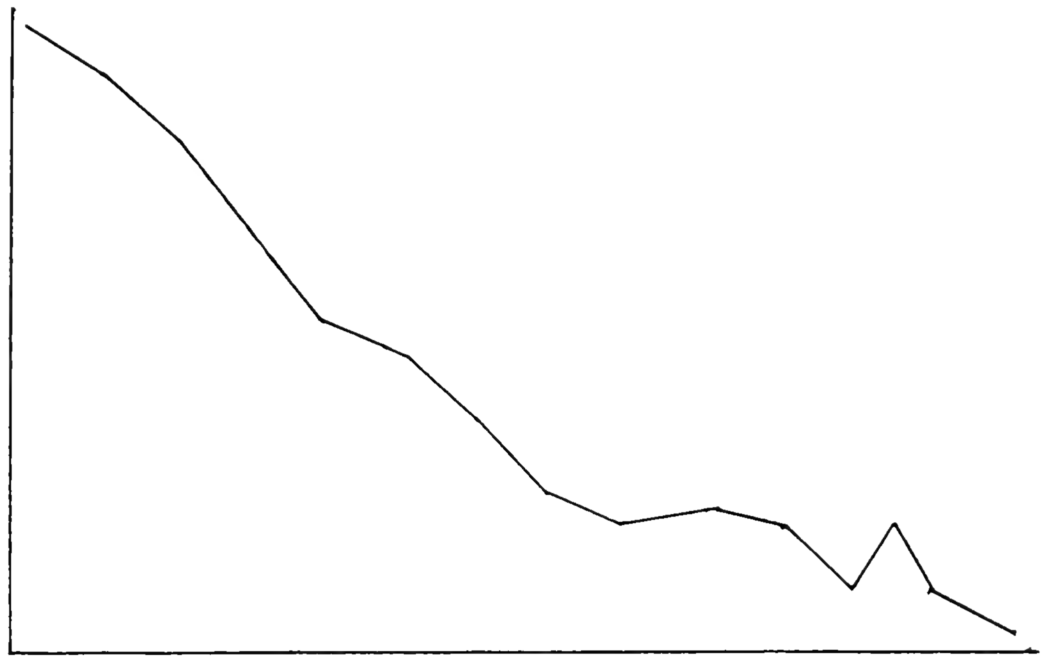
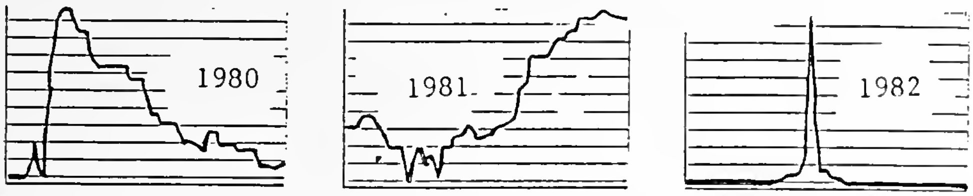


Figure 7. <u>Graphs of Coefficient of Variation (for individual firms) Plotted Against Time</u>

Note: the horizontal axis depicts the 52 weeks of the year and is common for all the graphs, the vertical axis represents the coefficient of variation and varies across graphs

Amax



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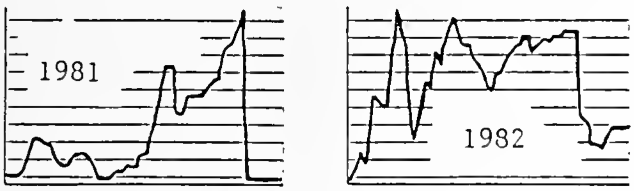
Amerada Hess



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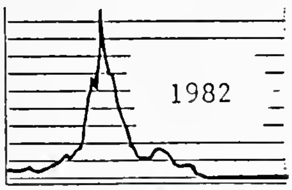

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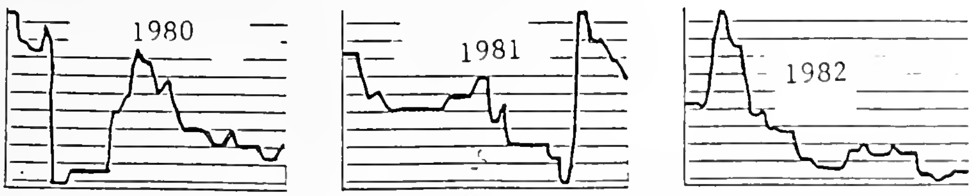

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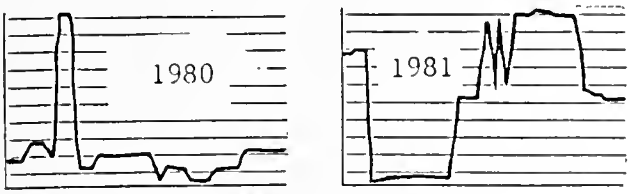

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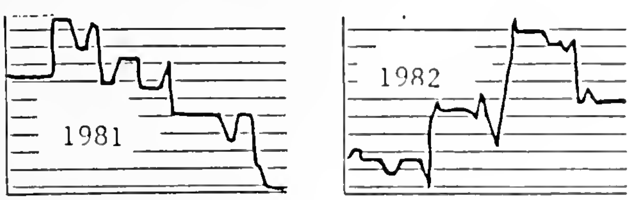

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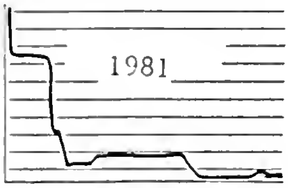

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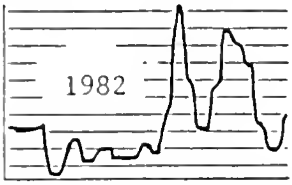

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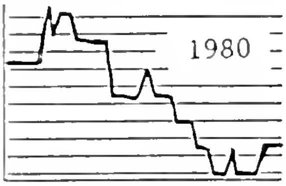

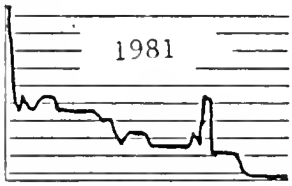

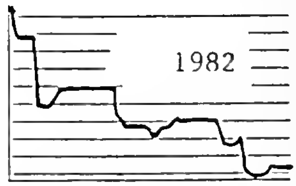

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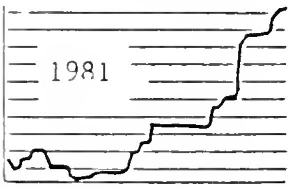

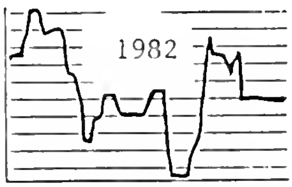

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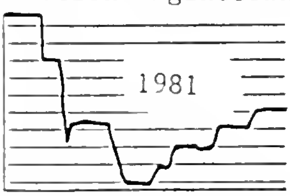

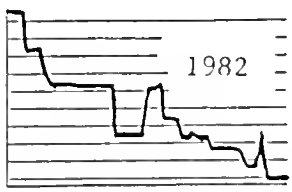

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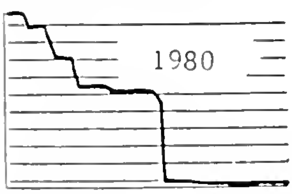
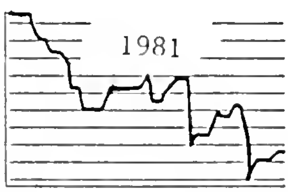
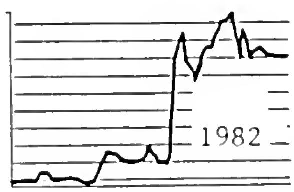
Cooper Industries







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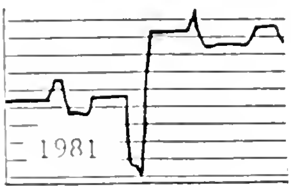

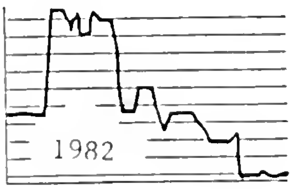

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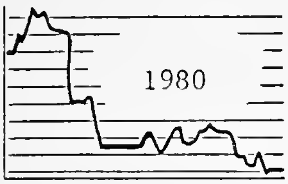

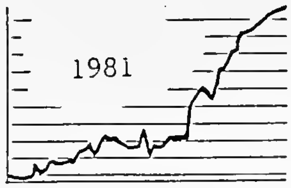

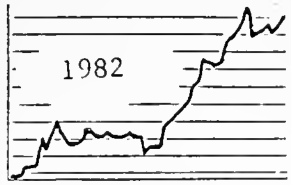

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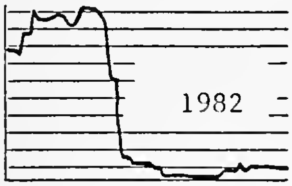

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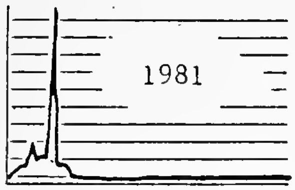
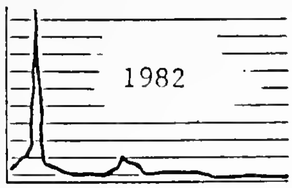
Ford





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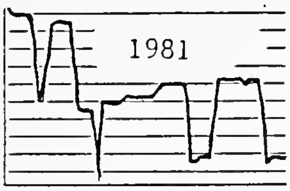
Foster Wheeler



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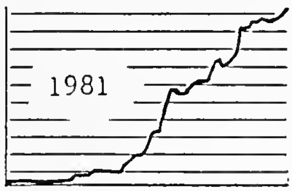
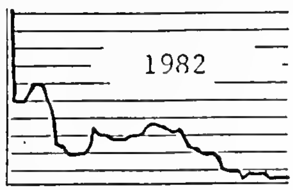
Gillette





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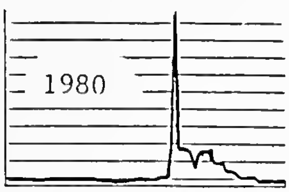

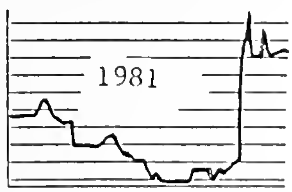

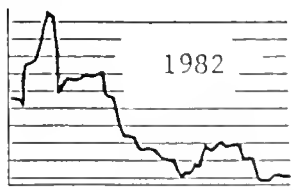

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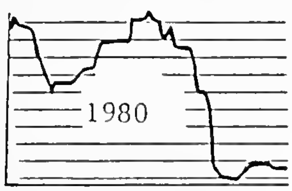

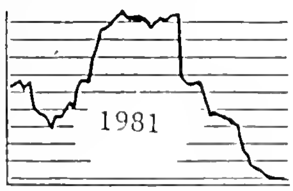

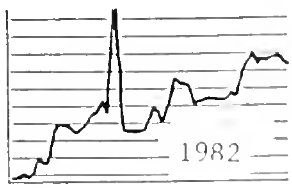

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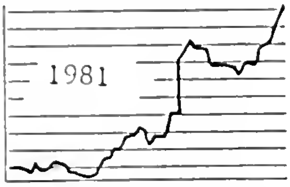

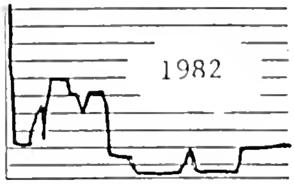

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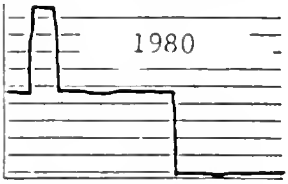

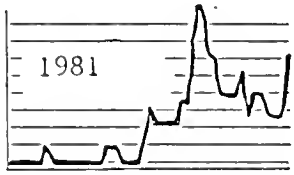

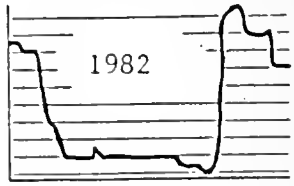

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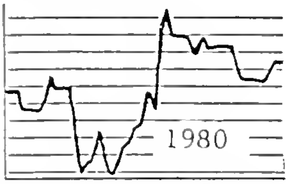
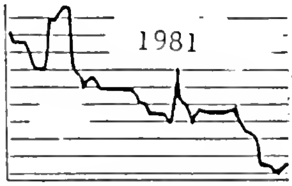
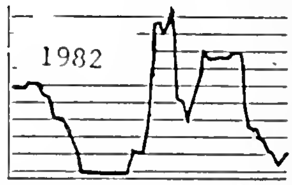
Lilly, Eli.







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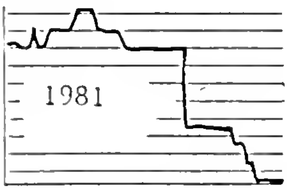
Masco



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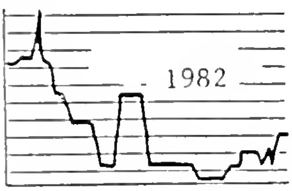

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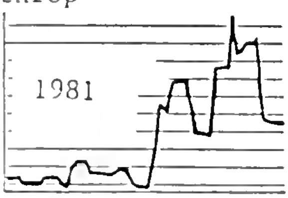

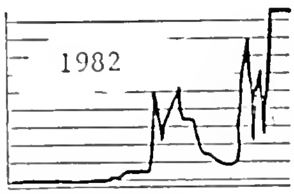

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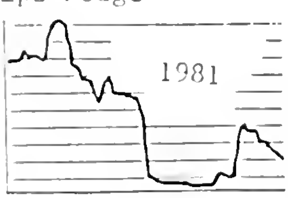

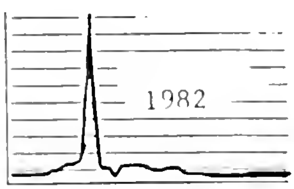

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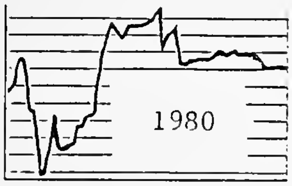

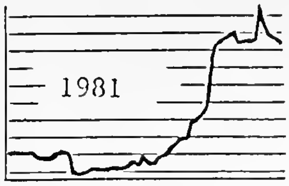

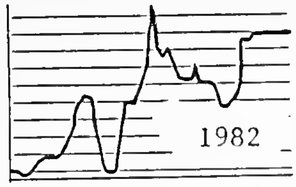

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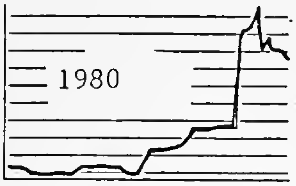

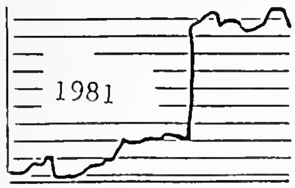

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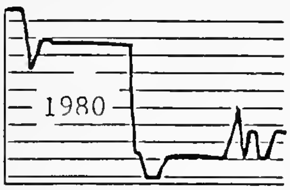
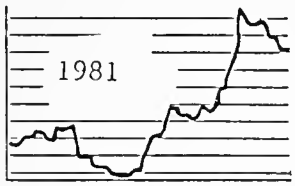
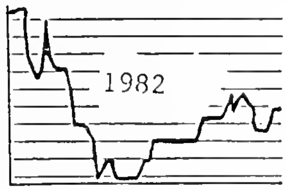
Schering Plough







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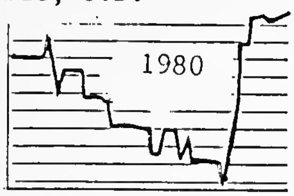
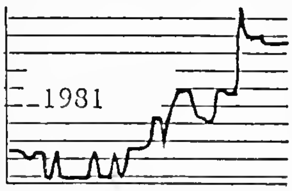
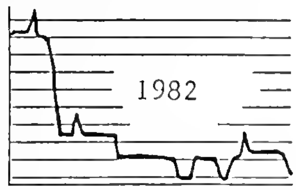
Searle, G.D.







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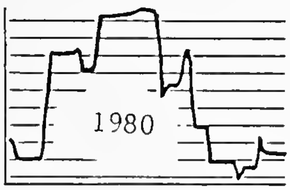
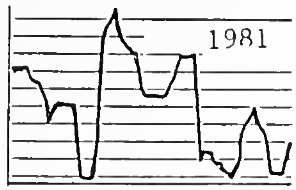
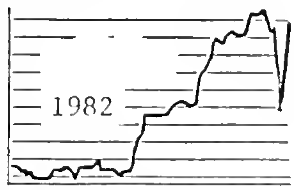
Smith International







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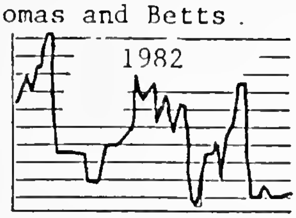
Thomas and Betts .



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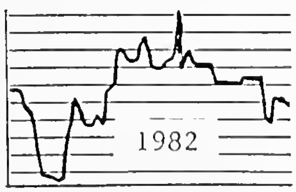
Times Mirror



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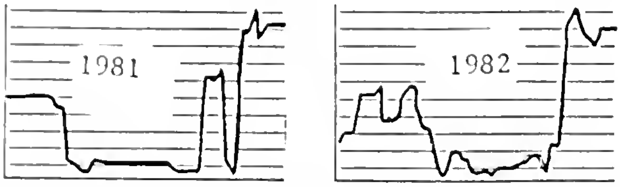
TRW



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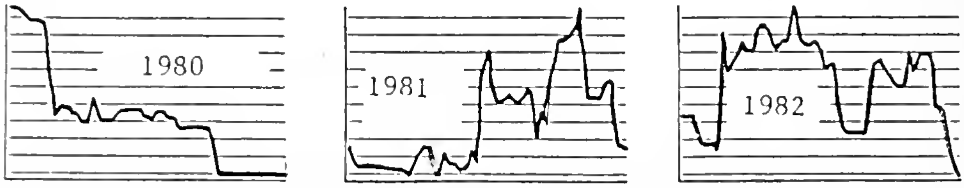
Upjohn



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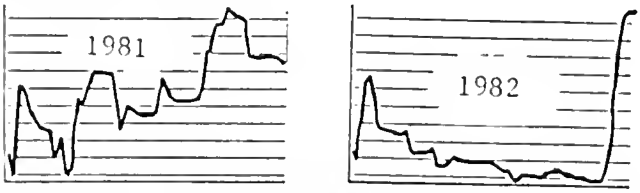
Warner Communications



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Warner Lambert

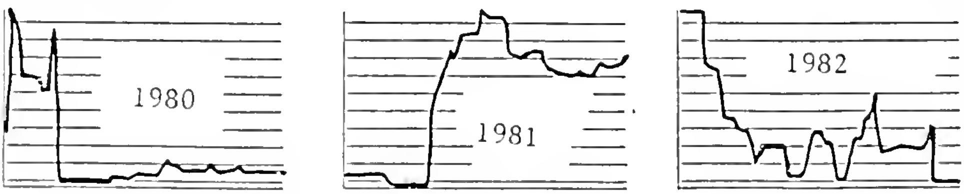

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Table 2. Regression Results: $\tilde{D}_{it} = \hat{a}_i + \hat{b}_i \tilde{D}_{it-1} + \tilde{e}_{it}$

Firm and Year	Ordinary Least Squares			Maximum Likelihood Autoregressive (Grid search with Dhrymes' distributed lag correction)		
	Est. Coeff.	St. Error	R^2	Est. Coeff.	St. Error	R^2
Amax						
1980[2]	.9277	.0503	.87	.8755	.0833	.89
1981	.9992	.0312	.95	.9987	.0316	.95
1982[2]	.4247*	.1294	.18	.3998$	.3441	.18
Amerada Hess						
1981	.8196*	.0823	.67	.7991	.1094	.67
1982[3]	.8185*	.0718	.73	.7396*	.1306	.74
Ampco Pittsburgh						
1982	.8880*	.0665	.78	.9200	.0594	.79
Avon						
1980	.8411*	.0659	.77	.8107	.0886	.77
1981	.8436	.0738	.73	.6648	.3128	.76
1982	.9539	.0436	.91	.9034	.0760	.92
Baxter Travenol Labs.						
1980	.6831*	.1043	.47	.4488	1.2962	.50
1981	.8762*	.0679	.77	.9193	.0567	.78
1982	.9501	.0398	.92	.9597	.0363	.92
Big Three						
1981	.9620	.0597	.84	.9734	.0592	.84
1982	.9023*	.0575	.83	.8989	.0632	.83
Braniff						
1981	.8827	.0342	.93	.8817	.0349	.93
Burndy						
1982[3]	.8358*	.0785	.70	.7015	.2103	.72
Capital Cities Communications						
1980	.9535	.0449	.90	.9707	.0367	.91
1981[2]	.7320	.0628	.74	.1425$	.1038	.81
1982	.8881*	.0447	.89	.8857	.0470	.89

Table 2. Continued

Colgate Palmolive						
1981	1.0363	.0261	.97	1.0355	.0265	.97
1982	.8518*	.0731	.73	.8172	.1014	.74
Combustion Engineering						
1981	.9164*	.0409	.91	.9225	.0379	.91
1982	.9084*	.0497	.87	.9235	.0438	.92
Cooper Industries						
1980	.9669	.0270	.96	.9633	.0298	.96
1981	.9188	.0498	.87	.9177	.0527	.87
1982	.9502	.0442	.90	.9502	.0455	.90
CPC						
1981	.8682*	.0707	.75	.8020	.1171	.76
1982	.9356	.0578	.84	.9339	.0628	.84
Dow						
1980	.9571	.0406	.92	.9594	.0402	.92
1981	1.0112	.0274	.97	1.0200	.0203	.97
Fairchild						
1982	.9767	.0296	.96	.9772	.0293	.96
Ford						
1981	.2228$	.1394	.05	.5019	.1731	.08
1982	.3850*	.1322	.15	.4674	.2308	.15
Foster Wheeler						
1981	.7533*	.0923	.58	.7572	.1165	.58
Gillette						
1981[3]	1.0163	.0140	.99	1.0137	.0175	.99
1982[2]	.7476	.0541	.80	.1167$	.0754	.91
General Motors						
1980	.2836*	.1369	.08	.5615	.1538	.12
1981	.9473	.0583	.84	.9122	.0806	.85
1982	.9509	.0483	.89	.9531	.0492	.89
Gulf Research and Chemical						
1980	.9858	.0343	.94	.9793	.0391	.94
1981	.9989	.0374	.94	.9920	.0419	.94
1982	.7962*	.0809	.66	.7806	.1040	.66
International Flavors and Fragrances						
1981	1.0118	.0311	.96	1.0107	.0322	.96
1982[2]	.6465	.0816	.56	-.0635$	.0925	.76

Table 2. Continued

Johnson and Johnson						
1980	.9351	.0546	.86	.9307	.0601	.86
1981	.9143	.0641	.81	.8993	.0802	.81
1982[2]	.9386	.0452	.90	.8592	.1050	.92
Lilly, Eli.						
1980	.8979	.0645	.80	.8781	.0806	.80
1981	.8800*	.0691	.77	.8396	.0982	.77
1982	.9263	.0565	.85	.9389	.0551	.85
Masco						
1981	1.0068	.0345	.95	1.0123	.0315	.95
Melville						
1982	.8773*	.0609	.81	.8948	.0577	.81
Northrop						
1981	.9058	.0588	.83	.9074	.0624	.83
1982	.8593	.0905	.65	.9928	.0614	.71
Phelps Dodge						
1981	.9601	.0371	.93	.9492	.0446	.93
1982	.5437*	.1209	.29	Non positive definite matrix		
Potlatch						
1980	.8957	.0626	.81	.8834	.0740	.81
1981	1.0019	.0274	.96	1.0002	.0286	.96
1982	.9276	.0521	.87	.8951	.0722	.87
Revlon						
1980	.9779	.0429	.91	.9788	.0436	.91
1981	.9760	.0356	.94	.9726	.0379	.94
Schering Plough						
1980	.9154*	.0497	.87	.9241	.0475	.87
1981	.9882	.0338	.95	.9776	.0408	.95
1982	.8897*	.0499	.87	.8960	.0489	.87
Searle, G.D.						
1980	.9512	.0532	.87	.9455	.0590	.87
1981	.9455	.0562	.85	.9826	.0420	.87
1982	.9038*	.0461	.89	.9054	.0467	.89
Smith International						
1980	.9246	.0558	.85	.9199	.0617	.85
1981	.8125*	.0829	.66	.6986	.1853	.68
1982	.9656	.0448	.90	.9861	.0249	.93
Thomas and Betts						
1982	.7518*	.0964	.55	.7097	.1559	.56

Table 2. Continued

Times Mirror						
1982	.8509*	.0756	.72	.8510	.0873	.72
TRW						
1981	.9085	.0709	.77	.8369	.1235	.78
1982	.9636	.0524	.87	.9184	.0795	.88
Upjohn						
1980[3]	.9451*	.0313	.95	.9339	.0400	.95
1981	.8555*	.0739	.73	.8418	.0913	.73
1982	.8641	.0856	.68	.8672	.1031	.68
Warner Communications						
1981	.8225*	.0765	.70	.8585	.0717	.71
1982	1.0109	.0811	.76	Non-positive definite matrix		
Warner Lambert						
1980	.7736*	.0903	.60	-.2126	.1182	.72
1981[2]	.9614	.0308	.95	.9466	.0419	.96
1982	.8676*	.0552	.83	.8847	.0498	.84

* denotes that the regression coefficient is significantly less than 1 at the .05 level with a one-tailed test

$ denotes that the regression coefficient is insignificant

2 denotes that the Durbin-Watson statistic for the OLS regression is less than the lower bound; autocorrelation is significant among the residuals

3 denotes that the Durbin-Watson statistic is within the inconclusive bounds

Table 3. Regression Results:

$$\text{Model (1)}\ \tilde{D}_{it} = \hat{a}_i + \hat{b}_i \tilde{D}_{it-4} + \tilde{e}_{it}$$

$$\text{Model (2)}\ \tilde{D}_{it} = \hat{a}_i + \hat{b}_i \tilde{D}_{it-8} + \tilde{e}_{it}$$

$$\text{Model (3)}\ \tilde{D}_{it} = \hat{a}_i + \hat{b}_i \tilde{D}_{it-12} + \tilde{e}_{it}$$

Firm and Year	Model 1		Model 2		Model 3	
	$\hat{b}$	S.E.	$\hat{b}$	S.E.	$\hat{b}$	S.E.
Amax						
1980	.091	.157	-.213	.081	-.045	.073
1981	.167	.148	.014	.151	.080	.141
1982	.042	.387	-.020	.357	-.033	.375
Amerada Hess						
1981	-.114	.167	.094	.176	NPD Matrix	
1982	.981	.156	-.122	.143	.065	.136
Ampco Pittsburgh						
1982	-.186	.152	-.021	.172	.022	.183
Avon						
1980	.135	.177	-.027	.168	-.075	.091
1981	.052	.171	-.059	.174	-.510	.417
1982	.103	.152	.049	.119	.672	.085
Baxter Travenol Labs.						
1980	-.093	.197	.007	.225	-.009	.141
1981	-.030	.164	.109	.144	-.011	.151
1982	-.071	.139	-.041	.139	-.073	.145
Big Three						
1981	-.096	.156	-.025	.186	-.017	.180
1982	.014	.159	.008	.169	.202	.133
Braniff						
1981	.048	.128	.373	.119	.004	.031
Burndy						
1982	-.214	.163	-.014	.190	.059	.229
Capital Cities Communications						
1980	.311	.172	.205	.147	-.157	.146
1981	-.012	.099	.099	.106	.119	.111
1982	.385	.157	-.037	.093	-.002	.104

Table 3. Continued

Colgate Palmolive						
1981	.144	.148	-.003	.153	.105	.248
1982	-.212	.146	.099	.177	-.161	.169
Combustion Engineerin						
1981	.395	.171	.046	.148	.046	.069
1982	.288	.191	.175	.199	.437	.259
Cooper Industries						
1980	.116	.145	.058	.151	.082	.156
1981	.031	.154	-.113	.196	-.051	.207
1982	-.079	.150	.158	.171	-.188	.183
CPC						
1981	-.063	.165	.069	.189	.095	.189
1982	-.048	.156	.119	.120	-.043	.132
Dow						
1980	.102	.148	-.191	.146	.002	.109
1981	.188	.147	-.009	.149	.267	.162
Fairchild						
1982	.076	.147	.084	.151	.028	.158
Ford						
1981	.208[1]	.145	-.018	.128	.002	.001
1982	.032	.438	-.007	.016	-.009	.016
Foster Wheeler						
1981	.192	.302	.043	.186	-.049	.190
Gillette						
1981	.498*	.132	.525*	.138	.548*	.183
1982	-.037	.076	.247*	.057	.028	.053
General Motors						
1980	.029	.603	.026	.616	-.065	.487
1981	.153	.165	.067	.214	.067	1.185
1982	.066	.141	-.097	.137	.126	.087
Gulf Research and Chemical						
1980	.239	.148	-.035	.139	-.139	.143
1981	.236	.150	-.010	.149	-.029	.162
1982	.164	.219	.013	.198	.145	.247
International Flavors and Fragrances						
1981	-.035	.154	.017	.166	.299*	.176
1982	-.141	.092	-.041	.072	.099	.074

Table 3. Continued

Johnson and Johnson						
1980	.052	.160	.016	.129	.013	.094
1981	-.082	.179	.381	.314	-.150	.211
1982	-.041	.155	-.010	.145	-.028	.237
Lilly, Eli.						
1980	.062	.171	.050	.170	.095	.180
1981	-.139	.159	-.038	.195	-.041	.205
1982	-.106	.150	.129	.154	.102	.133
Masco						
1981	.030	.147	.062	.152	.179	.166
Melville						
1982	-.075	.162	.131	.162	-.030	.146
Northrop						
1981	-.528	.153	.307	.249	-.107	.245
1982	.245	.506	-.138	.851	NPD Matrix	
Phelps Dodge						
1981	-.030	.151	-.041	.149	.024	.163
1982	-.001	.274	.008	.292	-.006	.304
Potlatch						
1980	.042	.144	.038	.114	-.168	.101
1981	.038	.159	.464*	.209	-.061	.143
1982	-.182	.146	.099	.168	.098	.203
Revlon						
1980	-.267	.142	-.015	.177	NPD Matrix	
1981	.061	.152	.030	.159	.044	.164
Schering Plough						
1980	-.002	.144	.097	.172	.101	.187
1981	.251	.155	-.036	.161	.121	.227
1982	.457*	.214	.355*	.127	.153	.128
Searle, G.D.						
1980	.129	.160	.148	.160	.111	.227
1981	.262	.175	-.025	.162	.267	.266
1982	-.197	.145	.223*	.056	.212*	.059
Smith International						
1980	-.085	.153	.051	.139	-.235	.138
1981	-.210	.158	-.045	.195	.034	.219
1982	NPD Matrix		NPD Matrix		NPD Matrix	
Thomas and Betts						
1982	-.059	.187	-.296	.169	-.049	.222

Table 3. Continued

Times Mirror						
1982	.069	.182	.032	.178	-.092	.142
TRW						
1981	-.232	.149	.027	.220	-.008	.356
1982	-.052	.146	.045	.159	-.180	.250
Upjohn						
1980	.111	.146	-.033	.114	-.013	.999
1981	.033	.192	-.032	.232	-.091	.259
1982	-.034	.176	-.051	.136	-.217	.130
Warner Communications						
1981	-.106	.123	-.133	.128	.039	.132
1982	-.004	.179	-.021	.184	.128	.192
Warner Lambert						
1980	.128	.146	.177	.132	-.003	.015
1981	.189	.151	.049	.157	-.001	.164
1982	.019	.158	.229*	.118	.069	.124

* denotes that the regression coefficient is significantly less than 1 at the .05 or better level for a one-tailed test

[1] denotes that auto correlation is not a problem and the estimates are OLS