

Developments in Business Simulation & Experiential Exercises, Volume 10, 1983

IMPORTANCE RATINGS AND OPERATIONS DATA AS PREDICTORS OF BUSINESS GAME PERFORMANCE

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INTRODUCTION

Efforts to predict future business game performance in terms of such overall measures as rate of return on assets and stock market price have not met with resounding success. However, the effect of including intermediate indicators, such as total sales volume, net income/sales, sales/R&D expenses, etc. for a number of teams in a multiple regression equation, to predict future return on assets or stock market prices for individual teams, has not been fully explored.

A related question is whether student or manager rankings of the importance of selected performance indicators (e.g., total sales, sales/advertising, net income/gales, sales/R&D expense) in one year could be used to predict rate of return or stock market price in future periods. This study is designed to investigate the perceived importance, as well as the actual value of certain return measures used to forecast organizational performance.

Six teams of undergraduate students (usually three to four members each) in a business policy class were used in an experiment to determine if performance ratings and previous period performance results can serve as valid predictors of future financial performance in a business game. Developed by Keys and Leftwich (1977) The Executive Simulation is a moderately complex game with two products and about a dozen decision variables, including selling price, advertising and research/development outlays, production units, number of salesmen and distribution centers, debt and dividend levels. Two trial decisions and eight quarters, simulating two years of play, were conducted. Income statements, balance sheets, and selected performance measures were calculated at the end of each quarter.

During the first year of game play, group members were asked to complete a survey form which contained fourteen commonly used marketing, production, and financial performance measures, of which eight were selected for further analysis. Groups 1 and 2 filled out the survey forms during period 2 of play, groups 3 and 4 completed the forms during period 3, and group! 5 and 6 filled in their forms during period 4. Key performance measures were also recorded for the various groups during corresponding periods of the second year of play (i.e., period 6 for groups 1 and 2, period 7 for groups 3 and 4, and period 8 for groups 5 and 6).

IMPORTANCE RATINGS AND FORECASTED PERFORMANCE MEASURES

Table I contains, the importance ratings assigned by each of the six teams to eight a elected performance measures during year one. Five was the high eat possible rating, and one was the lowest. Average or Mean Ratings for all six groups for each selected performance measure as we as ranges were calculated to indicate the relative importance overall of each performance measure as well as the dispersion of rankings for the various groups. Net income/sales has the highest average rating followed by total unit sales.

TABLE I
IMPORTANCE RATINGS FOR SELECTED PERFORMANCE MEASURES BY BUSINESS GAME GROUPS
(FIRST YEAR)

Performance Measures	I	II	III	IV	V	VI	\bar{X}	Range
1. Total Sales (Units)	4.33	3.00	4.33	5.00	3.00	3.67	3.89	2.00
2. Total Sales/ Salesmen	3.33	2.75	4.33	4.00	2.00	3.67	3.35	2.33
3. Net Income/Sales	4.67	3.00	4.33	3.67	4.25	4.00	3.99	1.67
4. Net Income/Assets	4.33	2.50	3.67	3.50	3.25	3.67	3.49	1.83
5. Current Assets/ Current Liabilities	4.67	2.50	3.00	3.50	2.50	3.67	3.31	2.17
6. Stock Market Price	3.33	4.00	2.67	3.00	3.50	4.33	3.47	1.60
7. Sales Revenue/ Advertising Expense	2.67	3.50	3.67	3.50	3.75	3.00	3.35	1.08
8. Sales Revenue/ R&D Expenses	2.67	3.50	3.33	2.50	4.00	3.00	3.17	1.50

Net income/assets and stock market price are third and fourth in importance on an average basis. Total sales/salesmen and sales revenue/advertising expense \$ are ranked fifth and sixth in importance while current assets/current liabilities and sales revenue/R&D expense, on the average were rated seventh and eighth.

Sales Revenue/Advertising Expense \$ and Sales Revenue/R&D expense had the smallest ranges, indicating less disagreement on the importance of these measures among the six groups. Stock Market Price and Net Income/Sales had the next highest ranges followed by Net Income/Assets and Total Sale! (Units). The two measures with the largest ranges, indicating the greatest amount of disagreement on importance, were current assets/current liabilities and total sales As can be seen from Table I, total sales and net/income/sales, on the average were ranked highly more often than net income/assets or stock market price. Sales Revenue/Advertising, Sales Revenue/R&D Expense, Current Assets/Current Liabilities, and Net Income/Assets were ranked lower more often than the other four measures.

Table II contains the values of the dependent and independent variables based on importance ratings which were used with a multiple correlation program to determine the degree of association between selected intermediate measures and the two chosen financial measures of return (i.e., return on assets and stock price). When values for variables X(3) and X(4), all for year one, are correlated with X(6) for year two, a multiple correlation coefficient of .96 is achieved. Thus, a high correlation with year two return on assets occurs when net income/assets (year one), and stock price (year one) are included in the multiple regression equation.

When the appropriate first year values of X_3 and X_4 are substituted in the regression equation, (i.e., $YRI = 93.42 - 10.39X_3 - 15.72X_4$) predicted return on asset values can be calculated for the second year as shown in Table II In five of six cases, the forecasted return on asset figures are reasonably close to the actual results. Thus, the two variable multiple regression equation provides an efficient and effective forecast of future financial performance without the need to include a large number of variables.

OPERATIONS DATA AND FORECASTED PERFORMANCE MEASURES

Table III contains a listing of the actual results for eight selected performance measures for the six teams.

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TABLE II
VALUES OF VARIABLE INCLUDED IN MULTIPLE CORRELATION ANALYSIS
TO PREDICT FINANCIAL MEASURES OF RETURN

Team	Total Sales (X ₁)	Sales/ Salesmen (X ₂)	Net Income/ Assets (X ₃)	Stock Price (X ₄)	Sales/ R&D (X ₅)	Net Income/ Assets (Actual II) (X ₆)	Stock Price (Actual II) (X ₇)
1	4.33	3.33	4.33	3.33	2.67	-6.34	38.47
2	3.00	2.75	2.50	4.00	3.75	2.99	50.44
3	4.33	4.33	3.67	2.67	3.33	14.81	93.69
4	5.00	4.00	3.50	3.00	2.54	-8.12	23.66
5	3.00	2.00	3.25	3.50	4.00	5.20	45.83
6	3.67	3.67	3.67	4.33	3.00	-10.84	35.52

Multiple Regression Equation:

$$YR_H = 93.42 - 10.39X_3 - 15.72X_4$$

$$R_{MULT} = .96$$

Calculation of ROA for individual teams:

$$R_1 = 93.42 - 10.39(4.33) - 15.72(3.33) = -3.92$$

$$R_2 = 93.42 - 10.39(2.50) - 15.72(4.00) = 4.56$$

$$R_3 = 93.42 - 10.39(3.67) - 15.72(2.67) = 13.32$$

$$R_4 = 93.42 - 10.39(3.50) - 15.72(3.00) = 9.89$$

$$R_5 = 93.42 - 10.39(3.25) - 15.72(3.50) = 4.63$$

$$R_6 = 93.42 - 10.39(3.67) - 15.72(4.33) = -12.78$$

As Table III indicates, two thirds of the teams increased total sales in units, net income/sales, current ratio, and stock market price. Only one third of the teams monitored increased sales revenue/advertising dollar and only one-sixth of the teams increased sales/salesman and sales revenue/R&D outlays.

TABLE II
ACTUAL PERFORMANCE RESULTS FOR SIX TEAMS USING SELECTED PERFORMANCE MEASURES

Performance Indicator	Group I Year		Group II Year		Group III Year		Group IV Year		Group V Year		Group IV Year	
	I	II	I	II	I	II	I	II	I	II	I	II
Total Sales Units	6372	6090	3980	6960	6086	8736	131	1816	7486	9436	5705	3140
Sales/Salesmen	797	435	398	387	405	317	35	182	299	236	501	262
Net Income/Sales	11.67	-6.78	0.02	2.04	5.56	11.84	-14.56	-	9.47	8.46	6.72	-15.54
								10.33				
Net Income/Assets	8.51	-6.34	0.99	2.99	5.81	14.81	-16.51	-8.12	1.68	5.20	5.99	-10.84
Current Assets/												
Current Liabilities	2.86	2.26	1.19	0.93	1.35	2.05	0.55	0.72	3.70	29.77	1.47	1.38
Stock Market Price	61.32	38.47	44.48	50.44	69.77	93.69	32.43	23.66	43.44	45.83	63.71	35.52
Sales Revenue/												
Advertising Expense	3.07	3.67	9.04	4.72	10.70	7.31	0.23	2.54	77.27	5.01	10.61	2.40
Sales REvenue/												
R&D Expense	12.07	5.20	18.08	5.73	8.28	7.31	2.50	3.00	11.17	28.10	14.14	6.00

COMPARISON OF FORECASTED ROA USING TWO DATA SETS

Table IV contains first year values for selected performance measures (X₁ to X₆) which resulted for individual teams and the second year values for net income/assets and stock price for year two (X₇ and X₈). The regression equation is also shown. When values X₃, X₅, and are included in a multiple correlation equation to determine the association with period two financial measures, the first year net income/sales, sales revenue/R&D outlays, and stock market prices can be used to predict year two return on Assets with a high degree of accuracy for this sample. year two are reasonably close to the year two figures for return

TABLE IV
VALUES OF PERFORMANCE MEASURES INCLUDED IN MULTIPLE REGRESSION ANALYSIS TO PREDICT PERFORMANCE MEASURES FOR FUTURE PERIOD

Team	Total Sales - 1 (X ₁)	Net Income/ Sales - 1 (X ₂)	Net Income/ Assets - 1 (X ₃)	Stock Price - 1 (X ₄)	Sales/ R&D - 1 (X ₅)	Sales/ Advertising - 1 (X ₆)	Net Income/ Assets - 2 (X ₇)	Stock Price (X ₈)
1	6372	11.76	8.51	61.32	12.07	12.07	-6.34	38.47
2	3980	0.02	0.99	44.48	18.08	9.04	2.99	50.44
3	6086	5.56	5.81	67.77	8.28	10.70	14.81	93.69
4	131	-14.56	-16.51	32.43	3388.00	0.23	-8.12	23.66
5	7486	9.47	1.68	43.44	11.17	577.27	5.20	45.83
6	5705	6.72	5.99	68.71	14.14	-10.61	-10.84	35.52

Multiple Regression Equation:

$$YR_1 = 82.50 - 3.38X_5 - 2.02X_2 - .43X_4$$

$$R_{MULTIPLE} = .98$$

Calculation of ROA for individual teams:

$$R_1 = 82.50 - 3.38(12.07) - 2.02(11.76) - .43(61.76) = -8.43$$

$$R_2 = 82.50 - 3.38(18.08) - 2.02(0.02) - .43(44.48) = 2.22$$

$$R_3 = 82.50 - 3.38(8.23) - 2.02(5.56) - .43(67.67) = 13.32$$

$$R_4 = \text{cannot not be calculated accurately from data available}$$

$$R_5 = 82.50 - 3.38(11.17) - 2.02(9.47) - .43(43.44) = 6.94$$

$$R_6 = 82.50 - 3.38(14.14) - 2.02(6.72) - .43(68.71) = -8.41$$

on assets. In the case of team four, the existence of negative figures for X₂ and X₃ make it impractical to calculate the return on assets for that team.

As Table V indicates, in three of six cases (i.e., teams two, five, and six), the forecasted values for return on assets based on importance ratings produce a smaller forecasting error than when selected actual performance measures (year one) are used. In two of six cases, the forecasted values based on selected actual performance measures produce a smaller forecasting error (i.e., for teams one and three) than that for forecasted returns computed using importance ratings. It was not possible to calculate a valid forecast for team four using selected performance measures, so no meaningful comparison is possible. Overall, the average forecasting error using the actual performance measure was 1.92 or considerably less than the 4.34 average forecasting error for the importance ranking-based forecast. But for five of the six companies, the year two forecasted values for return on assets using either selected performance measures or importance rankings provides a reasonably accurate estimate of the return on assets four quarters later.

COMPARISON OF FORECASTED STOCK PRICES USING TWO DATA SETS

Table VI contains importance rankings for total sales (X₁), total sales/salesmen (X₂), net income/assets (x₃), stock price (X₄), and sales/R&D (X₅) for period one and actual net income/assets (X₆) and stock price (x₇) for period two. A multiple correlation analysis relating importance ratings for X₁ to X₅ with stock market

price for period two produces a multiple correlation coefficient of only .50. The only two variables included in the multiple regression equation are net income/assets, and stock market price for period one. Only the forecasted values for teams one, two, and five are reasonably close to the period two values.

Table VII contains actual values for net income/sales, net income/assets, stock price, and sales/R&D for period one and return on assets and stock price for period two. In contrast with the analysis of importance ratings, the multiple correlation analysis of actual performance measures with period two stock price, including net income/sales, sales R&D \$, and stock price for period one, results in a multiple correlation coefficient of .98. Estimated stock price values for teams two, three, and five are very close to actual figures, while the estimated values for teams one and six differ from actual values by moderate amounts. It is not possible to calculate an estimated value for team four because of the negative values assumed by some of the independent variables in period one.

Table VIII contains a comparison of forecasting errors for estimated stock prices based on importance

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TABLE V
A COMPARISON OF ESTIMATED VALUES FOR RETURN ON ASSETS USING IMPORTANCE RATINGS
WITH ESTIMATED VALUES BASED ON PERFORMANCE MEASURES

Team	Two Variable		Forecasting Error	Forecast Based on Performance Measures	Forecasting Error
	Actual Return on Assets II	Forecast Based on Ratings			
1	-6.34	-3.92	2.42	-8.43	2.09
2	2.99	4.56	1.57	2.22	2.34
3	14.81	13.22	1.49	14.31	0.99
4	-8.12	9.89	18.02	N/A	--
5	5.20	4.63	0.57	6.94	1.74
6	-10.84	-12.78	1.94	8.41	2.43
Total			26.01		9.59
Avg.					

TABLE VI
VALUES OF TEAM IMPORTANCE RATINGS FOR SELECTED FACTORS TO BE CORRELATED
WITH PERIOD II PERFORMANCE

Team	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇
1	4.33	3.33	4.33	3.33	2.67	-6.34	38.47
2	3.00	2.75	2.50	4.00	3.75	2.99	50.44
3	4.33	4.33	3.67	2.67	3.33	14.81	93.69
4	5.00	4.00	3.50	3.00	2.54	-8.12	23.66
5	3.00	2.00	3.25	3.50	4.00	5.20	45.83
6	3.67	3.67	3.67	4.33	3.00	-10.84	35.52

Multiple regression equation for stock prices:

$$Y_{SP11} = 153.89 - 20.78 X_4 - 9.70 X_3 \quad R_{MUL} = .50 < R_{.05} = .81$$

Calculation of stock prices for individual teams:

$$Y_1 = 153.89 - 20.78 (3.33) - 9.70 (4.33) = 153.89 - 69.20 - 42.00 = 42.69$$

$$Y_2 = 153.89 - 20.78 (4.00) - 9.70 (2.50) = 153.89 - 83.12 - 24.25 = 46.50$$

$$Y_3 = 153.89 - 20.78 (2.67) - 9.70 (3.67) = 153.89 - 55.48 - 35.60 = 62.80$$

$$Y_4 = 153.89 - 20.78 (3.00) - 9.70 (3.50) = 153.89 - 63.34 - 33.95 = 57.60$$

$$Y_5 = 153.89 - 20.78 (3.50) - 9.70 (3.25) = 153.89 - 72.73 - 31.53 = 49.63$$

$$Y_6 = 153.89 - 20.78 (4.33) - 9.70 (3.67) = 153.89 - 89.98 - 35.60 = 28.30$$

TABLE VII
VALUES OF ACTUAL PERIOD I PERFORMANCE MEASURES TO BE CORRELATED
WITH PERIOD II MEASURES

Team	X ₁ Net Income/ Sales	X ₂ Return on Assets - I	X ₃ Stock Price - I	X ₄ Sales/ R&D Outlays	X ₅ Return on Assets II	X ₆ Stock Price II
1	11.76	7.51	61.32	12.07	-6.34	38.47
2	0.02	0.99	44.48	18.08	2.99	50.44
3	5.56	5.81	62.77	8.23	14.81	93.69
4	-14.56	-16.51	32.43	N/A	-8.12	23.66
5	9.47	1.68	43.44	11.17	5.20	45.83
6	6.72	5.99	68.71	14.14	-10.84	35.52

Multiple Regression Equation

$$SP_{11} = 178.09 - 5.43 X_3 - 7.26 X_6 + .81 X_4 \quad R_{MUL} = .98$$

Calculation of estimated return on assets:

$$SP_1 = 178.09 - 5.43 (11.76) - 7.26 (12.07) + .81 (8.51) = 33.49$$

$$SP_2 = 178.09 - 5.43 (0.02) - 7.26 (18.08) + .81 (0.99) = 47.52$$

$$SP_3 = 178.09 - 5.43 (5.56) - 7.26 (8.23) + .81 (5.81) = 92.86$$

SP₄ = cannot be calculated

$$SP_5 = 178.09 - 5.43 (9.47) - 7.26 (11.17) + .81 (1.68) = 46.94$$

$$SP_6 = 178.09 - 5.43 (6.72) - 7.26 (14.14) + .81 (5.99) = 41.91$$

ratings and actual performance measures with actual stock prices. Only in the case of team one is the forecasting error for values based on importance ratings less than the forecasting error for values based on performance measures. The forecasting errors for teams two, three, five, and six are less for values based on actual performance measures than for values based on importance ratings. The average forecasting error for performance measure values is 3.25, considerably less than the average forecasting error of 13.99 for the values based on importance ratings.

SUMMARY AND CONCLUSIONS

Of the eight performance measures considered, net income/sales and total unit sales are ranked higher than net income/assets and stock market price by a majority of the teams. Sales Revenue/Advertising dollars and Sales Revenue/R&D Outlays, current assets/current liabilities, and

total sales/salesmen were ranked lower than other measures by a majority of teams. The only importance ratings that correlate highly with period two net income/assets are net income/assets and stock market price for period one. Net income/Sales, Sales Revenue/R&D, and Stock Market Price for period one seem to be the most significant actual performance measures in predicting return on assets for period two. The only variable common to both forecasting approaches (i.e., importance ratings and performance measures) is stock market price. The average forecasting error is 4.34 for importance ratings and 1.92 for performance measures, so the performance measure based forecasts are clearly more accurate in most cases..

TABLE VIII
A COMPARISON OF FORECASTED VALUES FOR STOCK MARKET PRICE BASED ON IMPORTANCE
RATING WITH FORECASTED VALUES BASED ON ACTUAL PERFORMANCE MEASURES

Team	Actual Stock Price II	Forecasted Values from Importance Rating	Forecast Error 1	Forecasted Values from Performance Measures	
					Forecast Error 2
1	38.47	42.68	4.22	33.49	4.98
2	50.44	46.52	3.92	47.52	2.92
3	93.69	62.82	30.87	92.86	0.83
4	23.66	57.60	33.94	N/A	--
5	45.83	49.63	3.80	46.93	1.10
6	35.52	28.31	7.21	41.94	6.42
Total			83.96		16.25
Average			13.99		3.25

Net income/assets-I and stock market price-I are the most useful variables in predicting stock market price for period two from importance measures, but the forecasted values are not very accurate. Net income/sales-I, Sales Revenue/R&D-I, and Stock Price-I are the most important variables in predicting stock price for period two from actual performance measures. The average forecasting error for forecasts based on importance ranking is 13.96 compared to 3.25 for forecasts based on performance measures. Therefore, performance measure based forecasts of stock market price are much more accurate than forecasts based on importance measures. In addition, return on assets can be forecast more accurately than stock price based on the variables considered.

In terms of importance rankings, it is possible to identify two to four variables which student teams believe to be more important than other variables on a selected list. In the case of both importance rankings and actual performance, six to eight variables can be reduced to two or three significant factors for purposes of predicting return on assets and stock market price in future periods. Return on assets can be predicted with a reasonable degree of accuracy using either importance ratings or performance measures, but only actual performance measures result in an accurate forecast of stock market price. Generally, performance measure based forecasts are more accurate than importance rating based forecasts for both measures.

While the results of this study indicate some fruitful directions for further research, a note of caution should be interjected. The examination period included only eight quarters of play and six teams in one class. The effects of the interaction of the decisions of six teams and a changing economic index were not explicitly considered. Only a few factors and importance measures were evaluated. A larger number of influencing factors, more teams, and longer time periods are undoubtedly needed to validate the results. The business game results should also be compared with similar results for actual companies in consumer products and related industries. Despite these limitations, the exploratory results suggest it may be possible to identify a few key factors which are likely to have the greatest effect on selected performance measures.