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UNDERSTANDING CAUSALITY THROUGH PATH ANALYSIS FOR BETTER BUDGETING AND MANAGEMENT CONTROL

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Budgeting translates organizational goals into managerial performance. To achieve the manager's acceptance, budgeted levels must be set to account for the effect of variables beyond his (her) control. An organization that markets its goods or services through many retail units may prepare a budget for each unit in order to evaluate the performance of the unit's management. In these circumstances, there may be available a rich historical data base characterizing each of these units over a span of time, and these data can be used to estimate a structural equation system relating each unit's profit to variables which are (1) under local control, (2) under central control, and (3) uncontrolled. Path analysis of this equation system can, by yielding insight into both the direct and indirect effects of the determinants of profit, contribute to the formulation of budgets for each unit that are adjusted fairly for the effects of factors beyond local control.

The initial section of this paper discusses the relationship between management control systems and budgeting; the second deals with statistical procedures, specifically regression and path analysis, to estimate the effect of variables that are beyond the manager's control. The third section illustrates the use of path analysis and the partitioning of the data set into controlled and uncontrolled variables. The fourth section discusses the problems of applying this procedure when decisions must be

made about managers and business units, and finally, the conclusion indicates areas of future research.

Management Control Systems and Budgeting

Management control systems involve two separate but related functions, planning and control. Planning is the process by which decisions are made regarding the desired outcome of certain actions, and control is the process that assures that these desired outcomes are achieved. Management control systems are designed to ensure that resources are obtained and used effectively and efficiently in the accomplishment of organizational goals [1].

Designing a management control system requires an understanding of the behavioral implications as well as the technical aspects of actions taken or constraints imposed. The needs of the individual must be harmonized with the goals of the organization so a manager can fulfill his own needs by working towards rather than away from the organization's goals. Design of a management control system requires, in part, translating organizational goals into specific goals for the manager. The manager's perception of the achieveability of the goals--that is, does he beleive he controls the important variables that affect the outcomes and are his goals set at a reasonable level so they are neither too difficult nor too easy to obtain--has an impact on his motivation to perform [13]. Allowing the manager to participate in the goal-setting process can reduce potential difficulties with motivation as well as provide the manager with the sense of importance which he, in fact, has in the organizational scheme [1] [6].

In 1955 Argyis [2] presented the case for participative goal setting and several studies [7] [9] [15] [18] [20] have substantiated his early claims. Especially revealing is the study by Dermer [9] in which the budgetary motivation of retail store managers was measured. The results indicate that managers look on budget performance both as a measure of self-achievement and as the path to external rewards such as pay and advancement. If allowed to participate in budget setting, managers appear to be receptive to direction by their supervisors and respond with greater motivation. In addition, the greater the perceived influence the managers have over their operations, the greater their motivation to perform.

Budgeting has frequently been used as a means of translating organizational goals into managerial goals because it passes vertically through the organizational hierarchy, and ideally, it coordinates efforts and communicates information across functions. Budgeting can have a purpose in addition to planning, coordination and communication, [14] however. If properly designed, a budget represents a commitment by a manager to achieve the goals outlined in the budget, and the management control system should motivate the manager's performance by tying his rewards to his targets. The budget then becomes a standard by which a manager's performance can be measured and appropriately rewarded.

Some management control systems attempt to use an absolute level of profit rather than a budget as a measure of performance. This approach presents two problems: First, an absolute level of profit is

not really goal setting because it is every manager's implied goal to perform above average, which is impossible by definition. Managers are thus engaged in a zero sum game with a goal which fluctuates so that approximately half of them will not succeed, a situation which often reduces the manager's motivation. Second, a manager may not have control over some important variables that affect the goal. This may result in a change in the manager's attitude and a lessening of motivation to perform. For example, a business unit with fewer competitors should have a higher profit budget, thereby, taking the inherent advantage of a particular unit into account in evaluating the manager's performance. Conversely, a manager with more competitors should be expected to earn less.

In summary, a budget can (1) allow the manager to participate in the goal-setting process, (2) be designed as an open-ended reward system and not a zero sum game, (3) and finally, set a goal at a level which accounts for the effect of variables which are beyond a manager's control. The achievement of this final condition is a necessary but not a sufficient condition for obtaining the first two. The statistical portion of this paper will concentrate on methods of estimating the effects of uncontrollable variables on the budgeted goal.

Estimating Effects of Uncontrollable Variables

Whether the estimation procedure is an ad hoc method based on judgment and experience or a statistically based methodology, the foundation of the estimates lies on historical data. In some organizations a budget is a one-of-a-kind document supported by a time-series data base. In this environment ad hoc procedures have traditionally been employed because of

the lack of sufficient historical data. However, there is a growing number of organizations in which many parallel budgets are prepared every year for similar business units. For example, an organization that markets its goods or services through many retail outlets may prepare hundreds of budgets. These business units provide a cross-sectional as well as time series data base that could be used in a statistical procedure to estimate the effects of uncontrollable variables on manager's goals.

For illustrative purposes, let us assume that the management structure for these business units takes the following form. There is a manager responsible for the operation of the unit and he reports to central management. The budgeted goal is some measure of profit, and the variables that effect profit can be divided into three categories: first, there are variables controllable by the business unit manager; second, variables controllable by central management; and third, variables that are controllable by neither. Our purpose is to estimate the effects of the variables that are not under the business unit manager's control and to set the profit budget accordingly.

Estimation Using Regression Analysis

An ad hoc procedure for estimating the effects of certain variables on profit relies on experience, judgment, and the manager's ability to negotiate. A second procedure involves developing a mathematical model of the process. Ashton [3] [4], has advanced some definite ideas concerning this problem. He claims that an individual's implicit prediction model is typically represented by the linear multiple regression equation and this model best simulates the person's actual predictions. In this context "best" is defined as the model with the highest multiple correlation coefficient.

Ashton does not recommend replacing the person with his linear regression model, but he proposes that the results of the regression analysis be treated as an additional input to the person's intuitive prediction process.

There are several applications of multiple regression analysis in accounting and related areas [5] [8] [11] [19]. Hayya, Copeland and Chan [12] have explored the use of probabilistic budgets and confidence intervals to deal with the uncertainty in planning and budgeting.

In order to understand performance at the business unit's level and to estimate the effects of the uncontrollable variables on profit, one must construct a model that hypothesizes the relationship between the dependent variable profit and the explanatory variables. Table 1 contains the variables used in this paper for illustrative purposes. The point of this paper is not to assert that these are the only important variables or to discuss the relevance of those selected; the point is to demonstrate the application of the concept.

The determination of which variables are controllable and which variables are not is a function of the time frame considered. For example, the business unit size becomes a variable that is controllable by central management when long range plans are formulated. The placement of the variables into the categories in Table 1 is based on the one year time frame of an operating budget.

A multiple regression model requires interval data or better, and it may be the case that some potentially important variables, such as business location, may be nominal or ordinal. This requires breaking down these variables into sets of dichotomous variables for use in the regression

TABLE 1

Variables Affecting Profit

Variable		Definition
	Uncontrollable	
X_1	NOCOMP	Number of competitors within a specified distance
X_2	LOCBC	Index of local business conditions
X_3	SIZE	Size of the business unit
	Controllable by Central Management	
X_4	PRICE	Price level compared to local prices of competitors
X_5	MGMTR	Amount of management training provided by central management
	Controllable by Business Manager	
X_6	ADVEXP	Advertising expenditures
X_7	INV	Inventory Management Index
X_8	SERVICE	Service Level Index

model. Pindyck and Rubinfeld [16] explain this process, and Gloudemans and Miller [11] have used dichotomous explanatory variables to estimate the value of residential property.

A multiple regression model can predict the effect of the variables on profit which is represented in the model by X_0. The notation assumes that the model is based on a single year of cross-sectional data and N represents the number of observations or business units in the data base. Further assume that the variables have been written as deviations from the respective means, i.e. $x_j = X_j - \bar{X}_j$. For our purposes we will write the regression equation as:

$$X_{0,i} = b_{0,1}x_{1,i} + b_{0,2}x_{2,i} + b_{0,3}x_{3,i} + b_{0,4}x_{4,i} + b_{0,5}x_{5,i} + b_{0,6}x_{6,i} + b_{0,7}x_{7,i} + b_{0,8}x_{8,i} + e_{0,i} \qquad (i = 1,\ldots,N) \quad (1)$$

or in slightly simplified notation:

$$x_0 = b_{0,1}x_1 + b_{0,2}x_2 + \cdots + b_{0,8}x_8 + e_0 \qquad (2)$$

The estimated regression coefficient $b_{0,j}$ represents the effects of the explanatory variable x_j on profits x_0, and the sign of the coefficient determines if the effect is positive or negative. The standard error of the estimated coefficient $b_{0,j}$ will decrease as the number of business units in the sample (N) increases.

One of the assumptions of multiple regression analysis is that each of the explanatory variables acts independently upon the dependent variable. The result of this is that ordinary least squares regression analysis does not measure potential indirect effects. For example, business unit size should have a direct effect on profit, but it may also have an impact on

profitability because it improves the service level provided by the unit. This indirect effect will not be measured, and the direct effect of business unit size on profit may be confounded. Path analysis, of which multiple regression analysis is really a special case, allows measurement of these indirect effects, and it is examined in the next section.

Estimation Using Path Analysis

One major improvement over multiple regression analysis offered by path analysis [10] is the ability to accommodate hypothesized relationships among the explanatory variables. This difference is illustrated more effectively by contrasting the two models in Figure 1. The assumption in the first model is that the explanatory variables are independent of each other and directly affect profit. In the path diagram in Figure 1a, the single-equation ordinary least squares multiple regression model is the technique for representing the hypothesized relationships.

Using the same variables it is possible to hypothesize models with relationships between the explanatory variables, and the model in Figure 1b is one of several possibilities. This hypothesized model indicates that price (PRICE) is a function of the number of competitors (NOCOMP) and that PRICE and NOCOMP have direct impact on profits. Once again, the point of this paper is not to defend this model as the best representation of reality, but it is necessary to hypothesize a particular model to demonstrate the concept. The logical extension of this selection is that the model like any other mathematical model is subject to specification error.

Instead of a single-equation ordinary least squares model, the relationships in the path diagram in Figure 1b are represented by a set of

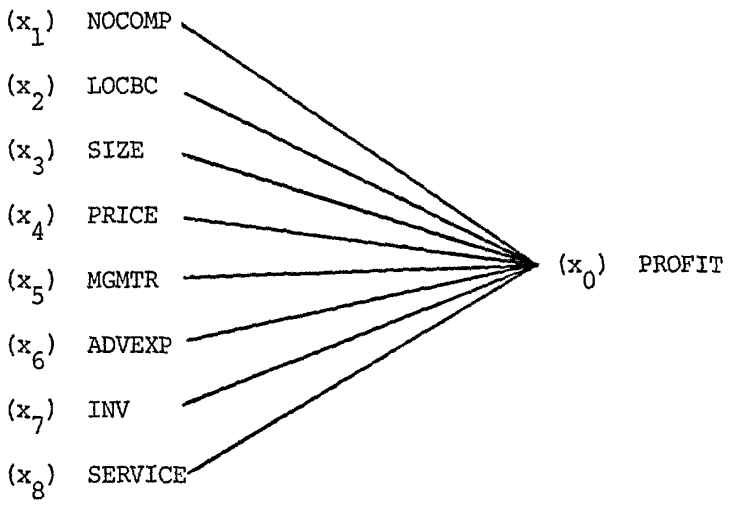

Fig. 1a Path diagram with no hypothesized relations between explanatory variables.

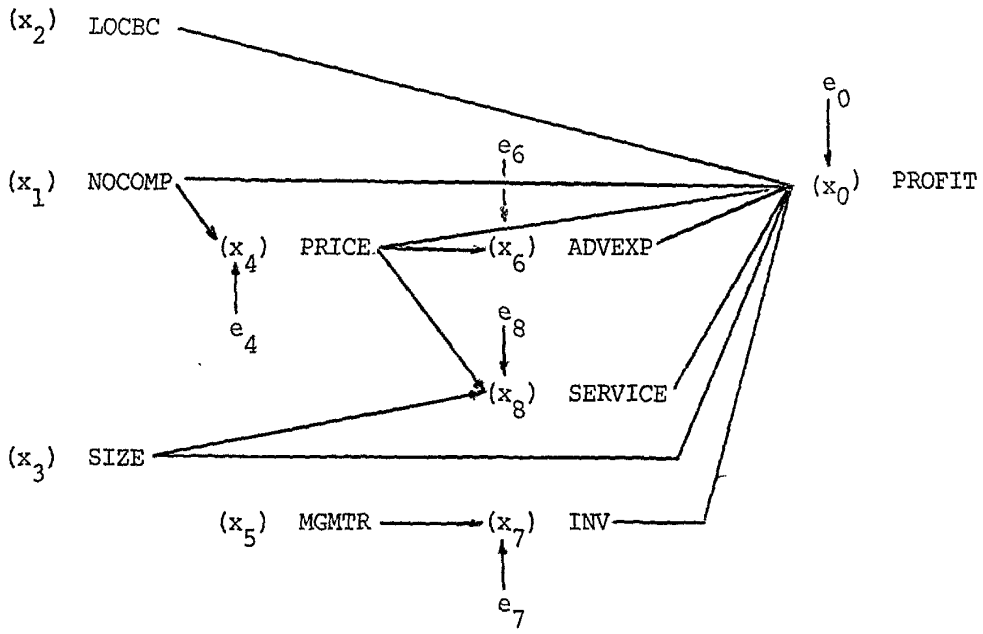

Fig. 1b. Path diagram with hypothesized realtions between explanatory variables.

equations called the structural equation system. Each variable is either exogeneous (not caused by other variables in the model) or endogeneous (dependent on one or more variables in the model). The exogeneous variables in Figure 1b are NOCOMP, LOCBC, SIZE, MGMTR, and the other explanatory variables are endogeneous. In formulating the structural equation system (3) through (7), each endogenous variable is written as a linear* equation. We assume that all exogeneous and error variables are mutually independent.**

Structural Equation System

$$x_4 = b_{41}x_1 + e_4 \tag{3}$$

$$x_6 = b_{64}x_4 + e_6 \tag{4}$$

$$x_7 = b_{75}x_5 + e_7 \tag{5}$$

$$x_8 = b_{83}x_3 + b_{84}x_4 + e_8 \tag{6}$$

$$X_0 = b_{01}x_1 + b_{02}x_2 + b_{03}x_3 + b_{04}x_4 + b_{06}x_6 + b_{07}x_7 + b_{08}x_8 + e_0 \tag{7}$$

It is possible for an explanatory variable to have its entire impact on profit transferred through another explanatory variable. For example, in Figure 1b the effect of variable x_5 manager training is hypothesized to

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* Path analysis is not limited to linear relationships. Quadratic or other functional relationships are possible.

** The path diagram in Figure 1b is a recursive model, because the endogeneous variables can be ordered so that the explanatory variables of each structural equation includes only exogeneous variables or endogeneous variables prior to the dependent variable. If the model is non recursive, estimation and analysis is more complex than discussed in this paper.

act only through its effect on x_7 inventory management index and not directly on profit. Such hypothesized indirect relationships cannot be modeled with traditional regression analysis.

To determine the total effect of an explanatory variable, which is the sum of the direct and indirect effects, on the dependent variable profit, the reduced form of the structural equation system must be obtained. This is accomplished by writing each endogeneous variable as a function of exogeneous variables alone.

Reduced Form

$$x_4 = b_{41}x_1 + e_4 \tag{8}$$

$$x_6 = b_{64}(b_{41}x_1 + e_4) + e_6 \tag{9}$$

$$x_7 = b_{75}x_5 + e_7 \tag{10}$$

$$x_8 = b_{83}x_3 + b_{84}(b_{41}x_1 + e_4) + e_8 \tag{11}$$

$$x_0 = b_{01}x_1 + b_{02}x_2 + b_{03}x_3 + b_{04}(b_{41}x_1 + e_4) + b_{06}[b_{64}(b_{41}x_1 + e_4) + e_6] + b_{07}(b_{75}x_5 + e_7) + b_{08}[b_{83}x_3 + b_{84}(b_{41}x_1 + e_4) + e_8] + e_0 \tag{12}$$

These equations can be simplified as:

$$x_4 = b_{41}x_1 + e_4 \tag{13}$$

$$x_6 = b^*_{61}x_1 + b_{64}e_4 + e_6 \tag{14}$$

$$x_7 = b_{75}x_5 + e_7 \tag{15}$$

$$x_8 = b^*_{81}x_1 + b_{84}e_4 + e_8 \tag{16}$$

$$x_0 = b^*_{01}x_1 + b_{02}x_2 + b^*_{03}x_3 + b^*_{05}x_5 + b^*_{04}e_4 + b_{06}e_6 + b_{07}e_7 + b_{08}e_8 + e_0 \tag{17}$$

The regression coefficients of the reduced form model are given here.

$$b^*_{61} = b_{64}b_{41} \tag{18}$$

$$b^*_{81} = b_{84}b_{41} \tag{19}$$

$$b^*_{01} = b_{06}b_{64}b_{41} + b_{08}b_{84}b_{41} + b_{04}b_{41} + b_{01} \tag{20}$$

$$b^*_{03} = b_{08}b_{83} + b_{03} \tag{21}$$

$$b^*_{05} = b_{07}b_{75} \tag{22}$$

$$b^*_{04} = b_{06}b_{64} + b_{08}b_{84} + b_{04} \tag{23}$$

To implement path analysis, the structural equations (3) through (7) are estimated using ordinary least squares. The coefficients obtained in this manner represent the direct casual effects. To obtain the total effect, those coefficients are used in equations (18) through (23). For an example, the total effect of x_3 SIZE on x_0 PROFIT is the direct effect of SIZE on PROFIT plus the indirect effect of SIZE on SERVICE which effects PROFIT.

$$b^*_{03} = b_{08}b_{83} + b_{03}$$

The total effects can be seen in Figure 1b by examining the path diagram. The total effects of a variable x_i on x_j, $b^*_{j,i}$ is the sum of the direct and indirect effects. Each indirect effect is the product of direct effects along a causal path linking x_i to x_j through intervening variables. In the preceding example the total effect b^*_{03} of x_3 SIZE on x_0 PROFIT is the sum of the direct b_{03} and the indirect effects b_{83} b_{08}.

$$b^*_{03} = b_{08}b_{83} + b_{03}.$$

This is precisely the result determined algebraically. The more complicated total effects can be determined by starting with any variable and summing the products of the path coefficient for each path from that variable to the endogeneous variable.

An Illustration

In order to implement path analysis as part of the budgeting process, it must be realized that the important distinction is not between exogeneous and endogeneous variables, but between variables which are controllable or uncontrollable by the business unit manager. The business unit manager is not concerned whether the variable is determined outside of the model or not, but he is concerned that his budget is set with regard to variables that are beyond his control. This requires an adaptation of the path analysis procedure described in Duncan [10] and briefly illustrated in the preceding section.

The key concept is that budgeted profit is set at its expected value conditioned upon the value of the variables beyond the business-unit manager's control. The estimated budget should be based on the actual value of the variables that are beyond the manager's control, and on the conditional expected value of variables that are within his control. If the business manager performs competently, then he should meet the budgeted goal, because it is adjusted for factors that are uncontrollable. To extend this reasoning, the manager who can improve performance--i.e., exceed the budgeted level--has managed the variables within his control more skillfully than projected and should be rewarded in proportion to the amount by which the actual result exceeds the budgeted goal.

Our objective is to reformulate the structural equations system so that profit is explained using only variables uncontrolled by the unit manager. This reformulation is similar to the derivation of the reduced form equations, with variables controlled by the unit manager treated like endogeneous variables. In this case we use the structural equation explaining profit, equation (7), as well as any structural equations explaining variables controlled by the unit manager, equations (4) through (6):

$$x_0 = b_{01}x_1 + b_{02}x_2 + b_{03}x_3 + b_{04}x_4 + b_{06}x_6 + b_{07}x_7 + b_{08}x_8 + e_0 \quad (7)$$

$$x_6 = b_{64}x_4 + e_6 \quad (4)$$

$$x_7 = b_{75}x_5 + e_7 \quad (5)$$

$$x_8 = b_{83}x_3 + b_{84}x_4 + e_8. \quad (6)$$

By substituting equations (4) through (6) into equation (7), we obtain equation (24) which gives the expected value of profit conditional only on variables uncontrolled by the business unit manager.*

$$x_0 = b'_{01}x_1 + b'_{02}x_2 + b'_{03}x_3 + b'_{04}x_4 + b'_{05}x_5 + e'_0 \quad (24)$$

Here:

$$b'_{01} = b_{01} \quad (25)$$

$$b'_{02} = b_{02} \quad (26)$$

$$b'_{03} = b_{08}b_{83} + b_{03} \quad (27)$$

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* A variable that is both exogeneous and controlled by the unit manager cannot be eliminated from the profit equation in this way. Instead it is simply dropped from the profit equation. This is because the expected value of such a variable, conditional on uncontrolled variables, is zero standard deviation from its mean.

$$b'_{04} = b_{08}b_{84} + b_{06}b_{64} + b_{04} \tag{28}$$

$$b'_{05} = b_{07}b_{75}. \tag{29}$$

In order to find the estimated budgeted profit, the following steps must be followed.

1. The data base is refined so that the data are in deviation form $x_j = X_j - \bar{X}_j$.

2. Ordinary least squares regression analysis is run according to the system of structural equations (4) through (7). From this analysis estimates of the regression coefficients are obtained. Hypothetical numbers used to illustrate the procedure appear in Table 2.

3. To obtain the budgeted profit, equation (24) must be evaluated. These calculations are performed in Table 3 using equations (25) through (29) and the data in Table 2.

4. The budgeted profit is now in deviation form and must be adjusted by the average profit $\bar{X}_0$ to make the number useful. For this example assume that $\bar{X}_0 = 1000$. The result is equation (30) in Table 3.

Table 2

ESTIMATES OF REGRESSION COEFFICIENTS

Regression Coefficient	Estimate	Regression Coefficient	Estimate
$\hat{b}_{01}$	-53	$\hat{b}_{08}$	6.43
$\hat{b}_{02}$	47	$\hat{b}_{64}$	1.31
$\hat{b}_{03}$	70	$\hat{b}_{75}$	.41
$\hat{b}_{04}$	43	$\hat{b}_{83}$	2.42
$\hat{b}_{05}$	.23	$\hat{b}_{84}$	1.78
$\hat{b}_{07}$	7.61		

Table 3

ESTIMATED BUDGETED PROFITS

$\hat{b}'_{01}$	$= -53$
$\hat{b}'_{02}$	$= 47$
$\hat{b}'_{03} = (6.43)(2.42) + 70$	$= 85.6$
$\hat{b}'_{04} = (6.43)(1.78) + (.23)(1.31) + 43$	$= 54.7$
$\hat{b}'_{05} = (7.61)(.41)$	$= 3.12$

$$\hat{x}_0 = -53x_1 + 47x_2 + 85.6x_3 + 54.7x_4 + 3.12x_5$$

$$\hat{X}_0 = \bar{X}_0 + \hat{x}_0 = 1000 - 53x_1 + 47x_2 + 85.6x_3 + 54.7x_4 + 3.12x_5 \qquad (30)$$

An example using three business units will help to clarify what is meant by the budgeted level of profit. In Table 4, the first business unit has the most favorable environment. It has the fewest competitors, the best business conditions, the largest size, the most favorable price ratio, and the manager with the most training. Because we are assuming these variables are beyond the unit manager's control, then the goal for the respective manager should be adjusted. Once the budget is set, it is up to the business-unit manager to improve upon budgeted profit by manipulating the variables that are under his control.

Table 4

EXAMPLE WITH THREE BUSINESS UNITS

Business Unit	Variable					Budgeted Profit
	x_1	x_2	x_3	x_4	x_5	
1	1	1.10	2.5	1.1	16	1322.75
2	3	1.00	2.0	1.0	14	1157.58
3	5	.90	1.8	0.9	12	1018.05

Of course, a critical element in this analysis is the statistical data base used to estimate the coefficients of the structural equation system. It is important that these data be representative of "good" or "competent" management in order to avoid a biased level for the budgeted profit.

Applying Budgeting to Managers and Business Units

A common problem is that the evaluation of the business unit's performance and the evaluation of the manager's performance is not distinguished. While it is true that there is a high level of interdependence between the business unit and the manager, central management must make two different decisions. The first involves whether the unit should continue in operation and at what level of investment. The local business conditions and competitive environment are important criteria in this decision. The second critical management decision involves evaluation of the manager's performance. Given the inherent advantages or disadvantages of a particular unit, how has the manager performed? If his performance is as good or better than anticipated, then the manager should be rewarded.

The variables attributable to the business unit and the variables controlled by the manager are interdependent, and both affect profit. Therefore, absolute profit is neither a good measure of business performance nor a good measure of managerial competence, but it does evaluate the combined influences.

The budgeted profit amount represents the expected business unit performance if competent management is applied. The level of budgeted profit reflects only the variables attributable to the business units;

the variables controlled by the manager are fixed at levels expected under competent managment. A low positive or a negative level of budgeted profits over several budgeting periods would seem to indicate a poor business unit because managerial performance has been assumed to be competent when the budget is prepared.

A manager's evaluation is based on actual profits related to budgeted profits. The business unit's evaluation is based on the level of budgeted profits.

Conclusions

The emphasis of this paper has been twofold. First, budgeting has been outlined as it relates to the concept of management control systems. The implications of using a budget as a standard have been discussed in conjunction with the pragmatic applications of budgeting, including planning, coordination and communication. It has been seen that budgeting can be implemented so that it is participative, open-ended in its reward system, and fair and reasonable because it takes into account the effects of the uncontrollable variables.

Second, the paper has outlined three approaches to estimating the effects of a variable. The ad hoc procedure has been traditionally employed in situations where one-of-a-kind budgets are formulated. If sufficient cross-sectional, or time-series data are available, then regression analysis or path analysis may provide better estimates. Path analysis has been shown to have an advantage over regression analysis because it can hypothesize relationships among the explanatory variables.

Finally, there are two important extensions in the methodology developed in this paper. First, items such as local business conditions are clearly beyond the control of the unit manager, and variable in the short-term. When this is the case, the budgeted standard could be made flexible, open to change during the time period of the budgets rather than negotiated at a fixed level at the beginning of the budgeting period. The degree of control a manager has over a variable is very important in this case. Flexibility should only be built in for factors over which the manager is perceived to have no control. If the question of control is in doubt, then these parameters should be fixed at the time the budget is negotiated.

As to the second extension in methodology, with an estimate of the effects of a variable on profit, it is possible for business unit managers to negotiate for a change in this variable. For example, in our illustration, business unit size has an effect on profit. A unit manager can negotiate an increase in business unit size on the basis of a commitment to a higher budgeted profit. This increase in expected profit can be estimated from the model for units with similar characteristics. The implication of this possibility is that it gives management a guide in making future investment decisions. More generally, a better understanding of the relationships between profit and the factors controllable by central management will help managers participate more fully in the budget-setting process.

References

1. Anthony and Reece. Management Accounting: Text and Cases, Homewood, Ill.: Richard D. Irwin, Inc., 1975.

2. Argyris, Chris. "Organizational Leadership and Participative Management." Journal of Business, January 1955, pp. 1-7.

3. Ashton, Robert H. "The Predictive-Ability Criterion and User Prediction Models." Accounting Review, October 1974, pp. 719-32.

4. _____. "User Prediction Models in Accounting: An Alternative Use." Accounting Review, October, 1975, pp. 710-22.

5. Benston, George J. "Multiple Regression Analysis of Cost Behavior." Accounting Review, October 1966, pp. 657-72.

6. Cammann; Cortlandt; and Nadler, David A. "Fit Control Systems to Your Managerial Style." Harvard Business Review, January-February 1976, pp. 65-72.

7. Caplin, Edwin H. Management Accounting and Behavorial Science. Reading, Mass.: Addison-Wesley Publishing Co., Inc., 1971.

8. Deakin, E. and Granof, M. "Regression Analysis As a Means of Determining Audit Sample Size." Accounting Review, October 1974, pp. 764-71.

9. Dermer, Jerry D. "Budgetary Motivation of Retail Store Managers and Buyers." Journal of Retailing, Fall 1974, pp. 23-32.

10. Duncan, Otis D. Introduction to Structural Equation Models. New York: Academic Press, 1975.

11. Gloudemans, R. J. and Miller, D. W. "Multiple Regression Analysis Applied to Residential Properties: A Study of Structural Relationships over Time." Decision Sciences, April 1976, pp. 294-304.

12. Hayya, J. C.; Copeland, R. M., and Chan, K. H. "On Extensions of Probabilistic Profit Budgets." Decision Sciences, January 1975, pp. 106-19.

13. Livingstone, J. L. and Runen, K. H. "On Extensions of Probabilistic Profit Budgets." Decision Sciences, January 1975, pp. 360-75.

14. May, Paul A. "The Budgeting Process." NAA Management Accounting, January 1973, pp. 19-25.

15. Milani, Ken. "The Relationship of Participation in Budget-Setting to Industrial Supervisor Performance and Attitudes: A Field Study." Accounting Review, April 1975, pp. 274-85.

16. Pindyck, R. S. and Rubinfeld. Econometric Models and Economic Forecasts. New York: McGraw-Hill Book Co., 1976.

17. Roberts, Reed M. "Tie Bonuses to Corporate Profit." Financial Executive, June 1973, pp. 12-19.

18. Ronens, J. and Livingstone, J. L. "An Expectancy Theory Approach to the Motivational Impacts of Budgets." Accounting Review, October 1975, pp. 671-85.

19. Skousen, K. F., and Bateman, M. J. "A Control Model to Assist in Forecasting State Tax Revenues." Decision Sciences, October 1973, pp. 559-62.

20. Swieringa, Robert J. "A Behavorial Approach to Participative Budgeting." NAA Management Accounting, February 1975, pp. 35-40.