ENHANCING THE USEFULNESS OF CVP ANALYSIS AS AN OPERATING AND STRATEGIC TOOL

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ABSTRACT

This paper offers an approach to enhance the usefulness of Cost Volume Profit Analysis by integrating it with Return on Investment and Residual Income for improved performance evaluation. Additionally, the paper provides discussion of the impact changing cost structure on business.

INTRODUCTION

Cost Volume Profit Analysis (CVP) is a relatively simple analytical managerial planning tool. Based on the premise that costs can be classified on the basis of their behavior patterns, CVP enables managers to understand the impact of various strategic alternatives on profitability. Using basic information such as price, variable cost per unit, and total fixed costs, managers can quickly evaluate possible alternative courses of action. Examples of such evaluations include pricing decisions, product and market decisions, allocation of plant capacity, and expense planning [2]. Additionally, CVP enables management to determine the firm's breakeven point.

Unfortunately, the simplicity of CVP hinders its usefulness for decision-makers. Oftentimes, managers are confronted with complex decision-making situations that are not easily represented by a CVP model. One way to enhance the usefulness of CVP as an analytical tool is broaden its scope to include other financial and operational dimensions, such as asset structure and the costs of financing.

The purpose of this paper is to offer an approach to link CVP with asset structure, the costs of financing, and cash flow for improved decision-making and enhanced performance evaluation. More specifically, performance measures such as Return on Investment (ROI) and Residual Income (RI) are integrated into the CVP model. The resulting model enables managers to better understand the impact of the price and cost variables in maximizing ROI and RI. Additionally, the paper presents an enhanced breakeven point that incorporates cash flows. The next section of the paper provides an overview and the changing nature of cost structure. The next section of the article discusses the disaggregation of operating income and linking it to ROI and RI. The final section provides an illustration of the approach for an improved understanding of performance. The final section of the paper discusses and alternative to traditional breakeven analysis.

A CHANGING COST STRUCTURE

CVP is a critical tool for operating and strategic decision-making. A company's operating cost structure is normally a combination of both variable and fixed costs. Variable costs are those costs that vary in

total proportionately with some measure of the volume of activity or cost driver. Common examples of variable costs include the direct materials and direct labor that goes into the manufacturing of product. On the other hand, fixed costs are those costs that do not vary in total with some measure of volume or cost driver. Examples fixed costs include capacity costs (depreciation of plant and machinery) and capacity-sustaining costs (plant security, insurance, administration, property taxes, etc.). These costs are not incurred based on the number of units produced. Rather, these costs are incurred to maintain a certain level of capacity.

In recent years numerous companies have experienced increasing levels of fixed costs. As operations evolve fixed costs have increased as a percentage of total costs for numerous firms. The primary reasons for increasing levels of fixed costs include factors such as the automation of operations and the use of information technology. For some firms fixed costs now account for well over half of their total costs. Although it is unlikely that any company is a completely 100% fixed cost operation, it is conceivable that some firms are nearly 100% fixed cost operations. For example colleges and universities with significant levels of tenured and tenure-track faculty, numerous administrators, and large facilities may have fixed costs that are upwards of 80% or more of their total operating costs. Their product is the generation of knowledge with minimal direct materials and conversion costs (direct labor and overhead) that for the most part are fixed. Oftentimes, high technology firms with automated operations and high levels of research and development exhibit high levels of fixed costs relative to variable costs. Other examples include wind energy farms with minimal levels of materials and direct labor and professional service firms with high levels of salaried staff [7].

A high fixed cost company has relatively few costs that are controllable in the short-run. For example, a college or university is a labor intensive operation. However, most of the faculty labor is salaried and are either tenured or on the tenure-track. Therefore, such costs are fixed and committed at least in the short-run. What the administrators have responsibility for is not the efficiency of the faculty but the utilization of the fixed costs (productivity). Common measures of faculty productivity include number of units and students taught, research and publication output, and service to the university and the profession. Therefore, the objective of short-run budgeting for fixed costs should be the utilization of resources and the accomplishment of goals. Notable reasons for the increasing levels of fixed costs include:

Automation of Operations

Automation has had significant effect on the way we manufacture products and provide services. Over the years companies that were previously labor-intensive have become machine-intensive operations. Projects to automate operations may encompass the entire operation or can be done on a piecemeal basis. Few companies have not benefited from automation. In terms of cost structure firms that automate have traded their variable costs for additional fixed costs as machines have replaced labor. Productivity gains, less waste and scrap, reduced labor costs, and expectations of higher profits are some of the benefits of automation.

Automation has enabled companies reduce their need for hourly labor doing routine jobs. For example, in most high rise buildings elevator operators have been replaced by automated systems. The results have not just reduced labor costs but have improved efficiency and the reliability of operations. Today elevators are on call by the user. There is no need for the user to wait for an elevator operator to come back from his break. An automated system does not need a lunch or a bathroom break. It can operate twenty-four hours a day. Additionally, automation has reduced labor disputes, and hiring and firing costs [6].

In a manufacturing operation automation means fewer defective units and less waste and scrap. For example, Rubbermaid employs an automated injection mold process in the mass production of plastic products (kitchen, bathroom, garbage cans, etc.). The automated operations have allowed the production of the standardized product with minimal spoilage. However, when defective units and waste and scrap do occur it is melted down and recycled as raw materials for later production. Hence, all of the raw material is used in the product of good output and costs are kept to a minimum.
Another example is an automated carwash. If an automobile driver desires to have his vehicle washed he normally takes it to an automated carwash which can wash on average sixty cars per hour with minimal labor. However, a driver may take his car to a "hand carwash" which requires two or more laborers to do the job. Such a carwash may do the job in fifteen minutes while the automated carwash can do the job in one or two minutes. In this case the variable costs of the automated carwash will be relatively low and the fixed costs will be high relative to the hand carwash. However, the automated carwash can service many more cars (volume) and charge a lower price than the hand carwash. Hence, there is higher productivity with the automated carwash operation.

Information Technology

Information Technology (IT) has had a profound effect on the way corporations do business. Numerous activities that previously required many labor hours to do can now be done through IT with minimal labor, more efficiently, and at lower cost. For example, corporate mailings have been replaced by email which significantly reduces postage costs reducing variable costs. However, IT requires significant investment and relatively high levels of fixed costs. For example, in prior years the telephone company maintained a significant crew of telephone operators who connected callers and answered questions such as what is someone's telephone number. Today the telephone operators have been replaced by an automated information system that has minimized cost and increased productivity. Other examples include airline reservations, telemarketing, for companies a whole new way to reach their customers.

As a corporation's cost structure evolve in response to changing technologies our operating and strategic tools cannot remain static. We offer enhancements to CVP techniques to make then more robust for planning and controlling.

MEASURING OPERATING INCOME WITH CVP

To generate an understanding of the impact of volume changes on operating income, an entity's cost structure can be disaggregated into variable costs (which vary directly with activity) and fixed costs (which do not vary in total with the volume of activity). With CVP operating income (OI) can be measured as:

$$OI = TR - TC = [P * Q] - [(V * Q) + F] \quad (1)$$

Where: TR = Total revenue
TC = Total cost
P = Selling price per unit
Q = Volume of activity
V = Variable cost per unit of activity
F = Total fixed cost

The difference between P and V, termed the contribution margin per unit (CM), is constant over a given range of activity. As a result, the preceding equation can be reduced to:

$$OI = [(P - V) * Q] - F \quad (2)$$

$$OI = [CM * Q] - F \quad (3)$$

Fixed costs can be further disaggregated into committed and discretionary components. Committed fixed costs (Fc) are those fixed costs that cannot be altered by managerial decisions in the short-run. Examples of committed fixed costs include property taxes, lease payments, and salaries of key personnel. On the other hand, discretionary fixed costs (Fd) are programmed costs and, therefore, can be affected by managerial action in the short-run. Examples of discretionary fixed costs include advertising, research and development, and staff training. Thus, the prior equation can be restated as:

$$OI = [CM * Q] - [Fc + Fd] \quad (4)$$

This equation implies that volume and discretionary fixed costs can be used in the short-run to manage operating income [1].

INTEGRATING CVP INTO PERFORMANCE MEASURES

An entity's performance extends beyond management's ability to control price, volume, variable costs, and fixed costs. Management is also responsible for making optimal use of an investment base. One such measure of performance is Return on Investment (ROI). ROI provides a common goal that is consistent with the corporate objective of optimal utilization of resources entrusted to the managers by the stockholders [4]. ROI can be expressed as:

$$ROI = OI / Inv = [OI / TR] * [TR / Inv] \quad (5)$$

Where: Inv = Investment

In the short form of ROI, operating income is expressed as a percentage of the entity's investment base. However, a longer and more informative variation expresses ROI as the product of the "profit margin on sales" and the "investment turnover." The implication is that ROI can be enhanced either by increasing margin on sales or increasing its investment turnover. Equation (4) can be integrated into the ROI model to yield:

$$ROI = [\{(CM * Q) - (Fc + Fd)\} / (P * Q)] * [(P * Q) / Inv] \quad (6)$$

$$ROI = [\{(CM * Q) / (P * Q)\} - (Fc + Fd) / (P * Q)] * TO \quad (7)$$

$$ROI = CMR * TO - [Fc / Inv] - [Fd / Inv] \quad (8)$$

Where: CMR = Contribution Margin Ratio
TO = Investment Turnover

Designating Fc/Inv and Fd/Inv as committed and discretionary cost ratios, the expression can be stated as:

$$ROI = CMR * TO - \text{Committed Ratio} - \text{Discretionary Ratio} \quad (9)$$

In the short run, both the committed and discretionary cost ratios are fixed components of ROI because all elements that comprise these ratios, by definition, do not vary with changes in activity levels. Turnover is the only item in the expression that varies with changes in activity levels. Thus, CMR * TO represents the variable component of ROI. As turnover increases, ROI will increase by the amount of the contribution margin ratio for every unit increase in turnover. This is clearly a more accurate assessment of the impact of changes in short-run turnover than that suggested by the traditional approach (equation 5), which gives an incorrect impression that ROI will increase by the amount of the profit margin on sales for each unit increase in turnover [5].

The traditional ROI approach also fails to highlight what factors can be controlled in the short-run to increase ROI. The integrated approach suggests that management can improve ROI by either increasing turnover and/or minimizing the discretionary fixed cost ratio. In the short-run, the manager cannot affect the committed cost ratio. In fact, a higher committed cost ratio normally means a lower ROI. Therefore, equation (9) can be divided into both a controllable component:

$$CMR * TO - Fd/Inv \tag{10}$$

and a noncontrollable component that cannot be affected by management action in the short-run:

$$Fc/Inv \tag{11}$$

In the short-run management should focus on the controllable components to boast ROI, such as increasing sales or reducing discretionary fixed costs.

TAKING PERFORMANCE MEASUREMENT ONE STEP FURTHER: RESIDUAL INCOME

Residual Income (RI) takes ROI further by recognizing a required return on investment. More specifically, RI is measured as operating income less an "imputed" interest or what the entity must pay for capital [3]. RI can be expressed as:

$$RI = OI - [Inv * R] \tag{12}$$

Where: R = Required Rate of Return

Frequently, RI is favored as a performance measure by entities because management is focused on maximizing total dollars of operating income rather than achieving a certain percentage return on investment. One criticism of setting performance objectives in terms of ROI targets is that ROI creates an artificial ceiling with no incentive to maximize operating income. With RI the quality of managerial performance is judged based on the degree to which the entity's operating income exceeds a minimum required return on investment. The RI approach is more consistent with the corporate objective of profit maximization. CVP and RI can be integrated as follows:

$$RI = [(CM * Q) - (Fc + Fd)] - (Inv * R) \tag{13}$$

$$RI = [\{(CM * Q) / (P * Q)\} - \{(Fc + Fd) / (P * Q)\}] * TO - (Inv * R) \tag{14}$$

$$RI = CMR * TO - [(Fc / Inv) + (Fd / Inv)] - (Inv * R) \tag{15}$$

$$RI = CMR * TO - \underset{\text{Ratio}}{\text{Committed}} - \underset{\text{Ratio}}{\text{Discretionary}} - (Inv * R) \tag{16}$$

$$\text{Controllable } RI = CMR * TO - (Fd / Inv) - (Inv * R) \tag{17}$$

Controllable RI (17) represents the contribution towards the coverage of residual income coming from revenues and expenses that management is able to control in the short-run. The difference between the Controllable RI and RI represents the reduction in residual income from the committed expenses that management is unable to control in the short-run.

AN ILLUSTRATION OF THE INTEGRATED APPROACH

The following example illustrates the integration of CVP relationships into ROI and RI for improved performance evaluation. Table 1 presents financial information for an example company and Table 2 demonstrates the linking of CVP, ROI, and RI.

TABLE 1: Financial Data for Example Company

Sales Revenue	$100,000
Variable Expenses	40,000
Contribution Margin	$ 60,000
Fixed Expenses—Discretionary	30,000
Fixed Expenses---Committed	20,000*
Operating Income	$ 10,000
Operating Assets	$ 80,000

*Includes $8000 of depreciation and other noncash expenses.

TABLE 2: ROI and RI Computation Using Disaggregation Method

CMR ($60,000 / $100,000)	60.0%
Turnover ($100,000 / $80,000)	125.0%
Variable ROI (CMR * Turnover)	75.0%
Less: Discretionary proportion ($30,000 / $80,000)	37.5%
Controllable ROI	37.5%
Less: Committed proportion ($20,000 / $80,000)	25.0%
ROI ($10,000 / $80,000)	12.5%
ROI	12.5%
Required Return	10.0%
RI	2.5%
Controllable ROI	37.5%
Required Return	10.0%
Controllable RI	27.5%

Using the contribution format operating income is presented for Example Company. Based on conventional measures ROI is 12.5% and assuming a required rate of return of 10.0% the RI is 2.5%. However, these figures provide an incomplete picture of the quality of management performance. The presence of committed fixed costs in both measures causes an ambiguous picture of management performance. These costs are not controllable by management action in the short-run. Committed costs,

such as property taxes and depreciation, are the result of long–run decisions and, therefore, should not be incorporated into short-run measures of performance.

The disaggregation of fixed costs into discretionary and committed components enables management to better understand the impact of short-run performance on the corporate goal of profit maximization. The conventional measures of ROI of 12.5% and RI 2.5% evolve into a Controllable ROI of 37.5%, a Controllable RI of 27.5%. The reduction in ROI and RI from Controllable ROI and Controllable RI is caused by the committed fixed costs. By emphasizing the attainment of Controllable ROI and Controllable RI management is better able to understand the link between corporate goals with current operating performance.

TAKING BREAKEVEN ANALYSIS ONE STEP FURTHER: CASH FLOW

Traditionally, breakeven point (zero profit, zero loss) is reached when a firm's total revenue equals its total costs or in CVP terms it occurs when the total contribution margin equals the firm's total fixed costs. Breakeven is a critical number in planning since operating at less than breakeven means a loss. If a firm's forecast of future sales is too low to generate a profit management must take action now to either increase the level of sales or reduce costs.

One problem with traditional breakeven calculations is that it includes depreciation, amortization, and other noncash using or provides items. It is measured on the accrual basis and is not a true cash flow number. Cash flow is the life blood of any firm. A firm may be able to operate without a profit for a number of years but if it runs out of cash it runs out of time. Therefore, the point at which the firm begins to earn a positive cash flow should be of interest to management. This can be determined by deducting depreciation and other noncash charges from total fixed costs and calculating the cash breakeven point.

Using the data for the example company in Table 1 breakeven calculations are presented in Table 3. It should be noted that the contribution margin ratio does not change for the cash breakeven point. For the Example Company the breakeven point using the traditional approach is $83,333 of sales while using the cash breakeven point is $70,000. At sales levels above $70,000 the company has a positive cash flow. However, the traditional breakeven approach the company does not reach breakeven point until reaches $83,333 in sales. The difference is significant in that a positive cash flow is achieved lower sales volume levels.

Table 3
Traditional versus Cash Breakeven Point

Traditional Breakeven Point ($50,000/0.60)	$83,333
Cash Breakeven Point ($42,000/0.60)	$70,000

CONCLUDING COMMENTS

CVP has been touted as a simple and quick technique for answering management's "What if" type of questions. It is a widely used technique for planning and performance evaluation. However, CVP's simplicity limits its usefulness as an operating and strategic tool. This paper offers suggestions for linking CVP with asset structure, the costs of financing, and cash flow for improved decision-making and enhanced performance evaluation.

REFERENCES

[1] Calderon, T. G., and Fisher S. A., "Integrating Cost Volume Profit Relationships into ROI for Improved Performance Evaluation, *Journal of Bank Cost & Management Accounting*, Volume 3, Number 3, 1990, pp. 51 – 55.
[2] Guidry, F., Horrigan, J. O., and Craycraft, C., "CVP Analysis: A New Look," *Journal of Managerial Issues*, Volume X, Number 1, Spring, 1998, pp. 74 – 85.
[3] Horngren, C. T., S. M. Datar, M. V. Rajan, *Cost Accounting, A Managerial Emphasis*, 15th Edition, Pearson, 2015.
[4] Reece, J. and W. Cool, "Measuring Investment Center Performance," *Harvard Business Review*, May-June, 1978, pp. 28-30, 34, 36, 42, 46, 174, 176.
[5] Tse, P. S., "Evaluating Performance in Multinationals," *Management Accounting*, June, 1979, pp. 21 –25.
[6] Varila, M., M. Seppanen, E. Heinonen, "Effects of Automation on Cost Accounting: A Case Study in Warehouse Logistics," *7th Manufacturing Accounting Research Conference*, Tempere, Finland, May 30-June 1, 2005.
[7] Zimmerman, J. L., *Accounting for Decision Making and Control*, 7th Edition, McGraw-Hill Irwin, 2011.