

Discussion on Cost-Volume-Profit Analysis

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Abstract: Cost-Volume-Profit Analysis (CVP) is very important for the management of modern enterprises. A common question in business management is how to use CVP to make decisions. At present, this analysis method is widely used. It is associated with enterprise risk analysis and can spur the company to strive to reduce business risk. Combined with the prediction technology, enterprises can make a break-even prediction, profit forecast, etc., and combine it with decision-making. At first, this paper introduces the viewpoints of CVP at home and abroad, then briefly introduces this method. After that, this paper expounds the basic assumptions of the traditional Cost-Volume-Profit Analysis and analyzes its limitations. Finally, this article puts forward some suggestions to improve this method.

1 INTRODUCTION

Any production and operation activities of an enterprise will incur costs. In order to pursue economic benefits, enterprise managers will try their best to control the costs of operation and production activities. In addition to simply practicing the concept of "saving", current enterprise managers pay more attention to the benefits brought by the occurrence of costs to enterprises, that is, "cost effectiveness". Cost - volume - profit analysis (CVP) is the key to help enterprises to achieve this "cost - benefit maximization".

CVP is the abbreviation of cost-volume-profit relationship analysis. It refers to a method to reveal the internal regular relationship between variables such as fixed cost, variable cost, sales volume, unit price, sales volume and profit with mathematical accounting model and diagram based on variable cost calculation mode. At present, CVP is widely used. It is associated with enterprise risk analysis and can spur the company to strive to reduce business risk. Combined with prediction technology, enterprises can make profit and loss balance prediction and profit prediction, and combine them with decision-making. While seeing the advantages of CVP, managers need to understand and concern its limitations - the limitations of CVP in product price unchanged, production and marketing balance and cost division.

2 LITERATURE REVIEW

2.1 Domestic Research Theory

Cost-Volume-Profit Analysis is one of the basic theories and methods of management accounting. It was introduced into China in the 1980s and began to be used in accounting. It can provide effective information for enterprise cost control and business decision-making, and has been more and more applied in China.

Guo Hua pointed out in *The Practical Application of CVP: Through CVP, enterprises can help judge the safety status of production and operation activities, grasp the impact of changes in various factors on profit changes, provide ideas and methods for enterprises to achieve profit objectives, and control production and operation activities in a favorable state* (Guo 2011). Ma Xiaofeng put forward in *The Discussion on The Application of CVP in Enterprise Marketing Management: CVP is directly related to the balance of revenue and expenditure and profit level in the enterprise's business activities, so it has a core position in the enterprise's daily business and management activities* (Ma 2011). Teng Ye pointed out in *The Application of CVP in Enterprises: The correct use of cost volume profit analysis can effectively carry out reasonable goal planning for enterprises, make scientific decisions and correctly assess the business results of enterprises* (Teng 2012). The effective combination of this analysis method

and the correct measures of enterprises is conducive to the development of enterprises in the right direction. Xue Kaihua proposed in *Management Accounting Analysis Method - CVP*: The main factors of cost volume profit analysis, such as the change of selling price, fixed cost, variable cost and business volume, will affect the breakeven point, which is only the point where the target profit is zero, while the target profit of the enterprise is often not zero (Xue 2011). We must discuss the change of the relationship between cost volume profit under the change of various factors. Li Pengyu and Niu Yanyan pointed out in *The Analysis of CVP Based on Cash Flow*: In the process of operation, enterprises should correctly evaluate the reported sales volume and rationally judge whether they can continue to maintain production and operation, which should be based on CVP (Li, Niu, 2013). Li Xiuying, Deng Xiaolong and Jing Xiling put forward in *Management Accounting: CVP is an analysis method based on cost behavior analysis and variable cost method to study the relationship among cost, business volume and profit* (Li, Deng, Jing, 2013). Xin Yun pointed out in *The Application Case Study of CVP Based on Graphical Model*: If CVP is combined with enterprise decision analysis, it can effectively promote and support enterprises to make relevant production decisions and optimal production combination decisions under factor constraints (Xin 2012). Li Xiuying, Deng Xiaolong and Jing Xiling put forward in *Management Accounting: The basic assumptions of CVP are cost behavior hypothesis, relevant scope hypothesis, constant variety structure hypothesis and production and marketing balance hypothesis* (Li, Deng, Jing, 2013). Yin Xinhua pointed out in *The Analysis and Application of CVP*: The key point of CVP is the breakeven point (Yin 2014). There are two ways to express the breakeven point, that is, the sales volume of breakeven point and the sales volume of breakeven point. Wu Wanfeng pointed out in *On the Limitations of CVP*: In the practical application of CVP, we should recognize its limitations and cannot blindly copy the ready-made conclusions of CVP (Wu 2007). We must study the actual changes of enterprise operating conditions, market and price, production factors, variety structure and technology from a dynamic perspective, and adjust and revise the analysis conclusions.

2.2 Foreign Research Theory

As early as 1904, there were written records about the original cost volume profit relationship diagram in the United States. In 1922, an accounting professor at

Columbia University put forward a complete breakeven analysis theory. After the 1950s, CVP has been widely used in western accounting practice. Its theory is becoming more and more perfect and has become an important part of modern management accounting.

Rajasekaran V mentioned in the book *Cost Accounting* that CVP plays an important role in enterprises. CVP can enable enterprise management to make more scientific decisions in cost control, profit prediction, cash flow planning and new production decisions (Rajasekaran 2010). Theodore Grossman, John Leslie Livingstone mentioned all aspects of CVP as a profit planning tool when talking about cost structure, profit planning and value creation in *The Portable MBA in Finance and Accounting* (Livingstone, Grossman, 2001).

To sum up, CVP has become more widely used in enterprises, and also for the enterprise the management, planning, decision-making and so on to provide beneficial reference, CVP has great role in enterprises, by the application of various industries, at the same time, we also want to see some of the problems of CVP, and then combined with the actual situation, give full play to the role of the CVP.

3 A COMPREHENSIVE DESCRIPTION OF CVP

3.1 Implications of CVP

CVP is an analysis of the relationship among cost, business volume and profit. The premise of using this method is to use cost behavior analysis, which means that after studying the cost-output relationship, the entire cost is divided into fixed and variable costs.

3.2 Basic Formulas of CVP

Operating profit = sales revenue - total cost
 = sales revenue - fixed cost
 = sales volume * unit price - sales volume * unit variable cost - fixed cost.

3.3 Basic Application of CVP

CVP can be used for break-even point analysis, profit point analysis, safety margin analysis, profit planning and sensitivity analysis. The following sections provide a brief description of break-even points, margin of safety analysis, profit points, profit planning and sensitivity analysis.

3.3.1 Break-even Point Analysis

a) Analysis in the case of single products.
 The break-even point calculation is the simplest form of cost volume profit analysis when there is only one product. The sales volume when the firm is in a position of no profit or loss, i.e. when the net operating profit is zero, is defined as the break-even point.

$$\text{Break-even volume} = \text{fixed cost} / (\text{unit price} - \text{variable cost})$$

$$\text{Break-even value} = \text{break-even volume} * \text{unit price}$$

$$= [\text{fixed cost} / (\text{unit Price} - \text{single variable cost})] * \text{unit price}$$

The firm can make a profit if its actual sales volume exceeds its break-even volume (or "the actual sales value is greater than the break-even value"), the enterprise can make a profit. Otherwise, the enterprise will lose money

b) Analysis in the case of multiple products.

In practice, because enterprises' products vary, the diversification of enterprise products could consider when calculating the break-even point. In this instance, the enterprise's break-even point can only be stated by the break-even amount. There are many methods to calculate the break-even point, including comprehensive contribution gross profit rate method, joint unit method, main variety method, etc. However, the comprehensive contribution gross profit rate approach is the most regularly used method by most businesses. The following calculation formula is used:

$$\text{Comprehensive break-even value} = \frac{\text{total fixed cost}}{\text{comprehensive marginal contribution rate}}$$

$$\text{Weighted average contribution gross profit rate} = \frac{\sum (\text{Marginal contribution rate of a product} * \text{sales proportion of a product})}{\text{Sales proportion of a product} = \text{value of this product} / \text{total value}}$$

c) Safety margin analysis.

The margin of safety is defined as the difference between the actual sales value or actual sales volume and the break-even value or break-even volume. The margin of safety varies between the absolute and relative numbers.

$$\text{Volume of safety margin} = \text{actual or expected sales volume} - \text{break-even volume}$$

$$\text{Value of safety margin} = \text{actual or expected sales value} - \text{break-even value}$$

$$\text{Safety margin rate} = \frac{\text{volume of safety margin}}{\text{actual or expected sales volume}} * 100\%$$

$$= \frac{\text{value of safety margin}}{\text{actual or expected sales value}} * 100\%$$

The higher the volume/value of the safety margin and safety margin rate, the higher the safety of profit.

3.3.2 Lucre-safeguarded Point Analysis

Lucre-safeguarded Point is also known as the business volume to achieve the target profit, divided into lucre-safeguarded volume and lucre-safeguarded amount. The basic formulas are:

a) Analysis in the case of single products.

$$\text{Lucre-safeguarded volume} = \frac{\text{fixed cost} + \text{target profit}}{(\text{unit price} - \text{unit variable cost})}$$

$$\text{Lucre-safeguarded amount} = \text{lucre-safeguarded volume} * \text{unit price}$$

$$= \frac{[(\text{fixed cost} + \text{target profit}) / (\text{unit price} - \text{unit variable cost})] * \text{unit price}}$$

d) Analysis in the case of multiple products.

$$\text{Comprehensive lucre-safeguarded amount} = \frac{\text{total fixed cost} + \text{target profit}}{\text{comprehensive marginal contribution rate}}$$

3.3.3 Profit Forecast and Profit Planning

The key factors affecting the enterprise's target profit are unit price, unit variable cost, sales volume, and fixed cost. To achieve the profit target, enterprises can take corresponding measures for these four factors, such as increasing the sales unit price, reducing variable costs, increasing production and sales, reducing fixed costs, etc. Furthermore, firms could also work together to take comprehensive measures to achieve the profit target.

3.3.4 Sensibility Analysis

Profit is sensitive, and it changes with certain factors. The investigation of its evolving process is known as a sensitivity analysis.

The factor that has a large impact on profit and causes it to fluctuate substantially has a high sensitivity. On the contrary, it has low sensitivity.

The emphasis of enterprises are different. The executive should prioritise characteristics with high

sensitivity and pay less attention to factors with low sensitivity.

Managers should determine the sensitivity based on a detailed understanding of the relationship between profit and factors and then predict profit.

3.3.5 Short-term Business Decisions

Through CVP, the enterprise can calculate the break-even point and lucre-safeguarded point and provide an entirely scientific basis for production and pricing decisions. For example, whether the company should develop new products, whether loss products should continue to be produced, whether the company should accept low price orders, how to determine the optimal price and decide the pricing strategy under special conditions, etc.

3.4 Basic Assumptions of CVP

3.4.1 Cost Trait Division and Assumptions of Variable Cost Method

The variable cost method is the core of the cost volume profit analysis method, which premise is to control the cost behavior analysis (Sun, Wen, Yang, 2012). According to the cost behavior analysis, the cost is divided into fixed, variable, and mixed costs (Tu, 1989). And then, the mixed cost is further divided into fixed cost and variable cost. Finally, the three major costs are reduced to fixed and variable costs.

Unit product cost = direct labor + direct material + variable

manufacturing cost

Period expenses = fixed manufacturing fee + sales expenses

+ management fee + financial expenses

3.4.2 Relevant Range and Linear Assumptions of Total Cost

CVP posits that, within the relevant range, assuming the fixed cost and unit variable cost are constant, total cost and business volume will have a linear relationship (Teng, Wei, 2012). The formula is expressed as $Y = A + BX$. when the unit price remains constant, the relationship between sales income and business volume is represented as $Y = PX$.

3.4.3 Balance between Production and Sales and Stable Variety Structure

If the proportion of the product revenue in the total revenue will not change, the breed structure is stable. However, it is difficult for companies to keep their

proportion constant. When a company changes its sales structure, the steady structure is disrupted, and the profit is substantially lower than it was previously.

What is the meaning of balance between production and sales? It signifies that the enterprise's sales volume and production volume have reached a balance. In this case, the volume in CVP refers to the sales volume. When the sales unit price remains constant, this figure represents the sales income. However, sales volume may vary from production, and as a result, production might affect profitability.

3.4.4 The Assumption That Target Profit is Operating Net Profit

The reason for assuming that the target profit is the operating net profit is that under this assumption, enterprises are allowed to use CVP combined with the profit-even map to obtain information about the break-even point, lucre-safeguarded point and so on, and to carry out safety analysis and sensitivity analysis.

4 LIMITATION ANALYSIS AND PRECAUTIONS OF CVP

4.1 Limitation Analysis

4.1.1 CVP Has Special Requirements for Cost Problems

The fixed cost separated from the mixed cost needs to be integrated into the original fixed cost before applying the cost volume profit analysis technique, and the new fixed cost and variable cost need to be divided from the mixed cost. However, in practice, we are confused about "how to split the mixed cost".

4.1.2 CVP Assumes That the Total Cost Has a Linear Relationship with Sales Volume, and the Sales Revenue Has a Linear Relationship with Sales Volume

When using CVP, the study analyzes it with the help of the break-even analysis chart.

Firstly, the cost-and-income line should be a curve in theory. When using CVP, this study assume that the fixed cost and unit variable cost remains constant. However, in practice, the overall cost of fixed assets cannot remain constant over time, and variable costs will also be curved as a result of changes in business scale and production efficiency. When analyzing sales revenue, the unit price will

fluctuate under the influence of the market economy, thus it will be a curve as well.

Secondly, BEP (break-even volume = fixed cost/unit marginal contribution) has no practical significance since fixed assets differ significantly between various types of firms. Therefore, there are also great differences in break-even point. However, it is meaningless if the break-even threshold is too high or too low.

4.1.3 CVP Only Considers "EBIT"

Pre-tax profit, such as total profit, operational profit, and operating net profit, is referred to as "EBIT." The quality of analysis results is directly tied to the index used as the profit in CVP. To be consistent with the subsequent profit sensitivity analysis, although this assumption strengthens the relationship between cost, business volume and profit, it excludes profit-affecting factors other than the enterprise's production and operation activities, resulting in the deviation from target profit. Moreover, policymakers are concerned about after-tax profits. Therefore, the key challenge to be solved in CVP is after-tax profit.

4.1.4 CVP Is Carried out under the Condition That Prices Remain Unchanged

Price changes have a significant impact on the success or failure of decision-making. Cost volume profit analysis follows the historical cost principle, which impedes the achievement of analysis objectives, such as information processing procedures that do not adapt to price changes. Most businesses have a minimal share of machinery and equipment in their total assets, and the possibility of replacement is also limited. The possibility of replacement of fixed assets such as houses, inventories and buildings are extremely high. Price changes affect the cost and inventory of these assets and the price of the company's products, and the latter is sometimes more affected by price fluctuations than the former. Therefore, the sales revenue line and total cost line on the break-even chart will fluctuate over time. Moreover, managers can achieve a lower break-even point if the increase in the cost of each product is smaller than the increase in the price. Therefore, increasing sales and profits is of no practical meaning.

4.1.5 CVP Does Not Consider the Impact of Simultaneous Changes of Multiple Factors on the Realization of Target Profit

The analysis method proves the impact of changes in quantity, cost and sales price on enterprises, but its application has certain limitations because it is based on the following assumptions: Single-product sales; Sales of various products, although the proportion of sales of various products remains constant. If the sales proportion of various products changes, the break-even point will also change. "All other variables remain unchanged in quantity" - this is unrealistic, so that this assumption may be unfeasible. Increased sales volume, for example, will certainly result in a decrease in unit variable cost.

4.2 Several Points for Attention in the Application of CVP

4.2.1 The Total Cost Is Divided into Fixed Cost and Variable Cost

Before to employing CVP, the cost is separated into variable and fixed costs based on an examination of cost behavior. Before employing cost behavior, costs are classified as variable, fixed, or mixed. When adopting cost behavior, variable cost is still a variable cost, and fixed cost is still a fixed cost, according to cost habit. However, because mixed cost has both variable cost and fixed cost habits, it must be divided into variable cost and fixed cost. In terms of how to decompose, the following strategies are commonly used:

a) High and low point method.

The cost behavior model is based on the total cost and business volume, from which the highest and lowest business volumes are determined, and the total cost is decomposed to obtain:

Unit variable cost = (maximum business volume cost –

minimum business volume cost) /
(maximum business volume –
minimum business volume)

Total fixed cost = maximum business volume cost
- unit

variable cost * maximum business
volume

= minimum business volume cost - unit
variable cost * minimum business
volume

b) Regression Analysis.

Based on the previous data, the business volume and mixed cost are analyzed, and the regression line indicating the link between business volume and the mixed cost is obtained using the least square principle to determine the fixed cost and variable cost. The mixed cost is assumed to conform to the total cost model, that is, $y = a + bx$ (a is the fixed cost component; b is the unit variable cost).

$$b = \frac{n \sum x_i y_i - \sum x_i \sum y_i}{n \sum x_i^2 - (\sum x_i)^2}$$

$$a = \frac{\sum y_i - b \sum x_i}{n}$$

c) Account Analysis Method.

The type close to the cost is judged based on the content of relevant cost accounting and its detailed accounting, as well as its dependence on production, and is recognised as the type of cost. This cost's type can be considered its closest cost type.

d) Technical Measurement Method.

It is a method to divide fixed and variable costs according to the technical measurement of various material consumption and labour costs in the production process.

e) Contract Confirmation Method.

According to the payment provisions in the agreement signed by the enterprise, confirm which items belong to variable cost and which items belong to fixed cost.

While there are several approaches for decomposing the mix of costs, the approach depends on the enterprise's specific situation.

4.2.2 Comprehensively Consider the Impact of Simultaneous Changes of Various Factors on the Realization of Target Profits

Various factors affect profits, one of which changes, and the other follows suit, one of which changes, and the other follows suit. For example, after lowering the price, if the sales department believes that the lucre-safeguarded volume (amount) can be fully realized and the production department believes that there is sufficient production capacity, the target profit can be implemented. However, the sales department believes it is difficult to realize the lucre-safeguarded volume (amount), and the volume(amount) cannot be realized after the price reduction. Thus, cost control is essential. Therefore, the production department needs to reduce the unit variable cost. If the production department believes that reducing

variable costs (such as raw materials and labor expenses) can assist the firm to achieve the predetermined profit goal, this method can help the enterprise achieve the predetermined profit goal. Otherwise, enterprises also need to save fixed costs.

5 SUGGESTIONS ON IMPROVING CVP

5.1 Understand Cost Drivers

Cost driver is the factor that leads to cost occurrence and determines the level of cost occurrence. According to the relationship between cost and cost driver, cost can still be divided into variable cost and fixed cost, but the definitions of variable cost and fixed cost have changed. Variable cost is a cost that is proportional to the change of cost drivers. Fixed costs refer to the costs that do not change with the changes in cost drivers. Compared with the simultaneous interpreting models, the following differences can be seen: Firstly, the variable cost of each production and marketing unit is different from the traditional unit variable cost, and the improved CVP is more accurate. Secondly, different from fixed costs, some once regarded as fixed costs may change at any time due to cost drivers unrelated to production and sales quantities. The results show that the target production and marketing quantity calculated by the expanded model is less than that calculated by the original model. Undoubtedly, the extended model is more accurate than the original model, and it also has a significant impact on enterprise planning and decision-making.

5.2 Combined with Rolling Budget and Dupont Analysis

Based on the traditional CVP, the advantages of rolling budget and DuPont analysis method are absorbed to overcome the disadvantage of the traditional CVP that "the annual target profit is determined by the planned variable cost, fixed cost, quantity and sales price, and the planned control number of some variables in the later stage is not adjusted according to the deviation between the actual amount of the above variables and the planned value". Adopt quarterly (or monthly) "rolling" calculation and financial analysis methods such as DuPont analysis to determine the controlled level of variables such as variable cost, fixed cost, sales volume and unit price in the later stage of the

enterprise in order to achieve the expected profit target of the enterprise, and take this as the guidance to urge the enterprise to take measures to "correct errors", to ensure the completion of the target profit, so that the CVP can be better used in the process of pre prediction, in-process analysis and control and post summary.

6 CONCLUSIONS

CVP is one of the practical technologies of modern enterprise management. The application research of cost-volume-profit by enterprises, through the analysis of the functional relationship between cost, business volume and profit, helps decision-makers correctly formulate price policies, marketing policies and effective cost management, control and assessment measures, which has important practical significance and long-term strategic role.

With the deepening of China's openness and competition, it is more and more necessary for enterprises to promote the application of CVP. When applying this method, we should pay attention to its five assumptions. In decision-making, we should correctly analyze the basic principle and function of CVP, avoid wrong decision-making, and understand the limitations of this method, so as to better play a role in the business decision-making of enterprises. As long as enterprises deeply understand, accurately grasp and flexibly use the essence of this analysis tool, CVP will bring huge economic benefits to enterprises.

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