USING COST – VOLUME – PROFIT ANALYSIS BY MANAGEMENT

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Abstract: *Founded on the distinction between variable costs and fixed costs, the analysis of the relationship between the volume of activity, costs and profits is directed to decision-making in order to guide an entity's management to obtain optimal results. It is known that the models that individualize the development of the expenses at an entity's level represent the basis of cost analysis. Then, given the fact that foresight imposes taken into account fluctuations in an activity, the grouping of expenses into variable and fixed will be used for forecasting management, for evaluating an entity's performance and for analyzing decisional alternatives.*

Key words: *breakeven point, safety interval, dynamic safety index, coverage factor.*

1. C-V-P analysis – a necessary tool for forecasting and managerial control

In terms of cost analysis, the variability of expenses is applied to measure the profitability on products. For a certain given structure, the fixed expenses are borne entirely by the entity, whatever its level of activity.

Consequently, the sales volume will have to reach a certain level for being able to cover the fixed expenses. In addition, any entity aims to have a profitable activity. These are the reasons supporting the use of cost-profit-volume relationship as the basis for many managerial decisions that can be taken on a short term.

This correlation is treated in the context of the analysis of the indicators: gross contribution to profit, the breakeven point, the safety interval and the dynamic safety index, the coverage factor.

a. Gross contribution to profit is calculated for each product in order to know to what extent the variable expenses with the manufacture and the sale of the product were covered and what further contribution it brings to cover the fixed expenses in order to make profit.

The unit gross contribution (c_{bu}) or, as it is called in the literature, the margin on variable costs per unit, is calculated as the difference between the unit sales price (p_{vu}) and the unit cost determined by the variable expenses (c_{vu}), according to the equation:

$$c_{bu} = p_{vu} - c_{vu} \qquad (1)$$

The total contribution to profit (Cb) is calculated according to the turnover (CA) and the total variable expenses (Chv), as follows:

$$Cb = CA - Chv \qquad (2)$$

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b. The breakeven point (the critical point, the neutral point or breakeven) is the indicator that represents the point at which the turnover coming from the sold production covers all variable expenses related to the sales volume and to the fixed expenses related to the period, so that the result is null. In other words, the breakeven point corresponds to that level of activity (in terms of turnover or volume) at which the turnover obtained from the selling of the production equals the expenses, and the profitability is zero, the starting point from which the entity makes a certain profit, its activity becoming profitable.

The breakeven point can be determined either arithmetically or graphically.

Arithmetically, this indicator (P_e) is calculated as the ratio between the fixed expenses (Chf) and the gross contribution to profit per unit (c_{bu}), according to the following equation:

$$P_e = \frac{Chf}{c_{bu}} \tag{3}$$

or

$$P_e = \frac{Chf}{p_{vu} - c_{vu}} \tag{4}$$

By multiplying the above equation with the unit sales price (p_{vu}), one gets the calculating relation for the critical turnover (CA_e) or the value breakeven point, as follows:

$$P_e \times p_{vu} = \frac{Chf}{p_{vu} - c_{vu}} \times p_{vu} \tag{5}$$

that is:

$$CA_e = \frac{Chf}{\dfrac{c_{bu}}{p_{vu}}} \tag{6}$$

where: $\dfrac{c_{bu}}{p_{vu}} = r$ (7)

or, at the entity's level

$$\frac{Cb}{CA} = R \tag{8}$$

the equation becomes:

$$CA_e = \frac{Chf}{r} \quad \text{or} \quad CA_e = \frac{Chf}{R} \tag{9}$$

where: r – rate of margin on variable costs per unit;

R - gross margin rate.

c. The safety interval and the dynamic safety index

The safety interval (I_s) is the indicator showing how much sales can fall for the entity to reach the critical point. It represents the total turnover that can be suppressed by unfavorable circumstances, without leading to loss for the entity.

It can be determined according to:

$$I_s = CA - CA_e \tag{10}$$

The dynamic safety index (I_d) determines the reduction percentage of the turnover for the entity to reach the critical point.

It is calculated according to:

$$I_d = \frac{I_s}{CA} \times 100 \tag{11}$$

d. The coverage factor (F_a) expresses the percentage of the turnover necessary to cover the expenses and make a profit.

It is determined according to:

$$F_a = \frac{CA_e}{CA} \times 100 \tag{12}$$

2. Analysis of decisional alternatives. Case Study

To illustrate the relationship between the indicators specific to the cost-profit-volume relation, we will consider the following hypothetical example:

Situation of the analyzed products   Table 1

Specification	Products			Total
	A	**B**	**C**	
Volume of the activity produced and sold (u.f.)	7500	4500	1500	
Unit sales price (u.m./u.f.)	3.0	7.5	16.5	
Total variable expenses (u.m.)	11250	13950	16950	
Fixed expenses (u.m.)				6000

Based on this example, the entity's managerial department examines the relationship between the volume of activity, costs and profit in the following ways:

- the breakeven point in terms of production and sale of the B product;
- the breakeven point in terms of manufacture and sale of three products;
- the physical and value breakeven point for the targeted profit of 15000 u.m.;
- the breakeven point for a profit rate of 10%;
- the critical period for the result to be zero;
- how much the sales may decrease, in absolute and relative figures, so that the entity does not enter the loss area;
- the percentage of sales needed to cover the fixed expenses and make a profit;
- the percentage of turnover necessary to cover all the fixed expenses.

A. The breakeven point in terms of production and sale of the B product

The fixed expenses of the period (Chf) are 1500 u.m; the other accounting information for this product remains unchanged (Table 1).

$$P_{eB} = \frac{Chf}{C_{bu}} = \frac{1500}{7.5 - 3.1} = \frac{1500}{4.4} = 340.90 \text{u.f.}$$

For the turnover to equal the expenses, it is necessary for the entity to produce and sell 341 u.f. of the B product, the entity's result being zero. To determine the breakeven point in monetary units, we multiply the unit sales price with the level determined by the P_e.

B. The breakeven point in terms of manufacture and sale of the three products

Assuming the product mix, relevant is the structure of the breakeven point, determined as follows:

$$Pe = \frac{Chf}{\overline{Cb}} \qquad (13)$$

where: $\overline{Cb}$ - average contribution to profit.

$$\overline{Cb} = \frac{\sum_{i=1}^{n}(q \times c_{bu})_i}{\sum_{i=1}^{n} q_i} = \frac{Cb}{\sum_{i=1}^{n} q_i} \qquad (14)$$

Substituting the data from Table 1 in the calculating equations, it results:

$$\overline{Cb} = \frac{7500 \times 1.5 + 4500 \times 4.4 + 1500 \times 5.2}{7500 + 4500 + 1500}$$

$$= \frac{38850}{13500} = 2.87 \text{u.m./u.f.}$$

$$Pe = \frac{6000}{2.87} = 2090.59 \text{u.f.}$$

In terms of manufacturing and sale of the three products, a production of 2091 u.f. is sufficient for the outcome of the entity to be zero. For this information to be complete and acknowledging the fact that we keep the manufacturing structure, we determine the structure of the breakeven point with the help of the equations (15) and (16).

To obtain the structure of the breakeven point we use the proportion (specific weight) of the volume of each cost object (g_i) in the total production. Keeping the previous notation, the equation is:

$$Pe_i = g_i \times Pe \qquad (15)$$

where:

$$g_i = \frac{q_i}{\sum_{i=1}^{n} q_i} \qquad (16)$$

$$g_A = \frac{7500}{13500} = 0,55$$

$$g_B = \frac{4500}{13500} = 0,33$$

$$g_C = \frac{1500}{13500} = 0,12$$

$$Pe_A = 0,55 \times 2090.59 = 1149.45 \text{u.f.}$$

$$Pe_B = 0,33 \times 2090.59 = 689.89 \text{u.f.}$$

$$Pe_C = 0,12 \times 2090.59 = 251.25 \text{u.f.}$$

For the turnover to equal the expenses it is necessary for the entity to produce and sell 1149 u.f. of the A product, 690 u.f. of the B product and 251 u.f. of the C product.

With the help of the equations (8) and (9), we determine the critical turnover (CA_e) or the value breakeven point:

$$R = \frac{38850}{81000} = 0.4796$$

$$CA_e = \frac{6000}{0.4796} = 12510.42 \text{u.m.}$$

From the entity's activity it was released a contribution of covering, its share in total sales being of 47.96%. This is the 'reserve' to cover fixed expenses and obtain the result, while the turnover corresponding to the breakeven point is of 12510.42 u.m. and corresponds to a production of 2090.59 u.f.

C. The physical and value breakeven point for the targeted profit of 15000 u.m.

While maintaining the structure of production and sales, without changes in the production capacity, changing the value of fixed expenses is not involved.

The breakeven point to achieve the targeted profit (Pe_p), in physical units:

$$Pe_p = \frac{Chf + P}{\overline{Cb}} \qquad (17)$$

$$Pe_p = \frac{6000 + 15000}{2.87} = 7317.07 \text{u.f.}$$

The breakeven point to achieve the targeted profit, in value units, represented by the turnover for the targeted profit (CA_p):

$$CA_p = \frac{Chf + P}{R} \qquad (18)$$

$$CA_p = \frac{6000 + 15000}{0.4796} = 43786.48 \text{u.m.}$$

Within the entity, the breakeven point, in physical units, to achieve the targeted profit of 15000 u.m. is of 7317 u.f. products, and the turnover for the targeted profit is worth 43786.48 u.m.

D. The breakeven point for a profit rate of 10%

The information on the turnover in terms of an expected profit rate (CA_{Rp}) can be found using the breakeven point, i.e. the volume of activity ensuring that target, as follows:

$$CA_{Rp} = \frac{Chf}{R - R_p} \qquad (19)$$

$$CA_{Rp} = \frac{6000}{0.4796 - 0.1000} = 15806.11 \text{u.m.}$$

The entity aims to achieve and maintain a profit rate of 10% if it makes a turnover of 15806.11 u.m.

E. The critical period for the result to be zero

We determine the breakeven point according to the time, also called the critical period (T_{crt}), based on the value of the sales per month or per day, depending on the reference size appropriate to the expression of production and sales and the critical turnover.

The incurred fixed expenses will be borne from the first days of the period. Over time, the aggregate value of sales increases and the coverage contribution is sufficient to bear all the fixed expenses. At this moment the result is zero, this being the time breakeven point. The covering contribution the entity will achieve from this moment on is entirely profit, and the period of time in which the breakeven point is reached is:

$$T_{crt} = \frac{CA_e}{\frac{CA}{T}} \qquad (20)$$

$$T_{crt} = \frac{12510.42}{81000/12} = 1.85 \text{months}$$

At 1.85 months since the activity started, the entity reaches the breakeven point, any further activity making profit.

F. How much the sales may decrease, in absolute and relative figures, so that the entity does not enter the loss area

The safety interval (I_s) determined according to the equation (10) expresses, in monetary units, how much the activity may decrease, so that the entity does not enter the loss area. The activity is far from the loss; the production and sale can decrease with 68489.58 u.m., as follows:

$I_s = 81000 - 12510.42 = 68489.58$ u.m.

The dynamic security index (I_d) expresses, in relative figures, how much the sales may decrease, so that the entity does not enter the loss area and reaches the breakeven point.

It is calculated according to the equation (11):

$$I_d = \frac{68489.58}{81000} \times 100 = 84.55\%$$

The volume of the production manufactured and sold may decrease by up to 84.55% for the entity not to pass in the loss area.

On the basis of the two indicators we actually determine the entity's risk of becoming unprofitable. The larger their values, the lower the unprofitable risk is; their negative values indicate losses in the activity and show, in absolute and relative values, how much the production and the sales should grow to reach the breakeven point.

G. The percentage of sales needed to cover the fixed expenses and make a profit

The information on percentage of sales needed to cover the fixed expenses and make a profit is provided by determining the coverage factor indicator (12), on cost object and globally.

$$Fa_A = \frac{12000}{22500} \times 100 = 53.33\%$$

$$Fa_B = \frac{10227.22}{33750} \times 100 = 30.30\%$$

$$Fa_C = \frac{19026.81}{24750} \times 100 = 76.87\%$$

$$\text{Fa} = \frac{12510.42}{81000} \times 100 = 15.45\%$$

With the help of the information this indicator provides, the structure of the activity may be changed in favor of the most profitable cost object, i.e. the one with the largest coverage factor.

Interpreting the value of the global coverage factor we notice that 15.45% of the value of the manufactured and sold production can cover the fixed expenses and induce profitability.

The information can lead to erroneous reasoning, so detailed information is required on the amount of the fixed expenses and their share in total sales.

H. The percentage of turnover necessary to cover all the fixed expenses

The rate of the fixed expenses (R_{Chf}) expresses how many percentages of the turnover are needed to fully cover the fixed expenses, and in the case of this analyzed entity, it is:

$$R_{Chf} = \frac{Chf}{CA} \times 100 \qquad (21)$$

$$R_{Chf} = \frac{6000}{81000} \times 100 = 7.40\%$$

Comparing the rates of the fixed expenses with the coverage factor we noticed that 7.40% of the sales are needed to cover the fixed expenses, the difference of 8.05% representing the potential profit. Therefore, the information communicated to the managerial team is that the produced and sold production is sufficient in order to join the profit area.

Conclusions

The information obtained while analyzing the correlation between the volume of activity, costs and profit can be useful to the entity's management only when certain assumptions are valid. From the large number of these assumptions and conditions, the literature notices: the evolution of variable and fixed costs can be determined accurately; expenses and turnover have linear trends; cost and price variables are constant in the short term; the structure of the sales does not change; the production and sales volume in the short term are approximately equal. In the long run, however, the effect is not the same and therefore we do not recommend taking into consideration the C-V-P analysis. Further analyses should form the basis of the strategies.

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