

Application of cost-volume-profit analysis for commodity operations management

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Abstract: *The principal aim of this paper is to make a short survey of Cost-Volume-Profit (CVP) analysis as a technique that usually examines variations in gross profit under different scenarios for changes in sales volume, cost, sales prices, and more. This approach has become popular in theory and practice and is called the critical point method. Accountants often perform CVP analysis to plan future levels of operating activity and to obtain information about:*

- ✓ *the amount of sales needed to reach a target profit level;*
- ✓ *the breakeven point, i.e. the amount of revenue needed to cover cost;*
- ✓ *whether a future increase in fixed costs will be effective or not;*
- ✓ *what are the stock to which priority should be given;*
- ✓ *whether the planned fixed costs expose the company to an unacceptably high level of risk or not, etc.*

Marginal income represents the difference between total revenue and total variable costs. Similarly, the marginal income per unit is the sales price per unit minus the variable price per unit. Both the contribution margin and the unit contribution margin are valuable instruments taking into account the effect of volume on profits. The contribution margin per unit shows how much revenue from each unit sold can be applied to the fixed costs. Once sufficient units are sold to cover all fixed costs, then the contribution margin per unit of all next sales becomes profit.

The paper also presents the results of the analysis "cost-volume-profit" for companies from Pazardjik region.

CVP analysis is a powerful tool in making managerial decisions including marketing, sales, investment and financial decisions.

Key words: *analysis, cost analysis, sales volume analysis, profit analysis, CVP*

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The term "analysis" is ancient Greek and means dismemberment, division of the whole. The analysis examines in detail the nature of the action or phenomenon.

It examines the complexity of the structure, the relationship of the elements of the object of study. Financial accounting is a process of selection, comparison and evaluation of accounting information in order to establish the relationships and trends in the enterprise that are required to make management decisions.

Cost-volume-profit (CVP) analysis is a technique that usually examines changes in gross profit under different scenarios of changes in sales volume, cost, sales prices etc. This approach has become famous in theory and practice and is called the critical point method. Accountants often perform CVP analysis to plan future levels of operating activity and to obtain information about:

- the amount of sales needed to reach a target profit level;
- breakeven point is the amount of revenue needed to cover losses;
- a future increase in fixed costs effective;
- which products or services should be prioritized;
- whether the planned fixed costs expose the company to an unacceptably high level of risk, etc.

Marginal income represents the difference between total revenue and total variable costs. Similarly, marginal unit income is the unit selling price minus the variable unit price.

Both the contribution margin and the contribution margin per unit are valuable tools in accounting for the effect of volume on profit. The unit contribution margin shows us how much revenue from each sold unit can be applied to fixed costs. Once enough units have been sold to cover all fixed costs, then the contribution margin per unit of all other sales is profitable.

The next part of this section presents the results of a cost-volume-profit analysis for company A in the Pazardzhik region, which is engaged in the production and sales of a Middle tower computer case.

Table 1 presents real data on the average selling price of a good, the minimum and maximum of cash sales over the last 5 years, the variable and fixed costs per item. In the last two rows of the table the critical point of the company in terms of cash sales and the critical point in terms of minimum sales value in BGN is calculated.

Table 1 Sales, fixed and variable cost per item for Company A

Unit selling price	BGN	54,90
Units sold:	BGN	1250,00
Minimum	pcs	200
Maximum	pcs	2600
Variable costs	BGN	5,25
For unit materials	BGN	1,10
For labor per unit	BGN	4,10
For electricity per unit	BGN	0,05
Fixed costs	BGN	19 300,00
rentals	BGN	4 500,00
Depreciation	BGN	10 000,00

Insurance	BGN	1 200,00
fin. expenses (interest, etc.)	BGN	3 600,00
Critical point (number of units)	pcs	388,72
Critical point (in value)	BGN	21 340,79

The critical point of sales of units for Company A is calculated as follows:

$$BEP = \frac{FC}{P - VC} = \frac{19300}{54,90 - 5,25} = 388,72 \approx 389 \text{ pcs.}$$

A critical selling point in value can be calculated in two ways. The first way is by multiplying BEP in units of market price, i.e.:

$$388,72 \text{ pcs.} * 54,90 = 21\,340,79 \text{ BGN.}$$

The other way is to collect the total amount of fixed costs and the total amount of variable costs for 389 pcs. (table 2) i.e.

$$19\,300,00 + 2\,040,79 = 21\,340,79 \text{ BGN}$$

Table 2 illustrates the calculated total fixed and variable costs for Company A for sales equal to the critical point. Total material, labour and electricity cost levels are also calculated, multiplying critical point cash sales by the respective unit cost variables.

Table 2 Analysis of Company Total Variable and Fixed Costs in a scenario of critical point

Sale price	54,90 BGN
Critical point in cash	388,72 pcs.
Total revenue	21 340,79 BGN
Total variable costs	2 040,79 BGN
for materials	427,59 BGN
for work	1 593,76 BGN.
for electricity	19,44 BGN
Total fixed costs	19 300,00 BGN
Total costs	21 340,79 BGN.
Gross profit	0,00 BGN.

Operating leverage measures the operational risk of a business that is generated by too high a fixed cost. It gives an idea of how risky (varying) an entity's operating income (EBIT) is and shows the effect of a change in sales on an entity's revenue.

It is calculated by the following formula:

$$OL = \frac{\% \text{ change in EBIT}}{\text{change in sales}} = \frac{(P - V) * X}{(P - V) * X - FC}$$

If we use the data in Table 1, then the operating leverage for the company is:

$$L = \frac{(54,9 - 5,25) * 1250}{(54,9 - 5,25) * 1250 - 19300} = 1,45$$

This means that if sales change by 1%, then gross revenue (EBIT) will fluctuate to 1.45%.

Financial leverage measures the financial risk an entity incurs. It is associated with fixed payments (on loans, leasing contracts, etc.) in order to increase the return on the enterprise. The higher the financial leverage, the higher the financial risk incurred and the higher the cost of capital.

Financial leverage can be calculated using the following formula:

$$FL = \frac{\% \text{ change in EPS}}{\text{change in EBIT}} = \frac{(P - V) * X - FC}{(P - V) * X - FC - IC}$$

where: EPS is a profit share;

IC - interest expense or dividend expense for preferred stock;

$$FL = \frac{(54,9 - 5,25) * 1250 - 19300}{(54,9 - 5,25) * 1250 - 19300 - 3600}$$

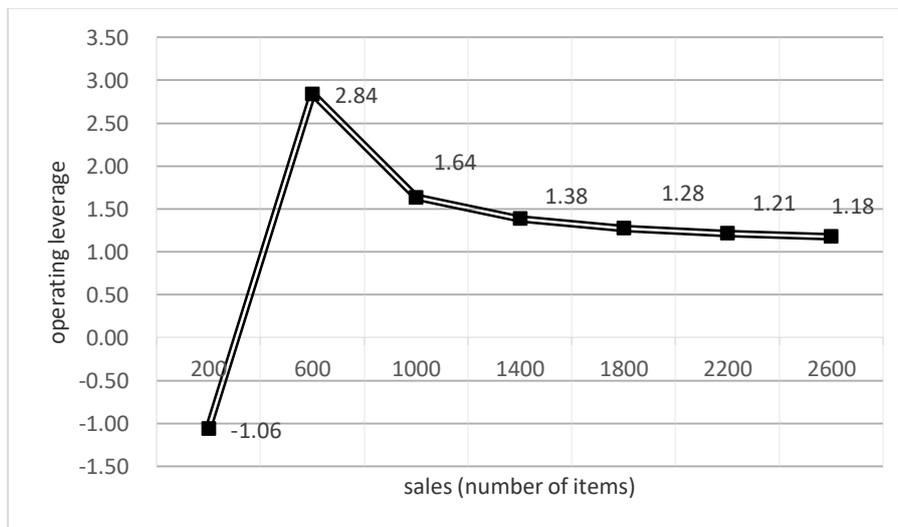
The specific value means that if gross income (EBIT) changes by 1%, then EPS will fluctuate within 1.58%. Table 3 shows the results of the analysis of the sensitivity of operating leverage to sales.

Table 3 Estimated values of the operating leverage of Company A under different sales scenarios

Sales	Operational leverage
200	-1,05977
600	2,83985
1000	1,63591
1400	1,38439
1800	1,27544
2200	1,21461
2600	1,17579

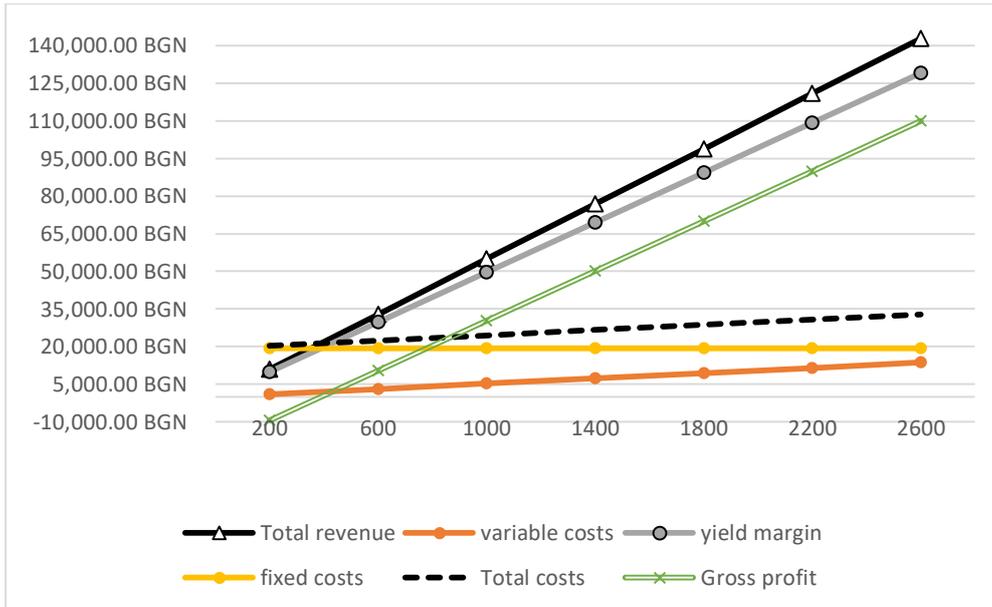
Graph 1 shows the relationship between the change in sales of Company A and the values of operating leverage.

Graph 1 Investigation of the operating leverage of the enterprise under different scenarios of cash sales



Graph 2 is known as cost-to-profit or CVP chart and shows visually the relationship between the change in total revenue and total cost. It is most often used to illustrate the expected profit changes in different business activity scenarios.

Graph 2 CVP diagram



Graph 2 is generated based on the calculated data in Table 4. The intersection of the line of total revenue with that of total cost indicates the critical point of the firm. For Company A it is at 388.72 PC boxes sold and is between 200 and 600 for the abscissa. With respect to the ordinate axis of the chart in value, the critical point of sales was calculated in Table 1 at BGN 21 340,79 (i.e. between BGN 20 000 and BGN 35 000).

Table 4 shows the calculated values of the performed sensitivity analysis. The purpose of this type of analysis is to investigate the change in variable costs, marginal income, fixed costs and gross profit of Company A under different sales scenarios.

Table 4 Investigation of the impact of sales on variable costs, marginal revenue, fixed costs and gross profit of Company A

Sales	200	600	1000	1400	1800	2200	2600
Total revenue	10 980,00	32 940,00	54 900,00	76 860,00	98 820,00	120 780,00	142 740,00
Variable costs	1 050,00	3 150,00	5 250,00	7 350,00	9 450,00	11 550,00	13 650,00
For unit materials	220,00	660,00	1 100,00	1 540,00	1 980,00	2 420,00	2 860,00
For labor per unit	820,00	2 460,00	4 100,00	5 740,00	7 380,00	9 020,00	10 660,00
For electricity per unit	10,00	30,00	50,00	70,00	90,00	110,00	130,00
Marginal income	9 930,00	29 790,00	49 650,00	69 510,00	89 370,00	109 230,00	129 090,00
Fixed costs	19 300,00	19 300,00	19 300,00	19 300,00	19 300,00	19 300,00	19 300,00
Total costs	20 350,00	22 450,00	24 550,00	26 650,00	28 750,00	30 850,00	32 950,00
Gross profit / loss	- 9 370,00	10 490,00	30 350,00	50 210,00.	70 070,00	89 930,00	109 790,00

In the second part of point 3 the results of the analysis of enterprise B will be presented. It realizes its turnover by trading with three canned vegetables. In the calculations below, they are indicated in the tables as Commodity A, B and C. Table 5 presents the sales for the last year, market prices and variable costs per unit of the company.

Table 5 Sales and variable costs per unit of enterprise B

Stockes	stock A	stock B	stock C
Units sold (number)	20170	14125	16460
Market price per unit	0,80	1,20	2,90
Variable cost per unit	0,52	0,90	1,95

When using the cost-volume-profit analysis of businesses that generate their revenue from the sale of a significant number of items and services, the sales mix approach is often used. It represents proportionally the enterprise's sales. It can be calculated both in terms of cash sales and sales revenues in BGN, with different values.

In the cost-volume-profit analysis, it is assumed that the sales mix is a constant value. Assuming that the sales mix remains unchanged, CVP analysis is allowed to represent sales (in cash or in levs) as a combined aggregate value for the enterprise as a whole.

Table 6 Analysis of marginal revenue enterprise B by item

	stock A	stock B	stock C	total
Units sold	20170	14125	16460	50755
Income BGN	16 136,00	16 950,00	47 734,00	80 820,00
Variable costs BGN	10 488,40	12 712,50	32 097,00	55 297,90
Marginal income BGN	5 647,60	4 237,50	15 637,00	25 522,10
Marginal income per unit BGN	0,28	0,30	0,95	0,50
The marginal income ratio	35,00%	25,00%	32,76%	31,58%
Sales mix (pieces)	39,74%	27,83%	32,43%	100,00%
Sales mix (earnings)	19,97%	20,97%	59,06%	100,00%

Table 6 presents the results of the calculations made with respect to the analysis of marginal revenue for enterprise B. Marginal income is a concept closely related to cost accounting and its purpose is to calculate the profitability of individual items in the enterprise sales mix.

The marginal revenue can be calculated both per item and for sales across the entire product line. In the first case, it is obtained by subtracting the variable cost per unit from the selling price of the product concerned with respect to the entire product line, as the total sales costs are deducted from the sales of an item. For example, for the entire product line of Product A, marginal income is estimated at BGN 5 657.60 (BGN 16 136.00 - BGN 10 488.40) and marginal income per unit is BGN 0,28 (0,80 – 0,52).

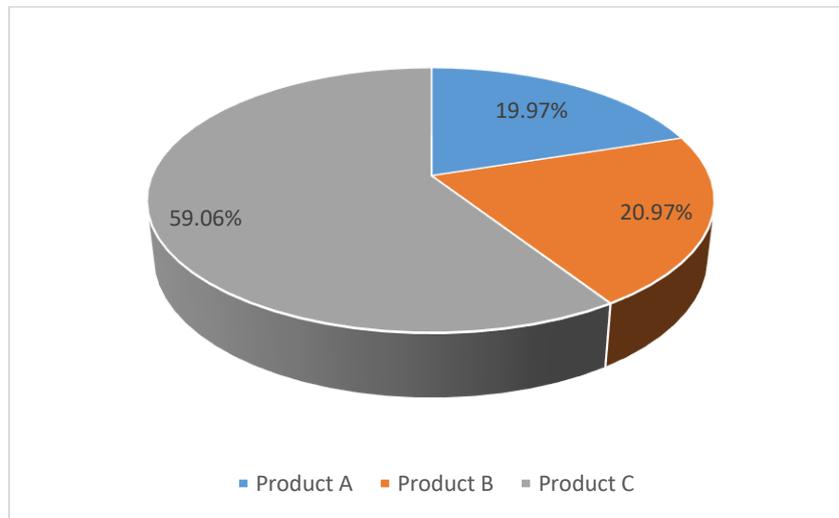
The marginal revenue ratio is calculated based on the unit and total sales metrics calculated. The marginal income ratio is obtained by dividing the marginal income in BGN for a given product by the sales made in BGN by the respective item. For example,

for product A it is equal to 35% (marginal income of BGN 5 647,60 realized income from sales of goods A 16 136,00 BGN).

A negative or low value of the profit margin is associated with a product line or business segment that is not profitable or low profitable.

Graph 3 shows the sales mix in terms of revenue.

Graph 3 Sales mix of revenue



The sales mix for the last year shows that the received revenue from sales of goods A is 19.97% of the total, those of goods B is 20.97% and the biggest contribution is made by goods with 59.06%.

Graph 4 illustrates the sales mix in terms of sales of items. As you can see here the percentages are different and this means that the sales structure in value is different from that in kind. In terms of cash sales, commodity A is accounted for the largest share of 39.74%, followed by commodity C by 32.43% and lastly commodity B.

Graph 4 Sales mix of revenue

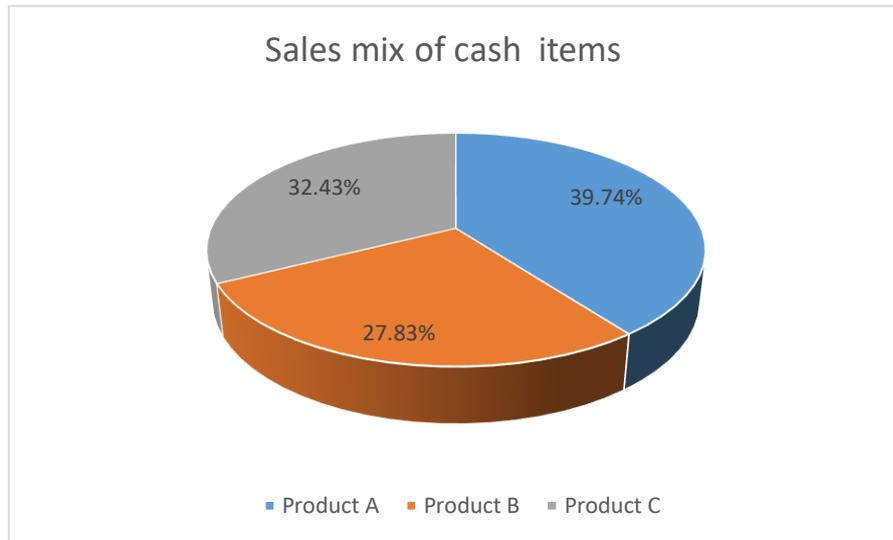


Table 7 shows the calculated main elements of the statement of income and expenses of enterprise B. The table shows that the net profit of the company for the last year is BGN 21 844,89.

Table 7 Calculation of the net profit of enterprise B

Marginal income	BGN	25 522,10
Fixed costs	BGN	1 250,00
Taxable income	BGN	24 272,10
Tax profit	BGN	2 427,21
Net profit	BGN	21 844,89

Table 8 shows the results of a cost-volume-profit analysis in a sales scenario equal to the critical point. As can be seen from the table, while maintaining the proportions of the sales mix unchanged, if company B wants to be able to cover its costs, it needs to make a minimum of sales in respect to product A of 988, of goods B 692 pcs. and from product C 806 pcs. or total sales amounted to 2 486 items. Accordingly, in this situation, the enterprise would generate total revenues of BGN 3 958,33, which cover exactly the total variable costs (BGN 2 708,33) and the total fixed costs (BGN 1 250.00).

Table 8 CVP analysis of enterprise B in a critical point scenario

	Product A	Product B	Product C	Total
Sales(units)	988	692	806	2486
Income BGN	790,30	830,16	2 337,88	3 958,33
Variable costs BGN	513,69	622,62	1 572,02	2 708,33
Marginal income BGN	276,60	207,54	765,86	1 250,00

In the last part of point 3, a cost-volume-profit analysis will be made in the scenario of maintaining the same product mix and a target net profit of BGN 50,000 per enterprise B. If the company wants to earn exactly BGN 50,000 next year, then at 10% corporate tax the gross and profit will be BGN 55 555,56 and accordingly the fixed costs + target profit will be BGN 56 805,36.

Table 9 CVP analysis of Company B in the scenario of a target net profit of BGN 50,000.

	Product A	Product B	Product C	Total
Sales in units	44893	31439	36636	112967
Income BGN	35 914,54	37 726,29	106 243,47	179 884,30
Variable costs BGN	23 344,45	28 294,72	71 439,57	123 078,74
Marginal income BGN	12 570,09	9 431,57	34 803,89	56 805,56
Fixed costs BGN				1 250,00
Taxable income BGN				55 555,56
Tax 10%				5 555,56
Net income BGN				50 000,00

Table 9 shows that if a company is aiming for a net profit of BGN 50,000, it is necessary to make total sales of 112,967 items in cash or if the existing sales mix is

maintained, it means that 44893 units are sold. goods A, 31439 pcs. goods B and 36 636 pcs. goods C.

The calculation of sales (in cash) for a target net profit of BGN 50,000 is made by the following formula:

$$Q = \frac{FC + 55555,56}{P - VC} = \frac{56\ 805,36}{0,50} = 112967 \text{ pcs.}$$

Specific item sales in pieces were found as the percentage of the item sales mix for a specific item (calculated in Table 6) multiplied by 112 967 items. For example, the required sales for commodity A are set at 44 893 pcs. (39,74% * 112 967).

The disadvantages of applying the cost-volume-profit analysis can be summarized in the following areas:

- the projected revenue and expenditure projections can deviate significantly from the real ones;
- CVP analysis does not calculate fluctuations in revenues or costs that could be caused by trade discounts on large deliveries, changes in production, changes in productivity, efficiency, special discounts for customers, etc.;
- CVP analysis suggests that the sales mix will remain unchanged in the future, which is not true;
- CVP analysis assumes that selling prices and variable costs will not change;
- Does not account for political, regulatory, operational, credit, liquidity risks, etc.

Conclusion

In summary, the Cost-to-Profit (CVP) analysis, which typically examines changes in gross profit under different scenarios of changes in sales volume, cost, sales prices, etc. It was made on the basis of real data of operating companies and it is necessary to conclude that it cannot account for small fluctuations in income and expenses, as well as political, regulatory, operational, credit, liquidity and other risks.

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