

Ch. 3

Cost - Volume - Profit Analysis (CVP)

~~RUBA~~
MTOOR

→ what is CVP? →

تصليح لكل أنواع الشركات

← خدماتية
← تجارية
← تصنيعية

الكمية
(Q)

Operating Income
(الدخل التشغيلي)

Total Revenue
Total Cost

← علاقة
← علاقة

$$\text{Total Revenue (TR)} - \text{Total Cost (TC)} = \text{Operating Income (OI)}$$

$$TR - TC = OI$$

$$\text{Total Cost} = \text{Variable Cost} + \text{Fixed Cost}$$

$$TC = VC + FC$$

Selling Price → P

Number of unit sold → Q

$$\text{Variable Cost} = \left[\text{Direct Material} + \text{Direct Labor} + \text{Variable Manufacturing overhead} \right] + \text{other variable costs}$$

variable manufacturing costs

$$VC = DM + DL + V. MOH + \text{other VC}$$

↳ يتأثر بحجم الإنتاج

Fixed Cost = Fixed Manufacturing overhead + other Fixed Costs

$$FC = F. MOH + \text{other FC}$$

↳ within Relevant Range
لا يتأثر بحجم الإنتاج

Example: Bookstore - selling GMAT textbooks

$$P = \$ 200$$

$$Vc/unit = \$ 120$$

$$FC = \$ 2,000$$

$$Q = 40 \text{ units}$$

* Full absorption costing Income statement (الطريقة التي يخرجها)
← مقبولة في GAAP ويتم خصمها للـ External users

(CM. IS)

Contribution margin Income statement: (Variable Costing)
← لغرض التقارير داخل الشركة فقط

← غير مقبولة في GAAP لأنها لا تطبق Matching principle

CM. IS

Sales

(Variable costs)

Contribution margin

(Fixed costs)

Operating Income

$$200 \times 40 \rightarrow 8,000$$

$$(120 \times 40) \rightarrow (4,800)$$

$$\hline 3,200 \rightarrow (80 \times 4) [200 - 120 = 80]$$

$$(2,000)$$

$$\hline 1,200$$

$$\therefore CM = \text{Sales} - VC \quad [\$3,200 = 8,000 - 4,800]$$

$$CM/\text{unit} = \frac{CM}{Q} \quad \left[\frac{3,200}{40} = 80 \right]$$

or

$$CM/\text{unit} = P - VC/\text{unit} \quad [200 - 120 = 80]$$

← عند زيادة Q، يصبح صافي الربح \$80 لكل وحدة و FC ثابتة

$$CM\% = \frac{CM}{\text{Sales}} \times 100\% \quad \left[\frac{3,200}{8,000} \times 100\% = 40\% \right]$$

or

$$CM\% = \frac{CM/\text{unit}}{P} \times 100\% \quad \left[\frac{80}{200} \times 100\% = 40\% \right]$$

يعني كل \$1 من Sales يجب \$0.4 CM و \$0.6 FC

→ CUP Equations:

$$\text{Rev.} - VC - FC = OI$$

$$(P \cdot Q) - (VC/\text{unit} \cdot Q) - FC = OI$$

$$Q(P - VC/\text{unit}) - FC = OI \quad \dots (1)$$

$$Q \cdot CM/\text{unit} - FC = OI \quad \dots (2)$$

$$\therefore CM - FC = OI \quad \dots (3)$$

Break-even point (BEP)

نقطة التعادل (الأرباح ولا فسارة)

$$Q(P - VC/\text{unit}) - FC = OI$$

$$Q(P - VC/\text{unit}) - FC = 0$$

$$Q(P - VC/\text{unit}) = FC$$

$$\therefore \text{BEP} = \frac{FC}{CM/\text{unit}} \rightarrow \left[\frac{2000}{80} = 25 \text{ unit} \right]$$

عند بيع 25 وحدة يكون فربح ولا فسارة

$$\text{BEP} = \text{BEP} \times P \left[25 \times 200 = \$5,000 \right]$$

or

$$\text{BEP} = \frac{FC}{CM\%} \left[\frac{2000}{40\%} = \$5,000 \right]$$

* Target OI

$$\text{Target} = \frac{FC + \text{target OI}}{CM/\text{unit}} \left[\frac{2,000 + 2,800}{80} = 60 \text{ unit} \right]$$

$$\text{Target Revenue} = \text{Target} \times P \left[60 \times 200 = \$12,000 \right]$$

or

$$\text{Target Revenue} = \frac{FC + \text{Target OI}}{CM\%} \left[\frac{2,000 + 2,800}{40\%} = \$12,000 \right]$$

CVP and Income tax

$$\text{Net Income} = \text{Operating Income} \cdot (1 - \text{tax Rate})$$

$$NI = OI \cdot (1 - \text{tax Rate})$$

$$OI = \frac{NI}{1 - \text{tax Rate}}$$

Tax Rate = 40% \therefore $\$1,200 \leftarrow NI$ كم وحدة لازم ابغشان اوصول على

$$OI = \frac{1,200}{60\%} = \$2,000$$

$$\text{Target } Q = \frac{FC + \text{target } OI}{CM/\text{unit}} \left[\frac{2,000 + 2,000}{80} = 50 \text{ unit} \right]$$

$$\text{Target Revenue } (\$) = \text{Target } Q \cdot P \left[50 \cdot 200 = \$10,000 \right]$$

$$\text{or } \left[\frac{2,000 + 2,000}{CM/\text{unit} \cdot P} \rightarrow \frac{4,000}{80/200} = 10,000 \right]$$

حالة أخرى

Status Que

الوضع الحالي

$$P = \$200$$

$$VC/unit = \$120$$

$$CM/unit = \$80$$

$$FC = \$2,000$$

$$Q = 40 \text{ unit}$$

↓

$$OI = 80 \cdot 40 - 2,000$$

$$OI = \$1,200$$

$$P = \$200$$

$$VC/unit = \$120$$

$$CM = \$80$$

$$FC \rightarrow \$2,000$$

$$\rightarrow \$500$$

$$Q \uparrow 10\%$$

$$\therefore Q = 10\% \times 40 + 40$$

$$Q = 44 \text{ unit}$$

↓

$$OI = 80 \times 44 - 2,500$$

$$OI = \$1,020$$

∴ Status Que

أحد

* عند أي سعر تستطيع الشركة بيع 50 وحدة إذا اشترتها \$115 وكان $OI = 1,200$

$$OI = (P - VC/unit) Q - FC$$

$$1,200 = (P - 115) 50 - 2000$$

$$\frac{3,200}{50} = P - 115$$

$$\rightarrow \boxed{P = \$179}$$

→ Sensitivity Analysis:

تحليل الحساسية

↳ what if analysis

[ماذا يحدث إذا تغيرت أي من المتغيرات؟]

$$MOS_Q = Sales_Q - BEP_Q \quad [15 = 40 - 25]$$

$$MOS_{\$} = Sales_{\$} - BEP_{\$} \quad [3,000 = 8,000 - 5,000]$$

$$MOS_{\%} = \frac{MOS_{\$}}{Sales_{\$}} \times 100\% \quad \left[\frac{3,000}{8,000} = 37.5\% \right]$$

Sales can drop by 37.5 before we start losing

Cost Structure:

TC/VC/FC

العلاقات بين

VC/TC ← نسبة

FC/TC ←

كل فائزات برزبه العبد على الأنا إذا قلت المبيعات يتكون الخسارة كبيرة

Degree of Operating leverage (DOL)

← يؤثر أثر FC على OI

$$DOL = \frac{CM}{OI}$$

تغير المبيعات زيادة أو نقصان يؤثر على OI اعتماداً على حجم FC [البسط والمقام التفرقة بينهم] FC

مثلاً زادت المبيعات 10%

$$DOL \times 10\% = \uparrow OI$$

لزيادة في OI

$$OI_{old} + \uparrow OI$$

ويصبح OI الجديد =

Multiple Product

← على الشركة ببيع

$$OI = (P - VC/unit) Q_1 + (P - VC/unit) Q_2 \dots - FC$$

$$OI = CM/unit_{Product_1} + CM/unit_{Product_2} \dots - FC$$

Sales mix بجزءه بالنسبة Bundle حزمة

Example:

Product₁

product₂

Sales
Q

60

40

→ Sales mix
3:2

بالتساوية

P

\$ 200

\$ 100

VC/unit

\$ 120

\$ 70

CM/unit
Product₁ = \$ 80
Product₂ = \$ 30

FC

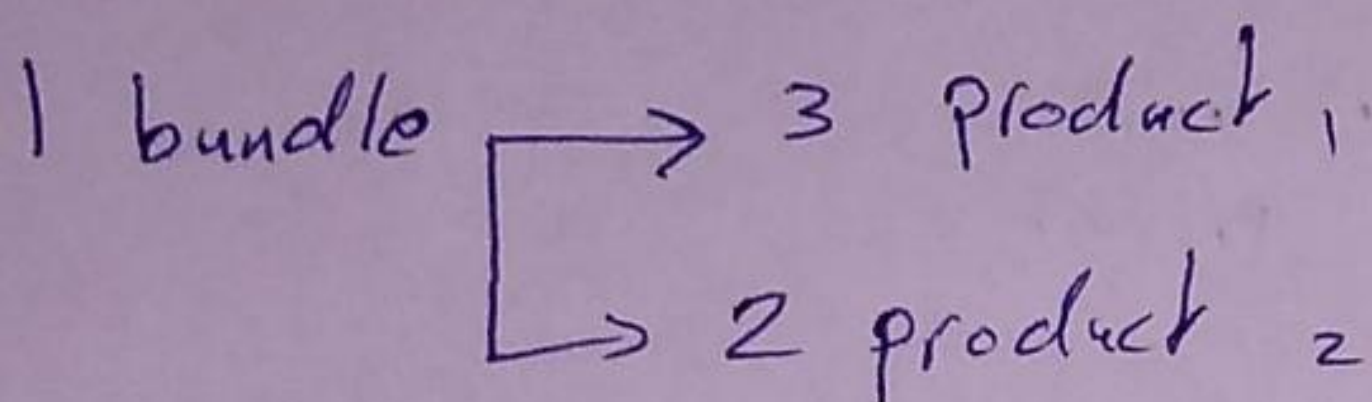
\$ 4,500

$$OI = 80 \times 60 + 30 \times 40 - 4,500$$

$$OI = \$ 1,500$$

$$\begin{aligned}
 CM/\text{bundle} &= CM_{\text{Product}_1} + CM_{\text{Product}_2} \\
 &= (Q \cdot CM/\text{unit}) + (Q \cdot CM/\text{unit}) \\
 &= 3 \times 80 + 2 \times 30 \\
 &= \$300
 \end{aligned}$$

$$\text{BEP} = \frac{FC}{CM/\text{bundle}} = \frac{4,500}{300} = 15 \text{ bundle}$$



$$\begin{aligned}
 \therefore 3 \times 15 &= 45 \text{ unit (product}_1) \\
 2 \times 15 &= 30 \text{ unit (product}_2)
 \end{aligned}$$

$$\text{BEP} = 45 \times 200 + 30 \times 100 \rightarrow \$12,000$$

$$\text{CM \% / bundle} = \frac{CM/\text{bundle}}{\text{Sales / bundle}} = \frac{300}{3 \times 200 + 2 \times 100} = 37.5\%$$

$$\therefore \text{BEP} = \frac{FC}{CM \% / \text{bundle}} = \frac{4,500}{37.5\%} = \$12,000$$

Ch. 3
CVP Analysis

قوانين

- ① $TR - TC = OI$
- ② $TC = FC + VC$
- ③ $VC = DM + DL + \text{Variable MOH} + \text{other VC.}$
- ④ $FC = \text{Fixed MOH} + \text{other FC}$
- ⑤ $CM/\text{unit} = P - VC/\text{unit} \quad \text{or} \quad CM/Q$
- ⑥ $CM = (P - VC/\text{unit}) Q \quad \text{or} \quad \text{Sales} - VC$
- ⑦ $CM\% = CM/\text{sales} \cdot 100\% \quad \text{or} \quad \frac{CM/\text{unit}}{P} \cdot 100\%$

⑧ CVP Equation:

- * $Q(P - VC/\text{unit}) - FC = OI$
- * $Q \cdot CM/\text{unit} - FC = OI$
- * $CM - FC = OI$

⑨ Breakeven point (BEP)

* $BEP_Q = \frac{FC}{CM/\text{unit}}$

* $BEP(\$) = BEP_Q \cdot P \quad \text{or} \quad \frac{FC}{CM\%}$

⑩ Target Operating Income

$$\text{Target (Q)} = \frac{\text{FC} + \text{target OI}}{\text{CM/unit}}$$

$$\text{Target Revenue (\$)} = \text{Target (Q)} \times P$$

or

$$\frac{\text{FC} + \text{target OI}}{\text{CM}\%}$$

⑪ CUP and Income tax

$$\text{OI} = \frac{\text{NI}}{1 - \text{tax Rate}}$$

⑫ Margin of Safety (MOS)

$$\text{MOS (Q)} = \text{Sales (Q)} - \text{BEP (Q)}$$

$$\text{MOS (\$)} = \text{Sales (\$)} - \text{BEP (\$)}$$

$$\text{MOS (\%)} = \frac{\text{MOS (\$)}}{\text{Sales (\$)}} \cdot 100\% \quad \text{or} \quad \frac{\text{MOS (Q)}}{\text{Sales (Q)}}$$

⑬ Degree of Operating leverage (DOL)

$$* DOL = \frac{CM}{OI}$$

(OI ↑) ← الزيادة في OI
(Sales ↑) ← الزيادة في Sales

$$* OI \uparrow = Sales \uparrow \% \cdot DOL$$

$$* New OI = old OI + OI \uparrow$$

⑭ Sales mix

لـ يُعَبَّرُ عَنْهُ بِالنِّسْبِ A : B : C [بِالنِّسْبَةِ] *نسبة*

Bundle *حزمة*

$$OI = (CM/unit \cdot Q)_{Product_1} + (CM/unit \cdot Q)_{Product_2} \dots - FC$$

↳ For more 1 product

$$CM/bundle = CM_{Product_1} + CM_{Product_2} \dots CM_{Product_n}$$

wher every $CM = CM/unit \cdot Q$

⑮ BEP / bundle

$$* BEP_{(Q)} / bundle = \frac{FC}{CM/bundle} \rightarrow \text{يوجد } Q \text{ لكل Product حسب Sales mix}$$

$$\text{BEP } (\$/\text{bundle}) = \left\{ \begin{array}{l} \text{BEP} \\ (\$/\text{bundle}) \\ \text{Product} \end{array} \right. \cdot P$$

or $\frac{FC}{CM (\%)/\text{bundle}}$

↓ لكل منتج كمال و كماله

$$\text{BEP } (\%) = \frac{CM / \text{bundle}}{(Q_1 \cdot P_1) + (Q_2 \cdot P_2) + \dots + (Q_n \cdot P_n)}$$

* Contribution margin Income Statement

Sales
(VC)
<hr style="width: 50%; margin: 0 auto;"/>
CM
(FC)
<hr style="width: 50%; margin: 0 auto;"/>
OI

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