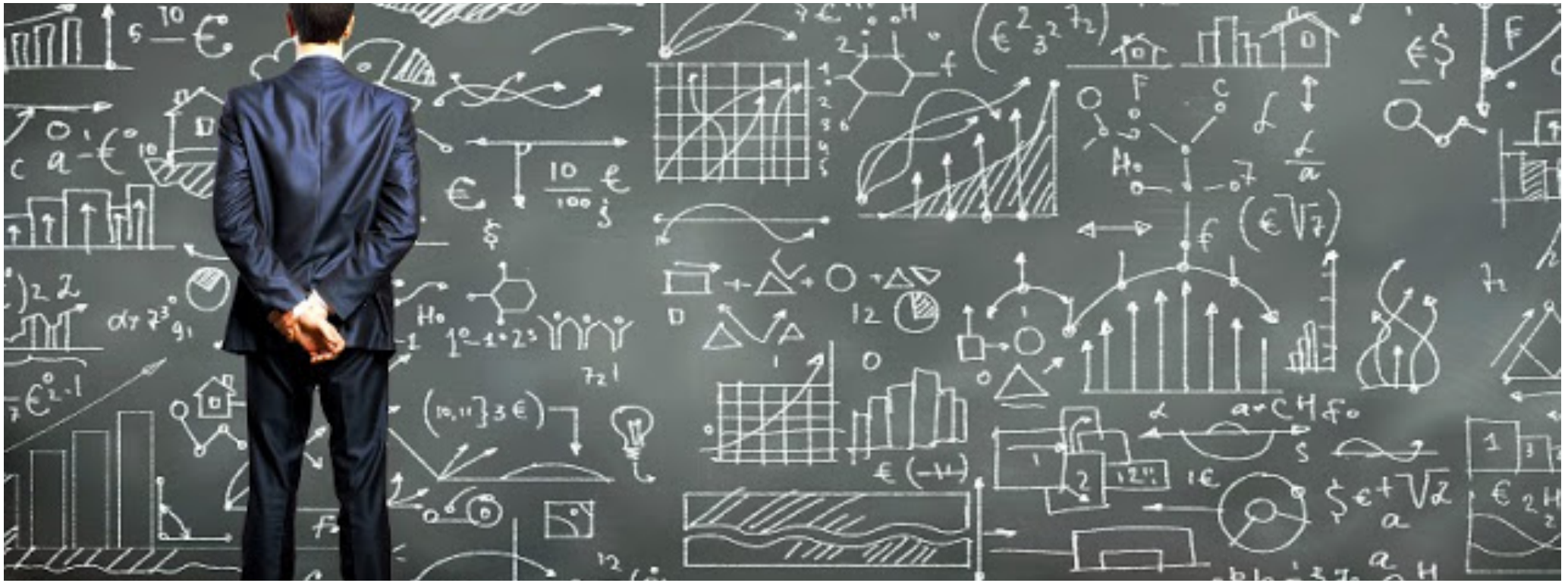
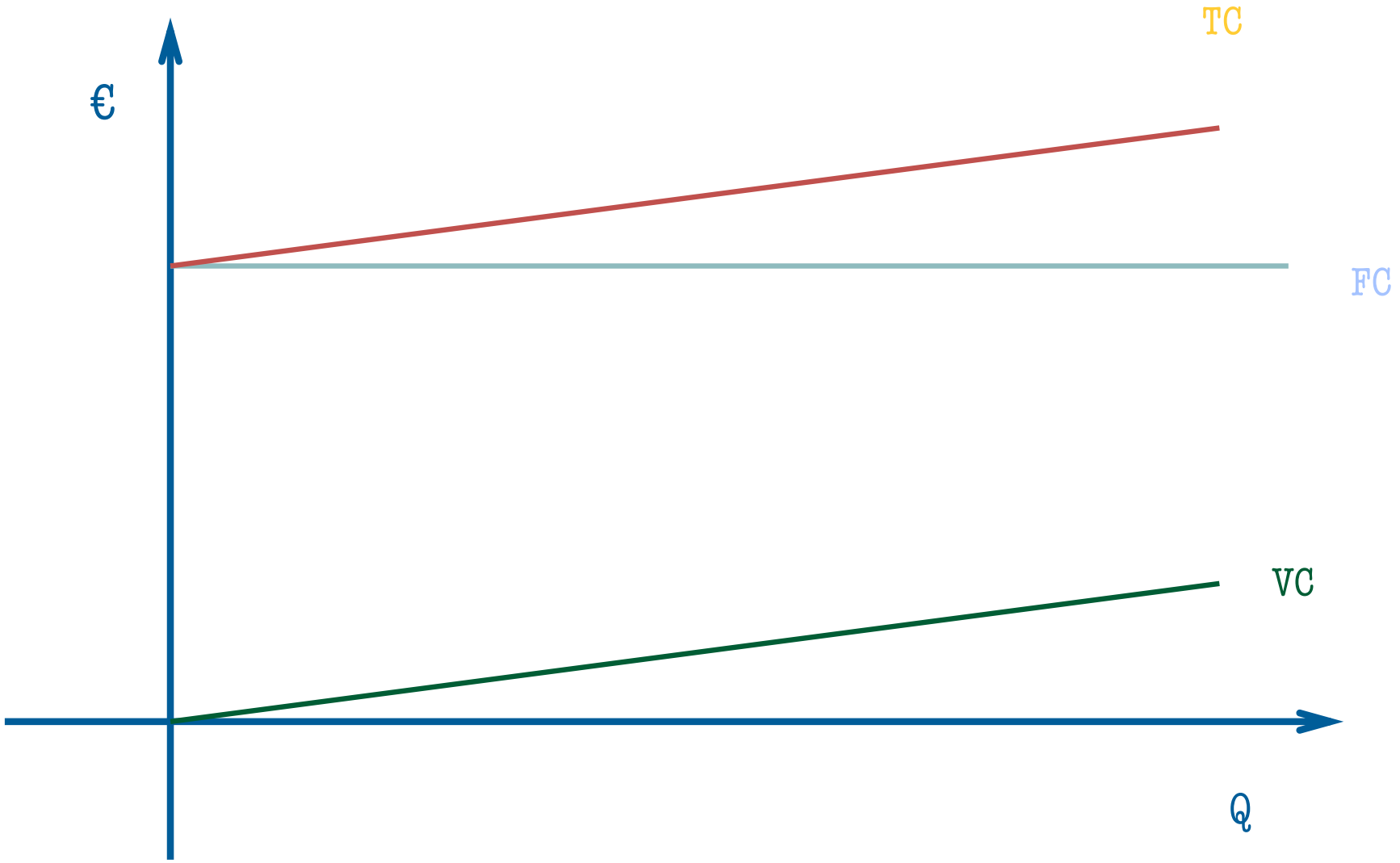
MANAGERIAL COSTING AND CVP ANALYSIS

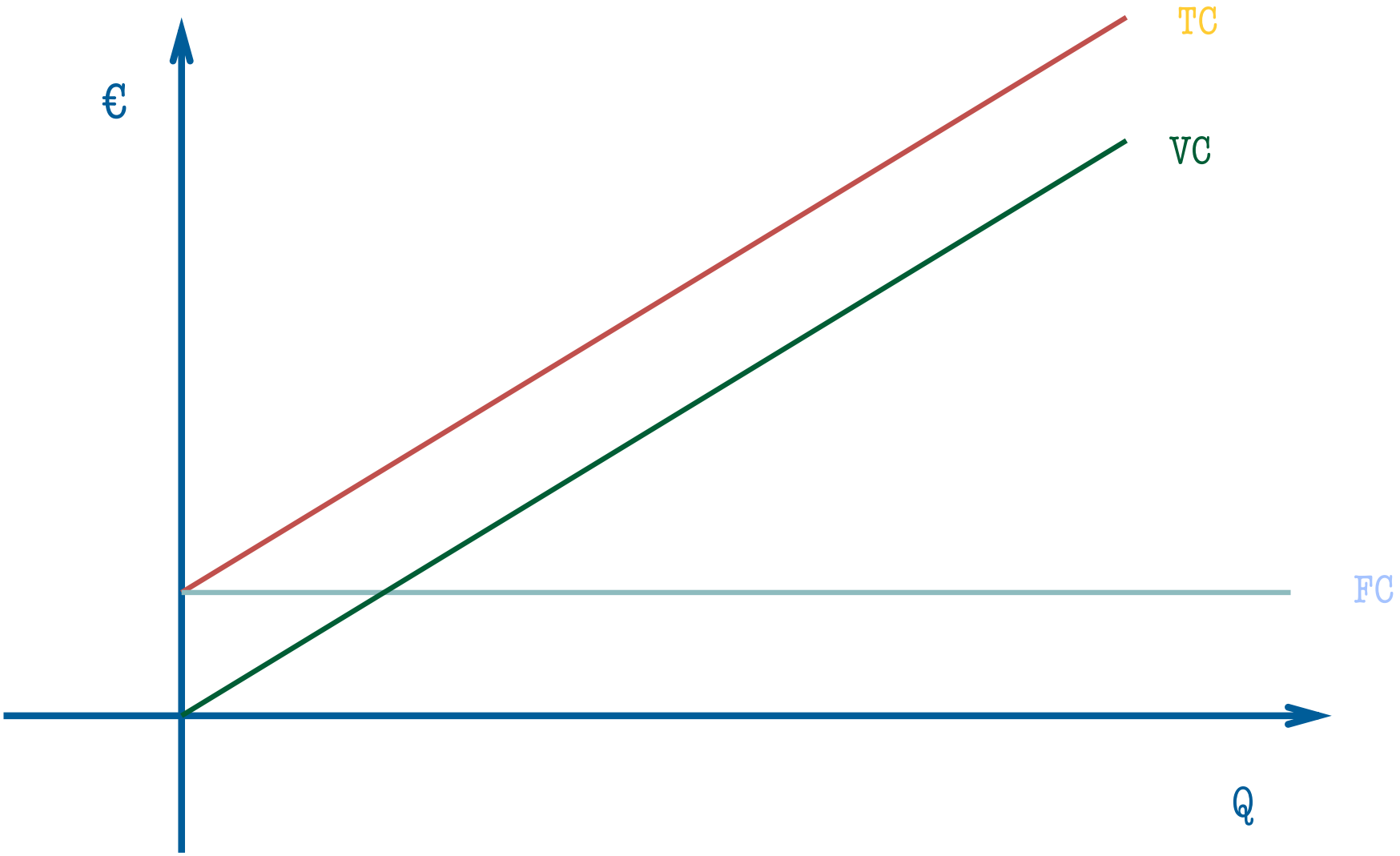
(C) Income sensitivity analysis and break-even point in case of multiple products



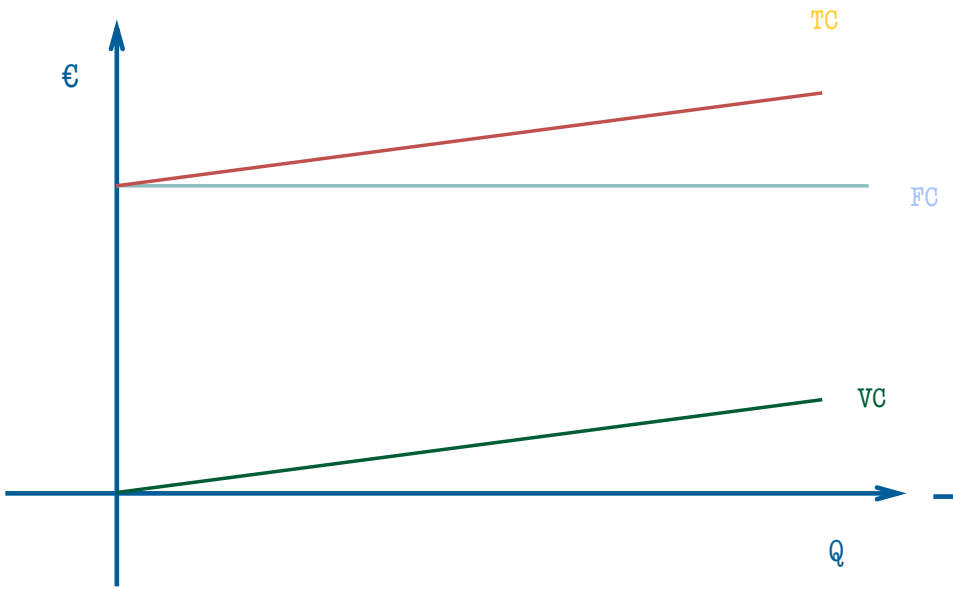
COMPANY «X»



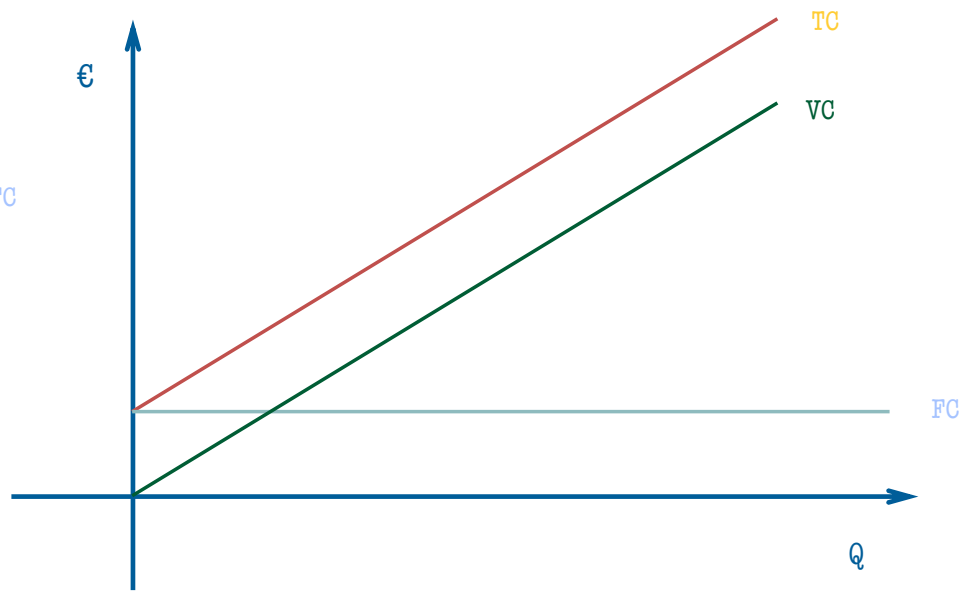
COMPANY «Y»



A COMPARISON



Cheese Maker



Shoes Manufacturer

COST ELASTICITY

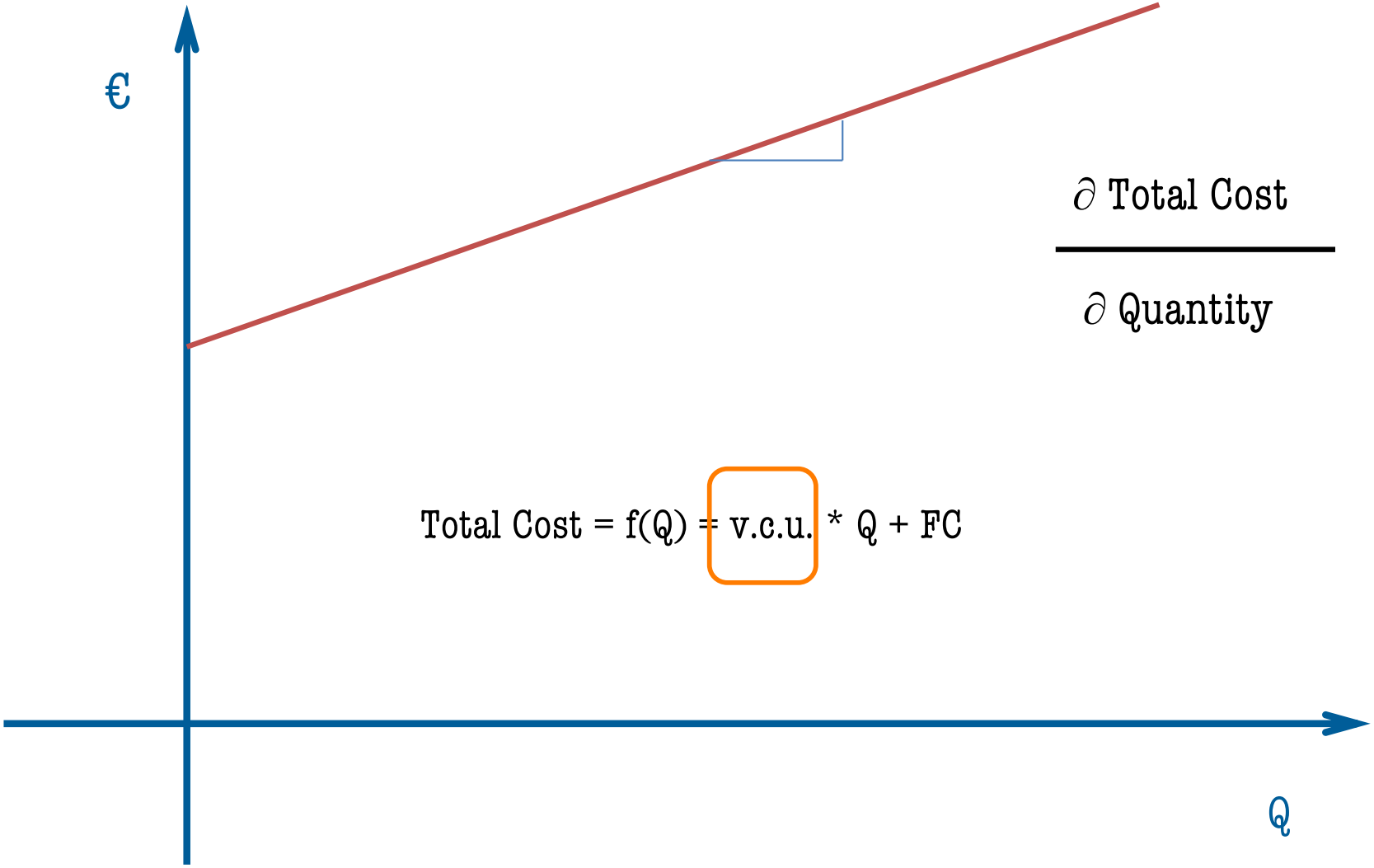
Cost elasticity (also called cost-output elasticity) measures the responsiveness of total cost to changes in output.
It is calculated by dividing the percentage change in cost with percentage change in output. A cost elasticity value of less than 1 means that economies of scale exists.

$$\text{Cost Elasticity} = \frac{\frac{\partial \text{ Total Cost}}{\text{Total Cost}}}{\frac{\partial \text{ Quantity}}{\text{Quantity}}}$$

first derivative of the total cost funcion in respect to the quantity

$$= \frac{\partial \text{ Total cost}}{\partial \text{ Quantity}} * \frac{\text{Quantity}}{\text{Total Cost}}$$

IF CVP ASSUMPTIONS APPLY



$$\frac{\partial \text{ Total Cost}}{\partial \text{ Quantity}}$$

$$\text{Total Cost} = f(Q) = \text{v.c.u.} * Q + FC$$

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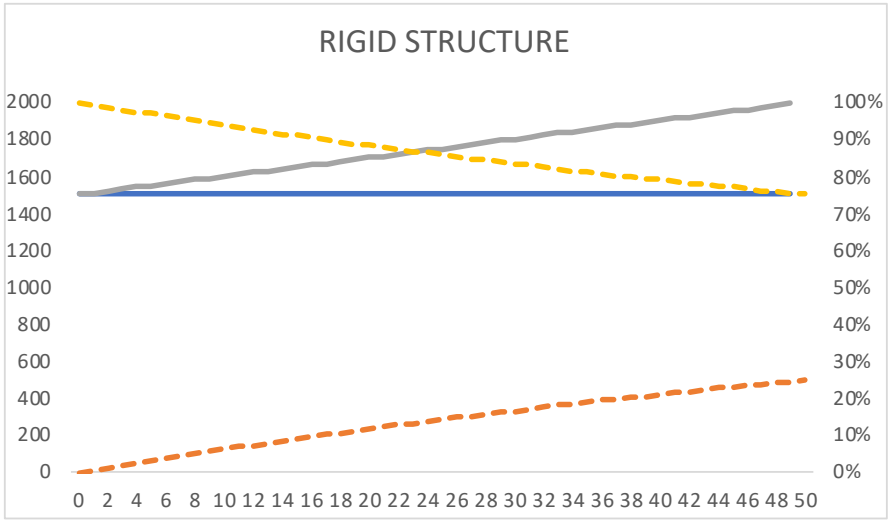
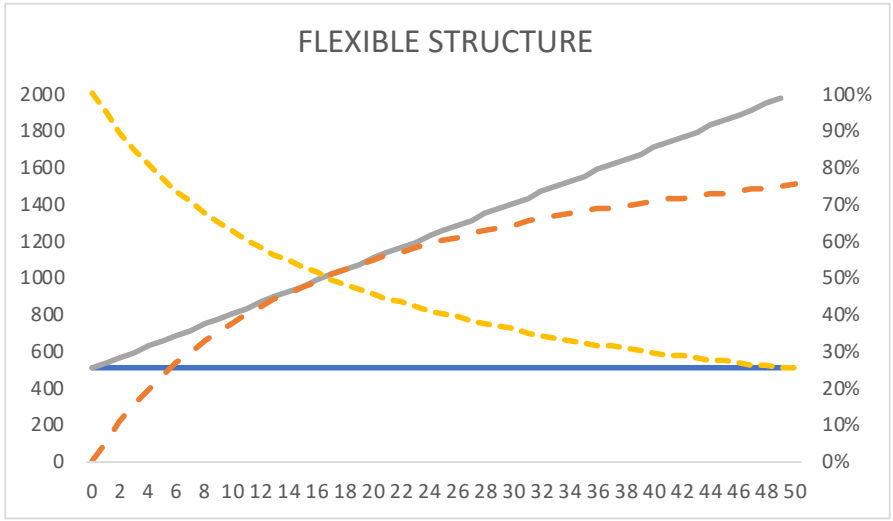
COST ELASTICITY AND COST RIGIDITY: A COMPARISON

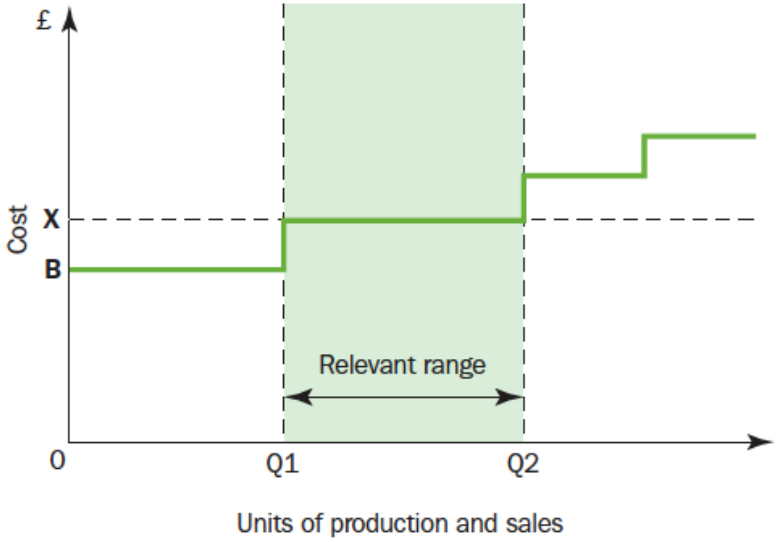


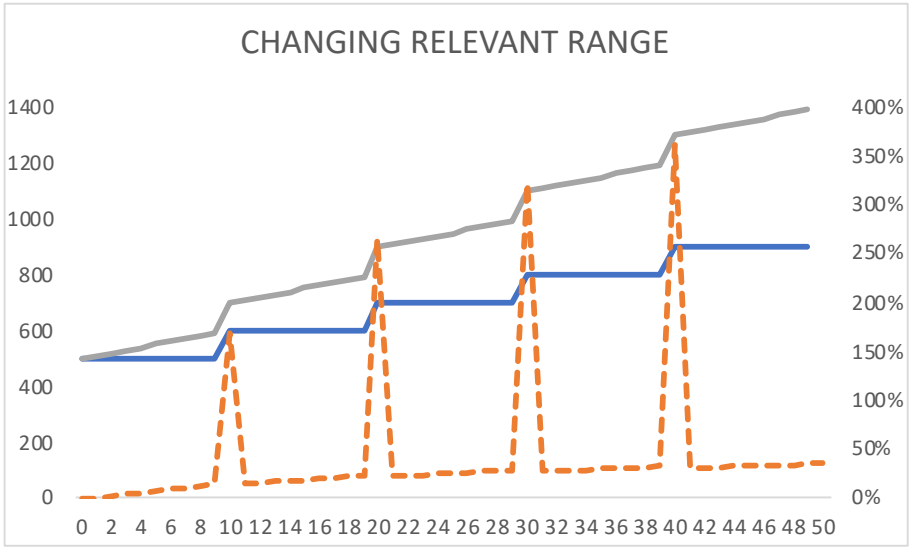


$$\text{Cost Elasticity} = \frac{\text{Variable Cost}}{\text{Total Cost}}$$

$$\text{Cost Rigidity} = 1 - \frac{\text{Variable Cost}}{\text{Total Cost}} = \frac{\text{Fixed Cost}}{\text{Total Cost}}$$

COST ELASTICITY AND ECONOMIES OF SCALE





Within the relevant range the phenomenon of economies of scale always exists, in the sense that if the maximum production value limiting the range is not reached the fixed costs associated with that level of capacity have not been fully exploited. Increases within the interval allow, therefore , the exploitation of existing economies. When one wants to move to a higher capacity level the inevitable increase in fixed costs brings the cost elasticity above one signaling that the cost increase is more than proportional to the increase in output achieved.

OPERATING LEVERAGE

A lever is a tool for multiplying force. Using a lever, a massive object can be moved with only a modest amount of force. In business, *operating leverage* serves a similar purpose.

Operating leverage is a measure of how sensitive net operating income is to a given percentage change in **volume**. Operating leverage acts as a multiplier. If operating leverage is high, a small percentage increase in sales (lead by an increase in the quantity sold) can produce a much larger percentage increase in net operating income.

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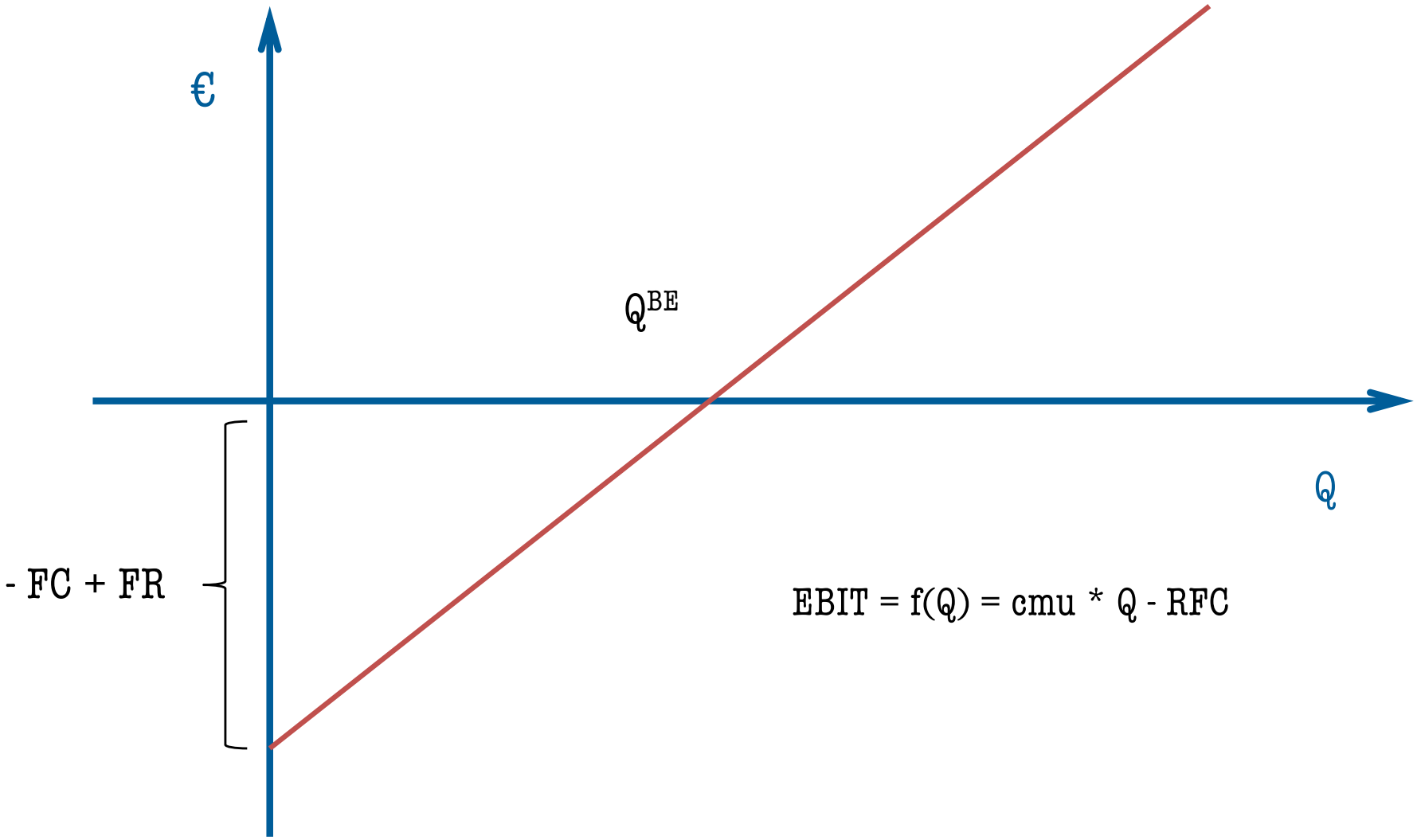
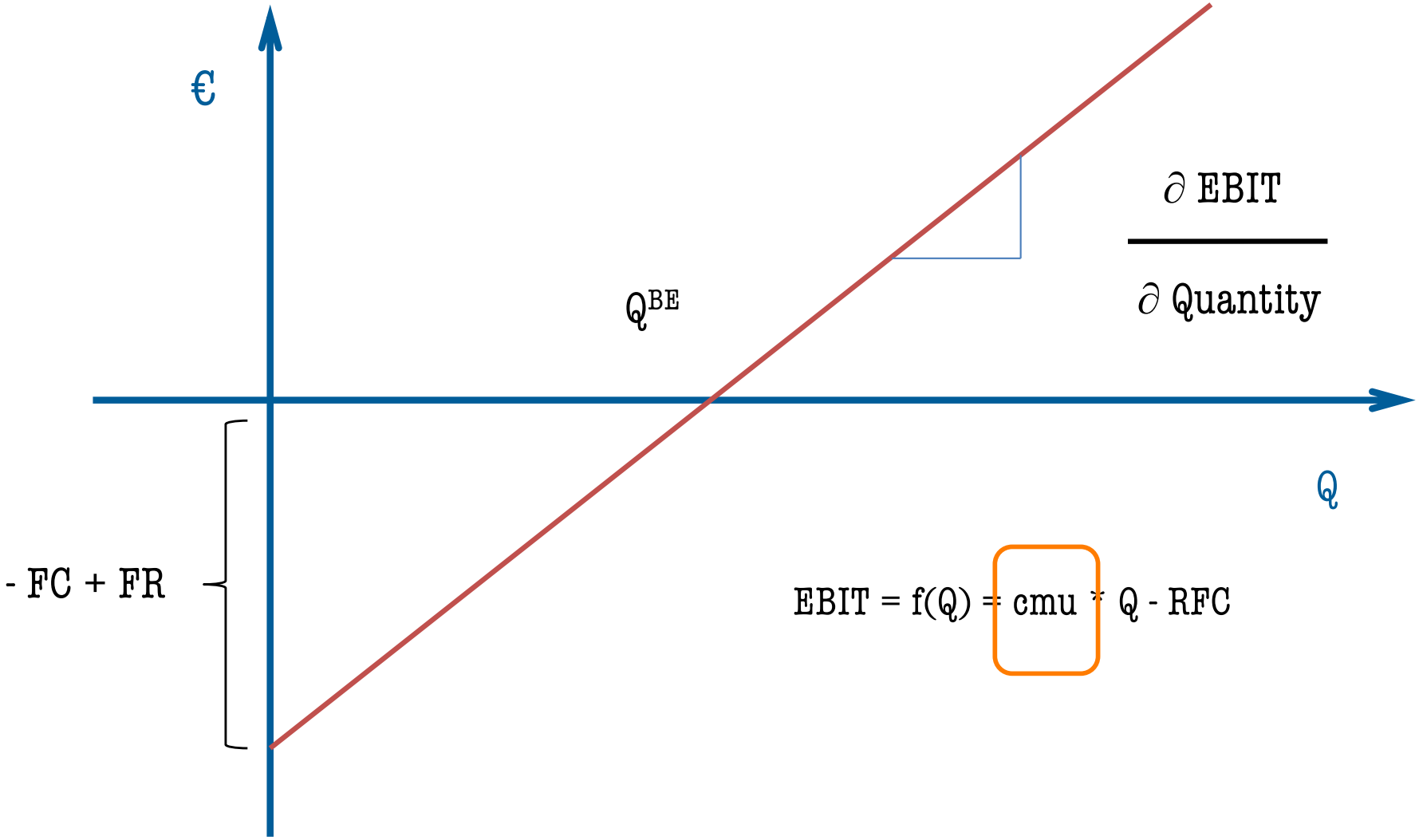
DEGREE OF OPERATING LEVERAGE

$$\text{Operating leverage} = \frac{\frac{\partial \text{EBIT}}{\text{EBIT}}}{\frac{\partial \text{Quantity}}{\text{Quantity}}} = \frac{\partial \text{EBIT}}{\partial \text{Quantity}} * \frac{\text{Quantity}}{\text{EBIT}} = \frac{\overbrace{\text{cmu} * \text{Quantity}}^{\text{TCM}}}{\text{EBIT}}$$

IF CVP ASSUMPTIONS APPLY



THE SLOPE OF THE EBIT FUNCTION



TWO DIFFERENT LEVERS

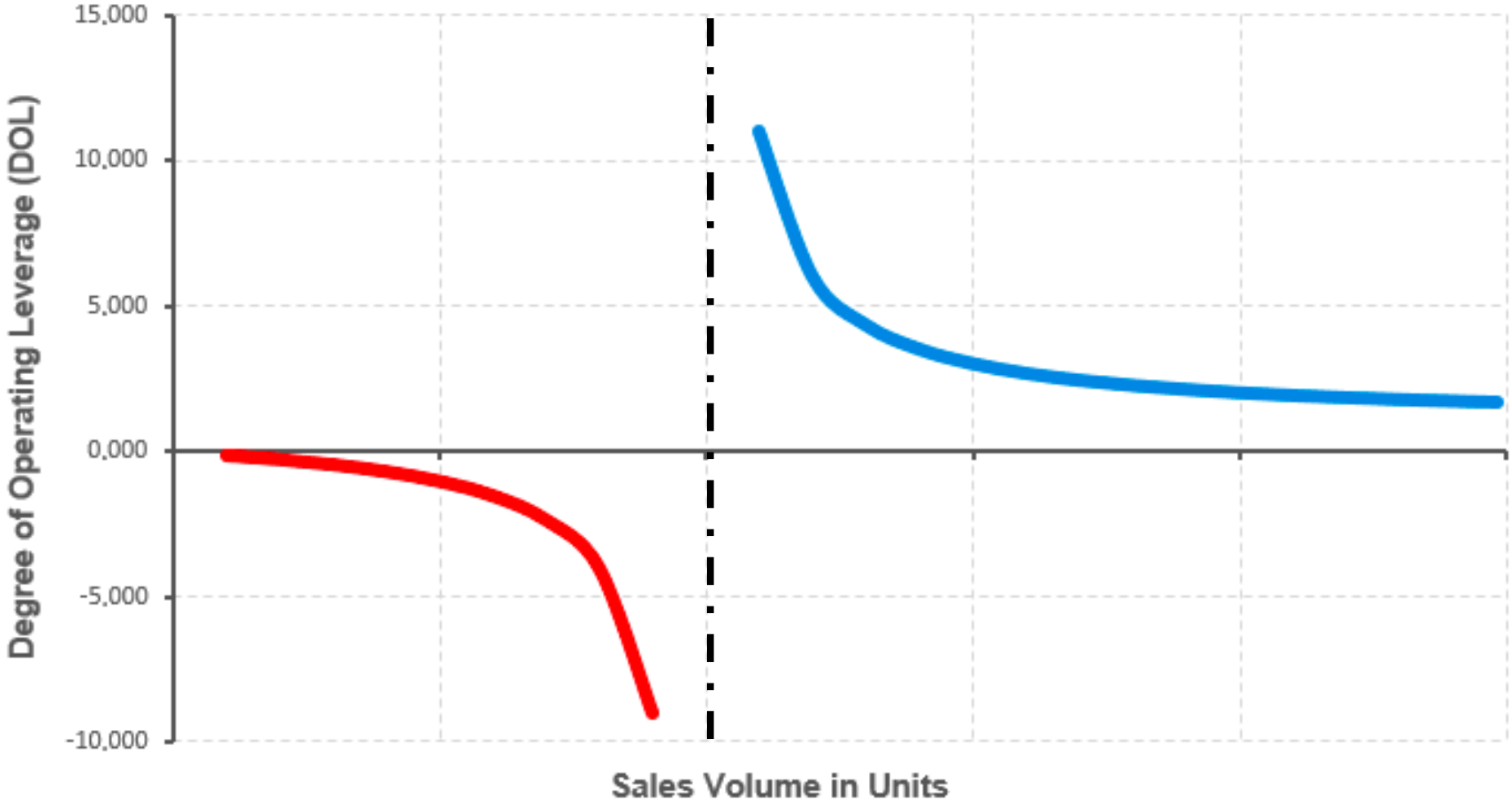
$$\text{Pricing leverage} = \frac{\frac{\partial \text{ EBIT}}{\text{EBIT}}}{\frac{\partial \text{ Average unit price}}{\text{Average unit price}}} = \frac{\overbrace{\text{Average unit price} * \text{Quantity}}^{\text{Sales Revenues}}}{\text{EBIT}}$$

$$\text{Variable cost leverage} = \frac{\frac{\partial \text{ EBIT}}{\text{EBIT}}}{\frac{\partial \text{ Variable cost per unit}}{\text{Variable cost per unit}}} = \frac{\overbrace{\text{- Variable cost per unit} * \text{Quantity}}^{\text{- Total Variable Costs}}}{\text{EBIT}}$$

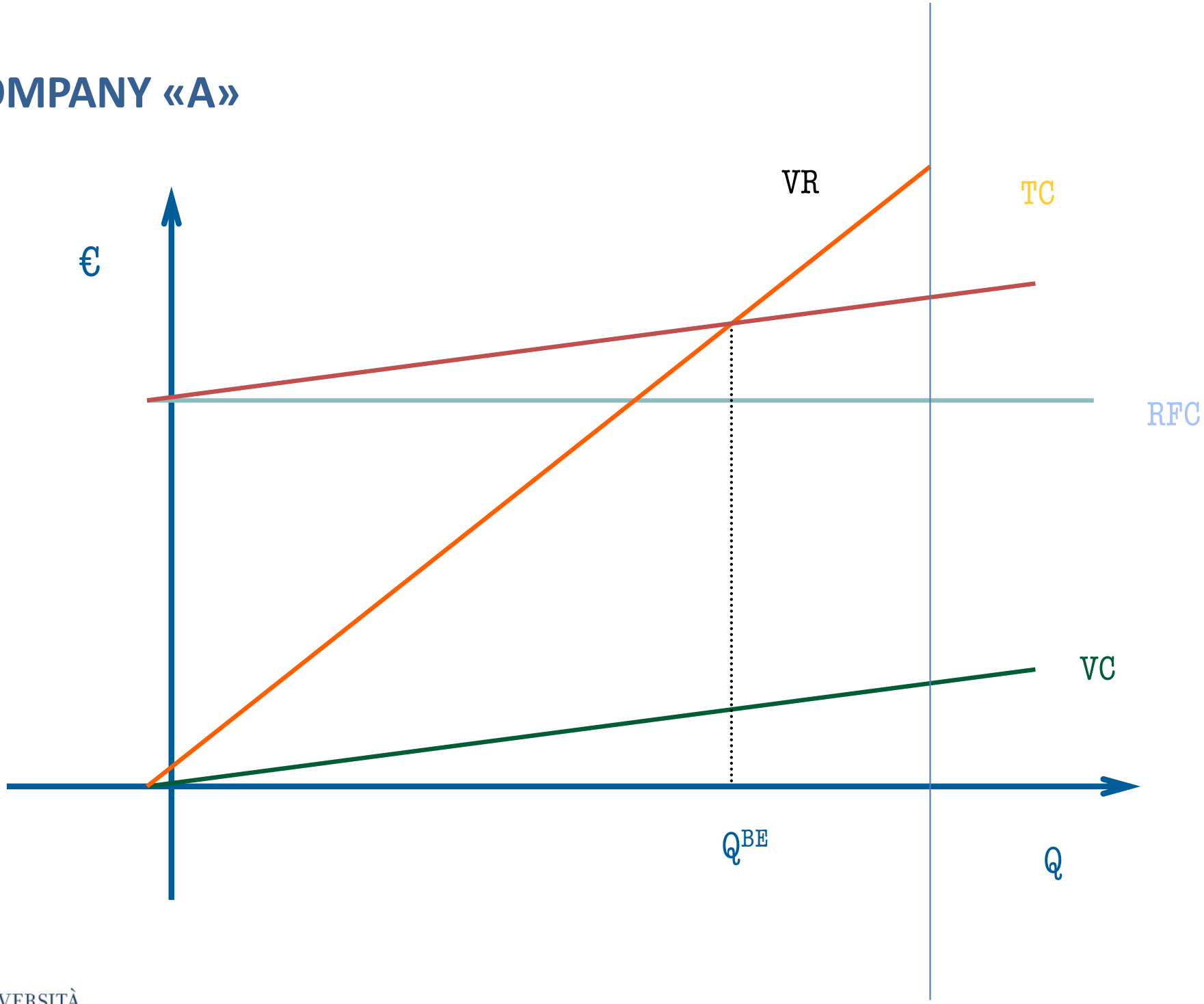
TWO DIFFERENT COMPANIES

	Lo-Lev Company (1,000,000 units)		Hi-Lev Company (1,000,000 units)	
	Amount	Percentage	Amount	Percentage
Sales	$1,000,000	100	$1,000,000	100
Variable costs	750,000	75	250,000	25
Contribution margin	$ 250,000	25	$ 750,000	75
Fixed costs	50,000	5	550,000	55
Operating profit	$ 200,000	20	$ 200,000	20
Break-even point	200,000 units		733,334 units	
Contribution margin per unit	$0.25		$0.75	

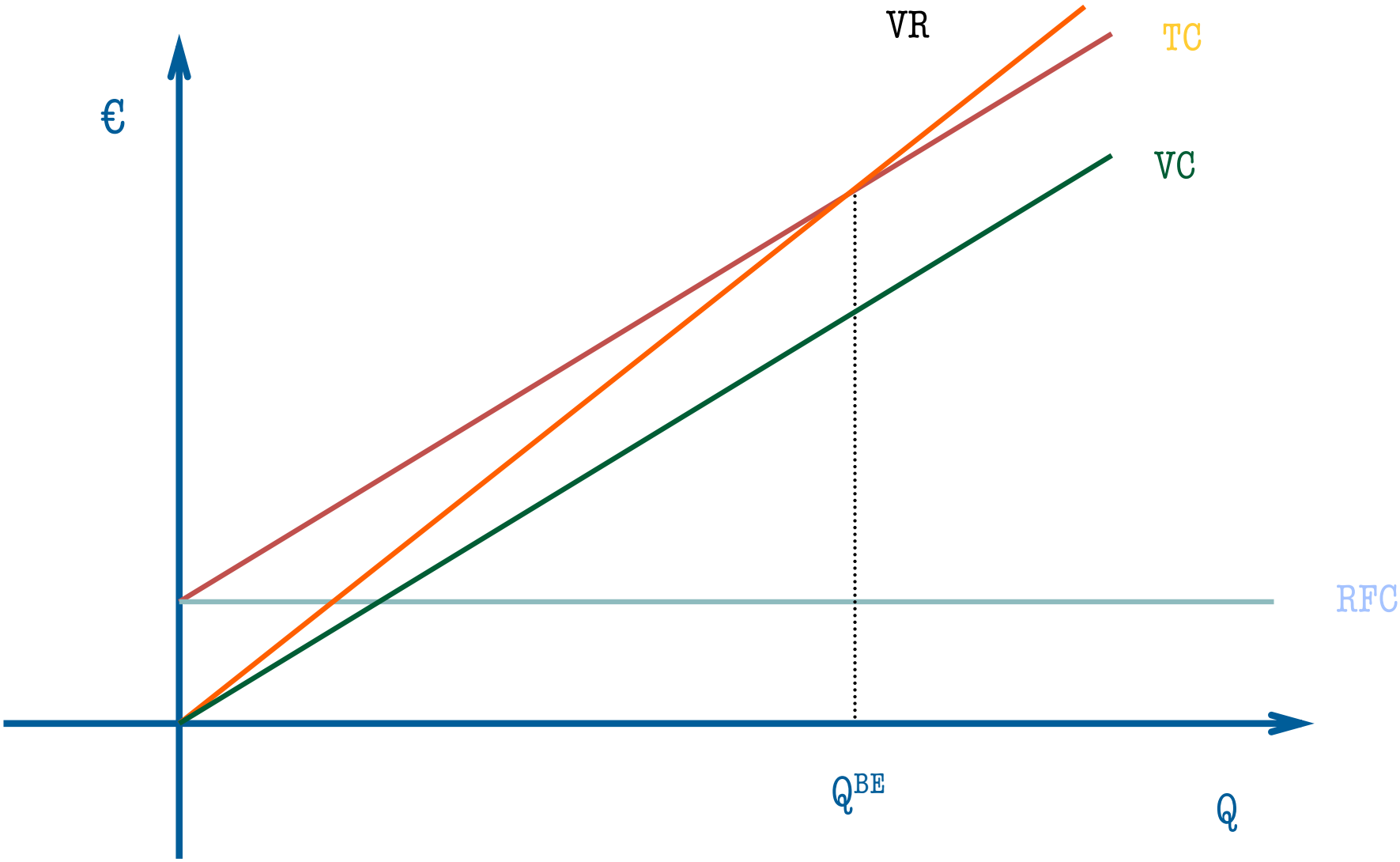
THE GRAPH OF DOL FUNCTION



COMPANY «A»



COMPANY «B»



OPERATING LEVERAGE

The operating data for two different companies follows:

	- Digir Co.-	**- Xibleflex Co. -**
Sales units	20,000	20,000
Average unit price	€600	€200
Variable unit cost	€100	€150
Fixed costs	€6,000,000	€800,000

Required:

a) Compute the break-even point of both companies in sales dollars and units.
b) Determine the degree of operating leverage for each company.
c) Calculate the margin of safety for both Digir and Xibleflex.

DIFFERENT COST STRUCTURES?

	COMPANY "A"	COMPANY "B"
+ TOTAL OUTPUT	100 €	100 €
- INTERMEDIATE CONSUMPTION	(10 €)	(60 €)
= ADDED VALUE	90 €	40 €
- OTHER OPERATING COSTS	(85 €)	(35 €)
= EBIT	5 €	5 €

STEP – 2 SHIFT IN BARGAIN POWER

2B

DIFFERENT PRODUCTS

TELESCOPIC HANDLERS

MIXER WAGON

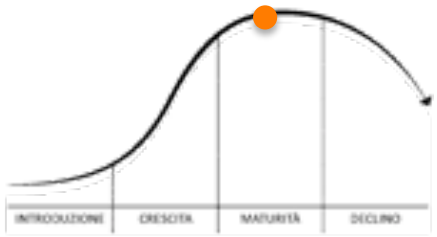
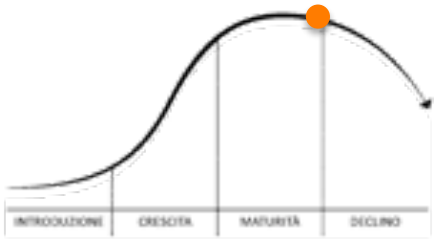
LEADER MONO STANDARD	LEADER MONO ECOMIX	LEADER MONO ECOMODE
Semovente 1 coclea verticale	Semovente 1 coclea verticale	Semovente 1 coclea verticale
1100 Standard 1400 A Standard 1400 B Standard 1700 A Standard 1700 B Standard 2000 Standard	1100 Ecomix 1400 A Ecomix 1400 B Ecomix 1700 A Ecomix 1700 B Ecomix 2000 Ecomix	1100 Ecomode 1400 A Ecomode 1400 B Ecomode 1700 A Ecomode 1700 B Ecomode 2000 Ecomode

LEADER DOUBLE STANDARD	LEADER DOUBLE ECOMIX	LEADER DOUBLE ECOMODE
Semovente 2 coclee verticali	Semovente 2 coclee verticali	Semovente 2 coclee verticali
1600 Standard 2200 Standard 2600 Standard 2800 Standard 3000 Standard 3300 Standard	1600 Ecomix 2200 Ecomix 2600 Ecomix 2800 Ecomix 3000 Ecomix 3300 Ecomix	1900 Ecomode 2200 Ecomode 2600 Ecomode 2800 Ecomode 3000 Ecomode 3300 Ecomode

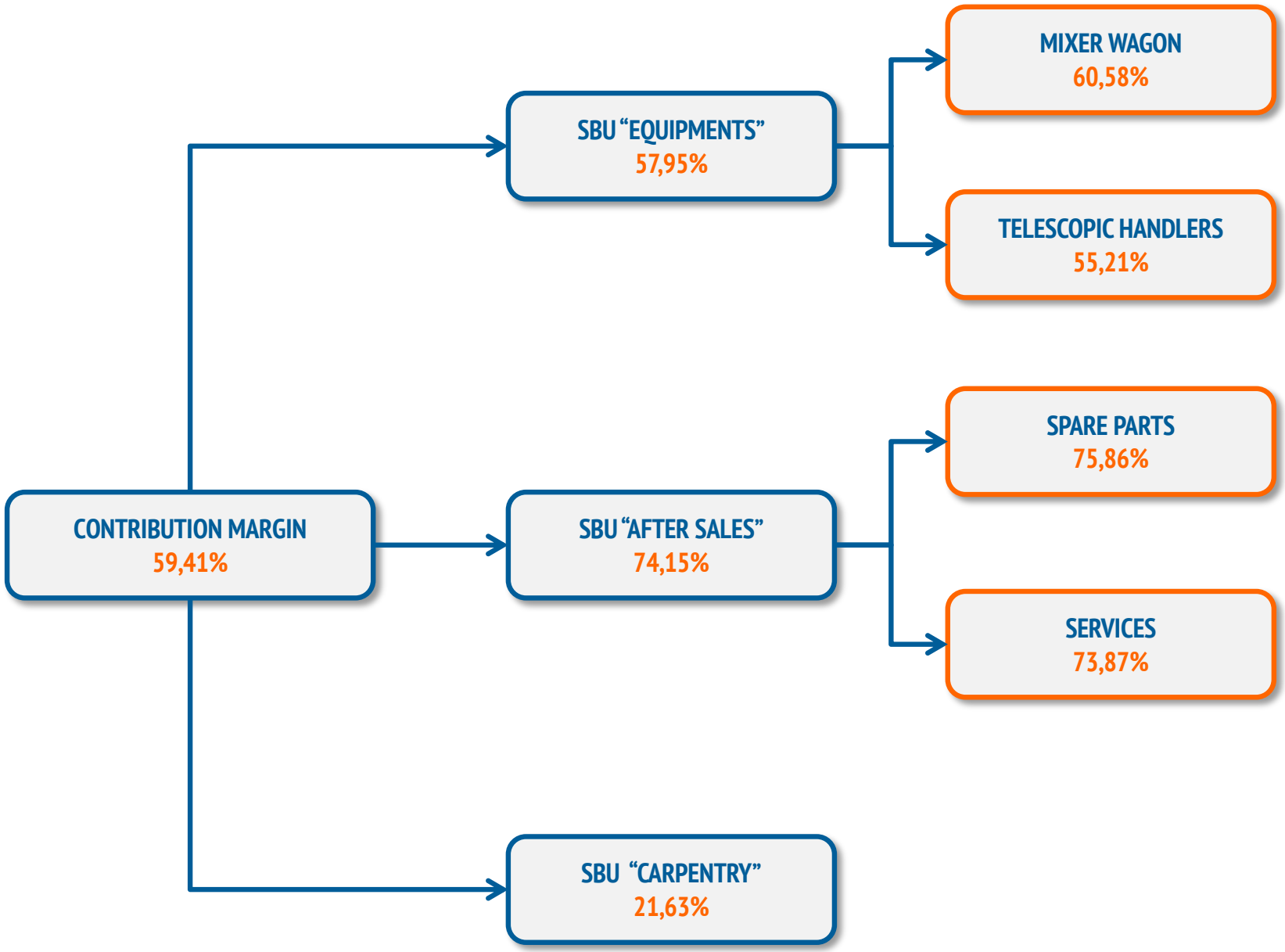
LEADER MONO COMPACT STANDARD	LEADER MONO COMPACT ECOMIX
Semovente 1 coclea verticale	Semovente 1 coclea verticale
1200 Standard 1400 Standard 1600 Standard	1200 Ecomix 1400 Ecomix 1600 Ecomix

LEADER DOUBLE COMPACT ECOMIX	LEADER DOUBLE COMPACT ECOMODE
Semovente 2 coclee verticali	Semovente 2 coclee verticali
1200 Ecomix 1400 Ecomix 1600 Ecomix	1200 Ecomode 1400 Ecomode 1600 Ecomode

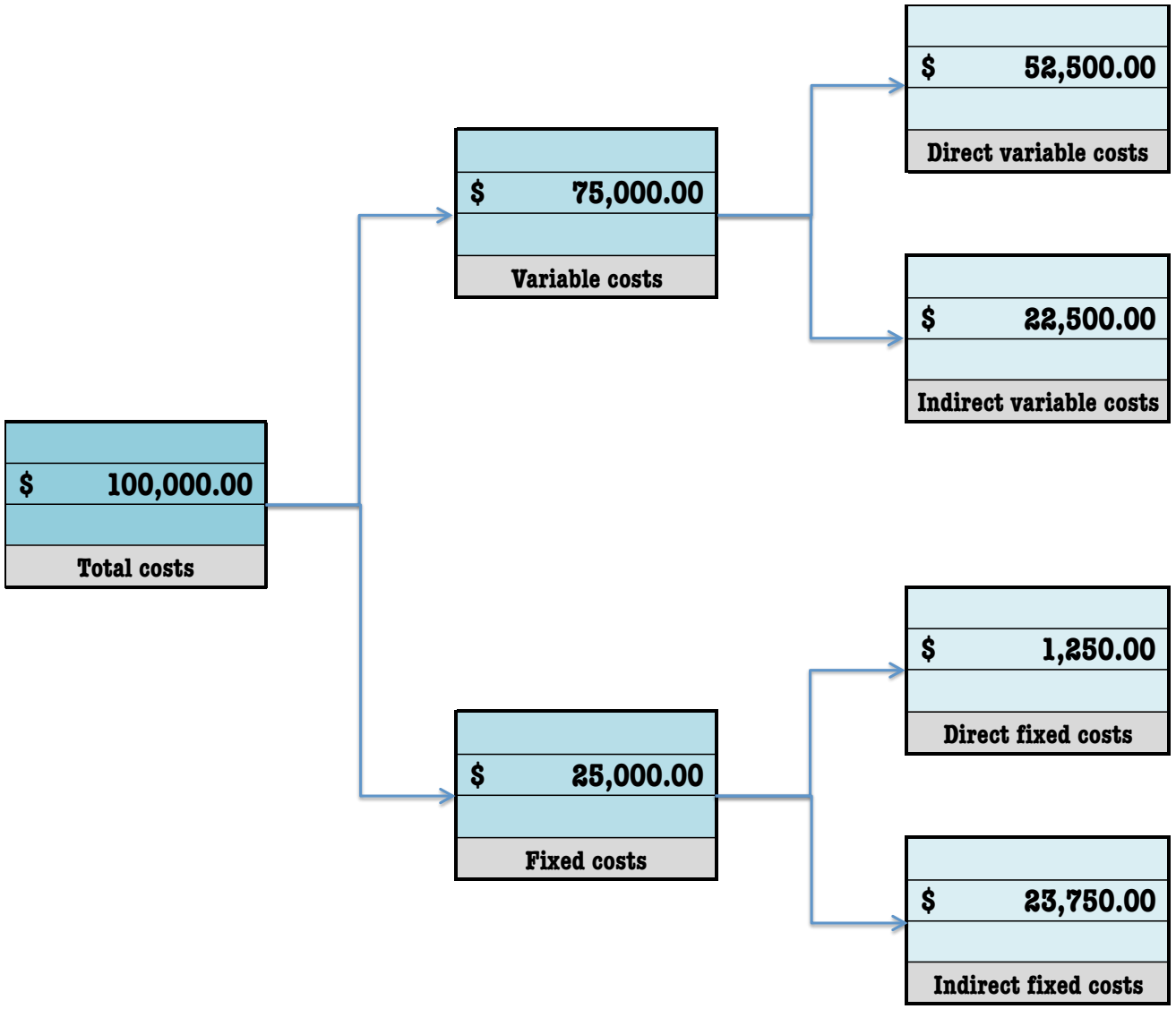
DIFFERENT MARKETS

Product / Market	Breeders			Farmers			Builders		
	Small dimensions	Medium dimensions	Big dimensions	Small dimensions	Medium dimensions	Big dimensions	Small dimensions	Medium dimensions	Big dimensions
MIXER WAGON	✓	✓	✓	SBU 1				SBU 2	
TELESCOPIC HANDLERS	✓	✓	✓	✓	✓	✓	✓	✓	✓
AFTER SALES	✓	✓	✓	✓	✓	✓	✓	✓	✓
	SBU 3 								

DIFFERENT MARGINS FOR DIFFERENT STRATEGIC BUSINESS UNITS



STEP 2 – INCREASE IN HETEROGENEITY



STEP 2 – INCOME STATEMENT

		Product 1		Product 2		Product 3		Total
+ Sales	**€**	**71,500.00**	**€**	**27,500.00**	**€**	**11,000.00**	**€**	**110,000.00**
- Direct variable costs	-€	26,250.00	-€	17,325.00	-€	8,925.00	-€	52,500.00
- Indirect variable costs	-€	16,875.00	-€	2,700.00	-€	2,925.00	-€	22,500.00
= Contribution margin	**€**	**28,375.00**	**€**	**7,475.00**	**-€**	**850.00**	**€**	**35,000.00**
- Fixed costs							-€	25,000.00
+ Fixed Revenues							€	3,500.00
= Operating Income							**€**	**13,500.00**

SEGMENT

A segment is a part or activity of an organization about which managers would like cost, revenue, or profit data.

Examples of segments include:

- Divisions of a company.
- Sales territories.
- Individual stores.
- Service centers.
- Manufacturing plants.
- Marketing departments.
- Individual customers.
- Product lines.

A company's operations can be segmented in many ways.

There is an evident relation between the terms "segment" and "cost object"

BREAK-EVEN CALCULATIONS FOR MULTIPLE PRODUCTS

Cost-volume-profit (CVP) analysis is a helpful tool regardless of the number of products a company sells.

CVP analysis is more complex with multiple products.

Two complications are encountered when multiple products are sold by companies:

A. First, companies rarely sell exactly the same number of units of each product.
B. Second, most products differ in their selling price and variable cost per unit.

As a consequence, in order to determine sales levels at breakeven or target profit levels, these two issues must be addressed.

BREAK-EVEN CALCULATIONS FOR MULTIPLE PRODUCTS

- When more than one product is produced and sold, managers must estimate the sales mix and calculate a package contribution margin ratio.
- Sales mix is the relative combination of products being sold by a firm.

$$\text{Break-Even Packages} = \frac{\text{Fixed Costs}}{\text{Package Contribution Margin Ratio}}$$

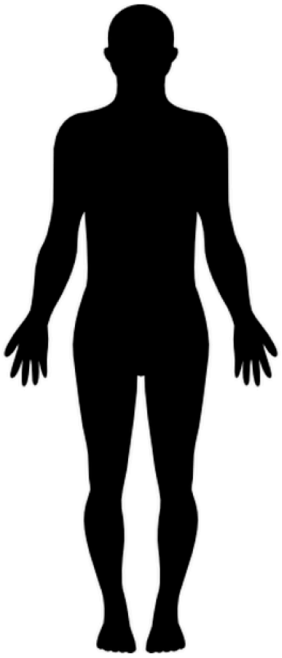
In order to consider the sales mix when calculating the breakeven point in units for multiple products, you must determine a *weighted average* contribution margin ratio which considers the differing selling prices, variable costs per unit, and number of units for each products.

BREAK-EVEN CALCULATIONS FOR TWO PRODUCTS: AN EXAMPLE

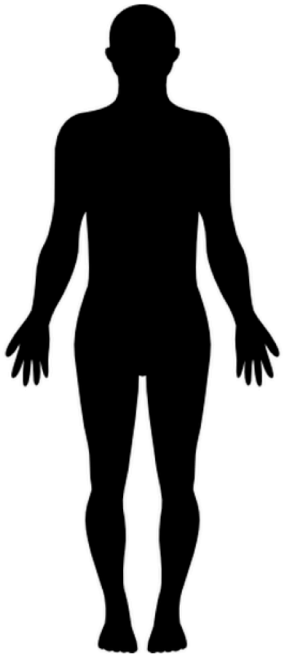
Average selling price	€	10.00	€	50.00
Variable cost per unit	-€	4.00	-€	38.00
Contribution margin	**€**	**6.00**	**€**	**12.00**

Fixed costs	€	500,000

MAKING COMPARISONS

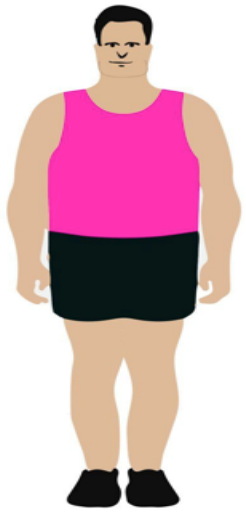


148 lbs.



204 lbs.

MAKING COMPARISONS - BODY MASS INDEX



148 lbs. - 147 cm

4’ 10” – 67 kg

BM: 30.9

204 lbs. – 193 cm

6’ 4” – 93 kg

BM: 24.8

PROFIT: NET PROFIT AND OTHER PROFIT MARGINS

Net Profit (also called “Net Income” or “Net Earnings) is the “bottom line” of the “Income Statement”. It is therefore computed as revenues, lesscost of goods sold less, less other expenses, less taxes.

More broadly, **Profit** is the difference between revenues and expenses. It can be assesses in a number of different ways because the appropriate measure depends on the specific question being asked. One can, therefore, determine different figures of profit (normally defined as “margins”) taking into consideration different subset of revenues and costs or expenses, earned or incurred within a defined time frame.

PROFITABILITY

PROFITABILITY

1. the ability, attitude, potentiality of a business or an activity to yield profit or, more broadly, to offer an adequate level of return

2. a relative number (a percentage) that gauge the level of profitability (in the sense specified above) and is normally expresses as the ratio between profit and another monetary term

PROFITABILITY MEASURES

Profit margin ratio: A company's profit margin ratio is calculated by comparing the amount of profit to sales revenue. The profit margin ratio indicates the portion of each sales dollar that contributes to the bottom-line profit (operating income) of a company. It represents the profit left after both fixed and variable costs have been deducted. This ratio changes when volume changes because the fixed cost per unit differs when activity changes.

Contribution margin ratio: The contribution margin ratio indicates the portion of each sales dollar available to cover fixed costs and contribute to profit. This percentage remains the same regardless of the fixed costs incurred by a company.
Because the contribution margin ratio does not fluctuate when sales levels change, it is more reliable in comparing profitability of multiple products

WHICH PRODUCT SHOULD WE SELL?

Because managers want to maximize profit, they prefer to sell the products with the higher profitability. Some companies do this by placing products with higher margins in obvious locations in stores, such as near the cash register or on the end cap of an aisle. Other companies 'push' a particular product by instructing the sales personnel to emphasize that product.

The answer to this question, "Which product should a company 'push' to its customers?" depends on the customer's spending attitude.

Some customers prefer to buy one particular item and are not concerned about the total price, such as choosing between the $4 cheeseburger, or the $5 bacon burger. Other customers plan to spend a fixed sum of money, perhaps buying one burger with a price of $4.00, or two smaller burgers with a price of $2.00 each. As such, two different answers exist to the question of which product to push:

- ✧ A customer plans to buy one item: Push the product with the higher contribution margin per unit.
- ✧ A customer plans to spend a set amount of money: Push the product with the higher contribution margin ratio.

PROFIT AND PROFITABILITY

Profitability is a measure of profit compared to another "entity" ("sales", "assets", "capital employed", etc.) and it is therefore expressed in relative terms. This way of computing it, enhance the level of comparability of the measure considered.

Profitability ratios gauge a company's profitability—its profits as a percentage of various other numbers. They'll help you determine whether your company's profits are healthy or anaemic, and whether they're moving in the right direction. Examples of profitability ratios are:

- *return on sales,*
- *contribution margin ratio,*
- *return on assets,*
- *return on inventory,*
- *return on equity.*

Technically, 'profit' is the absolute amount of money that a firm makes whereas 'profitability' is the proportion it makes.

BREAK-EVEN CALCULATIONS FOR TWO PRODUCTS: AN EXAMPLE

Average selling price	€	10.00	€	50.00
Variable cost per unit	-€	4.00	-€	38.00
Contribution margin	**€**	**6.00**	**€**	**12.00**
Contribution margin ratio		60.00%		24.00%
Fixed costs	€	500,000		

BEST CASE SCENARIO

Product A	100%	60%	60.00%
Product B	0%	24%	0.00%
Average contribution margin ratio			**60.00%**

Break Even Sales

$$\frac{\text{Fixed Costs}}{\text{Contribution margin ratio}} = \frac{€\ 500{,}000}{60.00\%} = €\ 833{,}333$$

Numbers of "bundles"

$$\frac{\text{Break Even Sales}}{\text{Average selling price}} = \frac{€\ 833{,}333}{€\ 10.00} = 83{,}334$$

Number of A	83,334
Numbers of B	-

WORST CASE SCENARIO

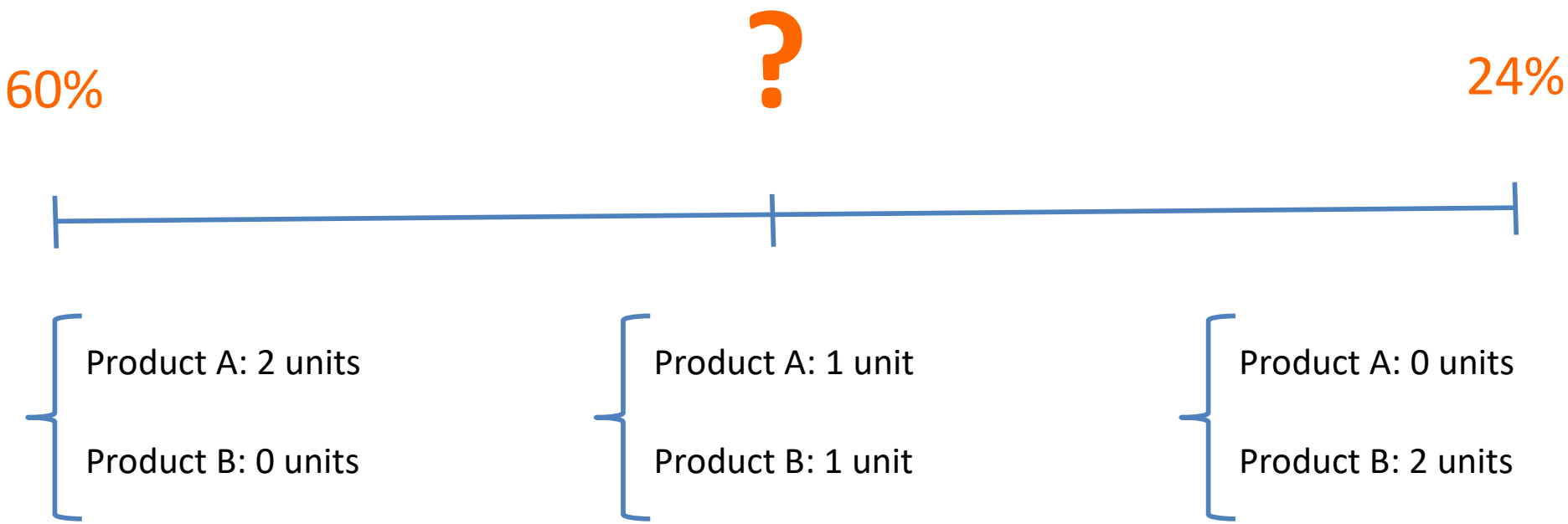
Product A	0%	60%	0.00%
Product B	100%	24%	24.00%
Average contribution margin ratio			**24.00%**

Break Even Sales $= \frac{\text{Fixed Costs}}{\text{Contribution margin ratio}} = \frac{€\ 500{,}000}{24.00\%} = €\ 2{,}083{,}333$

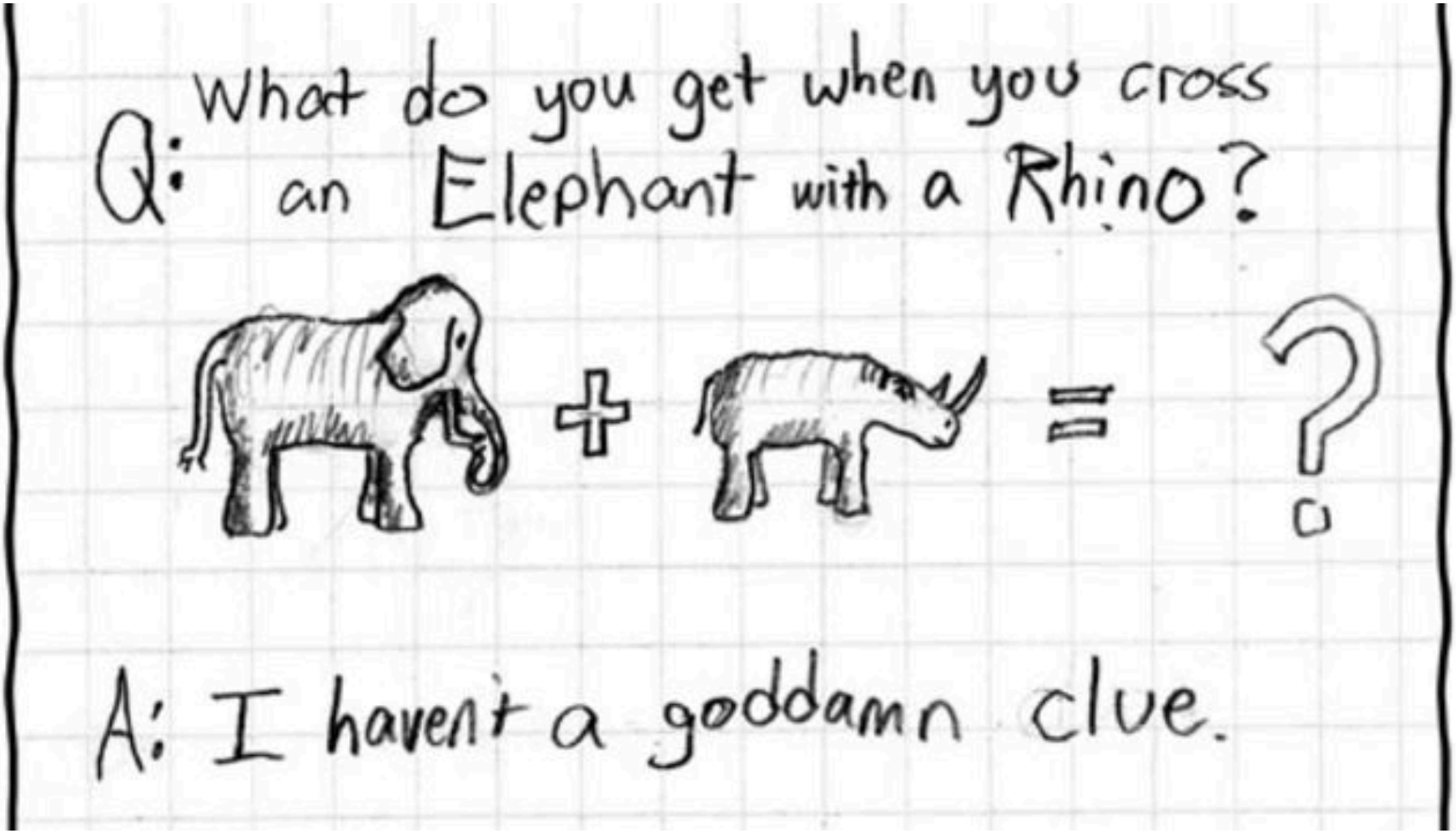
Numbers of "bundles" $= \frac{\text{Break Even Sales}}{\text{Average selling price}} = \frac{€\ 2{,}083{,}333}{€\ 50.00} = 41{,}667$

Number of A	-
Numbers of B	41,667.00

AN IMPORTANT REFLECTION

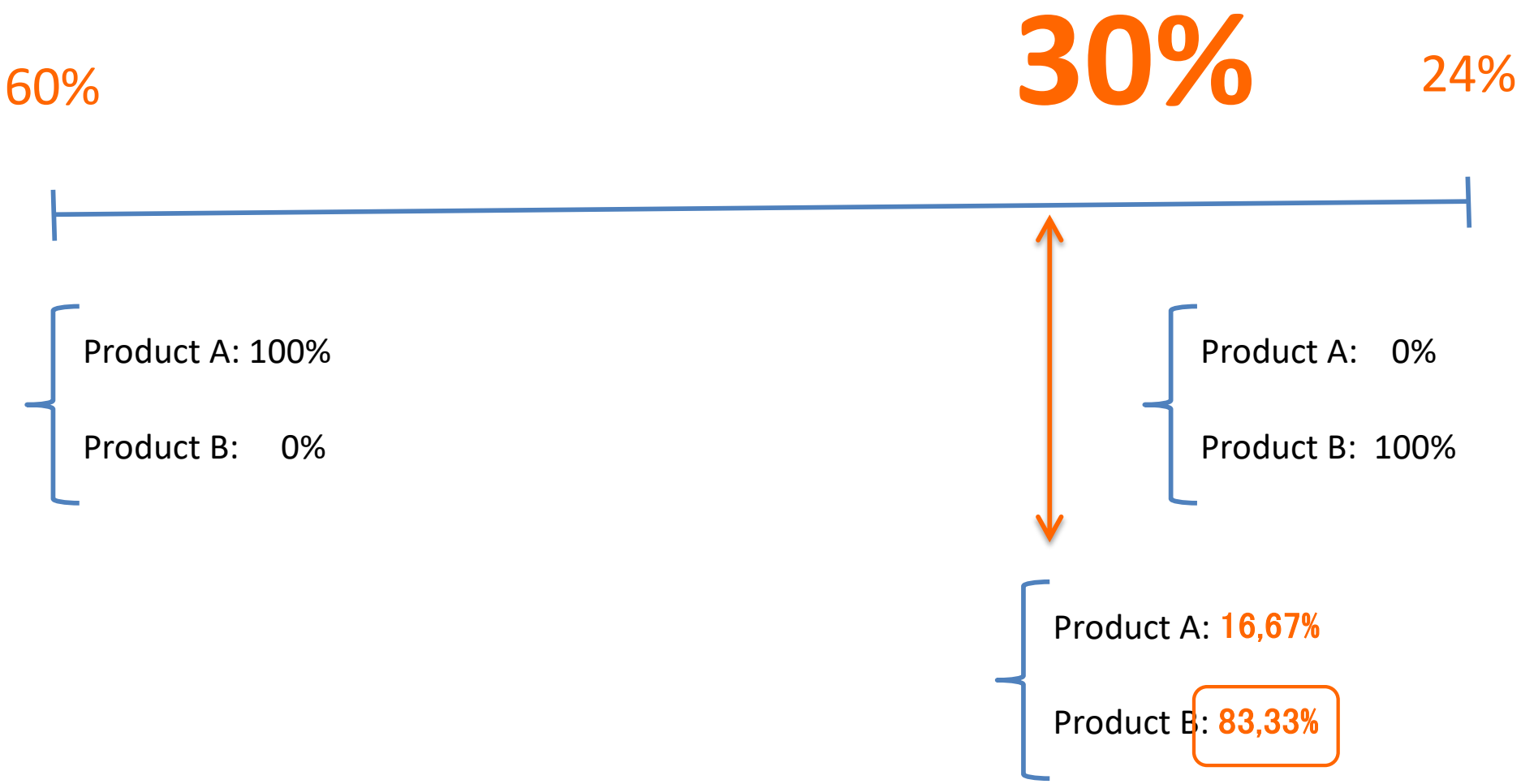


THE PROBLEM WITH HETEROGENEITY



WELL, I HAVE IT!

AN IMPORTANT REFLECTION



DEVICES?

PRICE AS “HOMOGENIZATION FACTOR”

$ 1,000

1 iPhone

$ 2,000

2 iPhone equivalent

$ 900

0,9 iPhone equivalent

Break even point in units → Break even point in total dollars

ONE UNIT OF EACH PRODUCT

	Units	Sales Revenue		Weight		Cmu		Cmr
Product A	1	€	10,00	16,67%	€	6,00		60,00%
Product B	1	€	50,00	83,33%	€	12,00		24,00%
Bundle		**€**	**60,00**	**100,00%**	**€**	**18,00**		**30,00%**

Product A	16,67%	60,00%	10,00%
Product B	83,33%	24,00%	20,00%
Average contribution margin ratio			**30,00%**

Break Even Sales

$$\frac{\text{Fixed Costs}}{\text{Contribution margin ratio}} = \frac{€\ 500.000}{30,00\%} = €\ 1.666.667$$

Numbers of "bundles"

$$\frac{\text{Break Even Sales}}{41667} = \frac{€\ 1.666.667}{€\ 60,00} = 27.778$$

Number of A	27.778
Numbers of B	27.778

MIXED SCENARIO

	Units	Sales Revenue	Weight	Cmu	Cmr
Product A	7	€ 70.00	31.82%	€ 42.00	60.00%
Product B	3	€ 150.00	68.18%	€ 36.00	24.00%
Bundle		**€ 220.00**	**100.00%**	**€ 78.00**	**35.45%**

Product A	31.82%	60.00%	19.09%
Product B	68.18%	24.00%	16.36%
Average contribution margin ratio			**35.45%**

Break Even Sales $= \dfrac{\text{Fixed Costs}}{\text{Contribution margin ratio}} = \dfrac{€\ 500{,}000}{35.45\%} = €\ 1{,}410{,}256$

Numbers of "bundles" $= \dfrac{\text{Break Even Sales}}{41667} = \dfrac{€\ 1{,}410{,}256}{€\ 220.00} = 6{,}411$

Number of A	44,877
Numbers of B	19,233

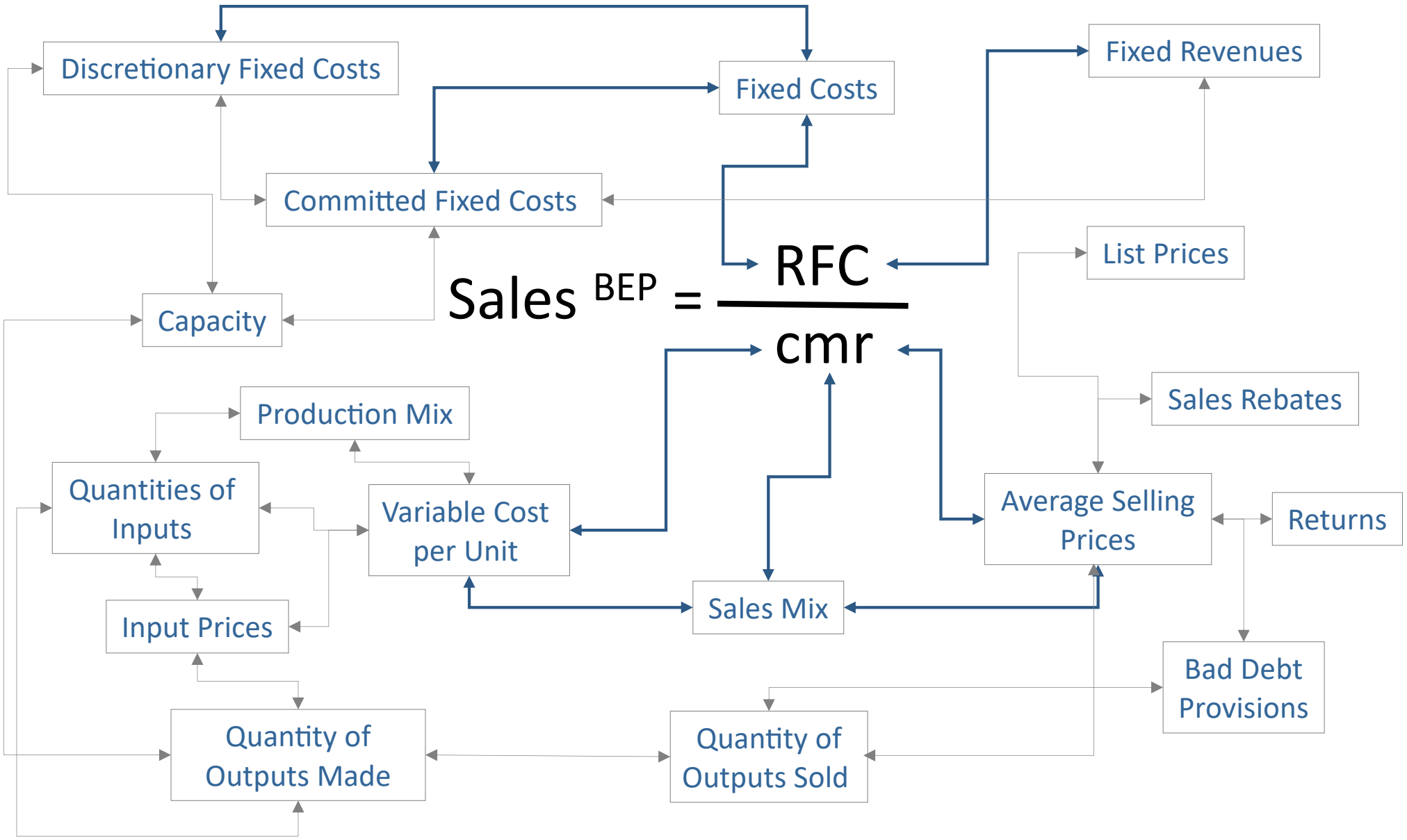
ASSUMPTIONS OF CVP ANALYSIS: A SUMMARY

A number of assumptions commonly underlie CVP analysis:

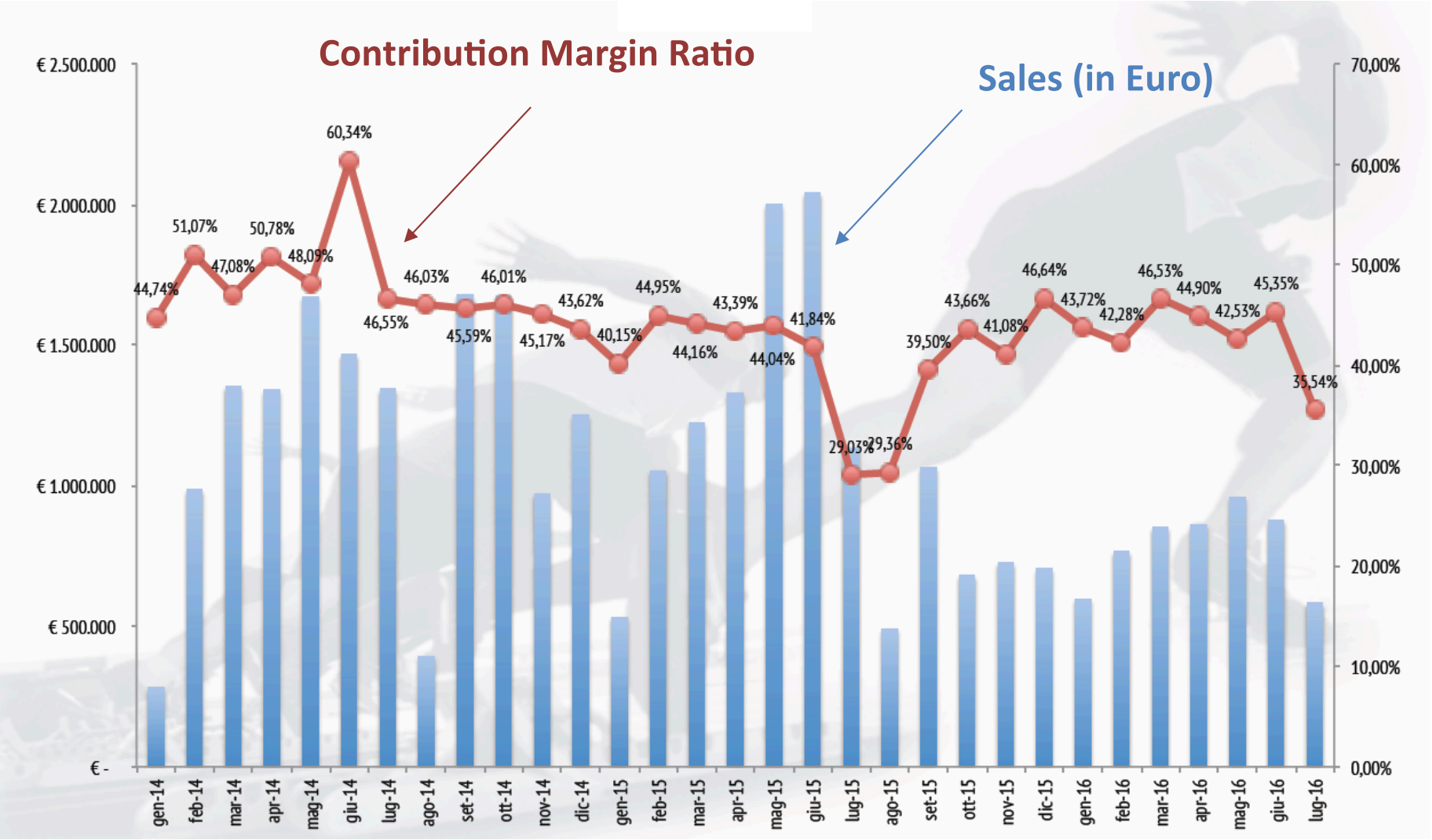
- ✧ Changes in activity are the only factors that affect costs.
- ✧ The behavior of both costs and revenues are linear throughout the relevant range of activity; therefore:
  - Selling price is constant. The price of a product or service will not change as volume changes.
  - The variable element is constant per unit.
  - The fixed elements of revenues and costs are constant in total over the entire relevant range.
- ✧ Inventories do not change. In manufacturing companies, the number of units produced equals the number of units sold. In merchandising companies the number of units purchased equals the the number of units sold.
- ✧ Costs can be classified accurately as either fixed or variable.
- ✧ In multiproduct companies, the sales mix is constant.

SOURCE: Noreen–Brewer– Garrison, "Managerial Accounting for Managers", Second Edition

DRIVERS OF BREAK-EVEN SALES



REAL LIFE ANALYSIS



A WEIGHTED AVERAGE OF DIFFERENT SBU