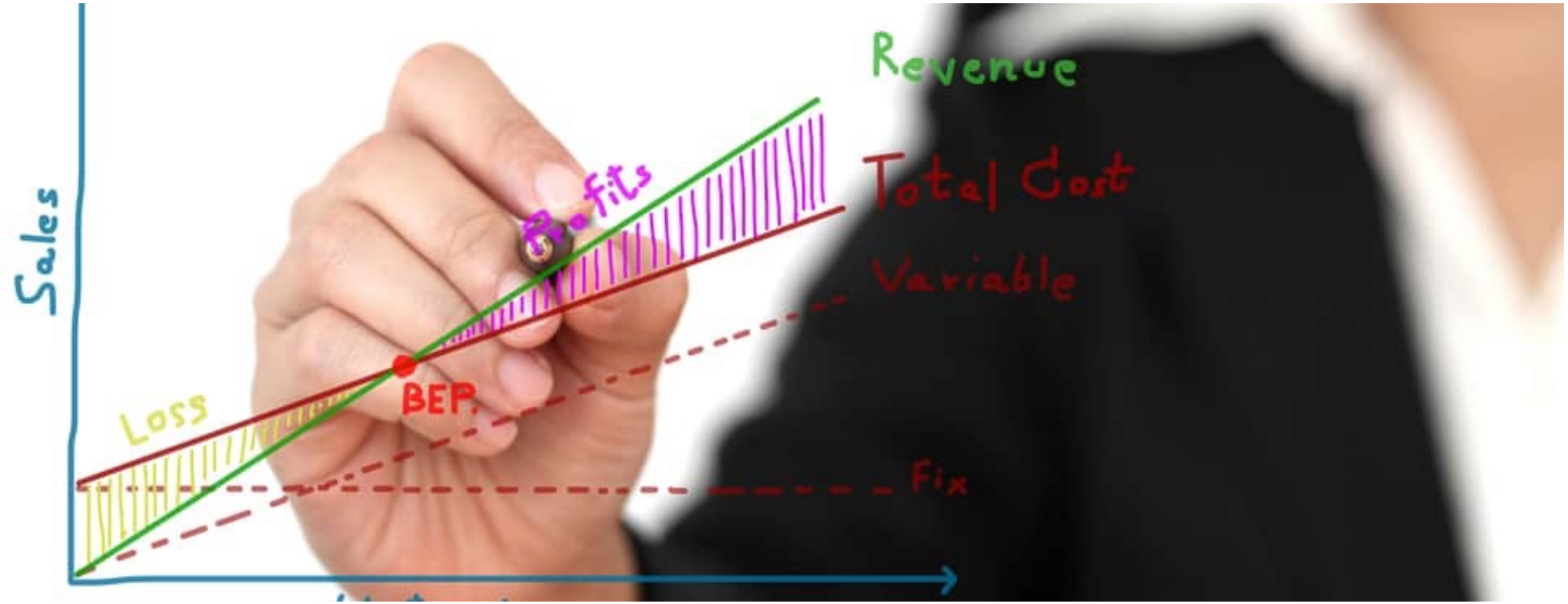
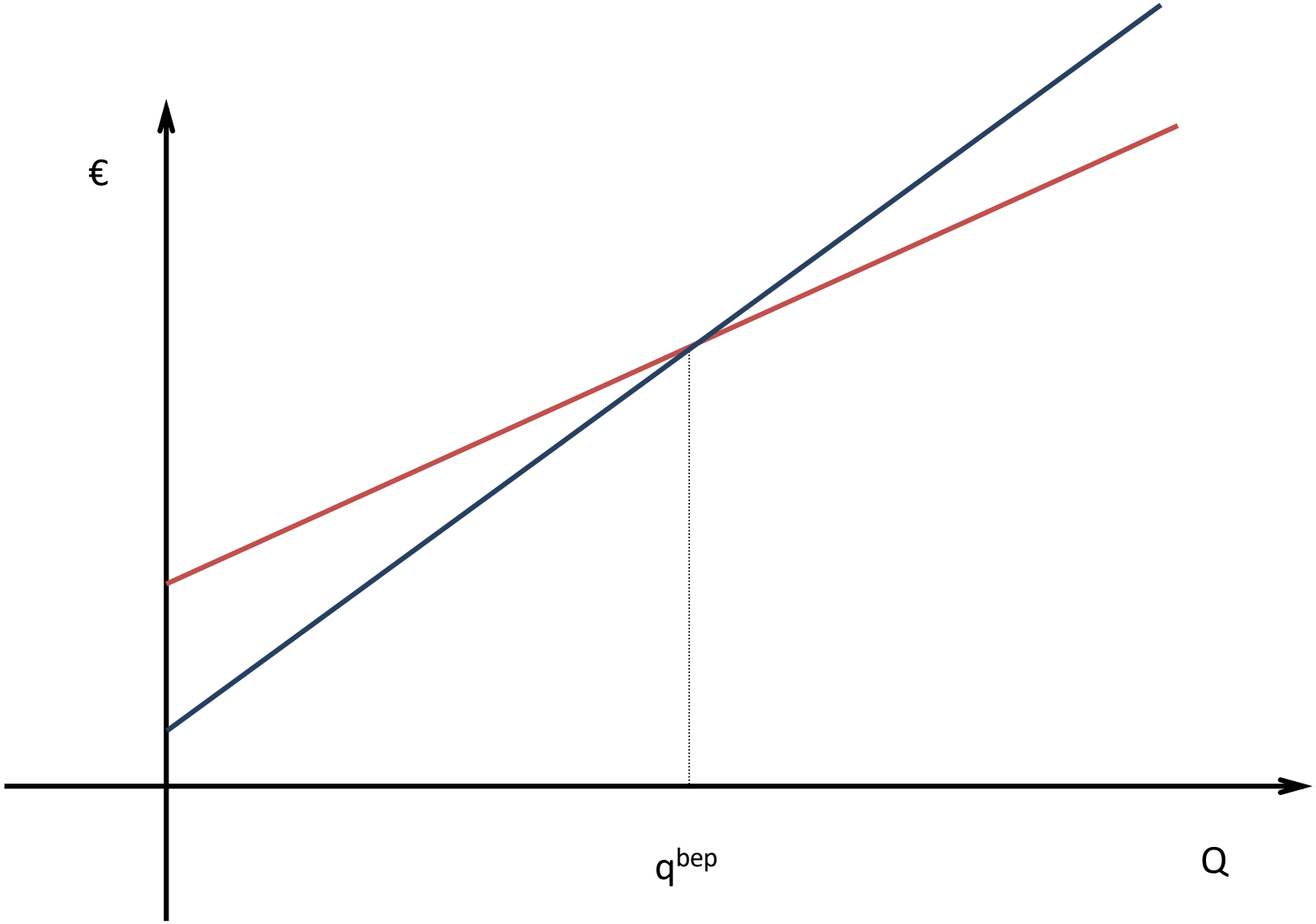
COST-VOLUME-PROFIT ANALYSIS

A review of the basic concepts and an increase in the level of sophistication of the model



COST-VOLUME-PROFIT ANALYSIS



MENTAL MODELS

In 1971 Jay Wright Forrester defined mental models as follows:

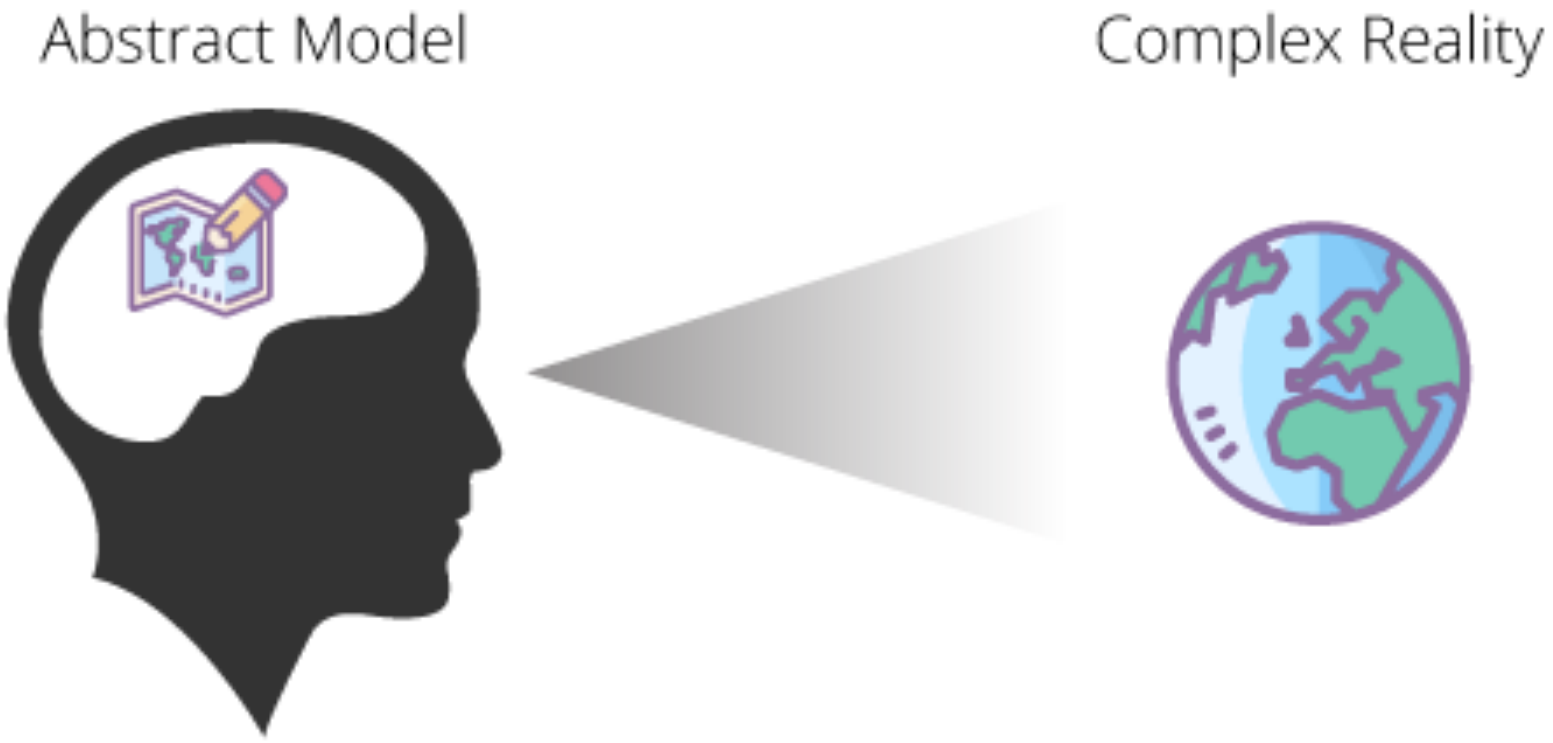
"The image of the world around us, which we carry in our head, is just a model. Nobody in his head imagines all the world, government or country. He has only selected concepts, and relationships between them, and uses those to represent the real system"

Mental model is an explanation of someone's thought process about how something works in the real world. It is a representation of the surrounding world, the relationships between its various parts and a person's intuitive perception about his or her own acts and their consequences. Mental models can help shape behavior and set an approach to solving problems (similar to a personal algorithm) and doing tasks.

A mental model is a kind of internal symbol or representation of external reality, hypothesized to play a major role in cognition, reasoning and decision-making. Kenneth Craik suggested in 1943 that the mind constructs "small-scale models" of reality that it uses to anticipate events.

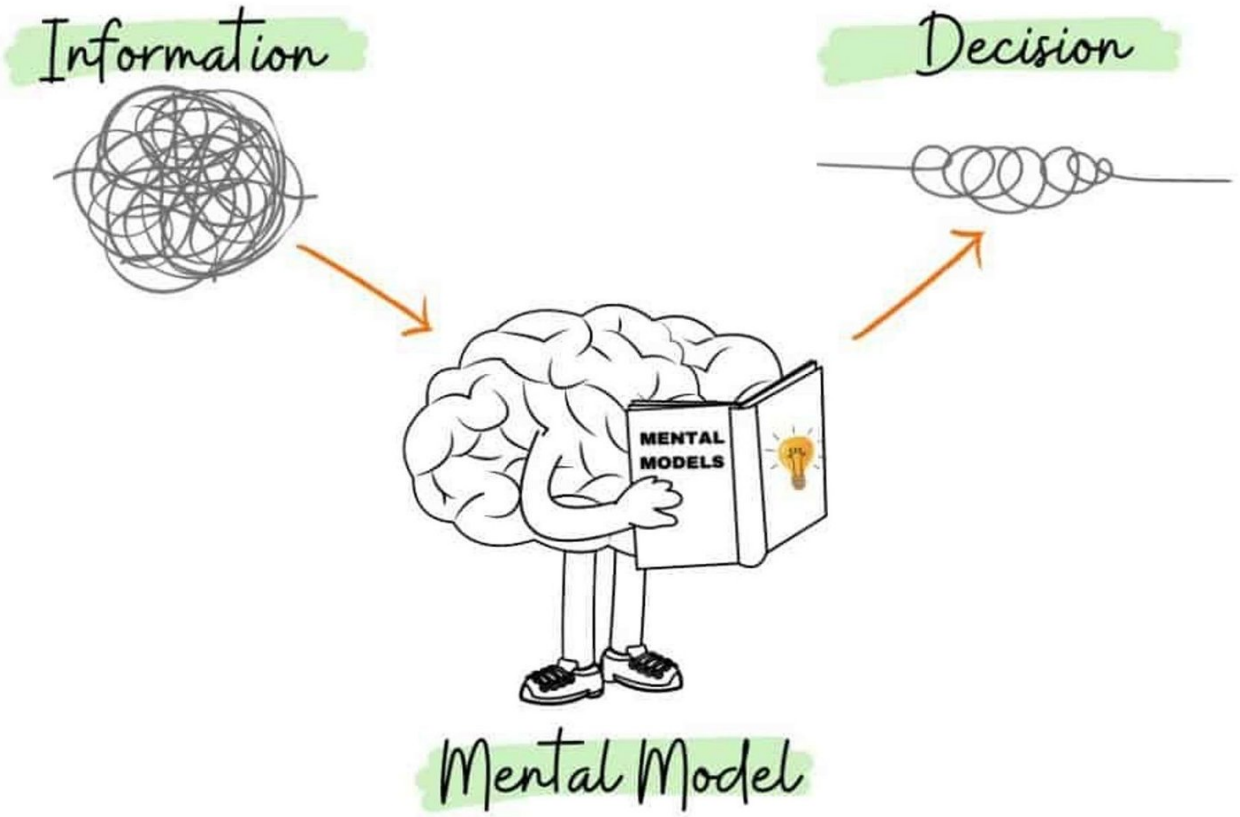
SOURCE: https://en.wikipedia.org/wiki/Mental_model

MENTAL MODELS



A mental model is a simplified observation of a certain part of reality that you can keep in your head.

MENTAL MODELS



SOURCE: https://thewizdomproject.com/mental-models-basics

MENTAL MODELS

"One thing all managers know is that many of the best ideas never get put into practice. Brilliant strategies fail to get translated into action. Systemic insights never find their way into operating policies. A pilot experiment may prove to everyone's satisfaction that a new approach leads to better results, but widespread adoption of the approach never occurs.

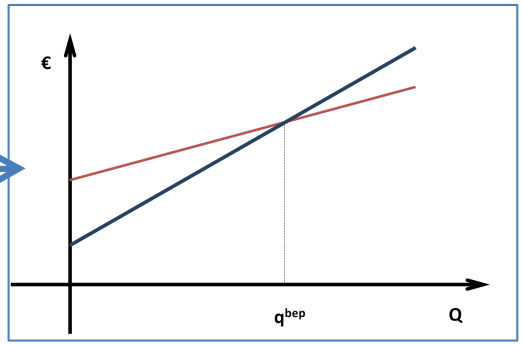
We are coming increasingly to believe that this "slip 'twixt cup and lip" stems, not from weak intentions, wavering will, or even nonsystemic understanding, but from mental models. More specifically, new insights fail to get put into practice because they conflict with deeply held internal images of how the world works, images that limit us to familiar ways of thinking and acting. That is why the discipline of managing mental models—surfacing, testing, and improving our internal pictures of how the world works— "promises to be a major breakthrough for building learning organizations. None of us can carry an organization in our minds—or a family, a community. What we carry in our heads are images, assumptions, and stories. [...]

Our "mental models" determine not only how we make sense of the world, but how we take action."

Excerpt From: Peter M Senge. "The Fifth Discipline: The Art and Practice of the Learning Organization: First Edition." iBooks.

DECISION MODELS

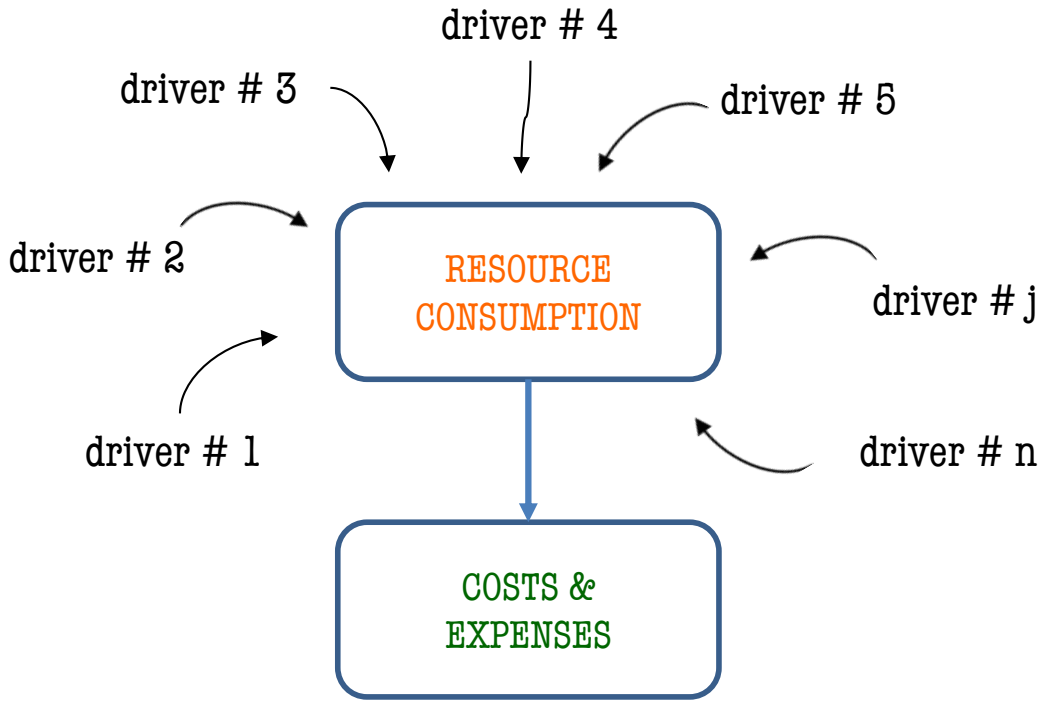
SELECTED CONCEPTS AND SELECTED RELATIONSHIPS BETWEEN THEM



DECISION MODEL (ABSTRACTION)

BUSINESS PROCESSES (REALITY)

COSTS, RESOURCES AND DRIVERS

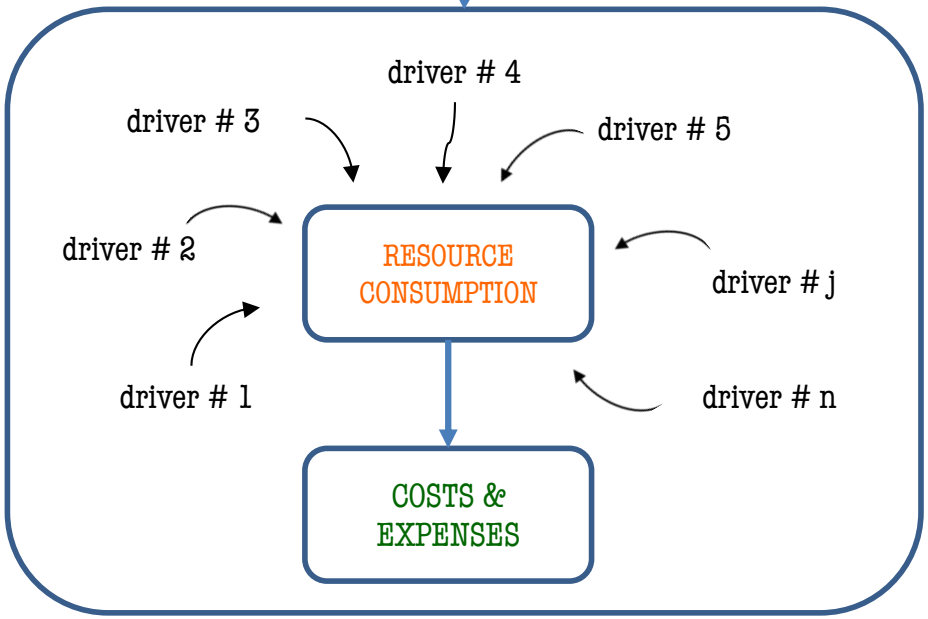


A **cost** is a sacrifice of resources. More precisely the cost (and therefore an expense) is the **monetary reflection of the sacrifice of one or more resources** that are used in order to perform business processes. The usage of a resource is determined by different kinds of causes (generally indicated in accounting as drivers)

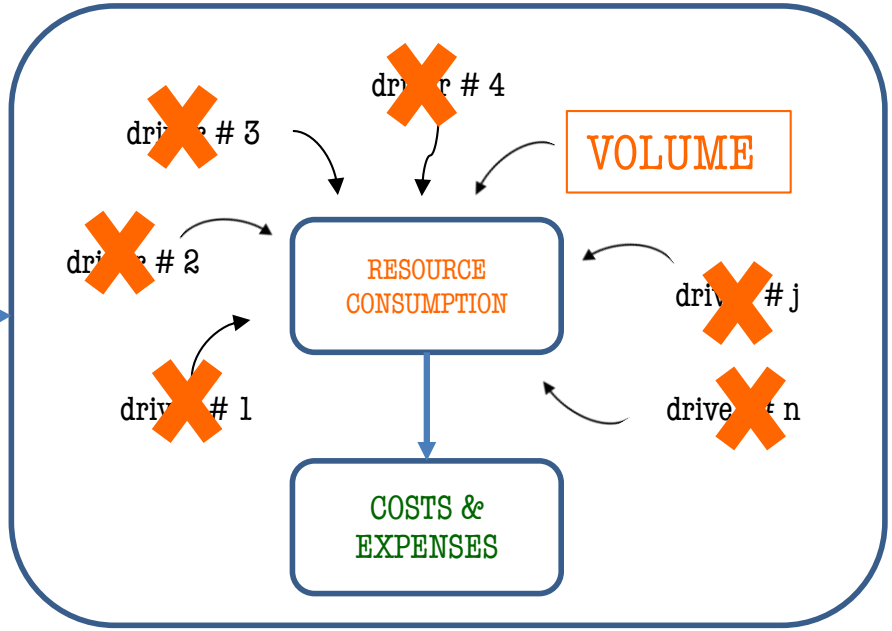
«The objective of **managerial costing** is **to provide a monetary reflection of the utilization of business resources and related cause and effect insights**».

COST-VOLUME-PROFIT MODEL

SELECTED CONCEPTS AND
SELECTED RELATIONSHIPS
BETWEEN THEM



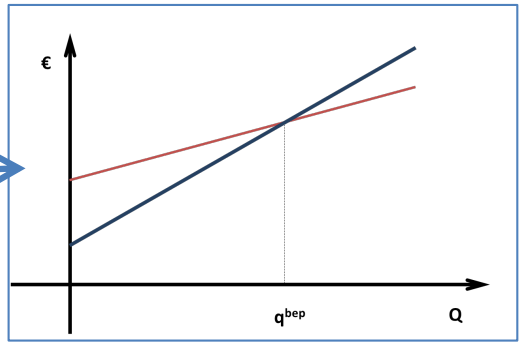
REALITY



DECISION MODEL

DECISION MODELS

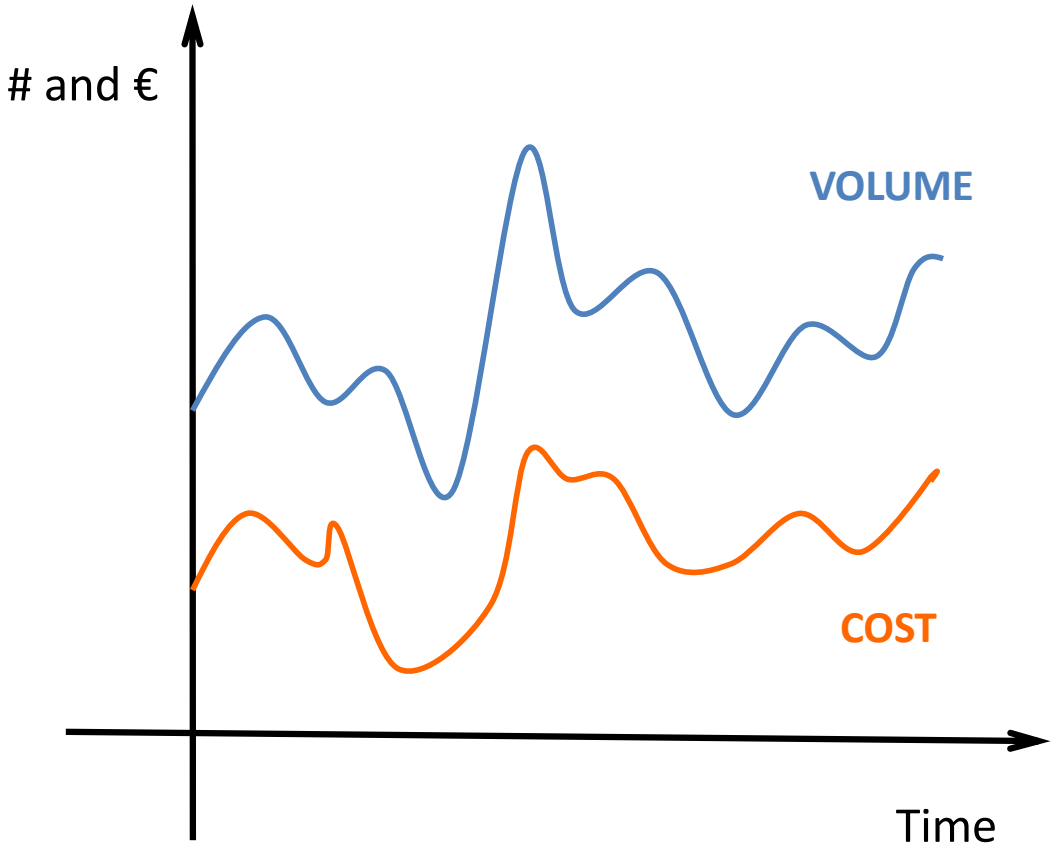
SELECTED CONCEPTS AND SELECTED RELATIONSHIPS BETWEEN THEM

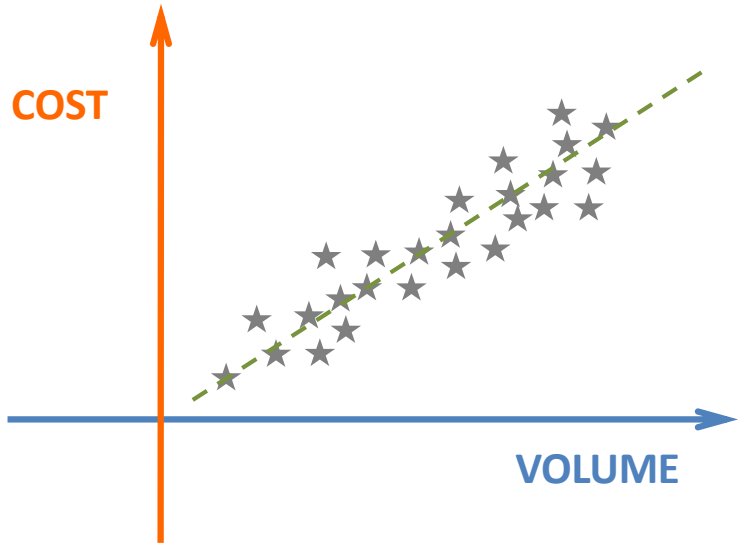


DECISION MODEL (ABSTRACTION)

BUSINESS PROCESSES (REALITY)

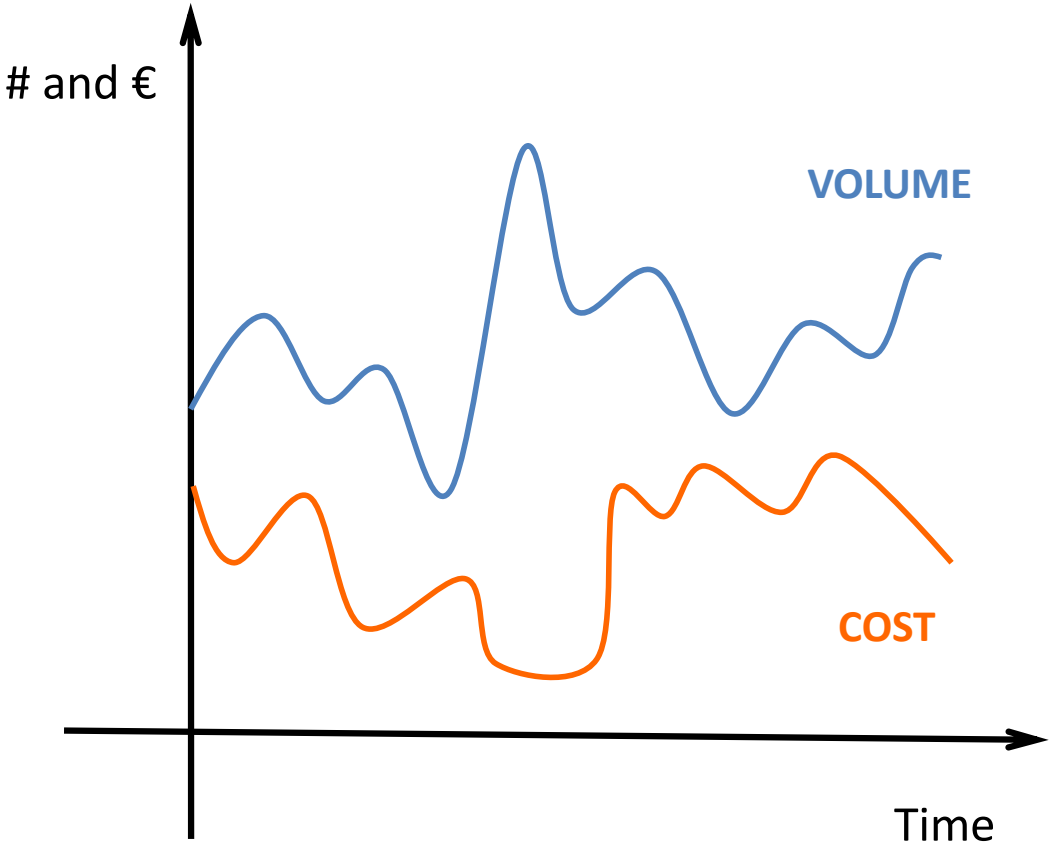
VARIABLE: CORRELATED

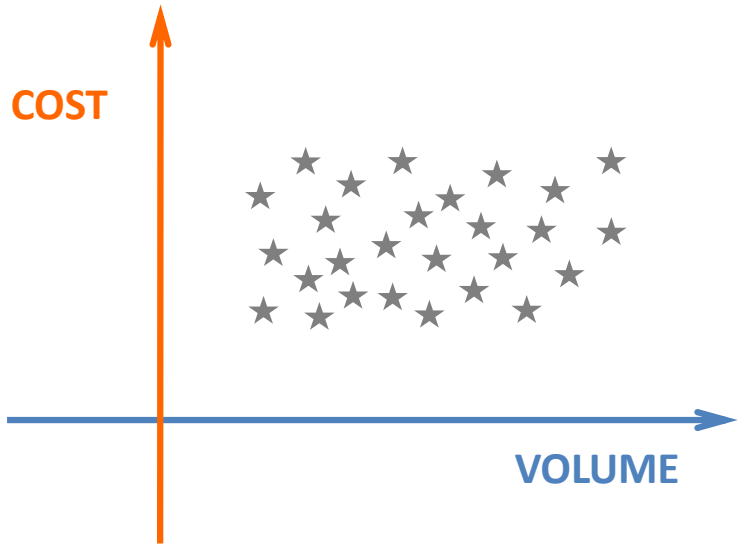




POSITIVE CORRELATION

FIXED: UN-CORRELATED



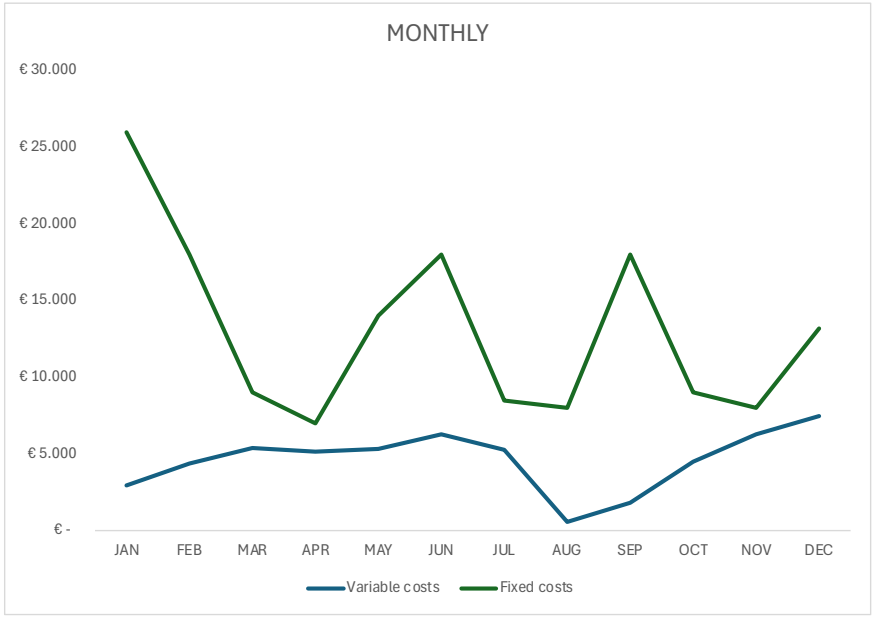


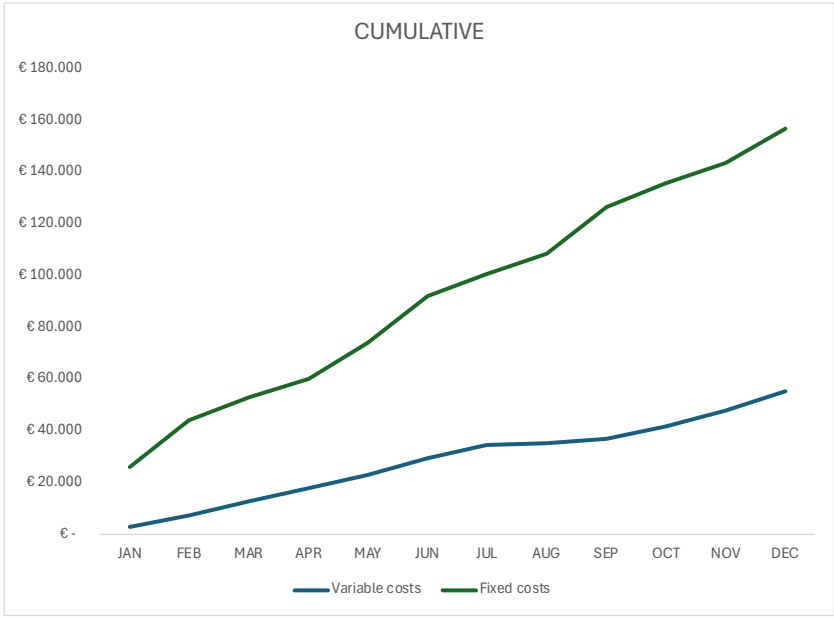
NO CORRELATION

AN EXAMPLE (FOR EDUCATIONAL PURPOSES)

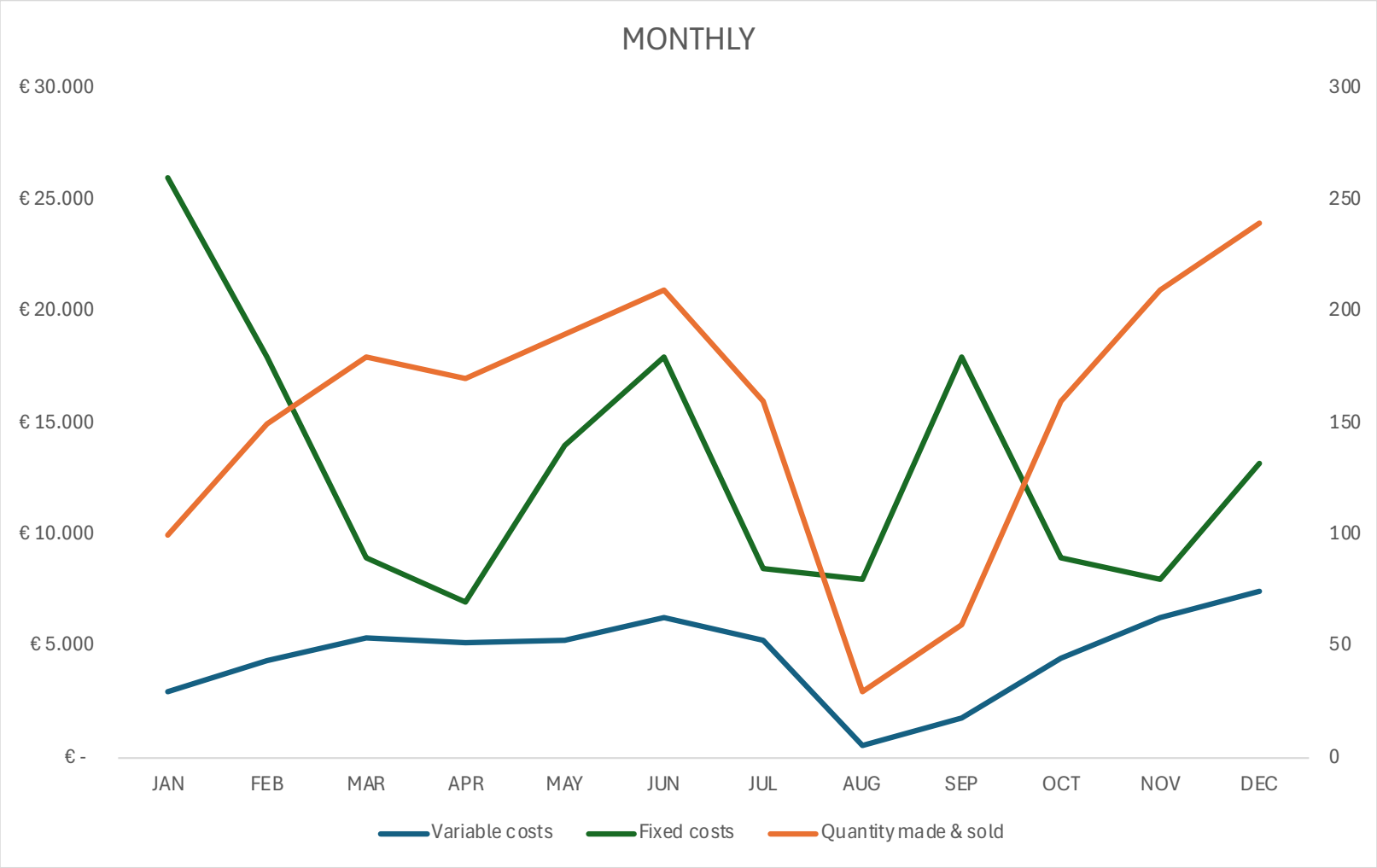
MONTHLY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Quantity made & sold	100	150	180	170	190	210	160	30	60	160	210	240
Variable costs	€ 2.884	€ 4.586	€ 5.178	€ 4.686	€ 5.257	€ 6.630	€ 5.088	€ 1.240	€ 2.059	€ 4.646	€ 6.458	€ 6.938
Fixed costs	€ 26.000	€ 18.000	€ 9.000	€ 7.000	€ 14.000	€ 18.000	€ 8.500	€ 8.000	€ 18.000	€ 9.000	€ 8.000	€ 13.200

CUMULATIVE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Quantity made & sold	€ 100	€ 250	€ 430	€ 600	€ 790	€ 1.000	€ 1.160	€ 1.190	€ 1.250	€ 1.410	€ 1.620	€ 1.860
Variable costs	€ 2.884	€ 7.470	€ 12.648	€ 17.334	€ 22.591	€ 29.221	€ 34.309	€ 35.549	€ 37.608	€ 42.254	€ 48.712	€ 55.650
Fixed costs	€ 26.000	€ 44.000	€ 53.000	€ 60.000	€ 74.000	€ 92.000	€ 100.500	€ 108.500	€ 126.500	€ 135.500	€ 143.500	€ 156.700





CORRELATED OR UN-CORRELATED?



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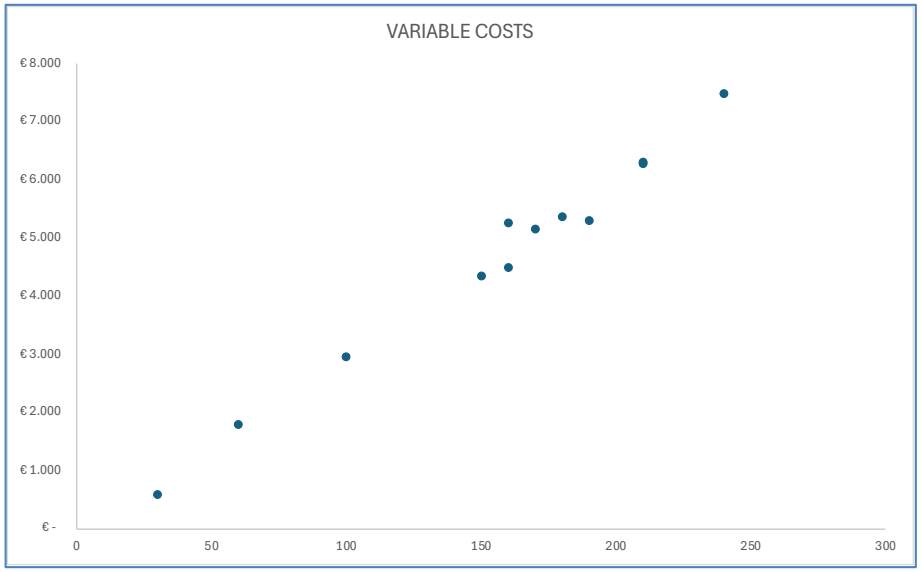

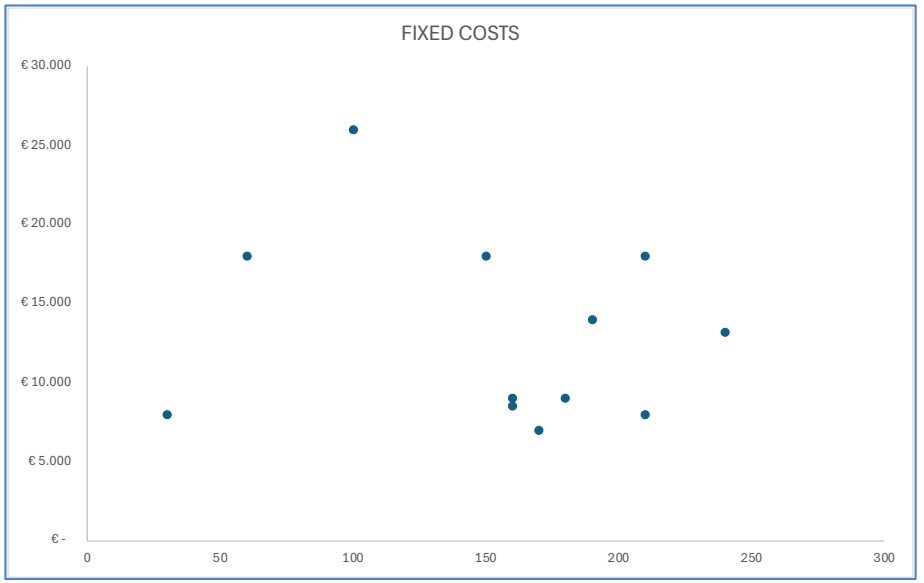

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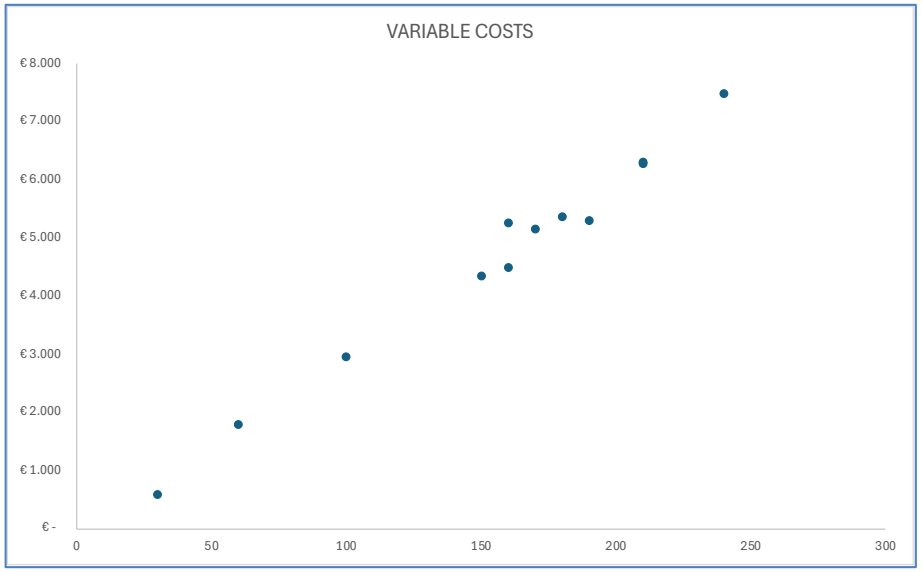
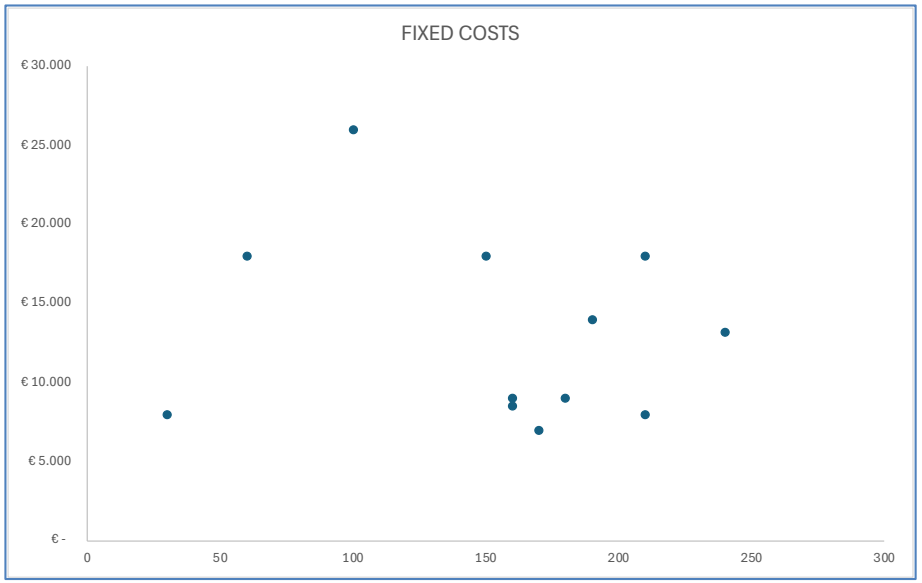
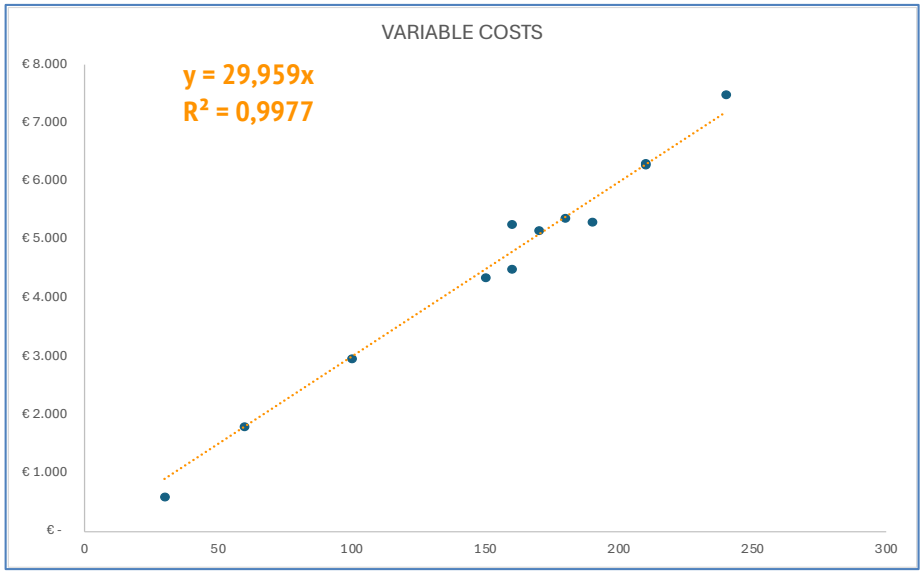
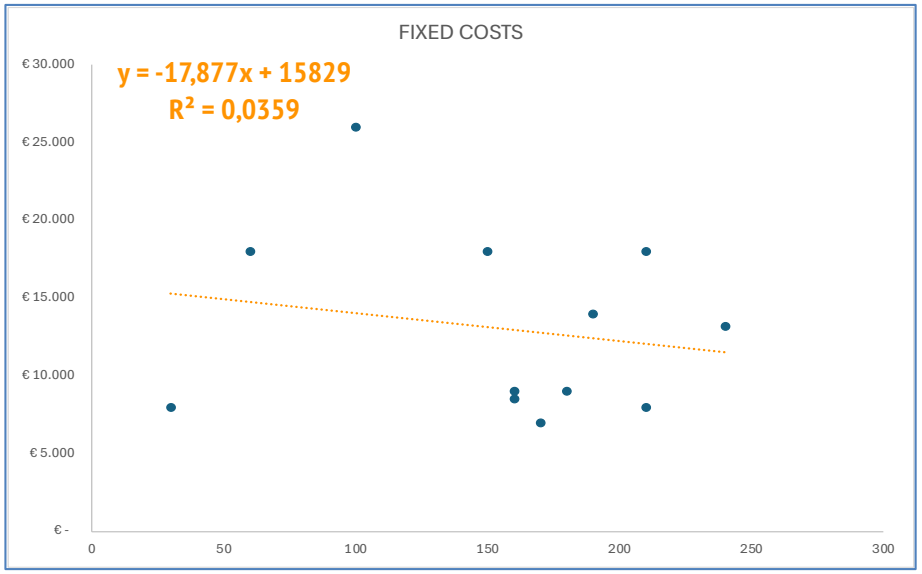


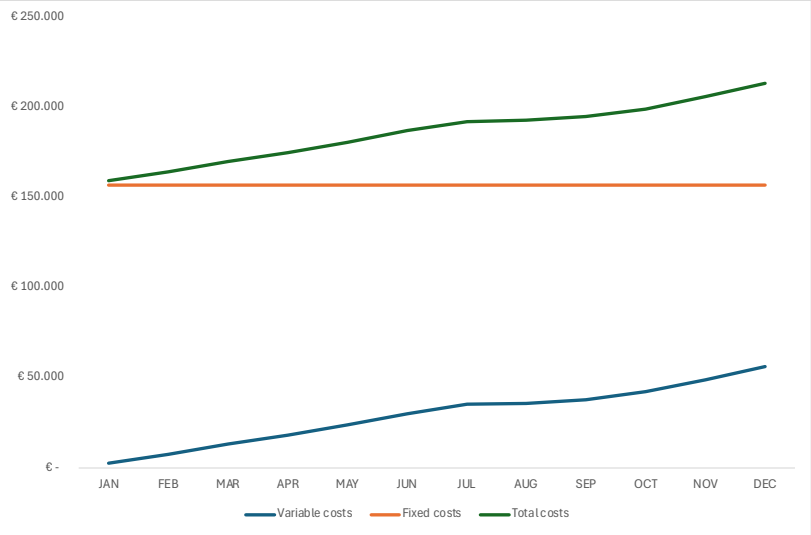


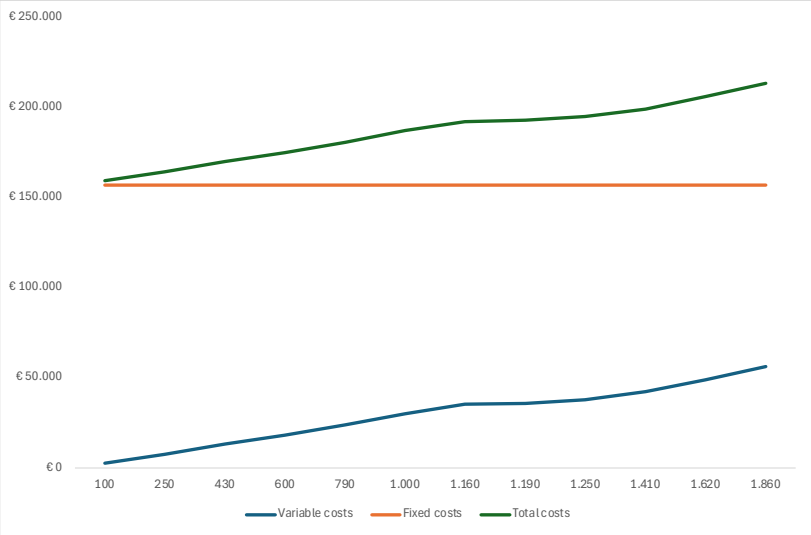




VARIABLE AND FIXED: "MONTHLY" (?) TRENDS

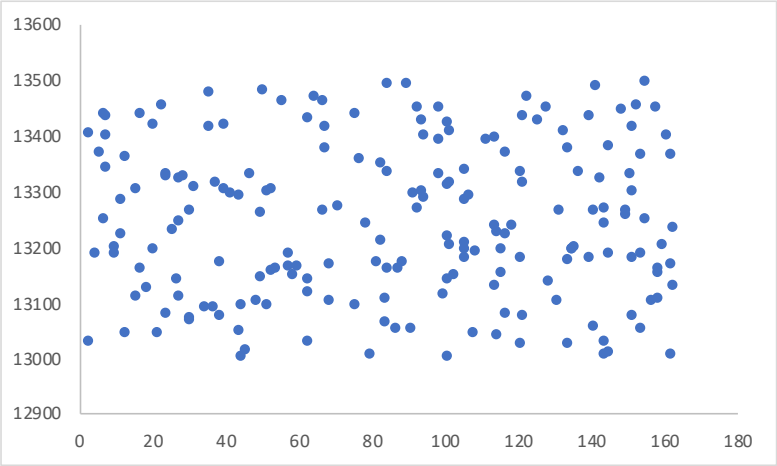
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Quantity made & sold	100	250	430	600	790	1.000	1.160	1.190	1.250	1.410	1.620	1.860
Variable costs	€ 2.607	€ 7.408	€ 13.087	€ 18.050	€ 23.792	€ 29.985	€ 35.176	€ 35.858	€ 37.763	€ 42.196	€ 48.938	€ 56.134
Fixed costs	€ 156.700	€ 156.700	€ 156.700	€ 156.700	€ 156.700	€ 156.700	€ 156.700	€ 156.700	€ 156.700	€ 156.700	€ 156.700	€ 156.700
Total costs	€ 159.307	€ 164.108	€ 169.787	€ 174.750	€ 180.492	€ 186.685	€ 191.876	€ 192.558	€ 194.463	€ 198.896	€ 205.638	€ 212.834

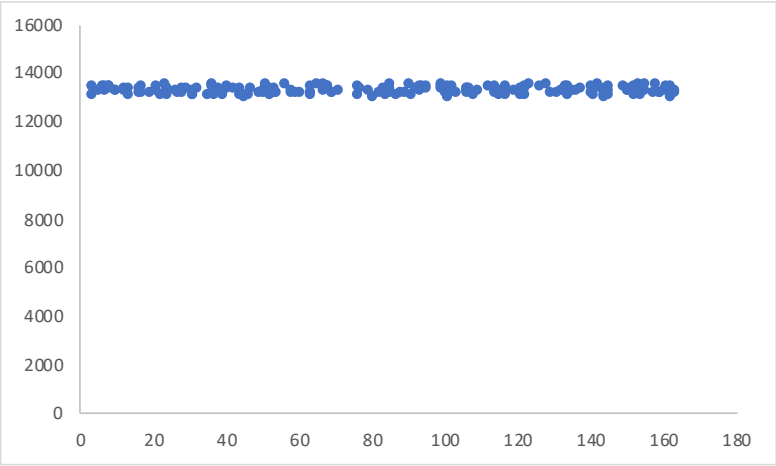




In this slide, just to help understanding, an analysis has been developed that shows the evolution of variable costs over the different months, while the value of fixed costs is held constant over the annual value. Note that although months are shown in the x-axis, this indication refers more correctly to the quantities sold in the different months (as read more correctly in the graph on the right). Also note that since the quantity sold in different months is not constant, the variable cost function appears to take a different slope in different months. In reality, the slope is always the same if (as one should correctly do) the cost of the individual month is related to the quantity sold in that month.

UNCORRELATED BUT NORMALLY QUITE STABLE



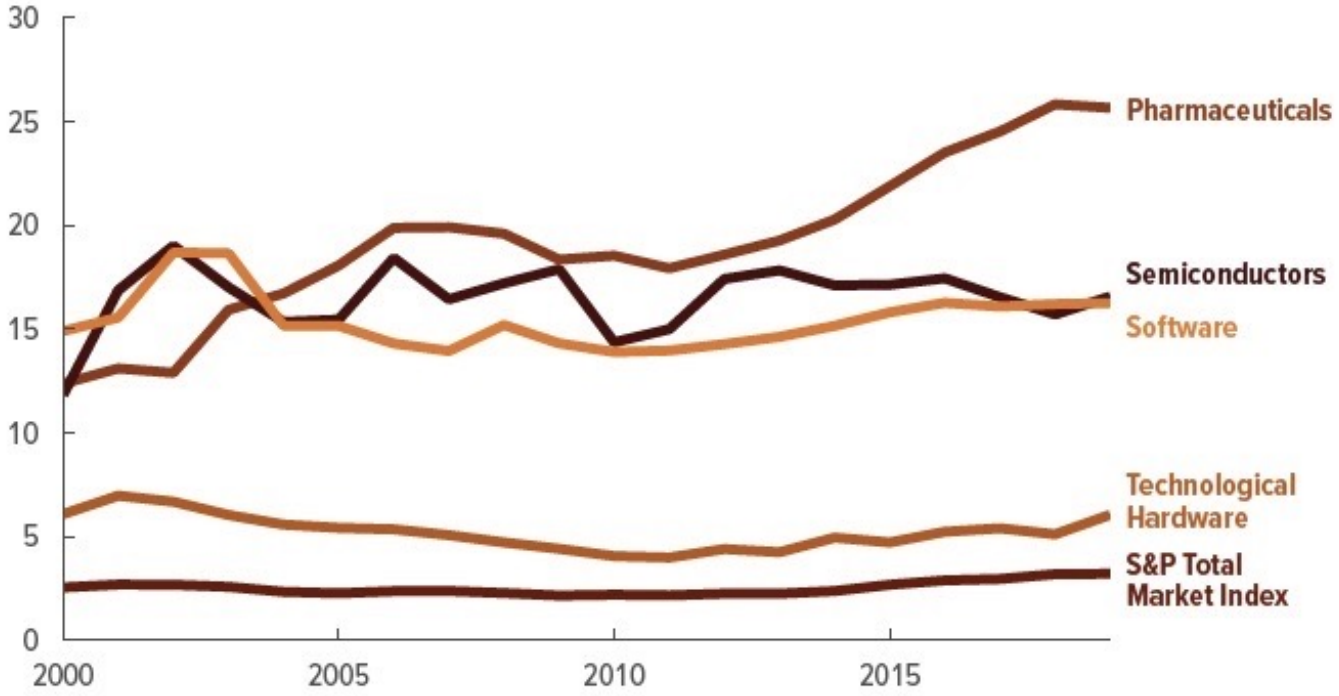


If nothing 'structural' changes (in particular, if there are no changes in production capacity or significant changes in prices), we can assume that the amount of fixed costs, while varying, remains sufficiently stable. This, of course, is hardly true in the long run precisely because in the long run structural changes are inevitable. In particular, production capacity will hopefully have to grow in order to follow the evolution of sales volumes. In the long run, therefore, all costs are variable.

ARE R&D EXPENSES VARIABLE?

Figure 1.

Average R&D Intensities for Publicly Traded U.S. Companies, by Industry



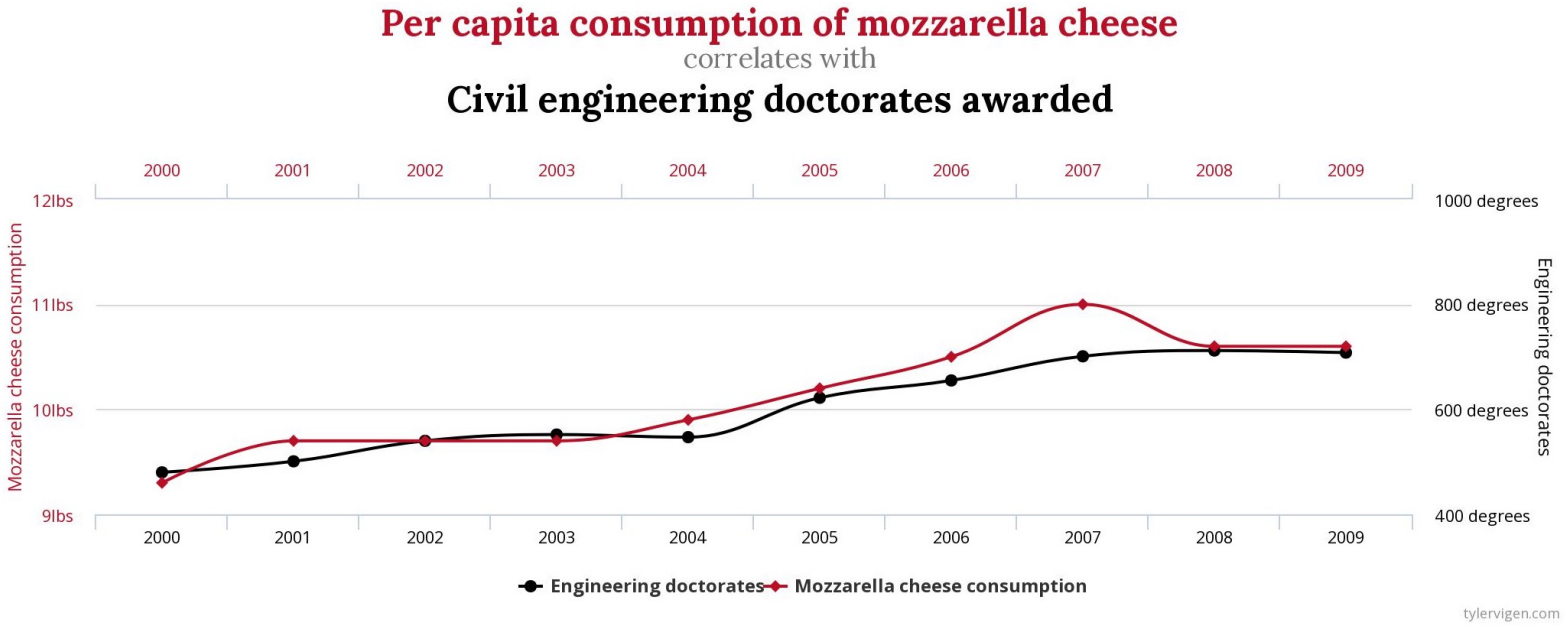
Pharmaceutical companies have devoted a growing share of their net revenues to R&D activities, averaging about 19 percent over the past two decades. By comparison, other research-intensive industries, like software and semiconductors, averaged about 15 percent.

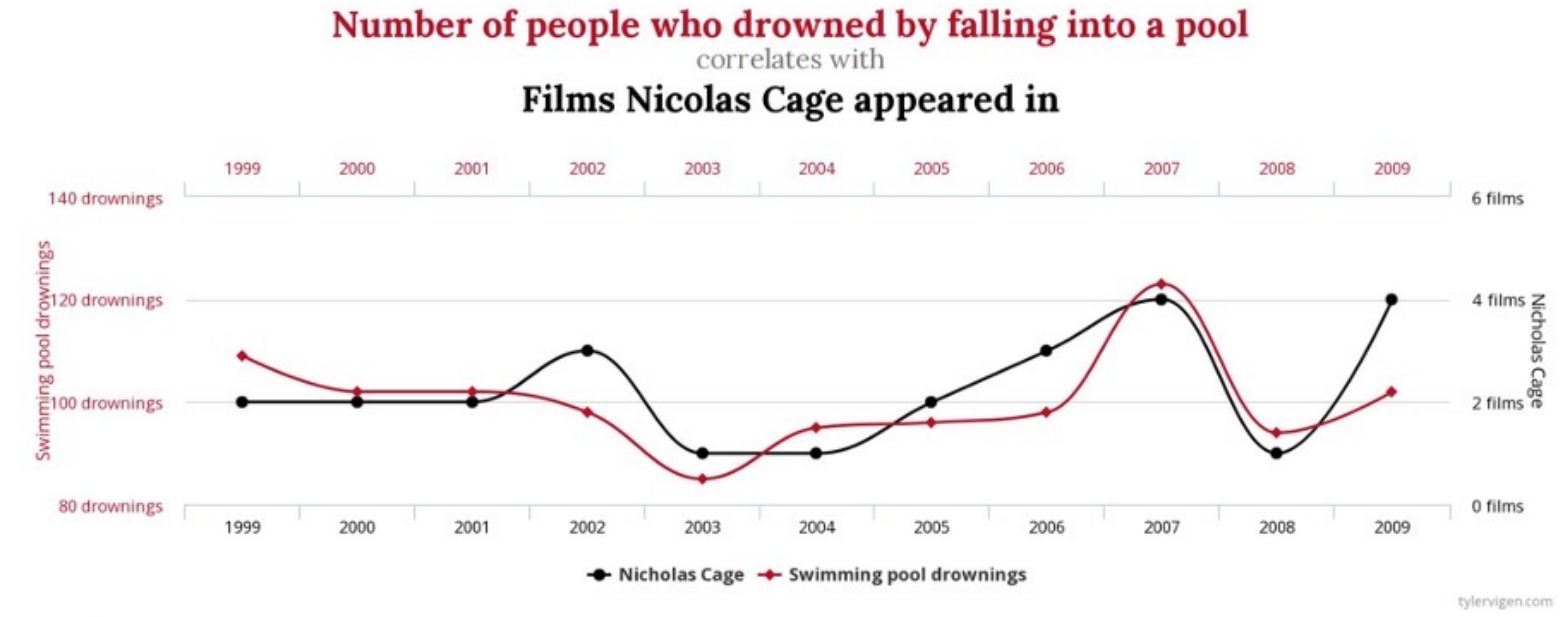
Data source: Congressional Budget Office, using data from Bloomberg, limited to U.S. firms as identified by Aswath Damodaran, "Data: Breakdown" (accessed January 13, 2020), https://tinyurl.com/yd5hq4t6. See www.cbo.gov/publication/57025#data.

R&D intensity is research and development spending as a share of net revenues (sales less expenses and rebates).

R&D = research and development; S&P = Standard and Poor's.

“CORRELATION IS NOT CAUSATION”





“CORRELATION IS NOT CAUSATION”

https://youtu.be/esOnPjLNsiO

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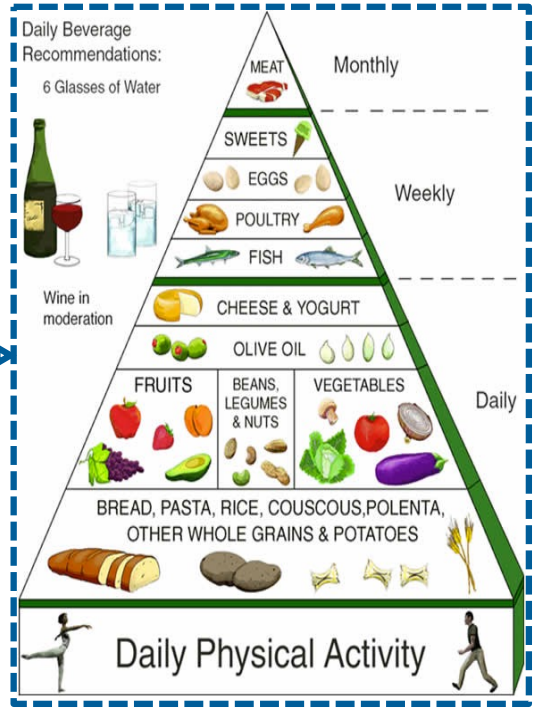
KAPLAN FINANCIAL - SEMINAR COSTS

- ✧Speaker
- ✧Flipchart pads
- ✧Markers
- ✧Binders, notepads, pens
- ✧Auditorium, conference room,
- ✧Coffee, beverages, fruit and snacks
- ✧Computer and Projector
- ✧Energy costs

COHERENCE BETWEEN INFORMATION AND DECISIONS



DECISION MODELS

The information must be **RELEVANT** for the decisions that managers, operating in a particular business environment with a particular strategy, make.

KAPLAN FINANCIAL - SEMINAR COSTS

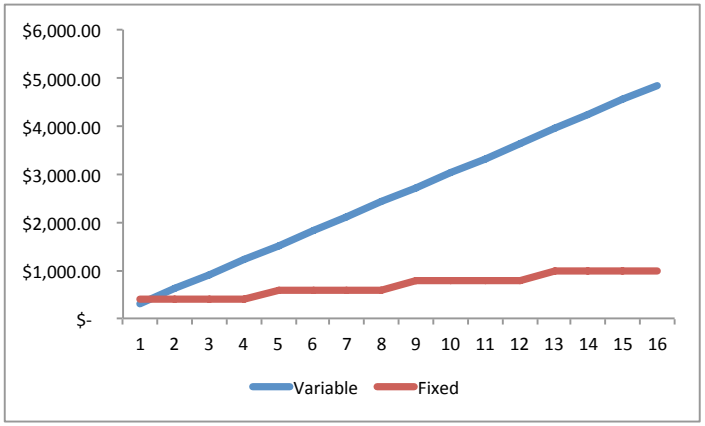
Two possible decisions to make:

- How many participants do I need in order to break even?
- How much does an individual participant have to pay to attend the seminar?

FIXED OR VARIABLE?

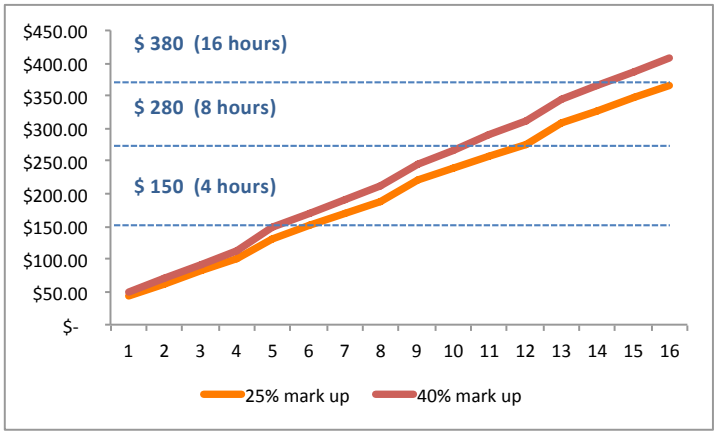
	# PARTECIPANTS	# HOURS
Speaker	Fixed	Variable
Flipchart pads	Fixed	Variable
Markers	Fixed	Variable
Binders, notepads, pens	Variable	Fixed/Variable
Auditorium, conference room,	Fixed	Variable
Coffee, beverages, fruit and snacks	Variable	Fixed/Variable
Computer and Projector	Fixed	Variable
Energy costs	Fixed/Variable	Variable

HOW MUCH DOES AN INDIVIDUAL PARTICIPANT HAVE TO PAY?



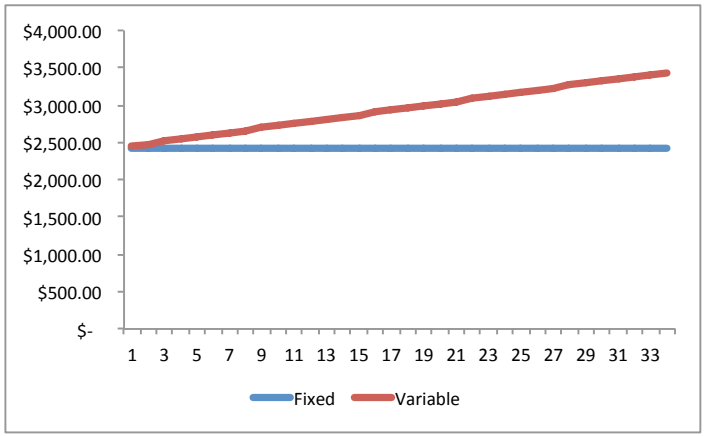
Analysis of cost behavior using “number of hours” as a parameter

Target number of participants: **20**

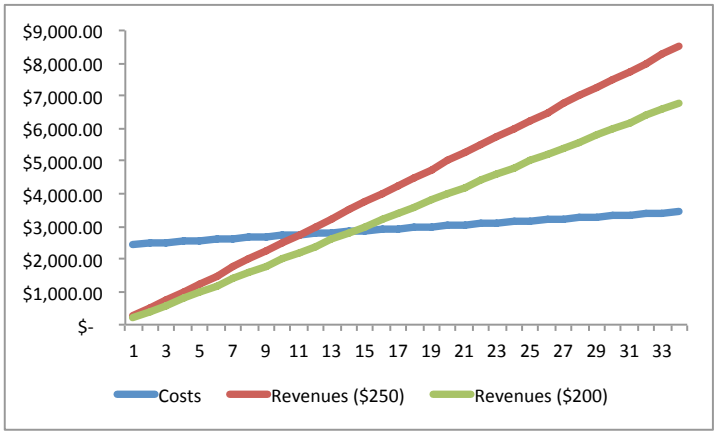


Comparison with competitors’ prices for different “formats”

HOW MANY PARTICIPANTS DO I NEED IN ORDER TO BREAK EVEN?

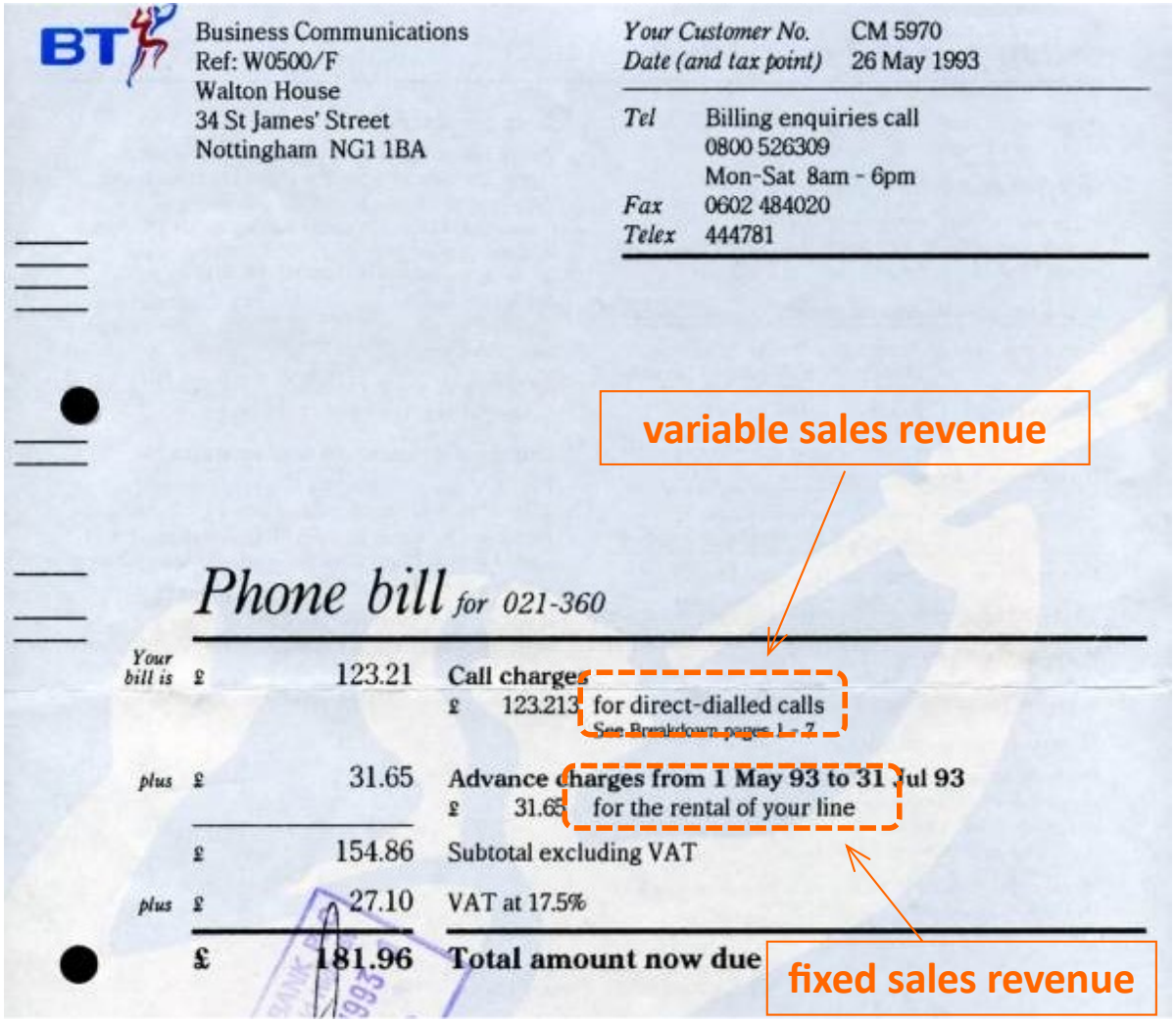


Analysis of cost behavior using “number of participants ” as a parameter



Break even point in term of number of participants needed

TELECOM SERVICE PROVIDERS: ORIGINALLY



BT

Business Communications
Ref: W0500/F
Walton House
34 St James' Street
Nottingham NG1 1BA

Your Customer No. CM 5970
Date (and tax point) 26 May 1993

Tel Billing enquiries call 0800 526309 Mon-Sat 8am - 6pm
Fax 0602 484020
Telex 444781

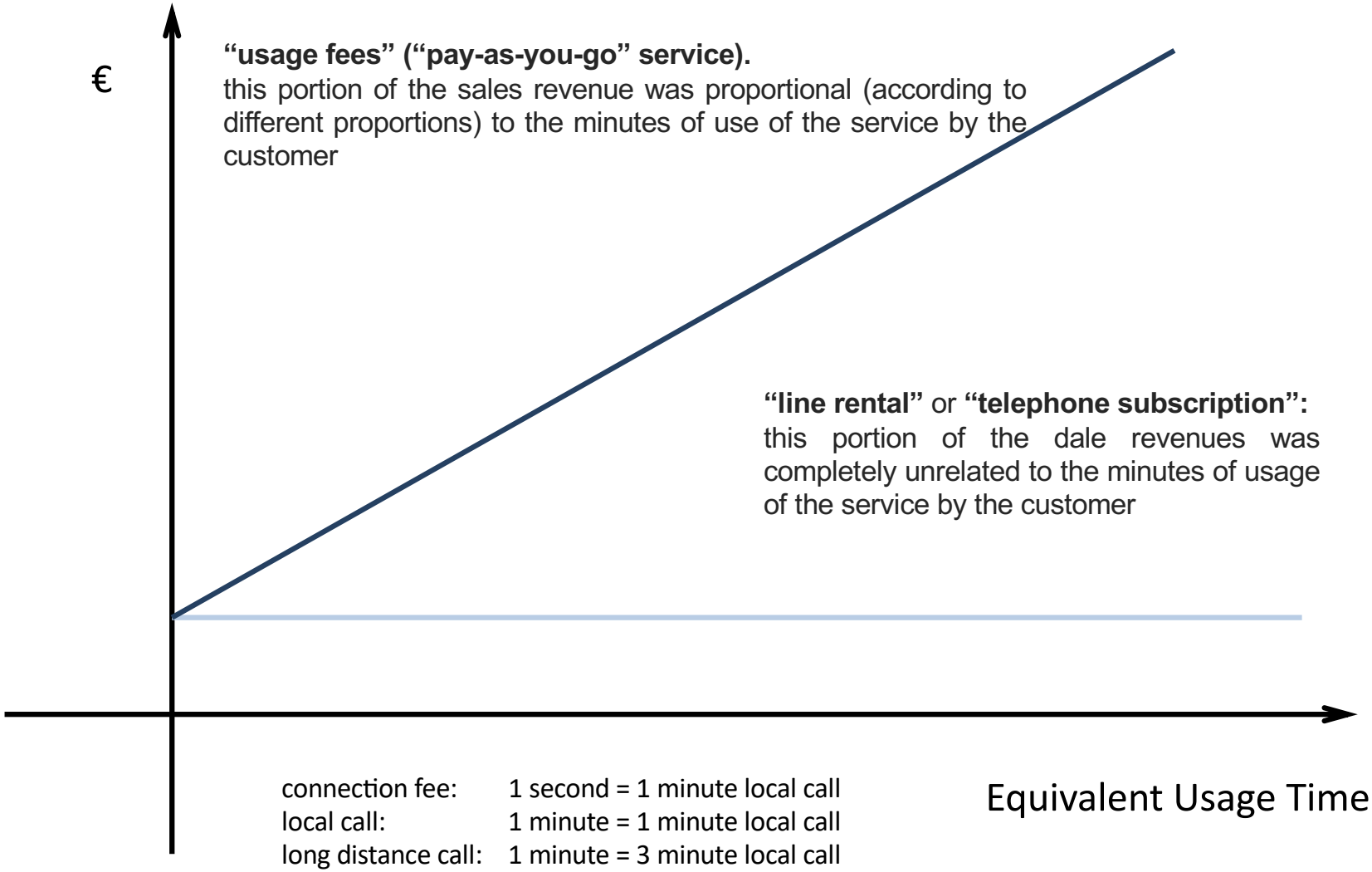
variable sales revenue

Phone bill *for 021-360*

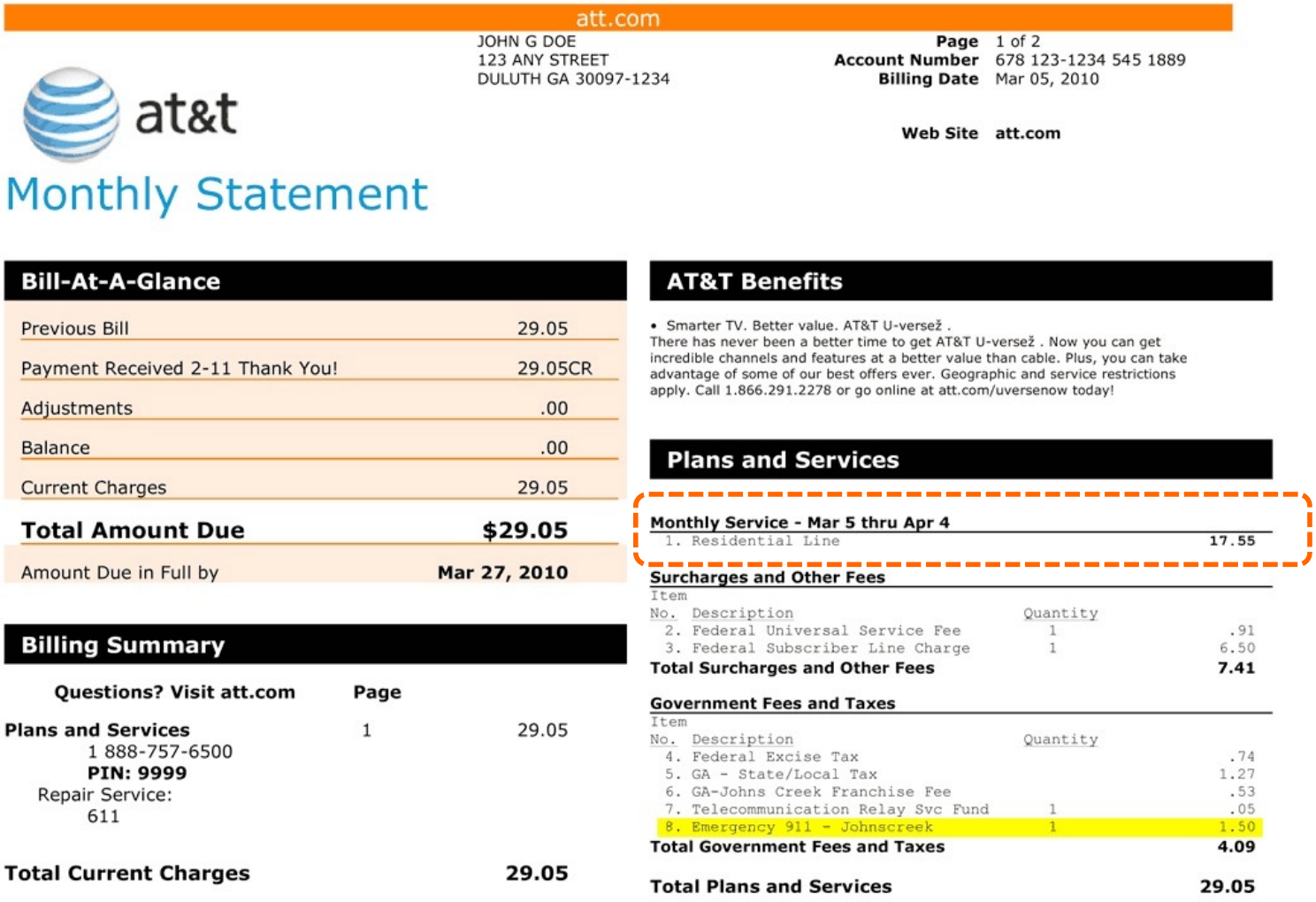
Your bill is	£	123.21	**Call charges**
		£ 123.213	for direct-dialled calls
			See Breakdown pages 1 - 2
plus	£	31.65	**Advance charges from 1 May 93 to 31 Jul 93**
		£ 31.65	for the rental of your line
	£	154.86	Subtotal excluding VAT
plus	£	27.10	VAT at 17.5%
	£	**181.96**	**Total amount now due**

fixed sales revenue

TELECOM SERVICE PROVIDERS: ORIGINALLY



TELECOM SERVICE PROVIDERS: NOW



att.com

JOHN G DOE
123 ANY STREET
DULUTH GA 30097-1234

Page 1 of 2
Account Number 678 123-1234 545 1889
Billing Date Mar 05, 2010

Web Site att.com

at&t

Monthly Statement

Bill-At-A-Glance

Previous Bill	29.05
Payment Received 2-11 Thank You!	29.05CR
Adjustments	.00
Balance	.00
Current Charges	29.05
Total Amount Due	**$29.05**
Amount Due in Full by	**Mar 27, 2010**

Billing Summary

Questions? Visit att.com	**Page**	
Plans and Services 1 888-757-6500 **PIN: 9999** Repair Service: 611	1	29.05
Total Current Charges		**29.05**

AT&T Benefits

• Smarter TV. Better value. AT&T U-versež .
There has never been a better time to get AT&T U-versež . Now you can get incredible channels and features at a better value than cable. Plus, you can take advantage of some of our best offers ever. Geographic and service restrictions apply. Call 1.866.291.2278 or go online at att.com/uversenow today!

Plans and Services

Monthly Service - Mar 5 thru Apr 4

1. Residential Line	17.55

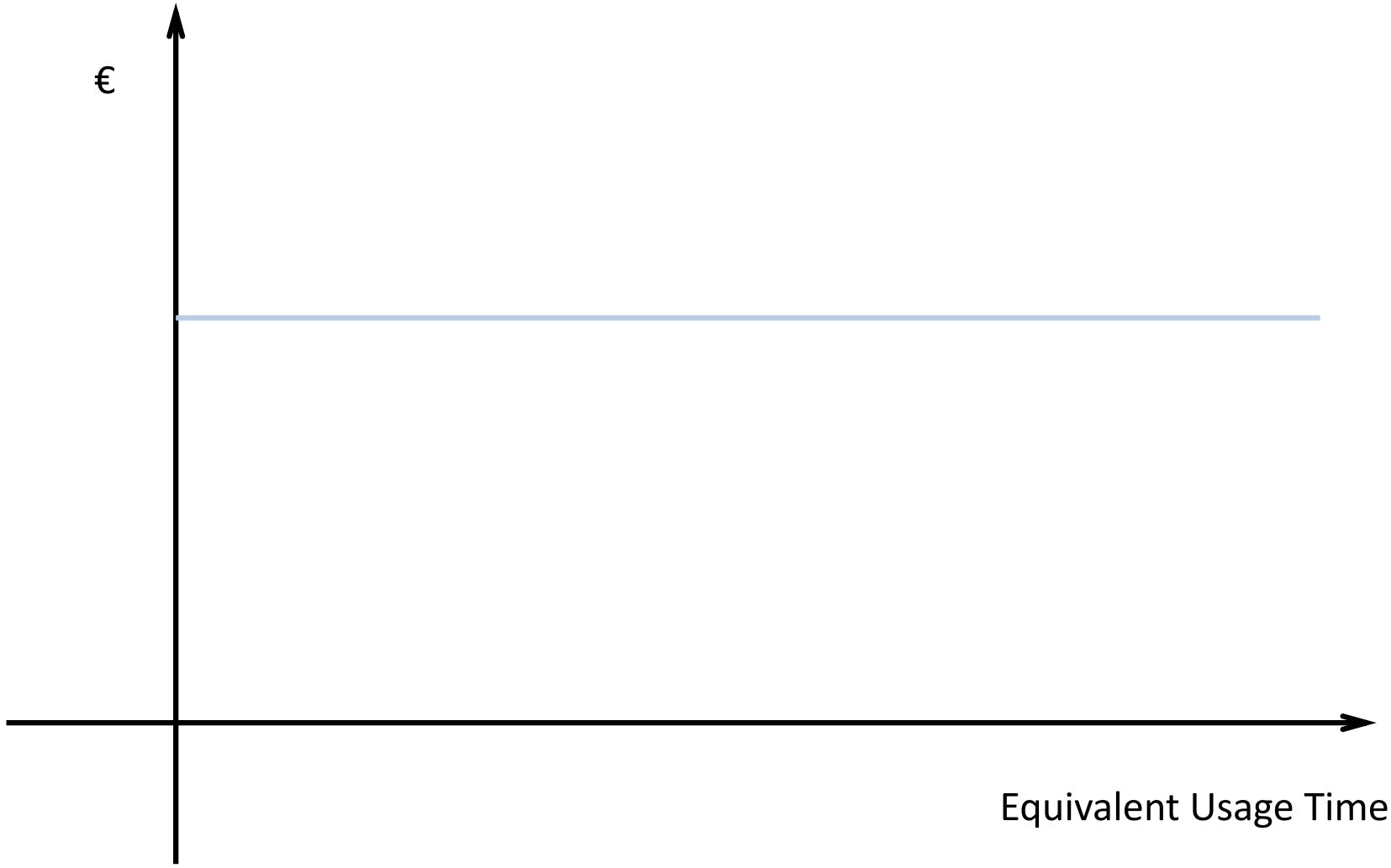
Surcharges and Other Fees

Item No.	Description	Quantity	
2.	Federal Universal Service Fee	1	.91
3.	Federal Subscriber Line Charge	1	6.50
Total Surcharges and Other Fees			**7.41**

Government Fees and Taxes

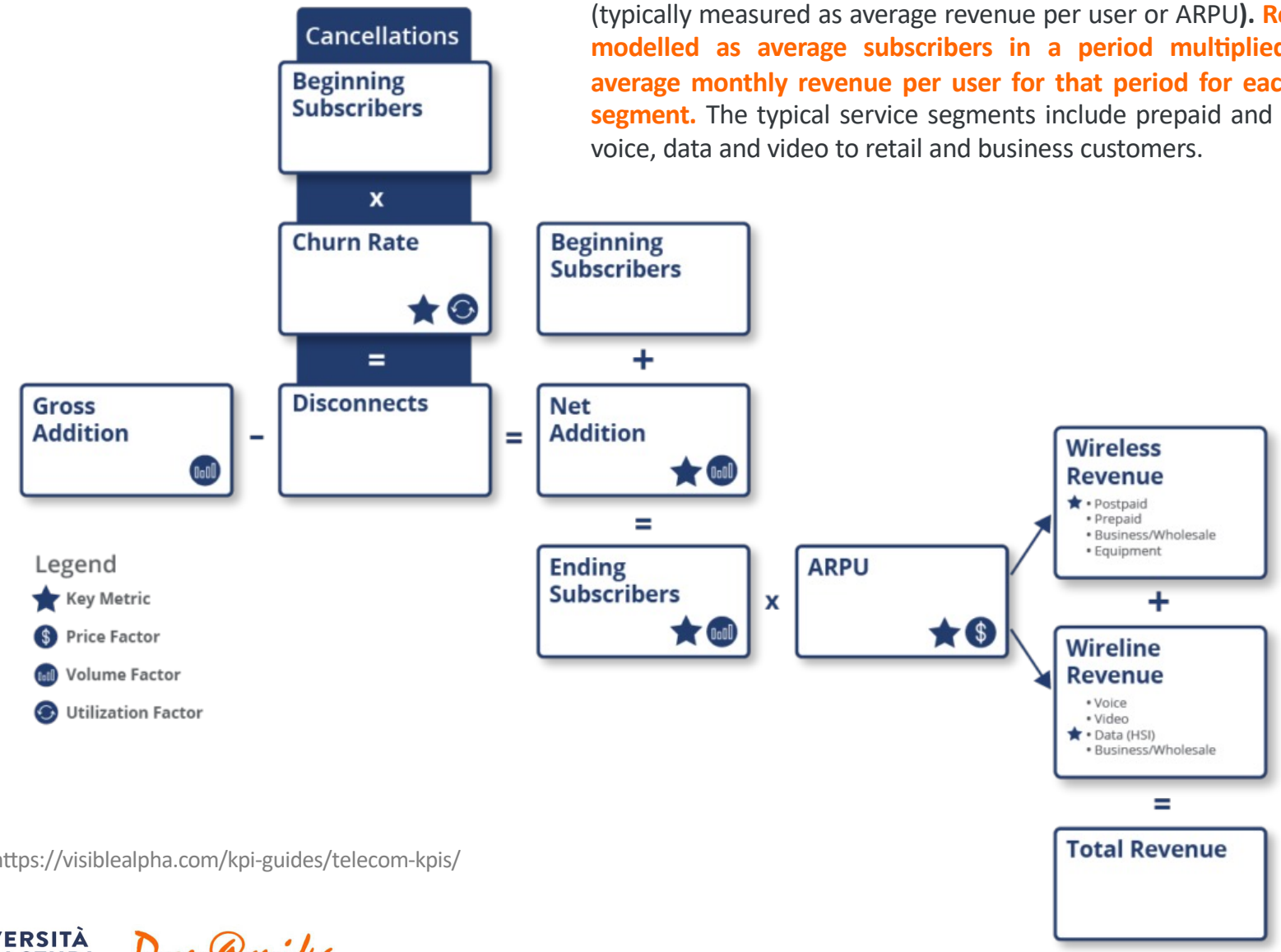
Item No.	Description	Quantity	
4.	Federal Excise Tax		.74
5.	GA - State/Local Tax		1.27
6.	GA-Johns Creek Franchise Fee		.53
7.	Telecommunication Relay Svc Fund	1	.05
8.	Emergency 911 - Johnscreek	1	1.50
Total Government Fees and Taxes			**4.09**
Total Plans and Services			**29.05**

TELECOM SERVICE PROVIDERS: NOW



TELECOM SERVICE PROVIDERS: NEW BUSINESS MODEL

A TSP's primary business model is driven by the volume of their subscribers and the price they charge for the services rendered (typically measured as average revenue per user or ARPU**). Revenue is modelled as average subscribers in a period multiplied by the average monthly revenue per user for that period for each service segment.** The typical service segments include prepaid and post-paid voice, data and video to retail and business customers.

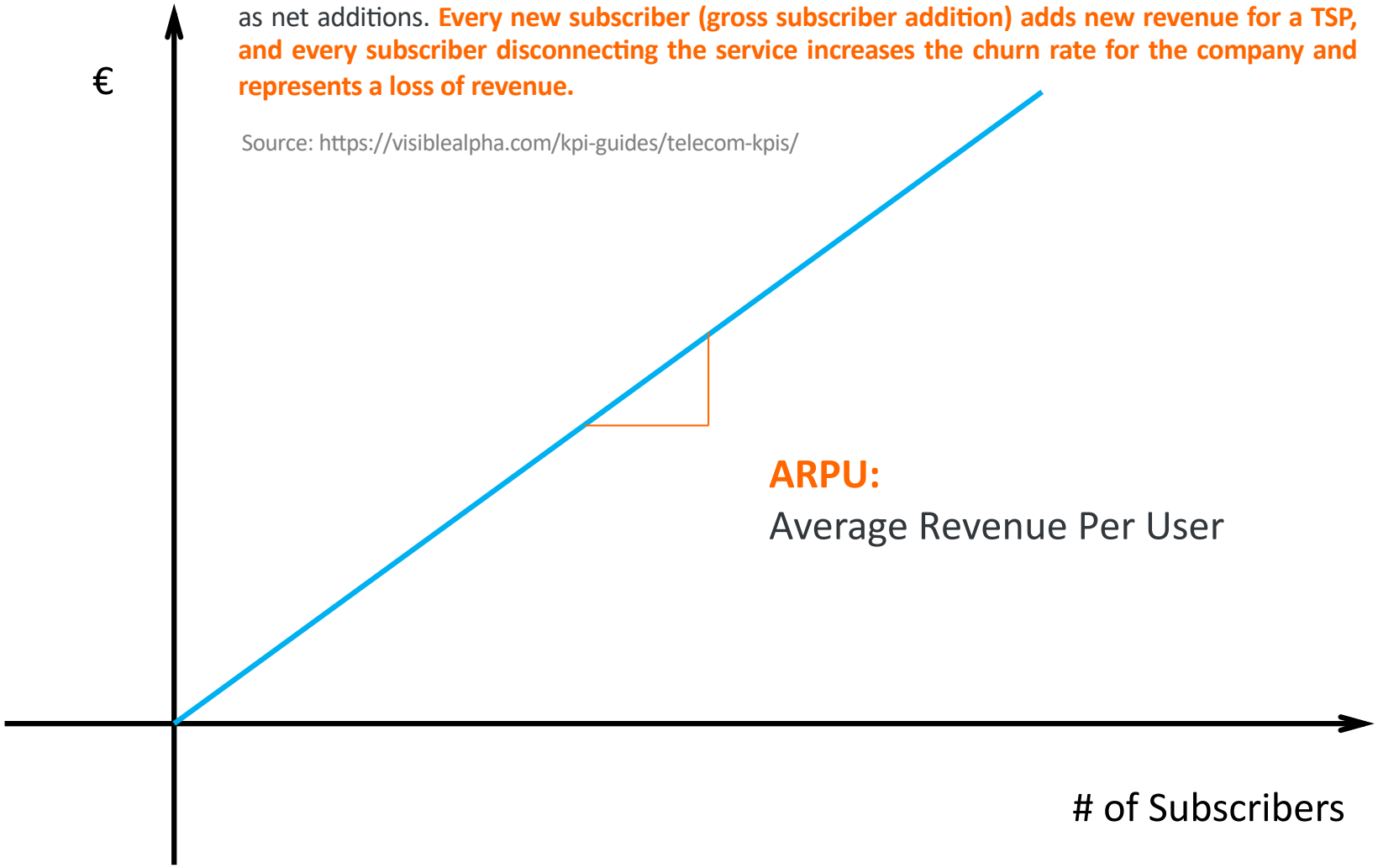


Source: https://visiblealpha.com/kpi-guides/telecom-kpis/

TELECOM SERVICE PROVIDERS: NOW

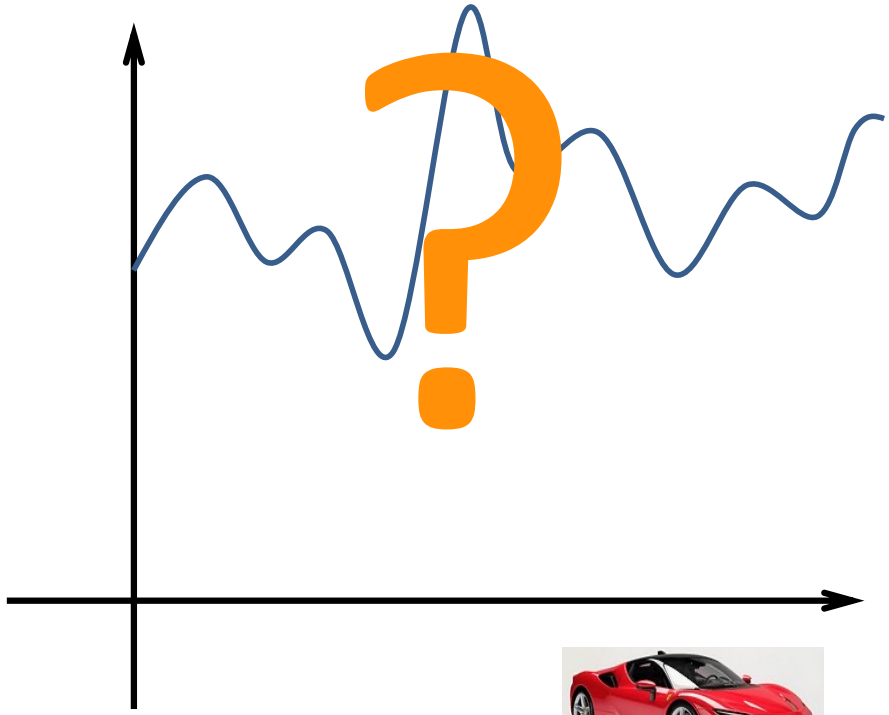
As a customer-facing business, **one of the key metrics tracked by investors for TSPs is ending subscribers.** Increases and decreases in subscribers are also closely monitored and are identified as net additions. **Every new subscriber (gross subscriber addition) adds new revenue for a TSP, and every subscriber disconnecting the service increases the churn rate for the company and represents a loss of revenue.**

Source: https://visiblealpha.com/kpi-guides/telecom-kpis/



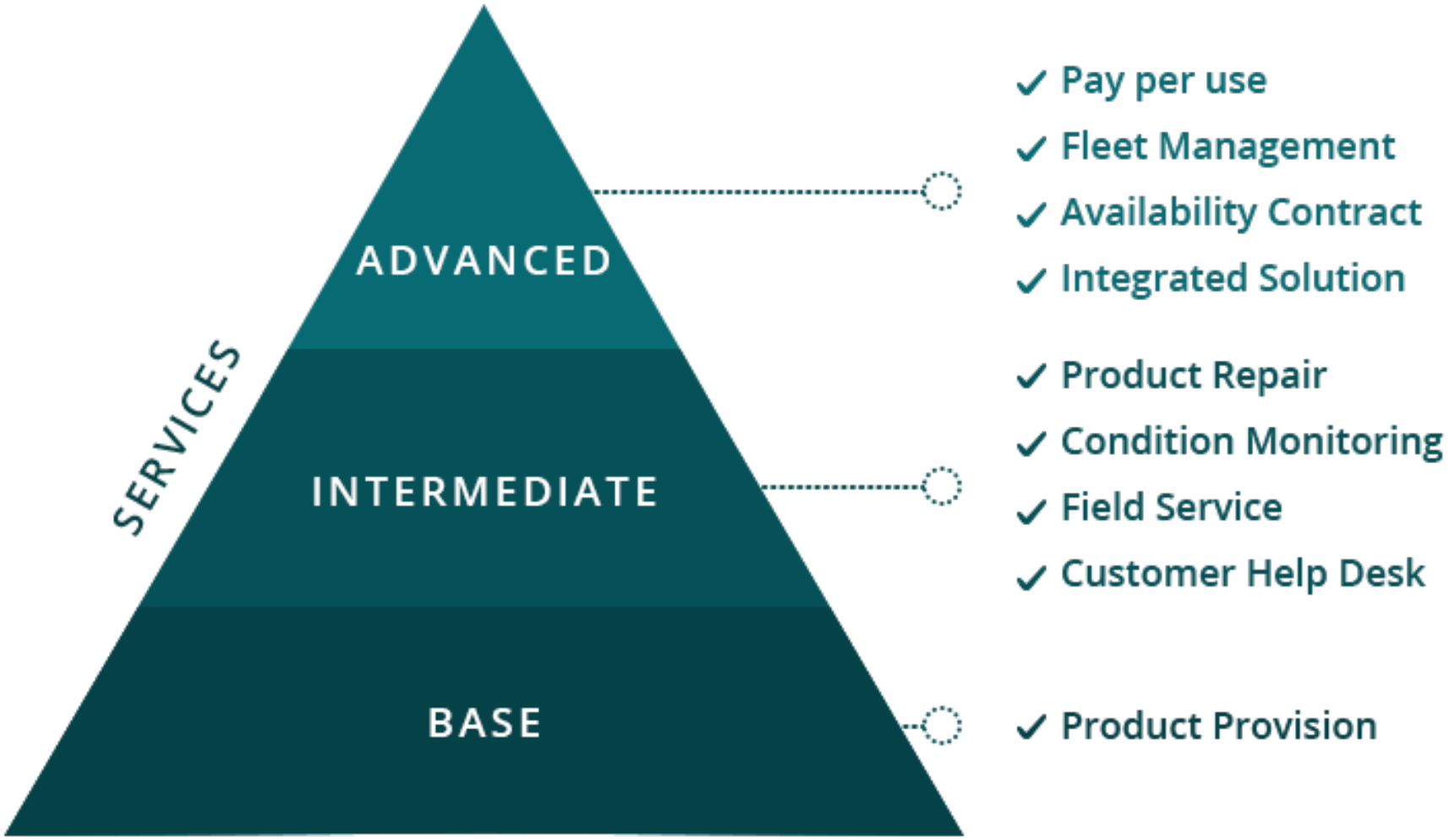
ARPU:
Average Revenue Per User

REVENUES FROM TRADEMARK USE (ROYALTIES)



A royalty is a legally binding payment made to an individual or company for the ongoing use of their assets, including copyrighted works, franchises, and natural resources.

SERVITIZATION



SOURCE: https://caddify.com/2019/12/07/why-does-successful-servitization-require-mobile-apps/

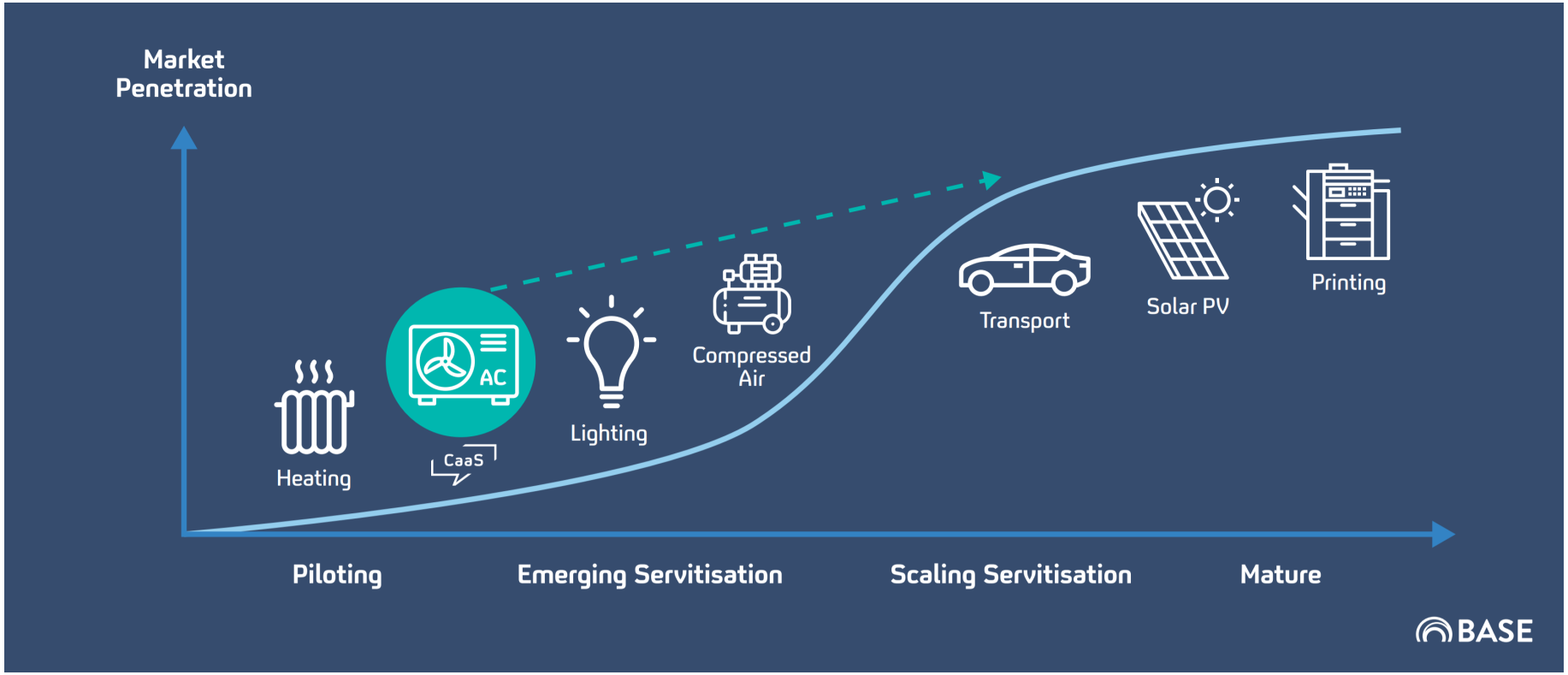
WHAT IS SERVITIZATION?

With a servitization model, the customer pays a fixed fee per unit of service consumed, while the ownership of the system remains with the technology provider, who remains responsible for all operation costs. As such, the model strongly incentivises the equipment owner – that is, the service provider – to think long-term when designing and selecting the technology. By offering state-of-the-art maintenance, the provider can minimise operating costs, in particular energy use, which is the largest cost component over the life cycle of the equipment. Keeping ownership of the equipment also encourages service providers to rethink the development of modular systems, which is key to a circular economy.

Examples include the printing company Xerox that offers 'pay-per-copy', and SunEdison, which has pioneered power purchase agreements (PPAs) for solar photovoltaics (PV); this enables rapid uptake of solar PV by allowing customers to purchase solar energy instead of investing in the panels themselves. Lighting company Signify has also adopted the model with their light-as-a-service product, which has been implemented at Amsterdam's Schiphol Airport and other locations.

SOURCE: https://www.weforum.org/stories/2020/11/what-is-servitization-and-how-can-it-help-save-the-planet/

A RAPIDLY EVOLVING PHENOMENON



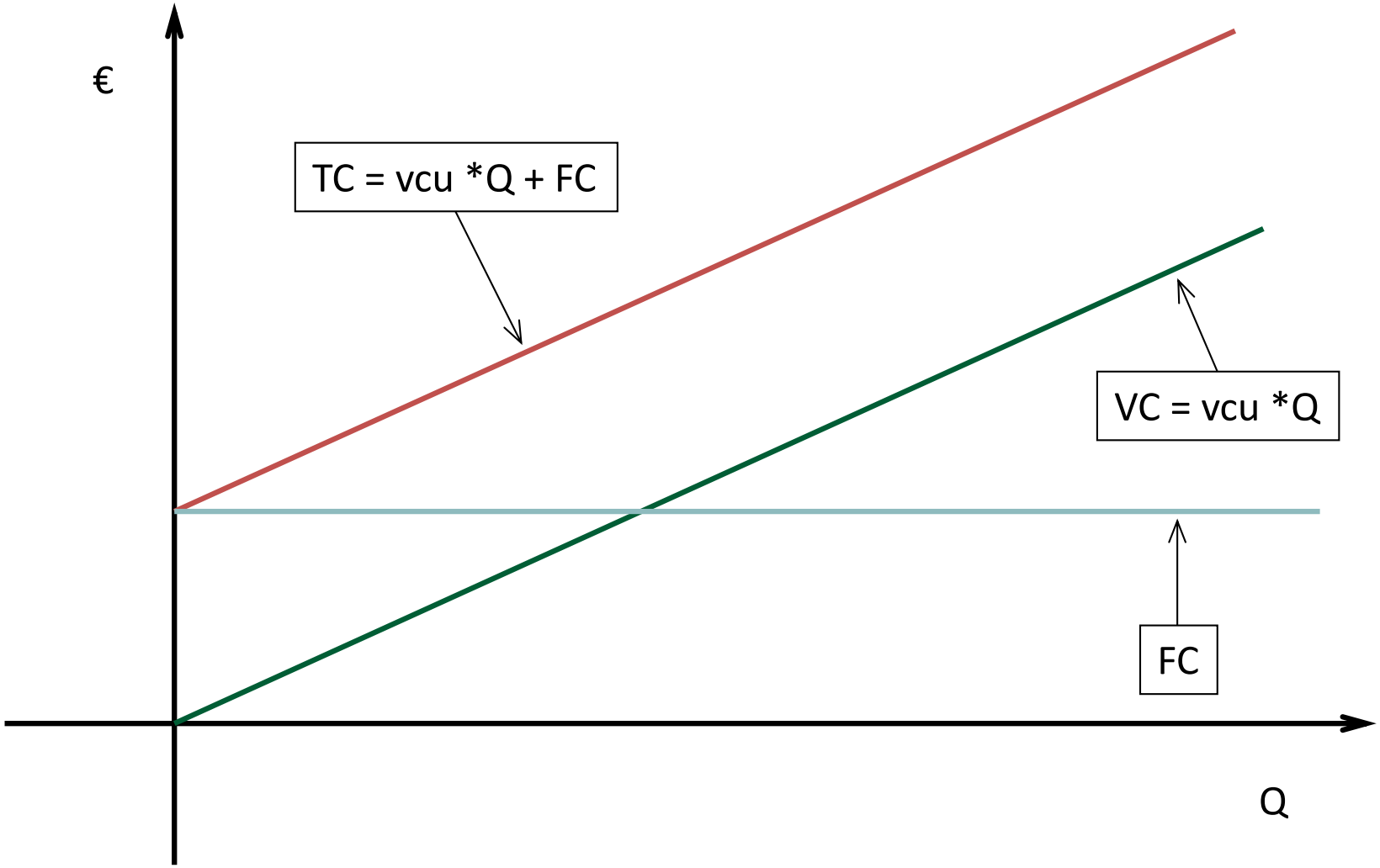
SOURCE: https://www.weforum.org/stories/2020/11/what-is-servitization-and-how-can-it-help-save-the-planet/

SELECTED COMPANY THAT HAVE INTRODUCED PAY-PER-USE

Company	Product	Offer	Pricing model
Winterhalter	Domestic electrical appliances	Next Level Solution	Pay-per-wash
Rolls Royce	Aeronautic engines	Total Care	Pay-per-hour-flown
Atlas Copco	Compressed air	Air Plan	Pay-per-m^3
Zipcar	Mobility	Car Sharing	Pay-per-hour
Amazon Web Service	IT services	Cloud Computing	Pay-per-GB
Michelin	Tires	Michelin Effitires	Pay-per-mile
Samoa Air	Air transport	Intera offerta	Pay-per-kilo

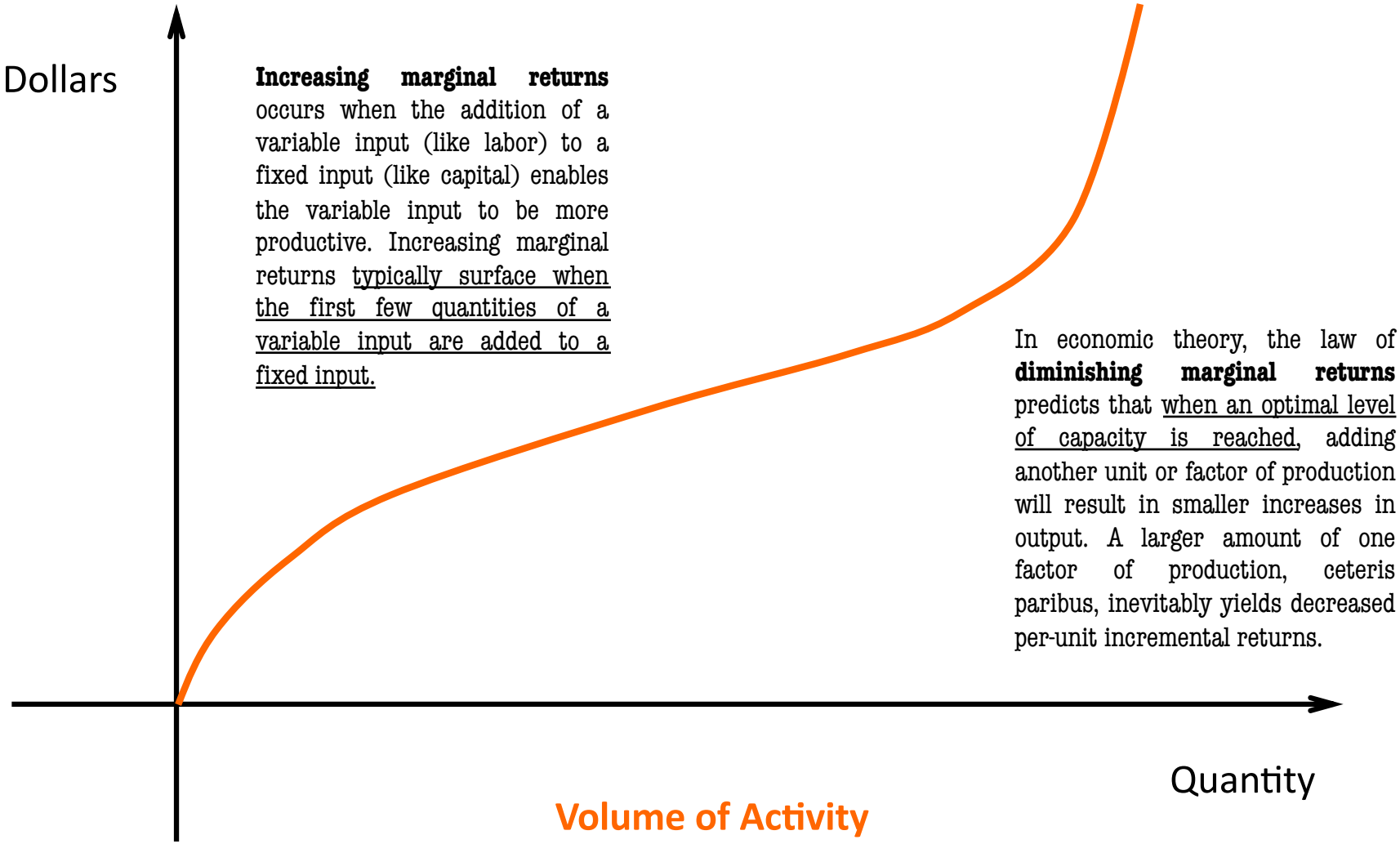
SOURCE: Danilo Zatta, *The Pricing Model Revolution: How Pricing Will Change the Way We Sell and Buy On and Offline*, John Wiley & Sons, 2022.

VARIABLE AND FIXED COSTS IN GRAPHIC FORM

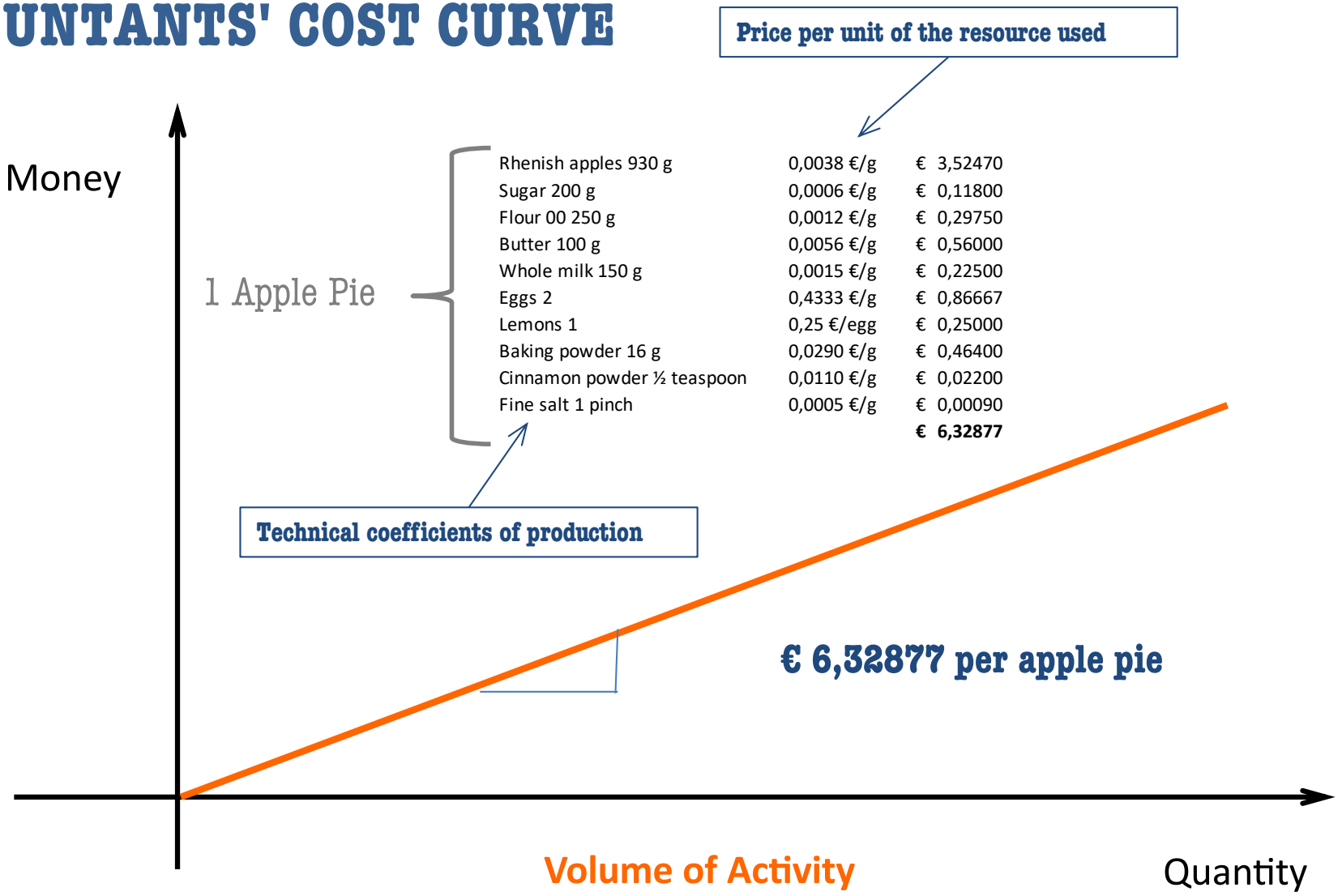


ECONOMISTS' COST CURVE

Economists correctly point out that many costs that the accountant classifies as variable actually behave in a *curvilinear* fashion.



ACCOUNTANTS' COST CURVE

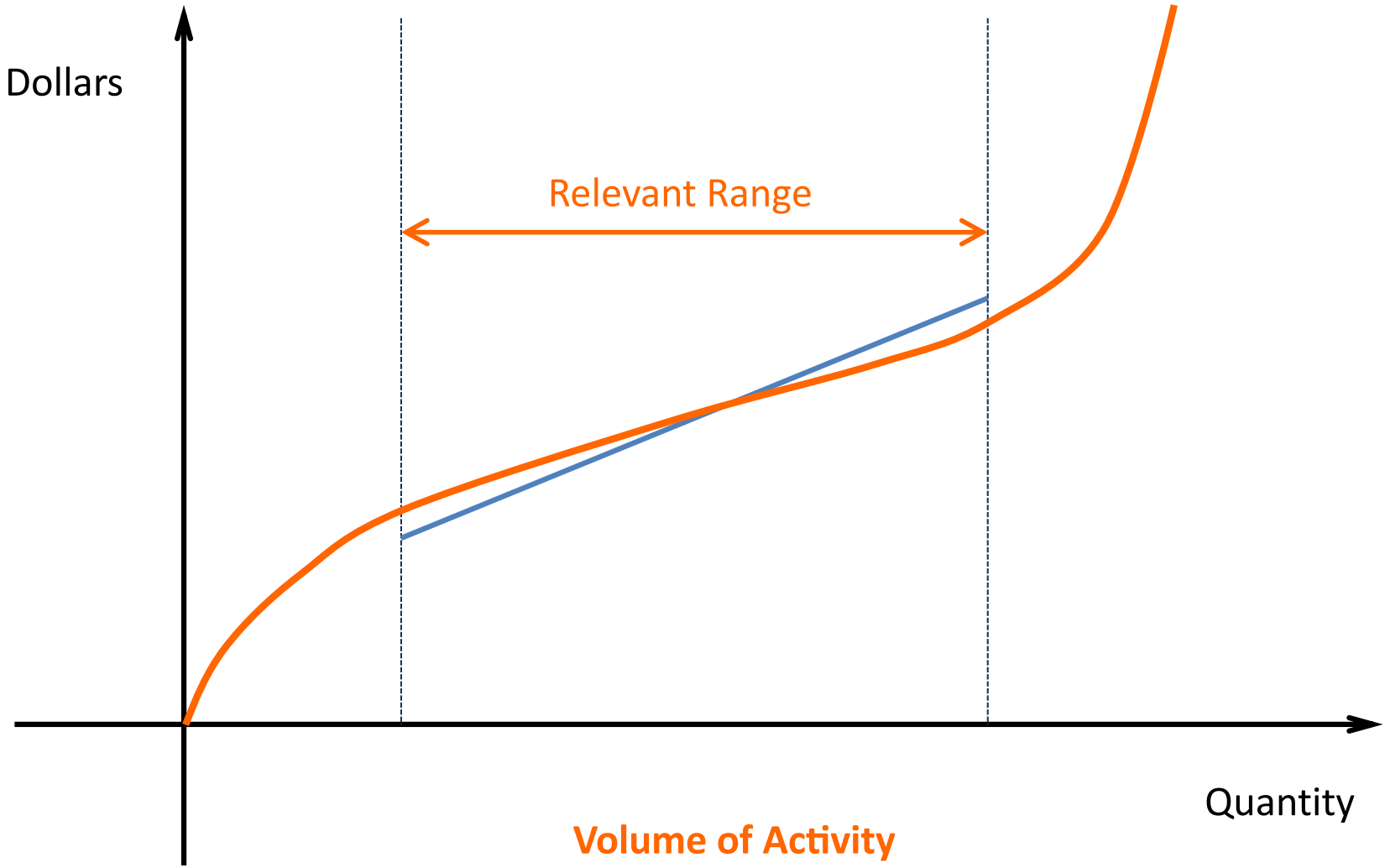


The assumption of setting a limited capacity range (so-called relevant range) is necessary, among other things, to be able to assume invariance of variable unit cost. In fact, the variable unit cost depends on the physical consumption of resources per unit of product produced (a fact, this, summarized by the values of the so-called **technical coefficients of production**) and the **unit price of the resources used**. If the production capacity range were too wide, both elements could vary.

AMANUENSI (SCRIBE) MONKS

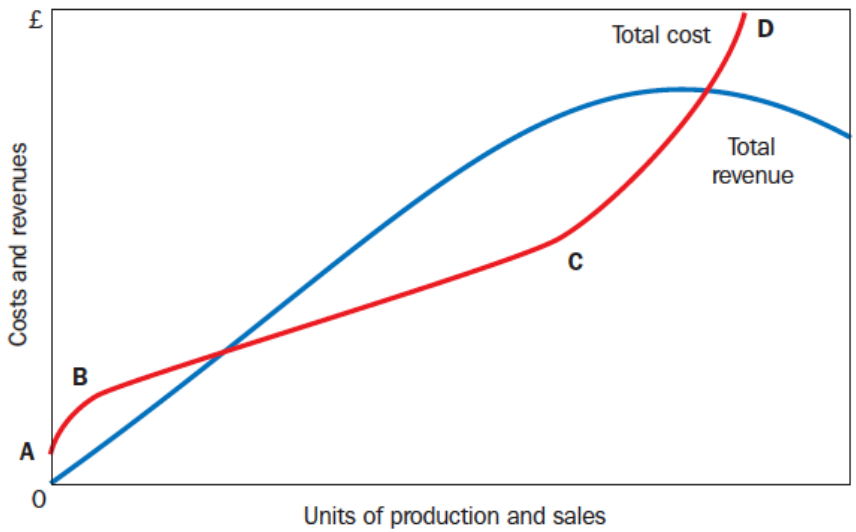
RELEVANT RANGE

Economists correctly point out that many costs that the accountant classifies as variable actually behave in a *curvilinear* fashion.

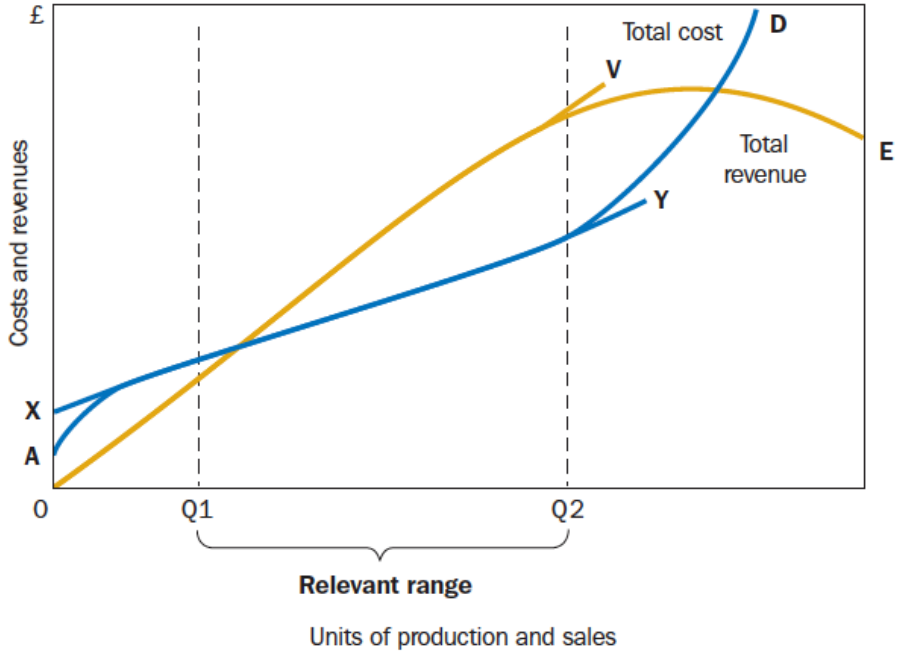


RELEVANT RANGE

ECONOMIST'S VIEW



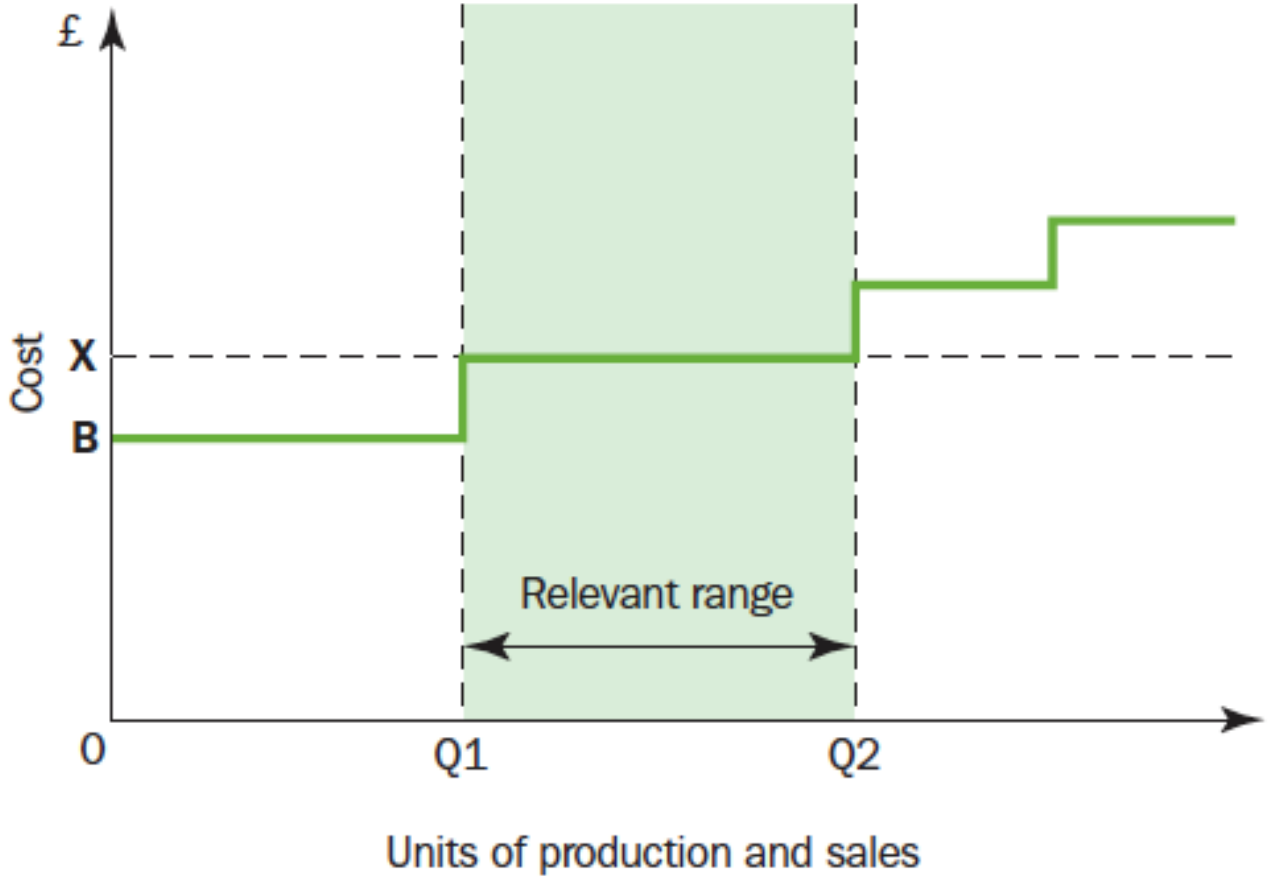
ACCOUNTANTS'S VIEW



«Linear relationships are not intended to provide an accurate representation of total cost and total revenue throughout all ranges of output. The objective is to represent the behaviour of total cost and revenue over the range of output at which a firm expects to be operating within a short-term planning horizon. […] The term relevant range is used to refer to the output range at which the firm expects to be operating within a short-term planning horizon. This relevant range also broadly represents the output levels that the firm has had experience of operating in the past and for which cost information is available.
[Within the relevant range] the cost and revenue relationships are more or less linear. It would be unwise, however, to make this assumption for output levels outside the relevant range. CVP analysis should therefore only be applied within the relevant range. If the relevant range changes, different fixed and variable costs and selling prices must be used».

Source: Colin Drury, "Management and Cost Accounting", eighth edition, Cengage Learning

FIXED COSTS APPLICABLE WITHIN THE RELEVANT RANGE



Source: Colin Drury, "Management and Cost Accounting", eighth edition, Cengage Learning

RELEVANT RANGE

Relevant range is the band of normal activity level or volume in which there is a specific relationship between the level of activity or volume and the cost in question.

For example, a fixed cost is fixed only in relation to a given wide range of total activity or volume (at which the company is expected to operate) and only for a given time span (usually a particular budget period).

Fixed costs may change from one year to the next.

The basic assumption of the relevant range also applies to variable costs. That is, outside the relevant range, variable costs, such as direct materials, may not change proportionately with changes in production volume. For example, above a certain volume, direct material costs may increase at a lower rate because of price discounts on purchases greater than a certain quantity.

COMMITTED FIXED COSTS

Those costs that **can't be significantly reduced even for short periods of time** without making fundamental changes.

Examples include depreciation of buildings and equipment, real estate taxes, insurance expenses, and salaries of top management and operating personnel. Even if operations are interrupted or cut back, committed fixed costs remain largely unchanged in the short term.

During a recession, for example, a company won't usually eliminate key executive positions or sell off key facilities—the basic organizational structure and facilities ordinarily are kept intact.

The costs of restoring them later are likely to be far greater than any short-run savings that might be realized.

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

DISCRETIONARY FIXED COSTS

Often referred to as *managed fixed costs* usually **arise from *annual* decisions by management to spend on certain fixed cost items.**

Examples of discretionary fixed costs include advertising, research, public relations, management development programs, and internships for students.

Two key differences exist between discretionary fixed costs and committed fixed costs.

First, **the planning horizon for a discretionary fixed cost is short term—usually a single year.** By contrast, committed fixed costs have a planning horizon that encompasses many years.

Second, **discretionary fixed costs can be cut for short periods of time with minimal damage to the long-run goals of the organization**. For example, spending on management development programs can be reduced because of poor economic conditions. Although some unfavorable consequences may result from the cutback, it is doubtful that these consequences would be as great as those that would result if the company decided to economize by laying off key personnel.

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

IS LABOR A VARIABLE OR A FIXED COST?

Wages and salaries may be fixed or variable.

The behavior of wage and salary costs will differ from one country to another, depending on labor regulations, labor contracts, and custom.

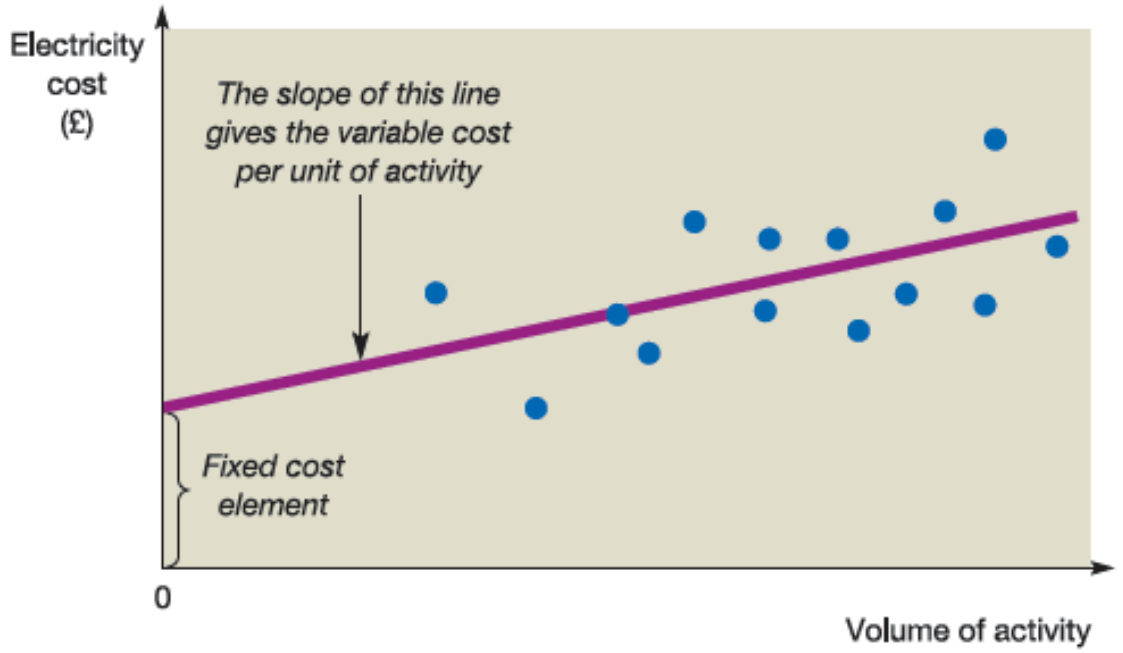
In some countries, such as Italy, France, Germany, and Japan, management has little flexibility in adjusting the labor force to changes in business activity. In countries such as the United States and the United Kingdom, management typically has much greater latitude. However, even in these less restrictive environments, managers may choose to treat employee compensation as a fixed cost for several reasons.

First, many managers are reluctant to decrease their workforce in response to short term declines in sales. These managers realize that the success of their businesses hinges on retaining highly skilled and trained employees. If these valuable workers are laid off, it is unlikely that they would ever return or be easily replaced. Furthermore, laying off workers undermines the morale of those employees who remain.

Second, managers do not want to be caught with a bloated payroll in an economic downturn. Therefore, managers are reluctant to add employees in response to short-term increases in sales. Instead, more and more companies rely on temporary and part-time workers to take up the slack when their permanent, full-time employees are unable to handle all of the demand for their products and services. In such companies, labor costs are a complex mixture of fixed and variable costs.

ESTIMATING SEMI-FIXED (SEMI-VARIABLE) COST

Figure 3.4 Graph of electricity cost against the volume of activity



Here the electricity bill for a time period (for example, three months) is plotted against the volume of activity for that same period. This is done for a series of periods. A line is then drawn that best 'fits' the various points on the graph. From this line we can then deduce both the cost at zero activity (the fixed element) and the slope of the line (the variable element).

Source: Peter Atrill and Eddie McLaney, "Management accounting for decision makers, 6th edition, FT Prentice Hall

VARIABLE AND FIXED REVENUES

There are two basic types of cost-behavior patterns that could be found in accounting systems.

A variable revenue is a cost that varies, in total, in direct proportion to changes in the level of activity.

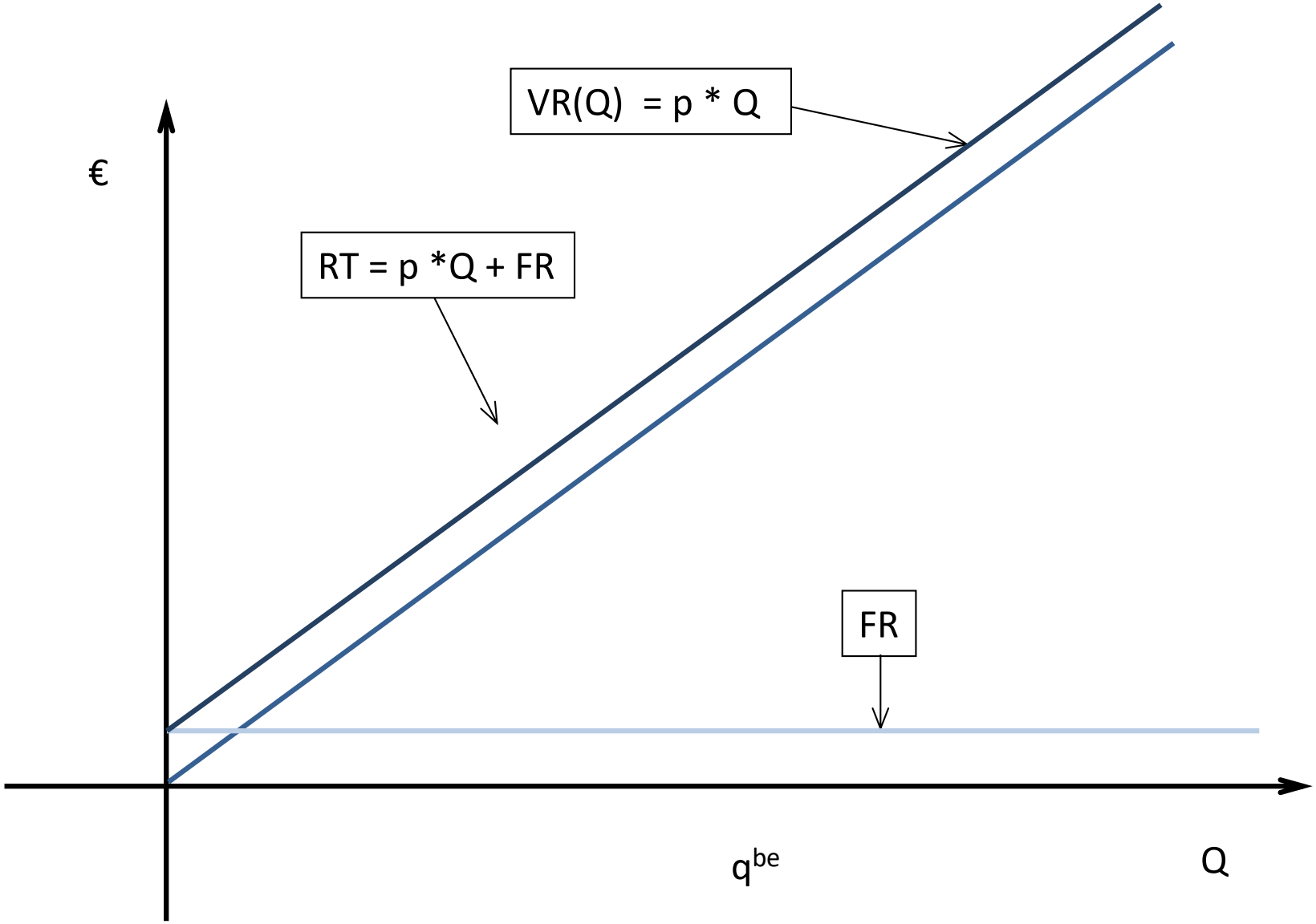
A fixed revenue is a revenue that remains constant, in total, regardless of changes in the level of activity. Unlike variable revenue, fixed revenue are therefore not affected by changes in the parameter used to measure the activity performed.

The amount of other operating income or sundry income (rent revenues, late fees, profits on the sales of minor assets or foreign exchange gains) generally is not linked to the level of units sold.

Total Operating Revenues = Variable Costs + Fixed Costs

$$TR = VR(Q) + FR$$

VARIABLE AND FIXED REVENUES IN GRAPHIC FORM



COST-VOLUME-PROFIT ANALYSIS

Cost-volume-profit (CVP) analysis is a powerful tool that helps managers understand the relationships behavior and relationship among total revenues, total costs, and income as changes occur in the level of the "activity performed" (volume).

Operating Income = Total Operating Revenues – Total Operating Costs

OI = TR –TC

Cost-volume-profit analysis focuses on how profits are affected by the following five factors:

1. Selling prices.
2. Sales volume.
3. Unit variable costs.
4. Total fixed costs revenue.
5. Total fixed costs revenue.

CVP RELATIONSHIPS IN EQUATION FORM

Operating Income = Total Operating Revenues – Total Operating Costs

Total Operating Revenues = Variable Revenues + Fixed Revenues

Variable Revenues = Selling price per unit * Quantity of units sold

Total Operating Expenses = Variable Costs + Fixed Costs

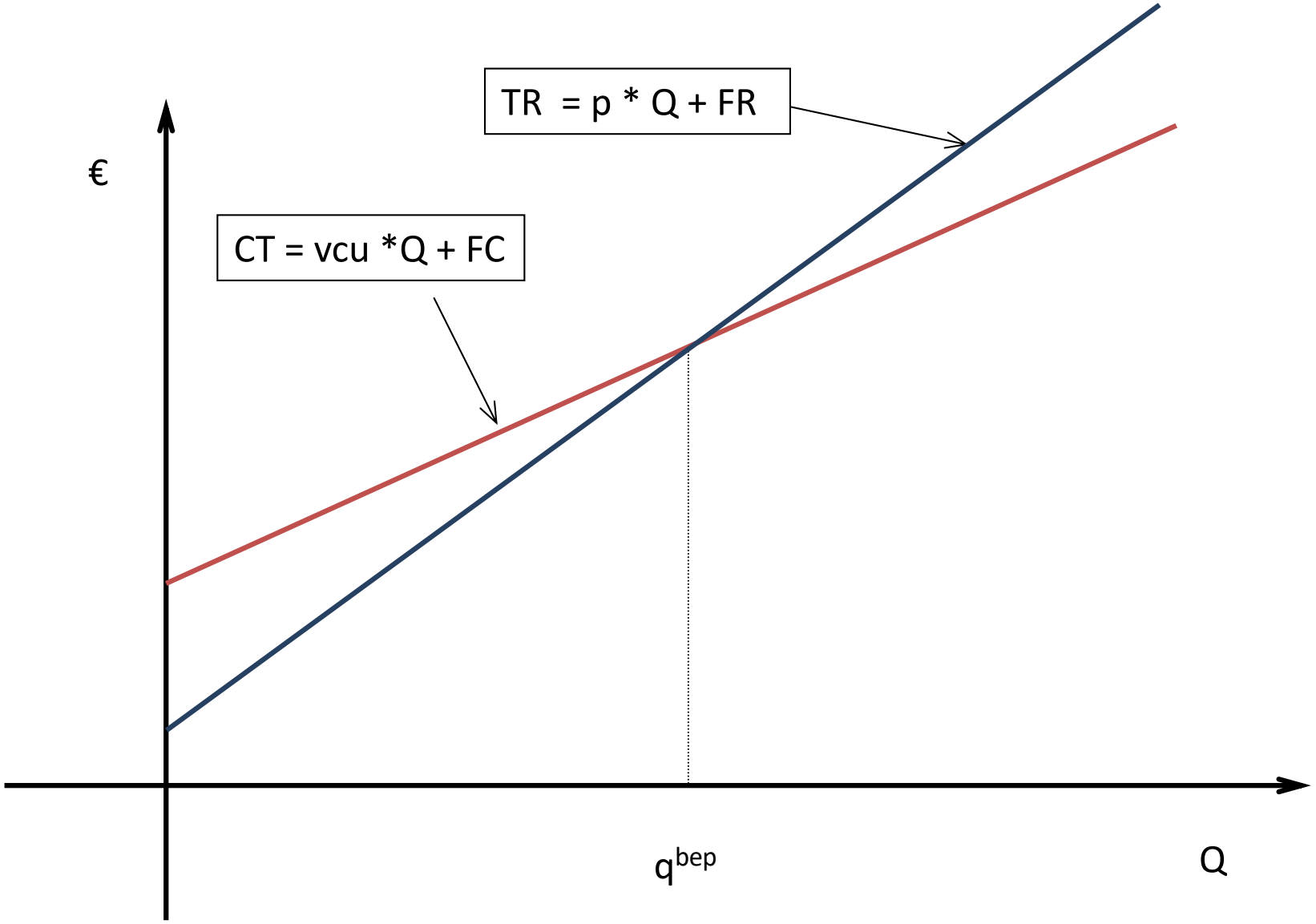
Variable Costs = Variable cost per unit * Quantity of units sold

$$OI = [(p * Q) + FR] – [(vcu * Q) + FC]$$

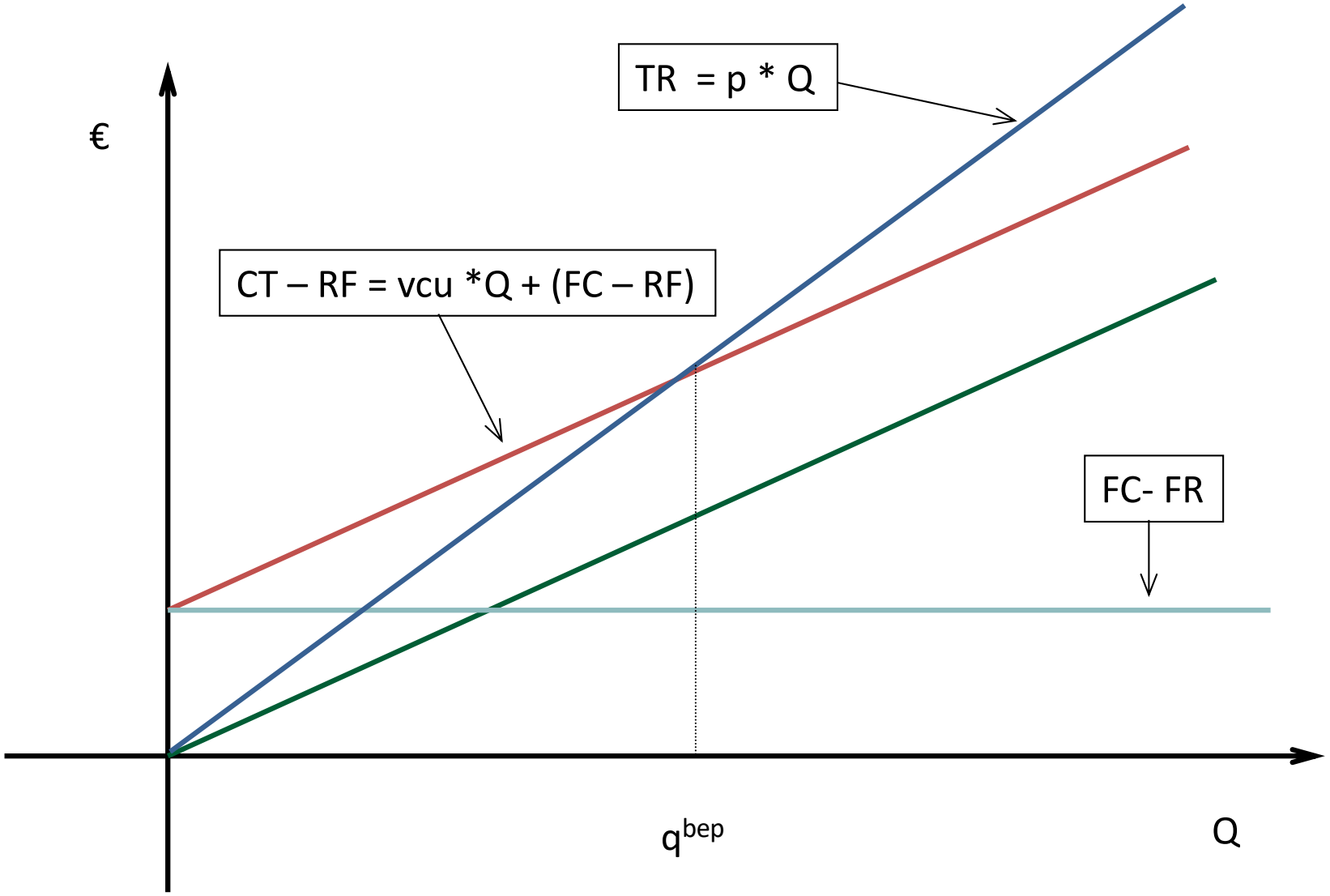
$$= [(p * Q) – (vcu * Q)] – (CF – RF)$$

$$= (p – vcu) * Q - RFC$$

CVP RELATIONSHIPS IN GRAPHIC FORM (1)



CVP RELATIONSHIPS IN GRAPHIC FORM (2)



CONTRIBUTION MARGINS & CONTRIBUTION MARGIN PER UNIT

The difference between total variable revenues and total variable costs is called contribution margin. That is,

Contribution margin = Total variable revenues - Total variable costs

Contribution margin indicates why operating income changes as the number of units sold changes.

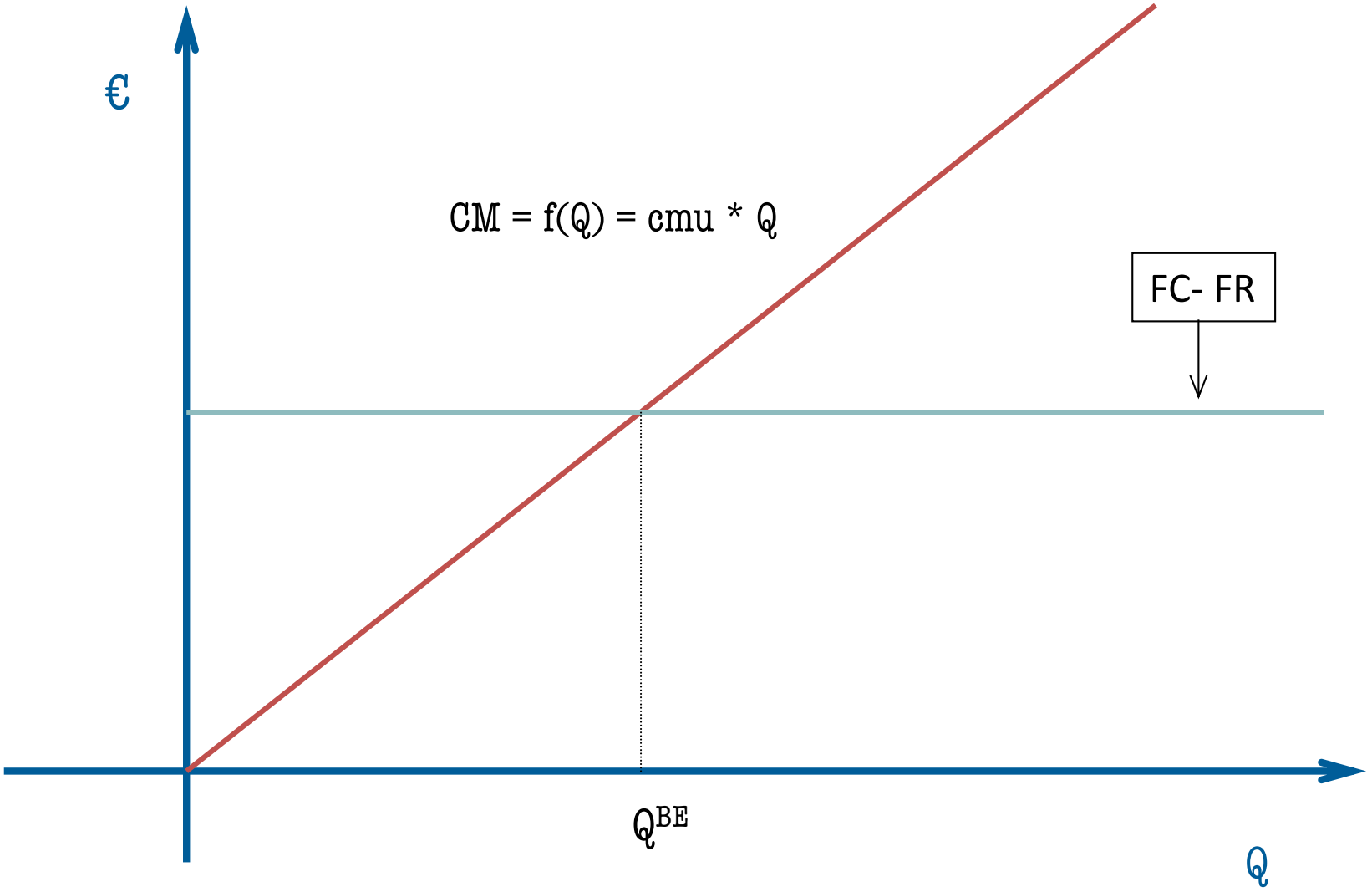
Contribution margin per unit is a useful tool for calculating contribution margin and operating income. It is defined as,

Contribution margin per unit = Selling price - Variable cost per unit

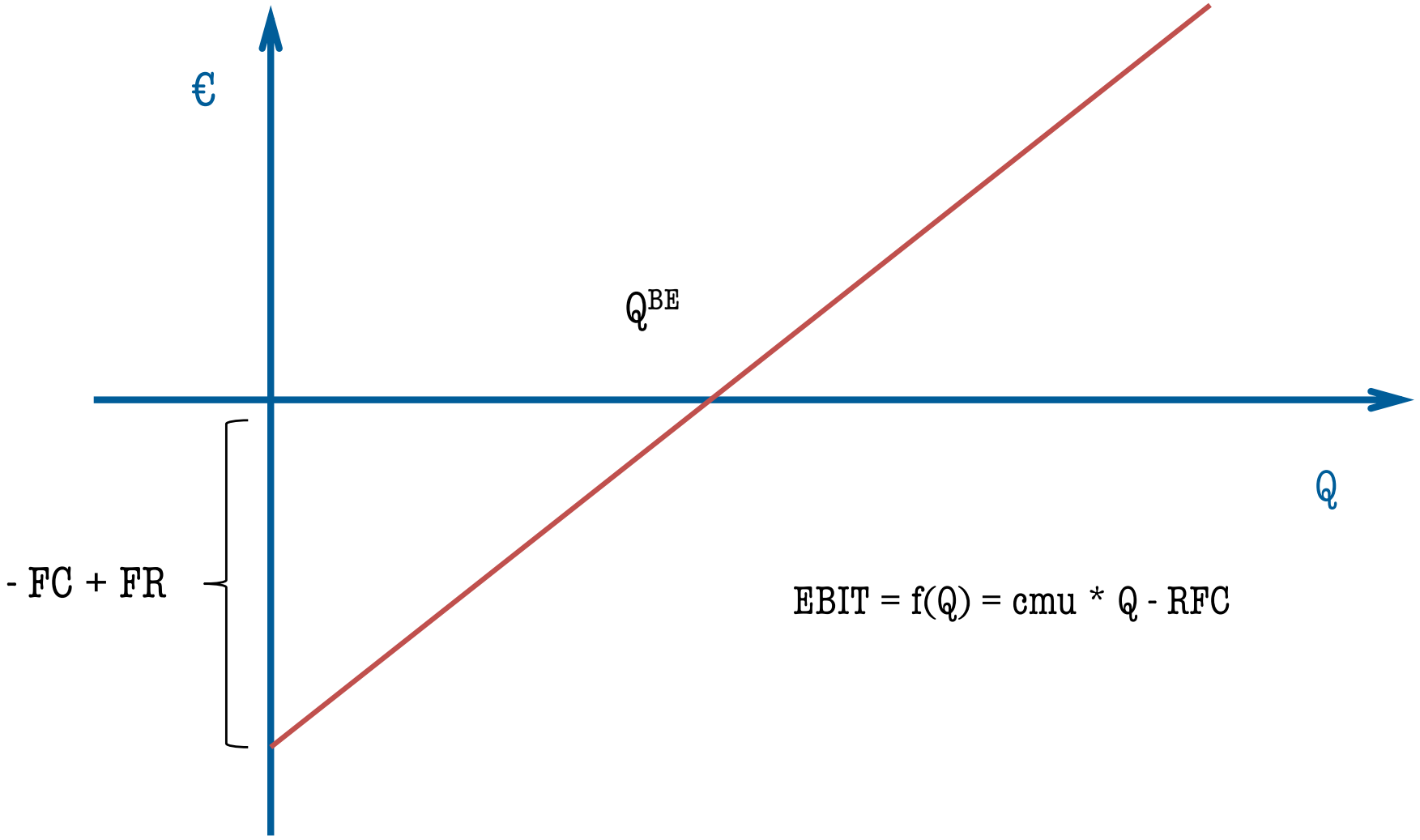
Contribution margin per unit provides a second way to calculate contribution margin:

Contribution margin = Contribution margin per unit * Number of units sold

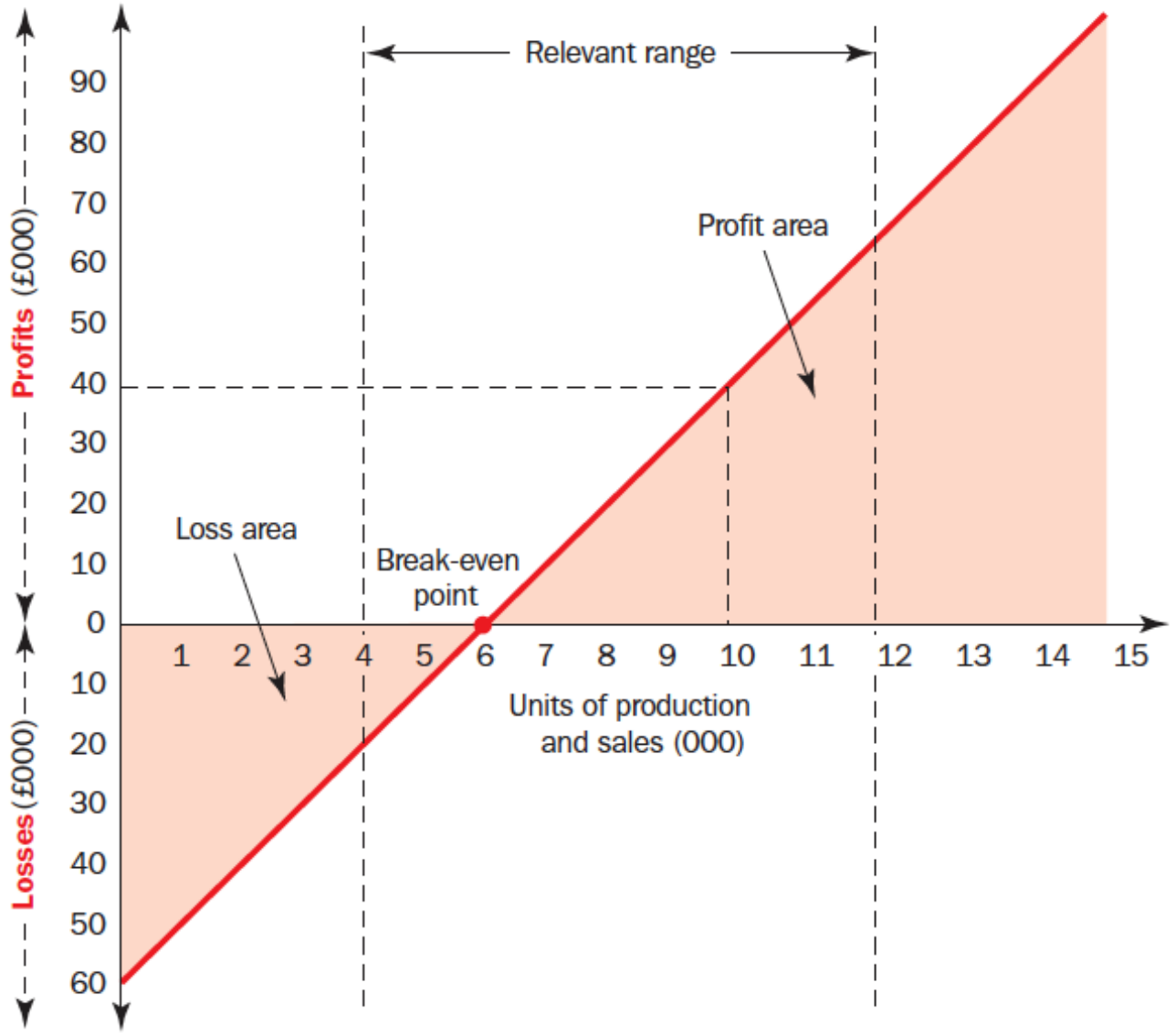
THE CONTRIBUTION MARGIN FUNCTION



THE EBIT FUNCTION



PROFIT-VOLUME GRAPH



Source: Colin Drury, "Management and Cost Accounting", eighth edition, Cengage Learning

FOOD FOR THOUGHTS

Exercise 1

Knowing the following information:

EBIT:	negative for $ 123,574
Unit sale price:	$ 29.10
Unit variable cost:	$12.70
Quantity sold:	21,040

Determine

- the break-even quantity.
- the level of residual fixed costs
- by how much would the break-even quantity change if the unit selling price decreased by 9%?

JUNE 17, 2024 EXAM

Exercise MC_1 – Cost-Profit-Volume Model

The following information is known about Zumba Inc.:

Description		20X0		20X1
Capacity		18.000		18.000
Quantity made		11.650		10.275
Quantity sold		8.600		12.600
Manifacturing variable cost per unit	€	38	€	38
Selling variable cost per unit	€	12	€	12
EBIT	€	52.000	€	48.000

Required:

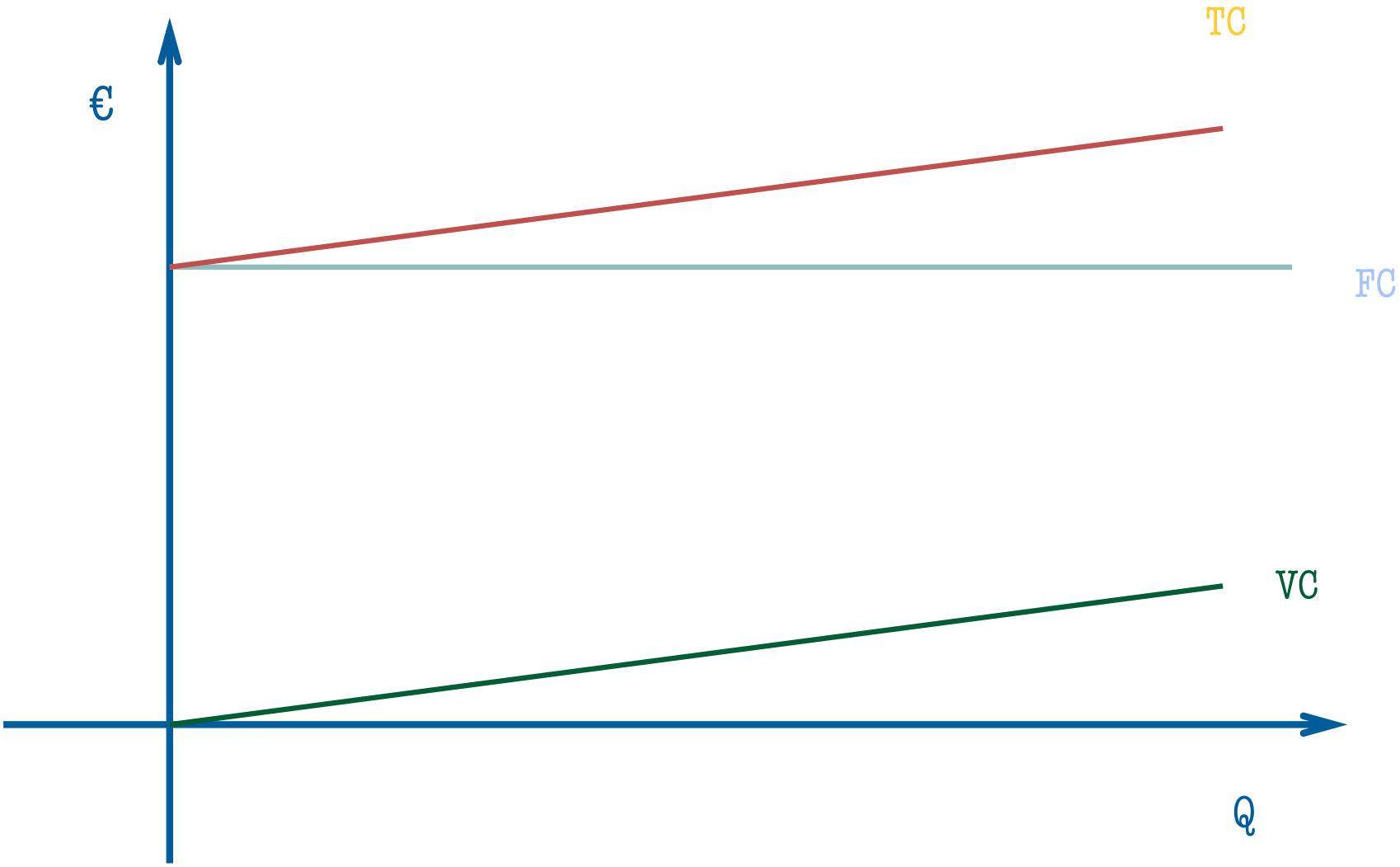
Assuming that in the two fiscal years the level of average selling price and that of residual fixed costs was the same, determine:

1. The contribution margin per unit.
2. The amount of residual fixed costs.
3. The break-even quantity for the two fiscal years just ended.

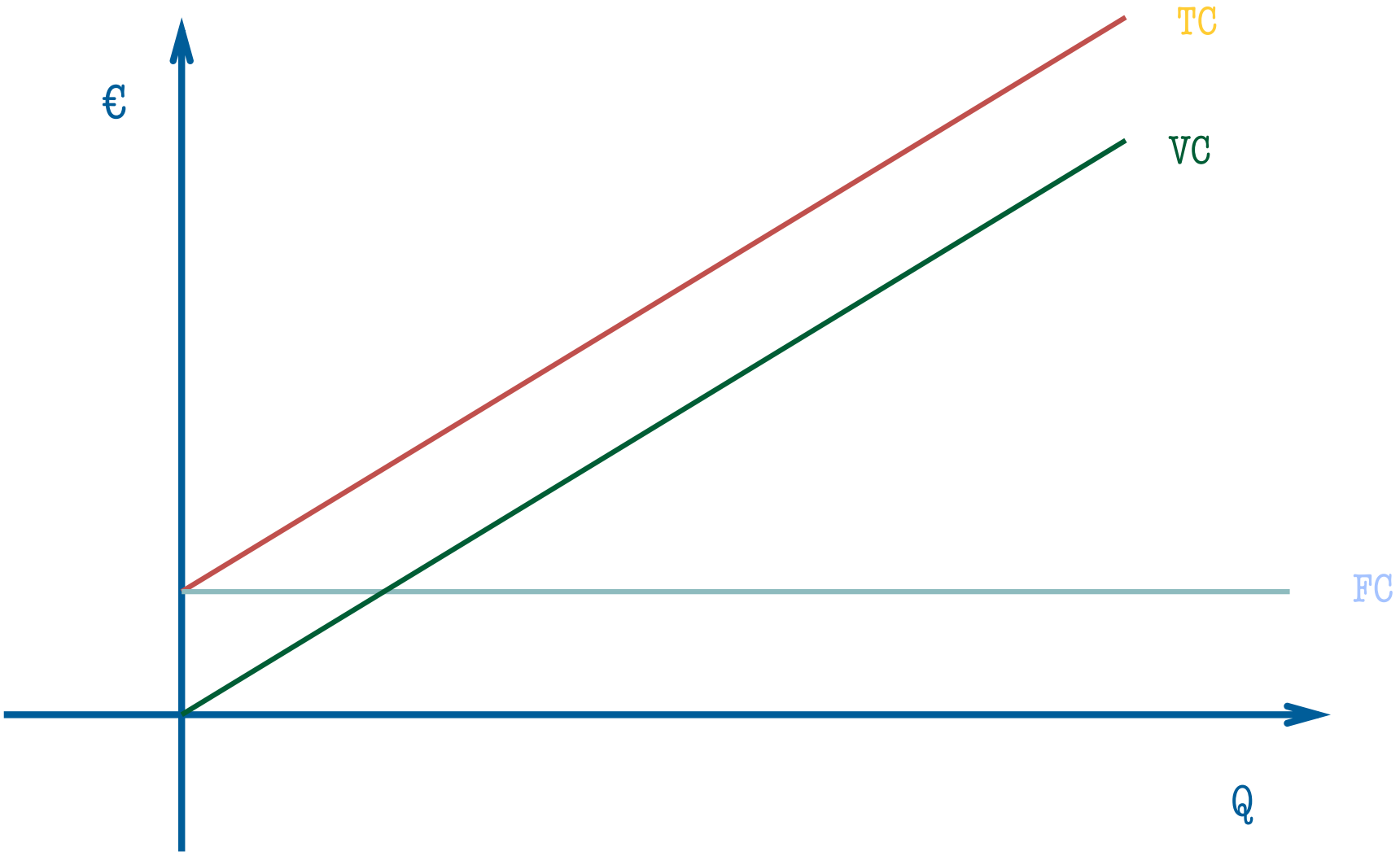
CONTRIBUTION INCOME STATEMENT

+ Variable Revenue	$	2,000.00
- Variable Costs	$	(650.00)
= Contribution Margin	**$**	**1,350.00**
+ Fixed Revenue	$	180.00
- Fixed Costs	$	(1,150.00)
= Operating Income	**$**	**380,00**

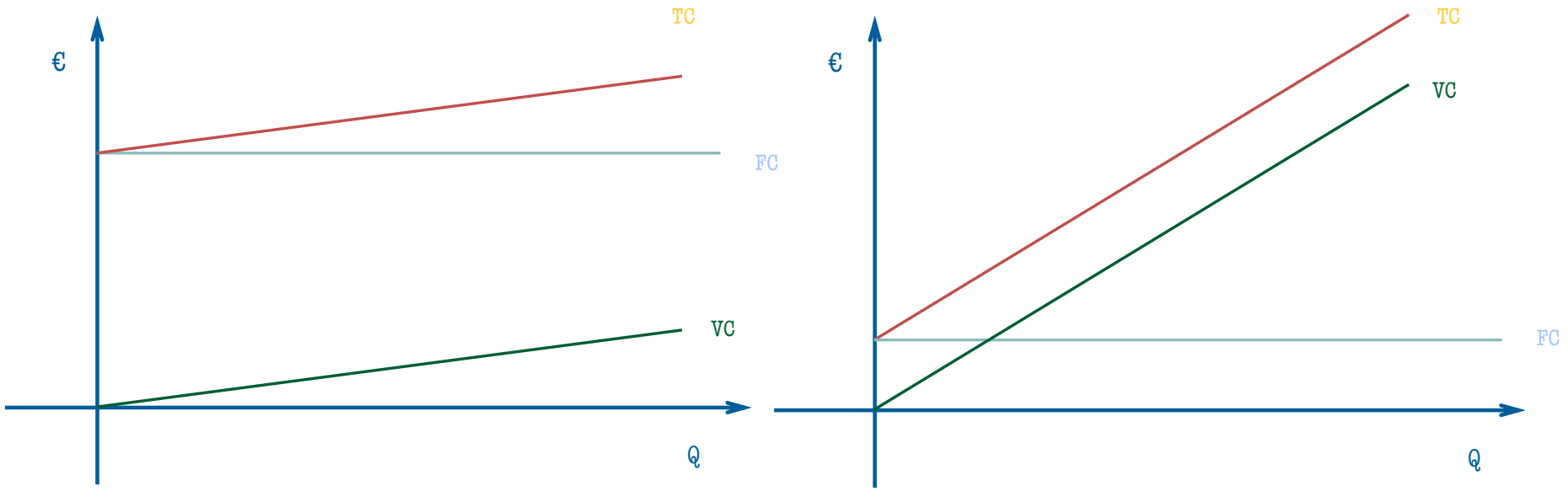
COMPANY «X»



COMPANY «Y»



A COMPARISON



Cheese Maker

Shoes Manufacturer

SENSITIVITY MEASURES

This term is used to refer to that set of indicators that allow the measurement of the change in results or other financial values when one or more variables change, without prejudice to all others.

Thus, these are simple metrics that make possible the concrete implementation of sufficiently simple forms of “what if” type analysis. They make it possible, therefore, to assess , in advance, the effect that a change in a hypothesis – concerning the magnitude assumed by a variable that is considered significant for the purposes of the analysis – could cause on the economic variable linked to it.

Insofar as they are expressive of the variability of the economic outcome with respect to one or more economic entities they are, evidently, tools for analyzing the risk associated with the concrete trends of those entities.

COST ELASTICITY

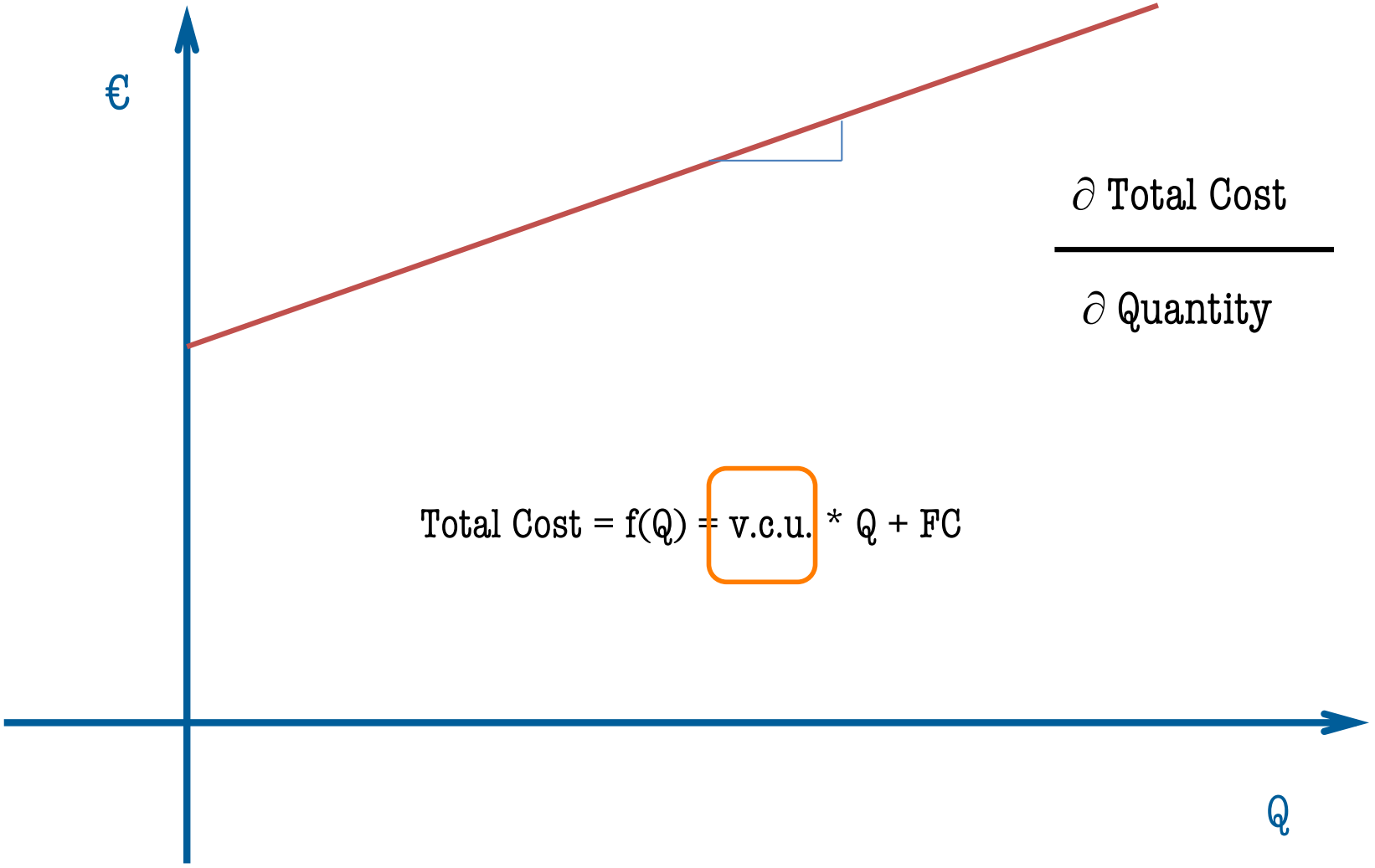
Cost elasticity (also called cost-output elasticity) measures the responsiveness of total cost to changes in output.
It is calculated by dividing the percentage change in cost with percentage change in output. A cost elasticity value of less than 1 means that economies of scale exists.

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

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



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

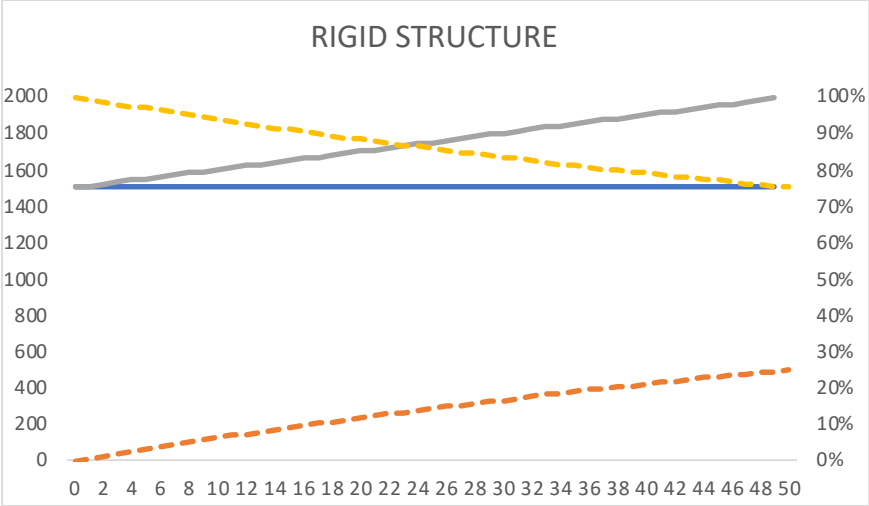
$$\text{Total Cost} = f(Q) = \text{v.c.u.} * Q + FC$$

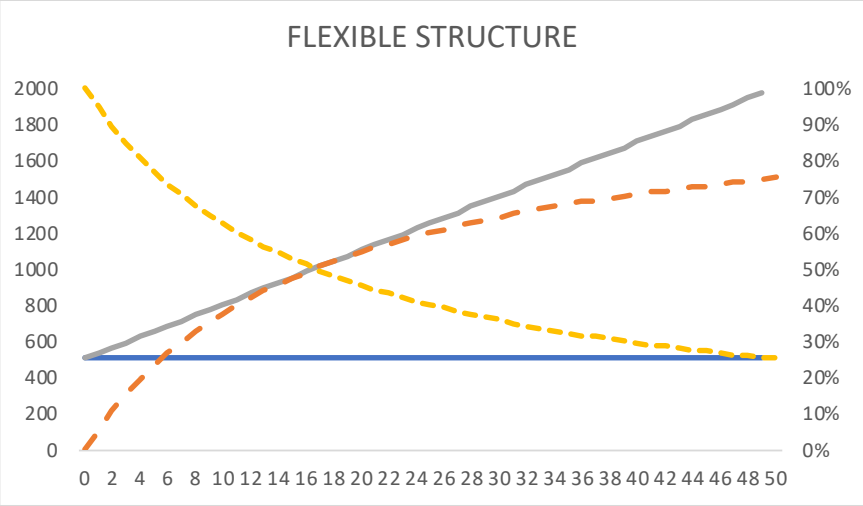
COST ELASTICITY

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.

$$\text{Cost Elasticity} = \frac{\frac{\partial \text{ Total Cost}}{\text{Total Cost}}}{\frac{\partial \text{ Quantity}}{\text{Quantity}}} = \frac{\partial \text{ Total cost}}{\partial \text{ Quantity}} * \frac{\text{Quantity}}{\text{Total Cost}} = \frac{\overbrace{\text{v.c.u. * Quantity}}^{\text{Variable Cost}}}{\text{Total Cost}}$$

COST ELASTICITY AND COST RIGIDITY: A COMPARISON

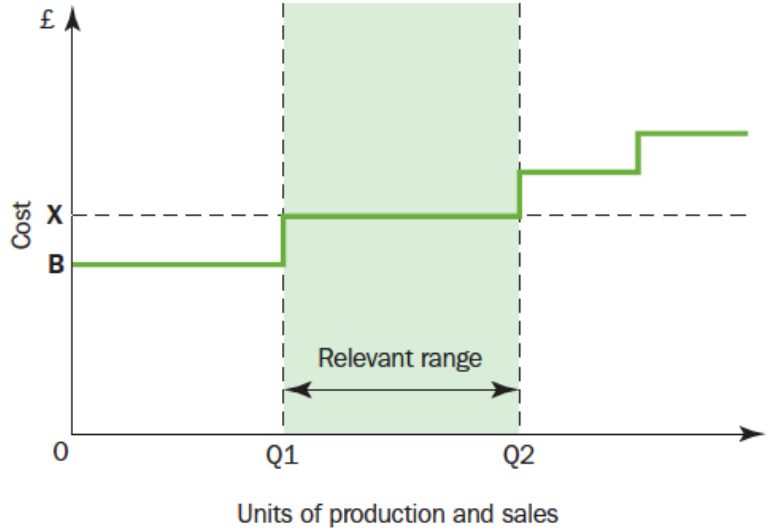


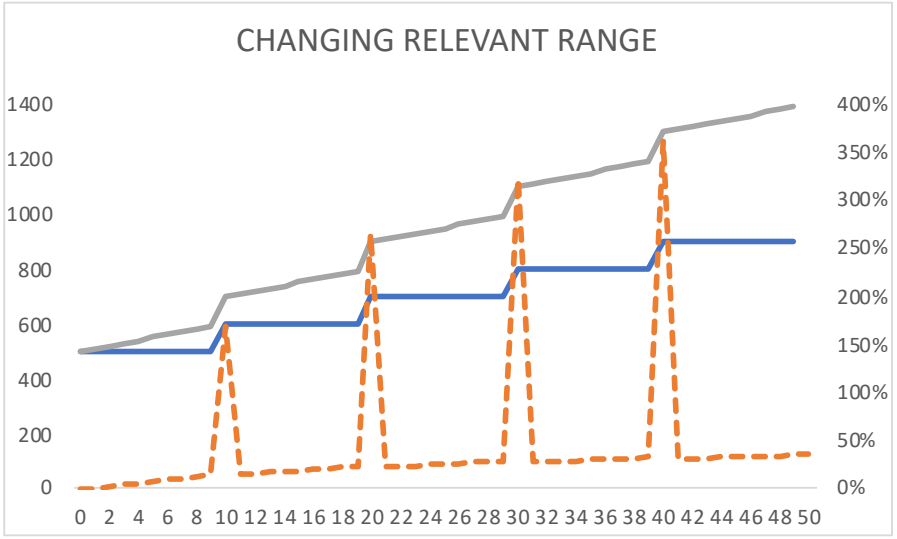


$$\text{Cost Elasticity} = \frac{\text{Variable Cost}}{\text{Total Cost}}$$

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

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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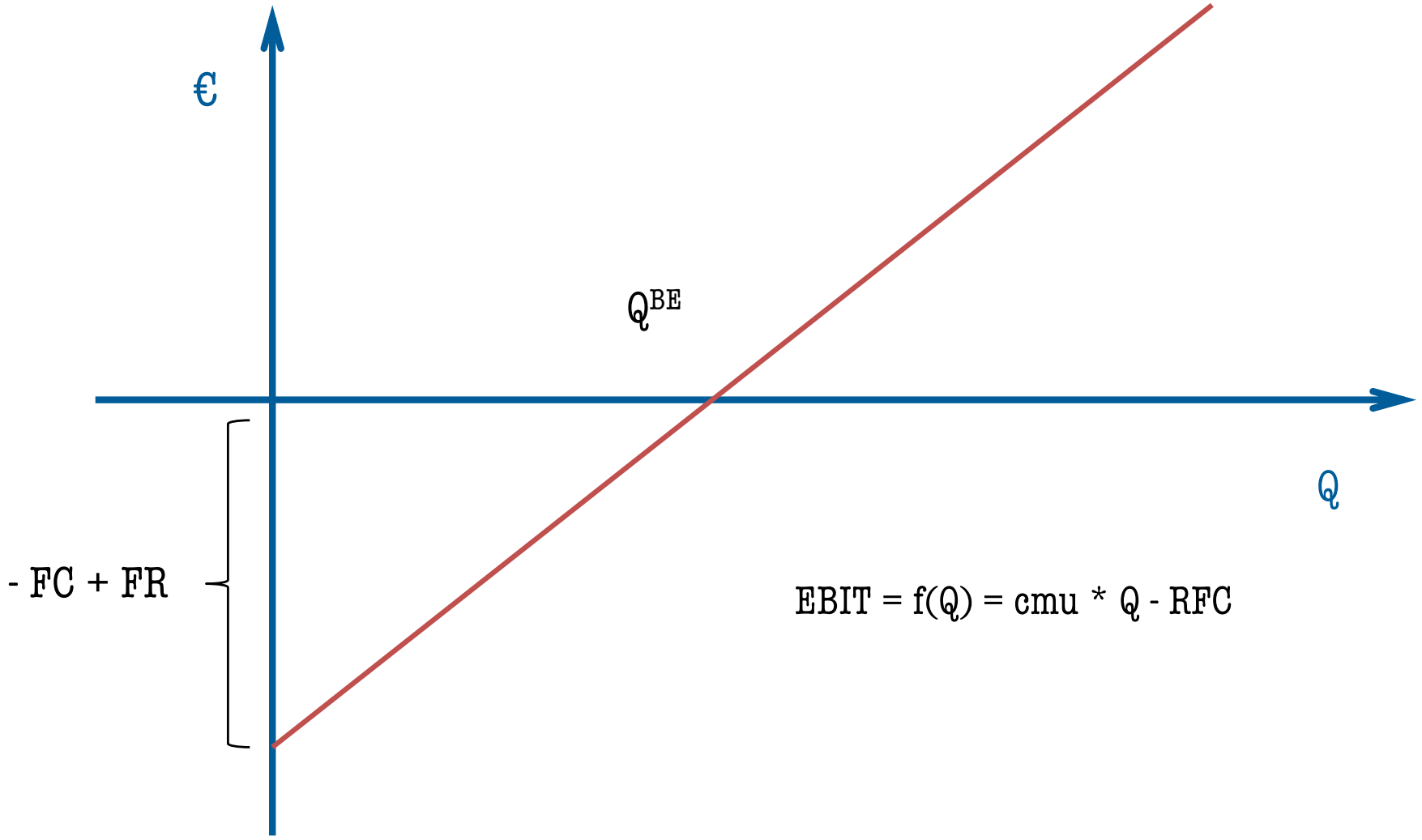
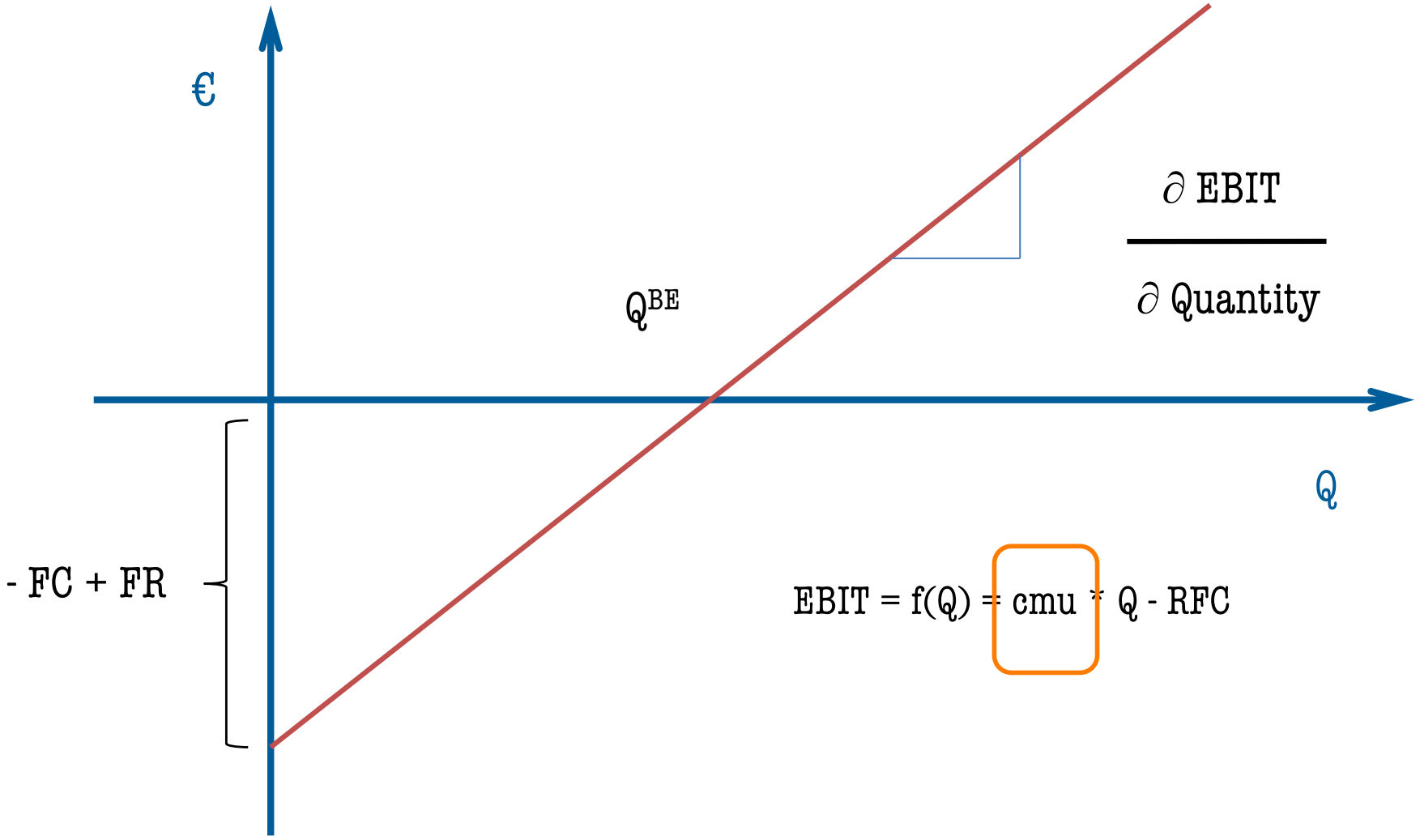
DEGREE OF OPERATING LEVERAGE

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

IF CVP ASSUMPTIONS APPLY



THE SLOPE OF THE EBIT FUNCTION



TWO DIFFERENT LEVERS

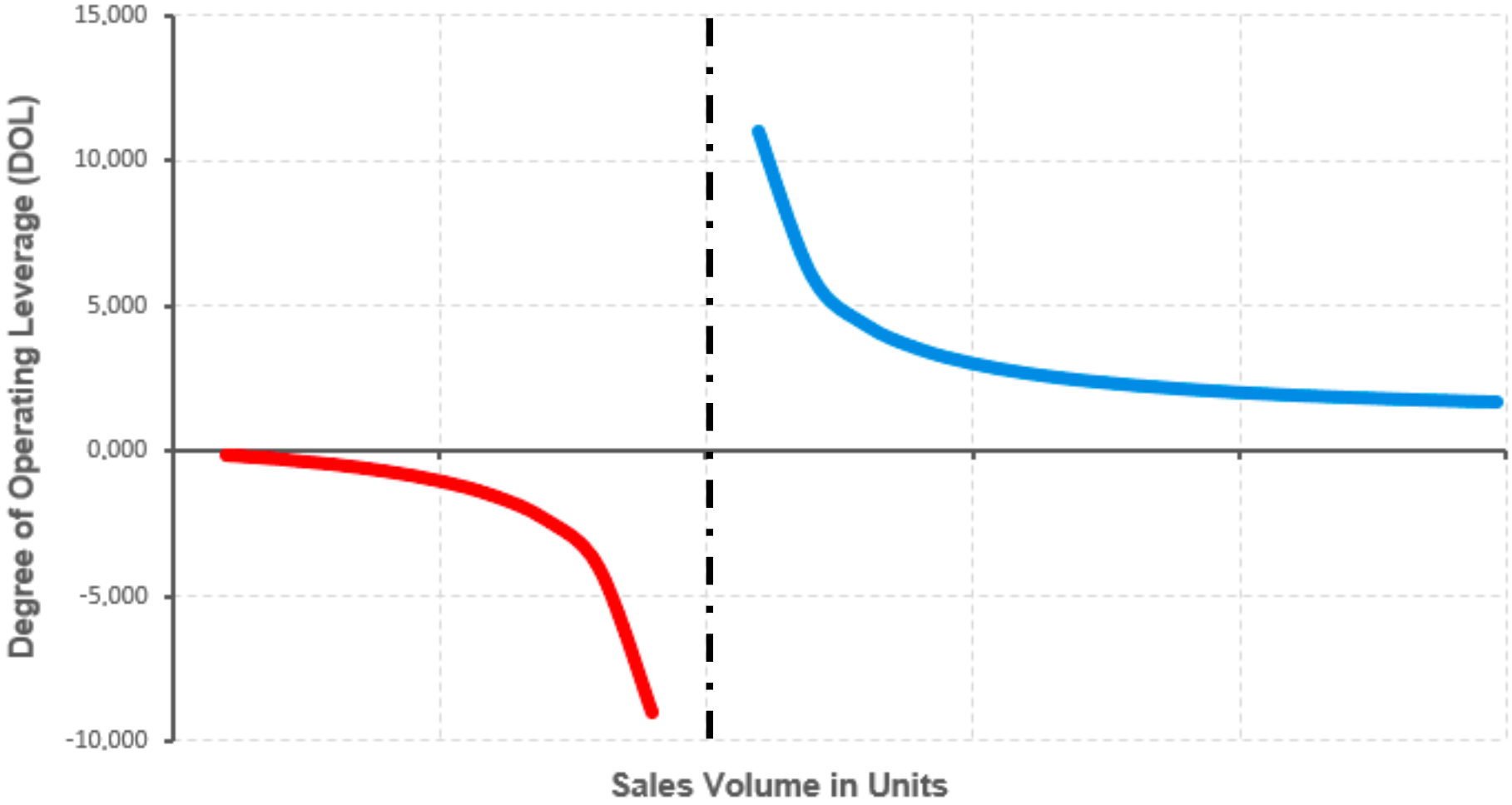
$$\text{Pricing leverage} = \frac{\frac{\partial \text{EBIT}}{\text{EBIT}}}{\frac{\partial \text{Average unit price}}{\text{Average unit price}}} = \frac{\overbrace{\text{Average unit price} * \text{Quantity}}^{\text{Sales Revenues}}}{\text{EBIT}}$$

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

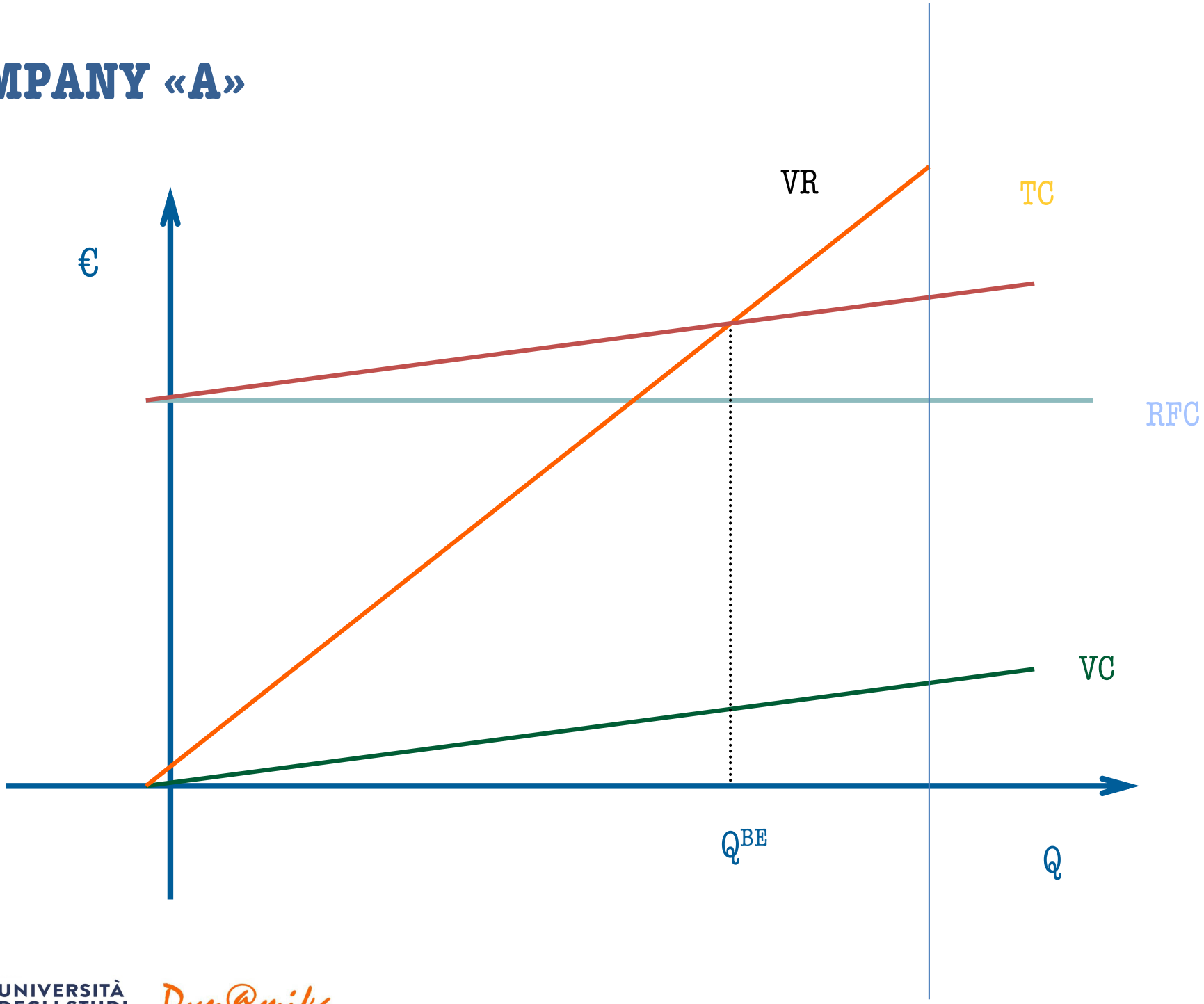
TWO DIFFERENT COMPANIES

	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	

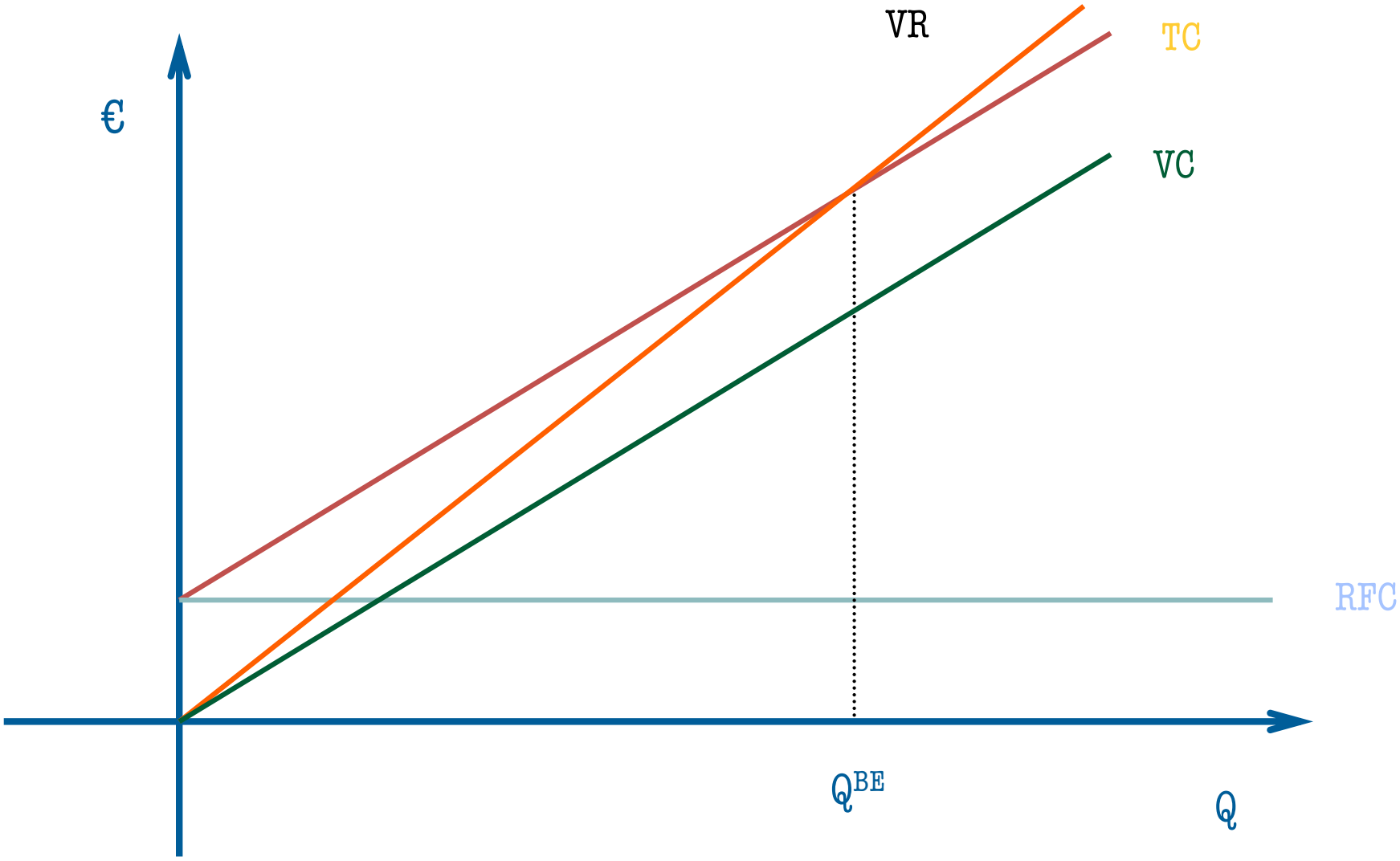
THE GRAPH OF DOL FUNCTION



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:

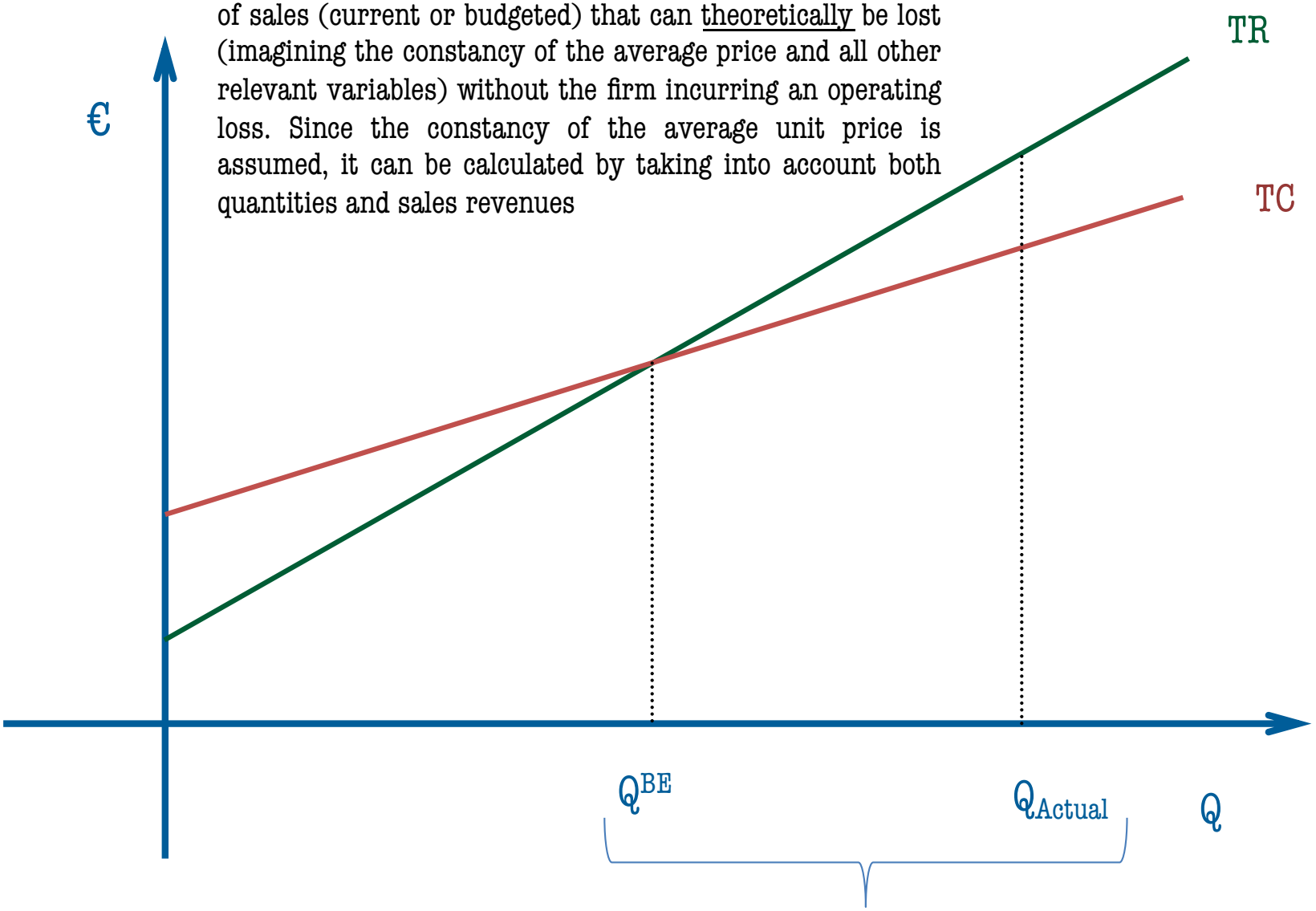
a) Compute the break-even point of both companies in sales dollars and units.
b) Determine the degree of operating leverage for each company.
c) Calculate the margin of safety for both Digir and Xibleflex.

SOLUTIONS

	(in thousands)	(in thousands)
Sales revenues	€12.000	€4.000
- COGS (@ variable)	€2.000	€3.000
=Total Contribution Margin	**€10.000**	**€1.000**
-Residual Fixed Costs	€6.000	€800
= EBIT	**€4.000**	**€200**
B.E.P.	**12.000**	**16.000**
Degree of Operating Leverage	**2,5**	**5**
Margin of Safety	**40%**	**20%**

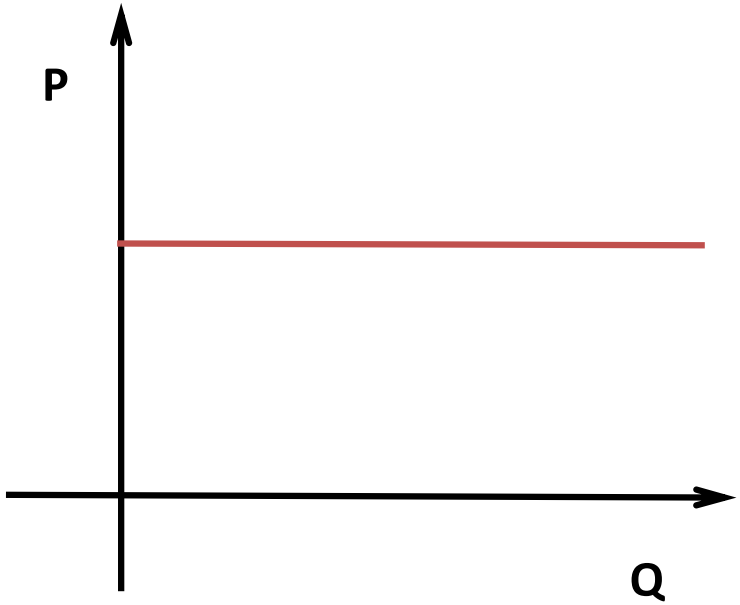
MARGIN OF SAFETY

The so-called "margin of safety" is composed of the amount of sales (current or budgeted) that can theoretically be lost (imagining the constancy of the average price and all other relevant variables) without the firm incurring an operating loss. Since the constancy of the average unit price is assumed, it can be calculated by taking into account both quantities and sales revenues

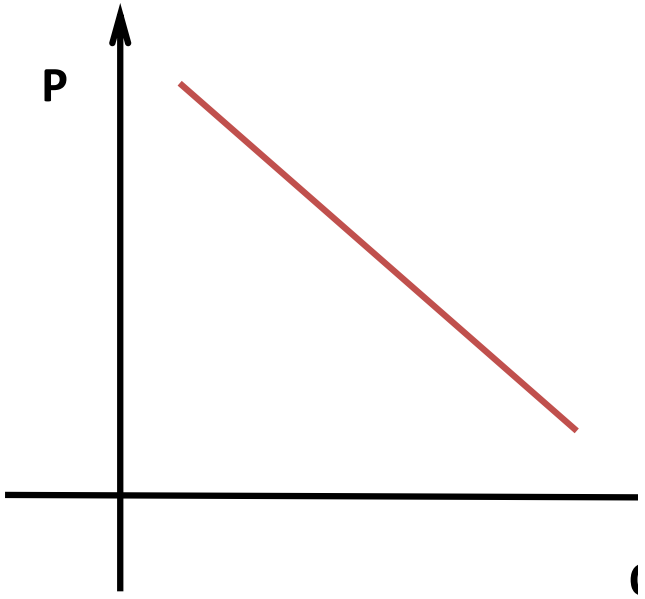


PRICE ELASTICITY OF DEMAND

Price elasticity of demand measures the responsiveness of demand to changes in price for a particular good.
If the price elasticity of demand is equal to ∞, demand is perfectly elastic (the quantity that is demanded change infinitely when there is a little change in the price of the product).



$$e_{\langle p \rangle} = \frac{dQ/Q}{dP/P} = \infty$$



$$e_{\langle p \rangle} = \frac{dQ/Q}{dP/P} > 0$$

MARGINALISM

Marginalism is a theory that asserts individuals make decisions on the purchase of **an additional unit of a good or service** based on the additional utility they will receive from it.

10.1 The Marginalist Revolution: An Overview

The term 'marginalist revolution' is commonly utilised to indicate the abandonment of the classical approach and the shift to a new approach based on a subjective theory of value and the analytical notion of marginal utility. The years between 1871 and 1874 saw publication of the major writings of the leaders of the Austrian marginalist school, Carl Menger (1840–1921); of the British school, William Stanley Jevons (1835–1882); and of the French (Lausanne) school, Léon Walras (1834–1910).

PERFET COMPETITION

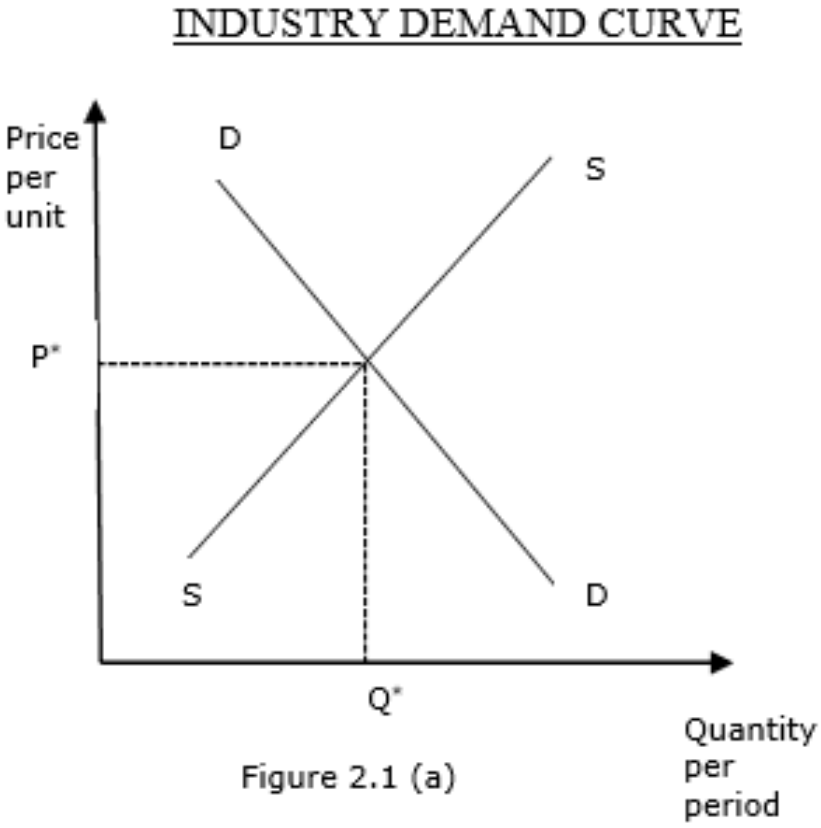


Figure 2.1 (a)

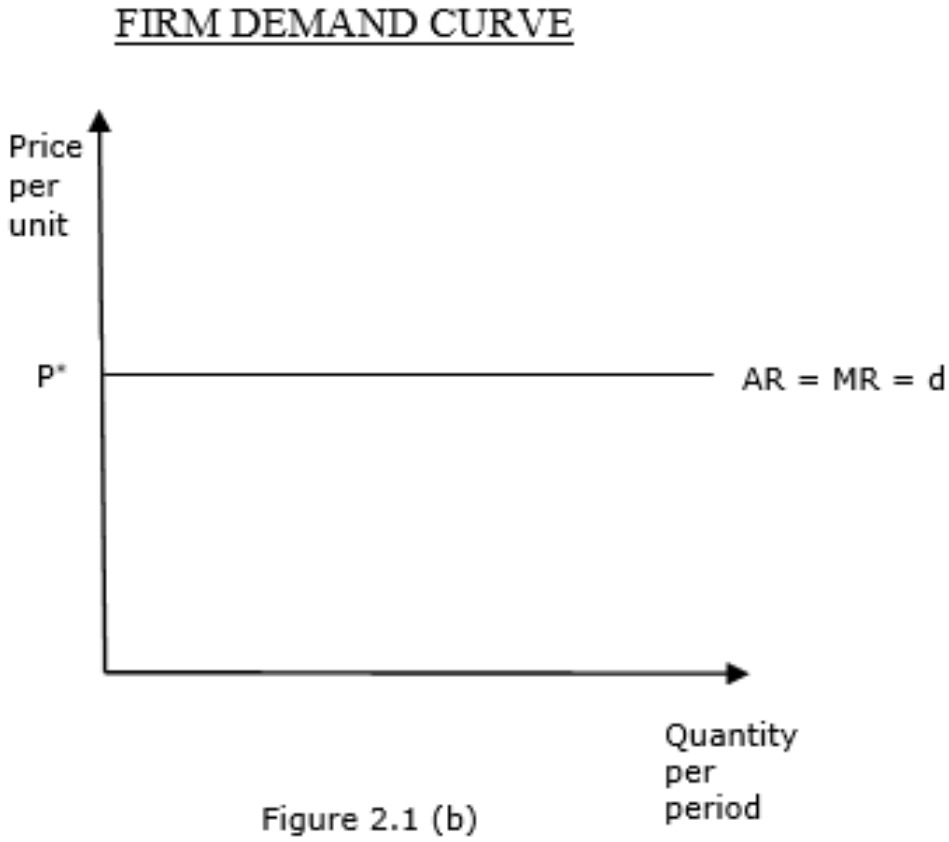
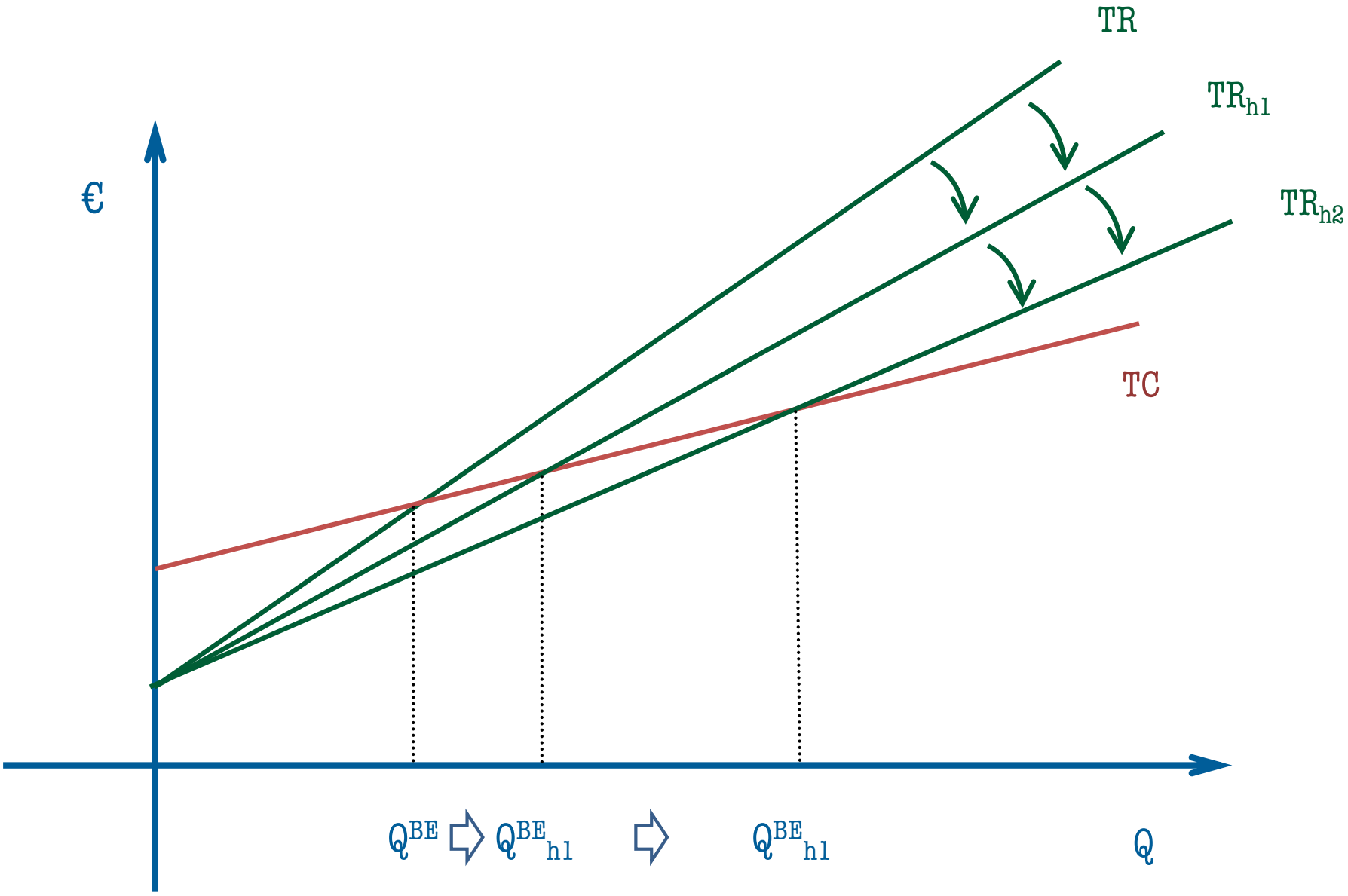
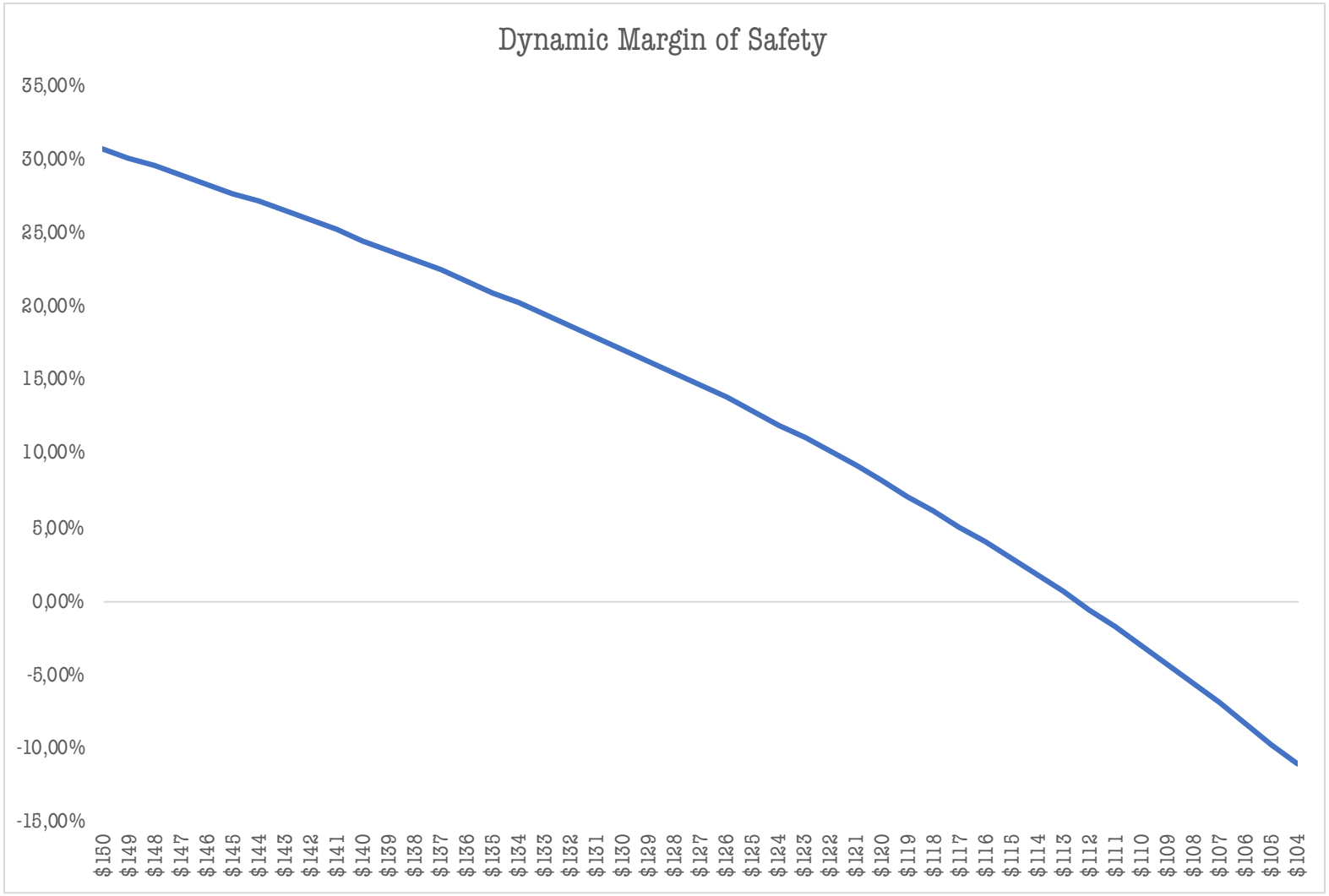


Figure 2.1 (b)

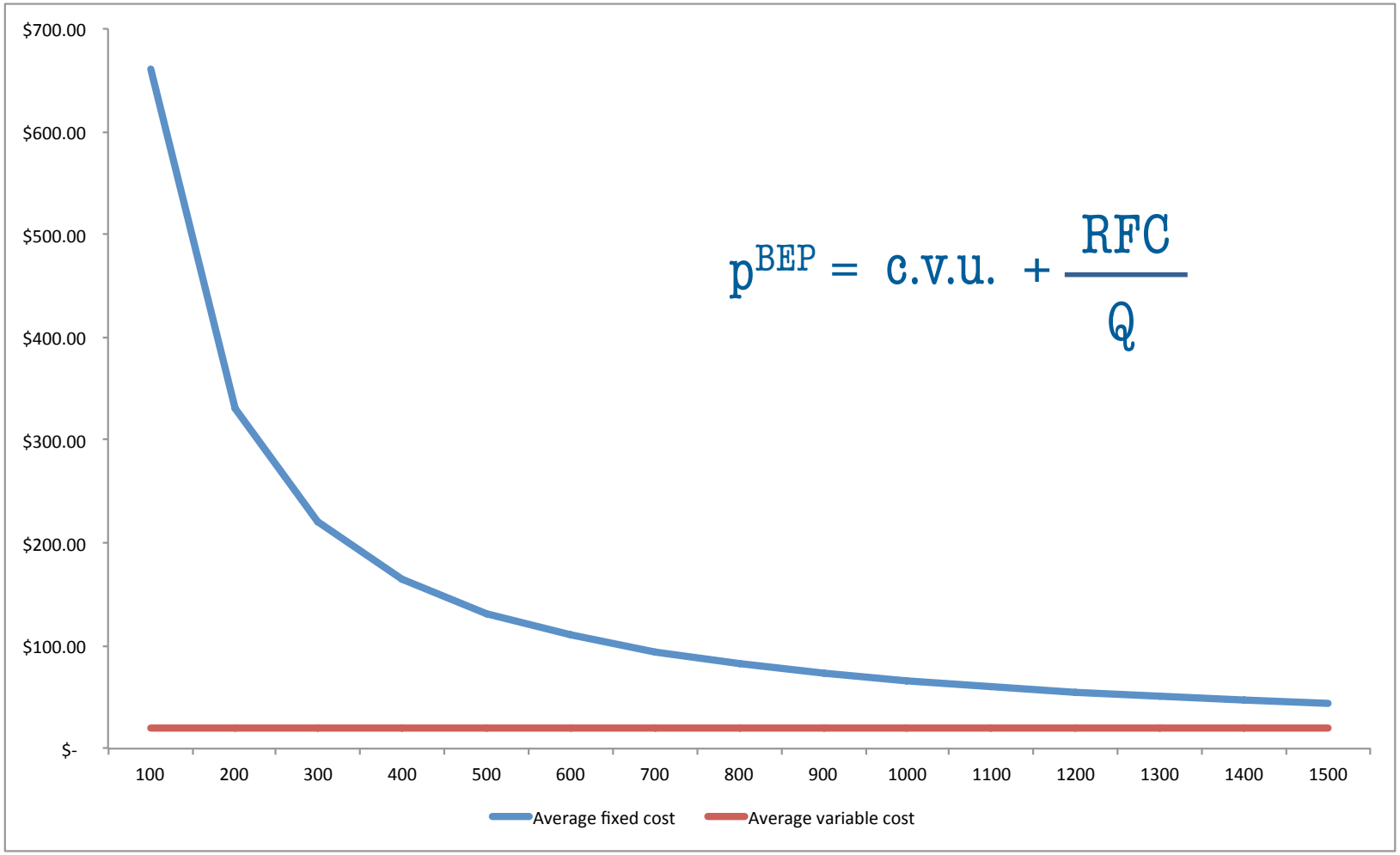
DYNAMIC MARGIN OF SAFETY



DYNAMIC MARGIN OF SAFETY

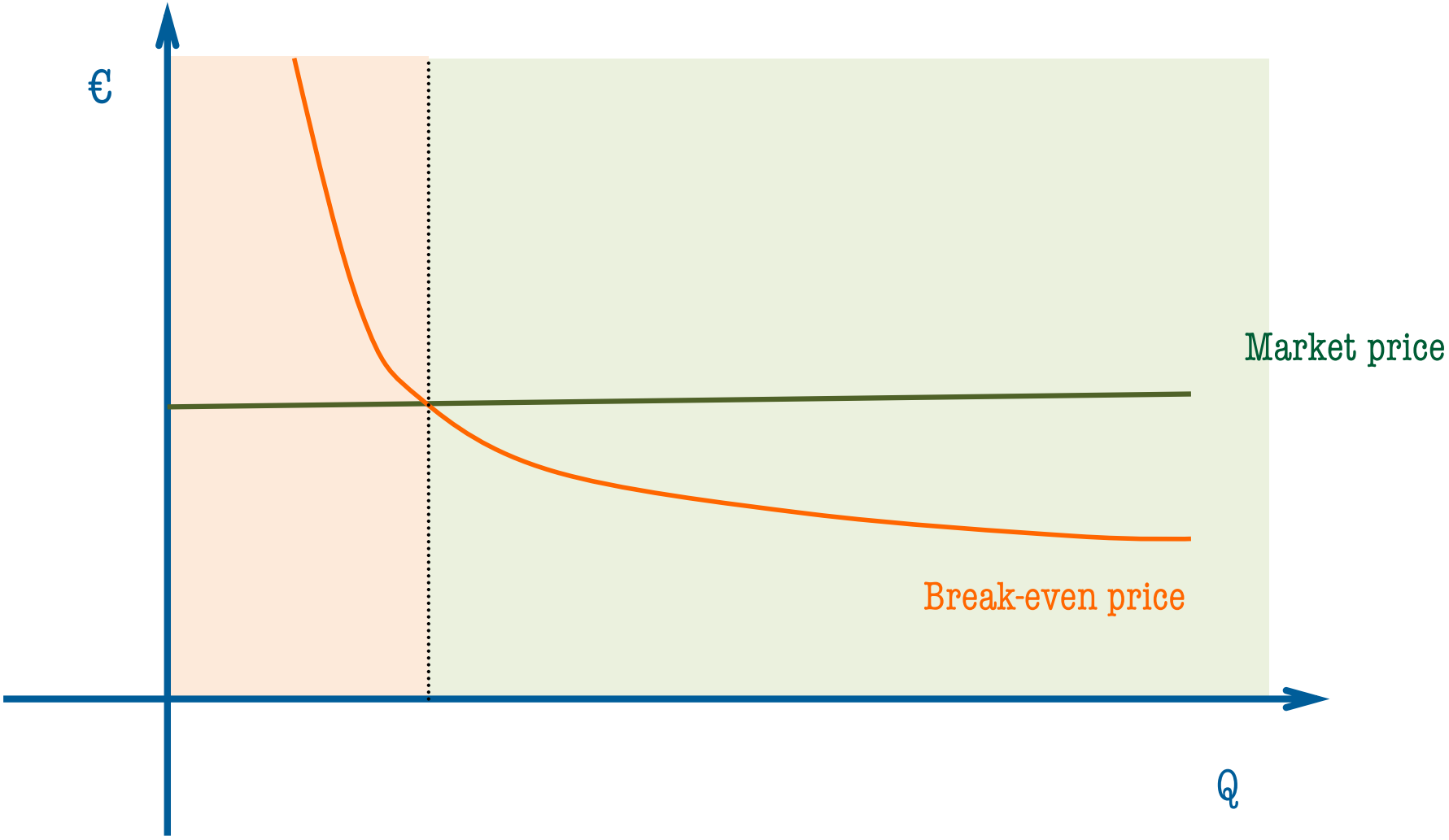


BREAK-EVEN PRICE



$$p^{BEP} = c.v.u. + \frac{RFC}{Q}$$

HOW TO "READ" THE BREAK-EVEN PRICE CURVE



PROFITABILITY STRUCTURE ANALYSIS

The following information is known of three different companies operating in the same market:

	Company X	Company Z	Company W
Quantity made	34,000	18,000	60,000
Quantity sold	31,000	21,000	50,000
Capacity	43,400	32,550	75,000
COGS (@ variable costing)	€ 310,000	€ 84,000	€ 600,000
Residual Fixed Cost	€ 217,000	€ 325,500	€ 300,000

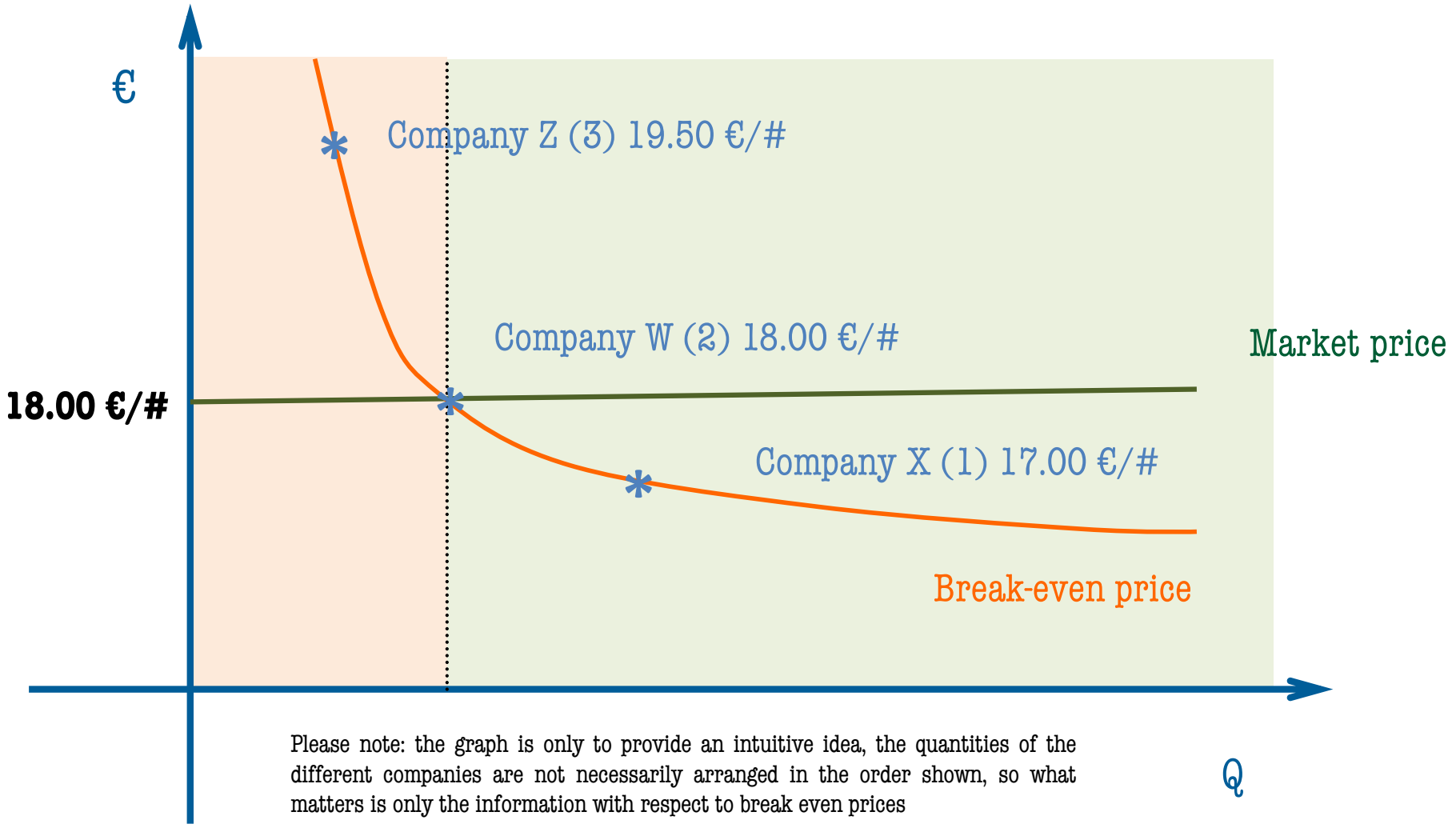
The current price in the market at the moment is € 18.00

Based on the preceding information, are you able to rank the three cost structures in descending order (from best to worst) basing your analysis on the current level of business volume that characterize the three companies? (the answer will of course not be considered correct unless adequately demonstrated and explained)

How does the ordering change if instead of looking at the current level of performance we consider the maximum level of activity that can be developed by the three companies?

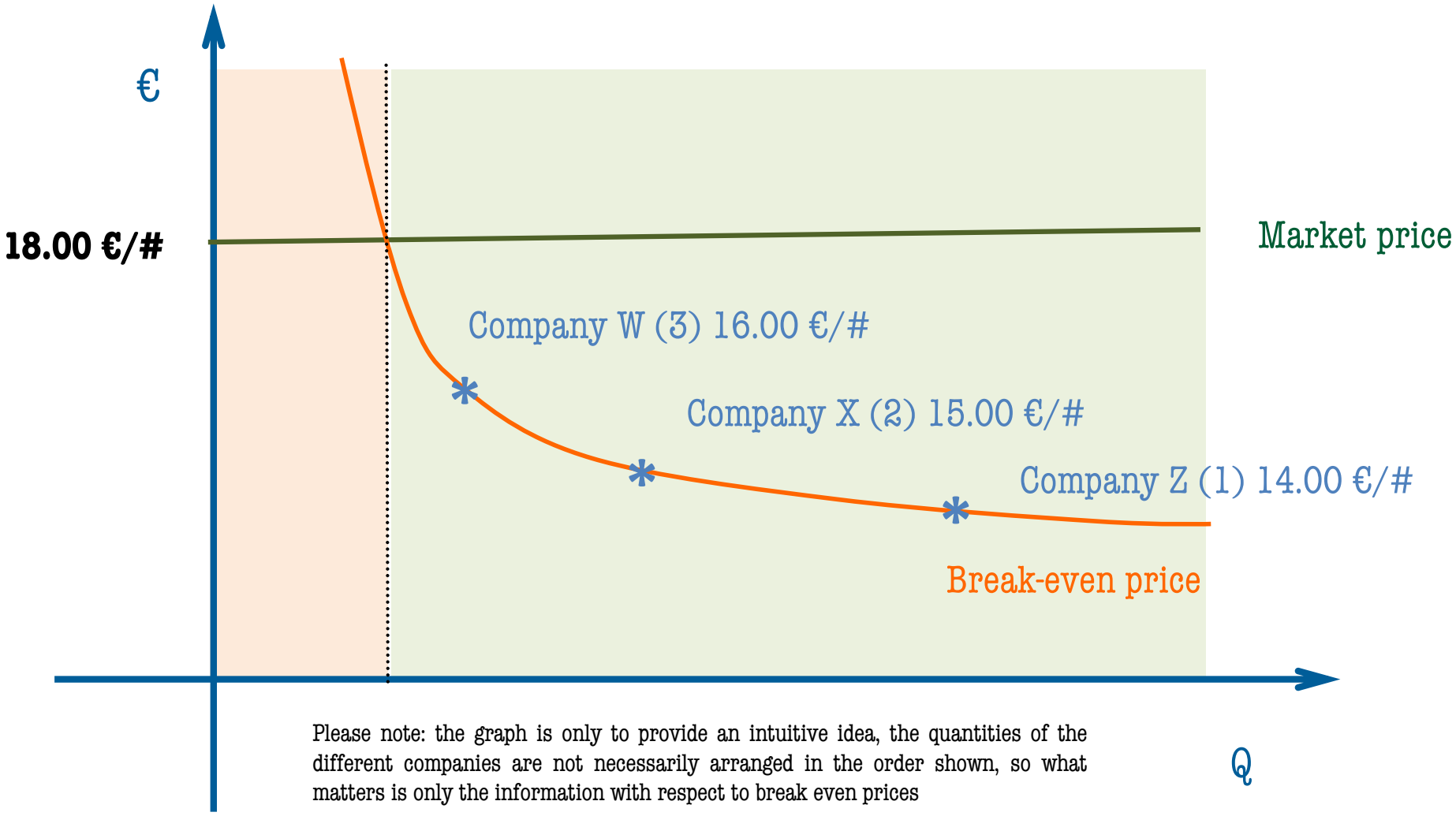
18 gennaio 2023 – First Written Exam Winter Session

AT CURRENT LEVEL OF ACTIVITY



Please note: the graph is only to provide an intuitive idea, the quantities of the different companies are not necessarily arranged in the order shown, so what matters is only the information with respect to break even prices

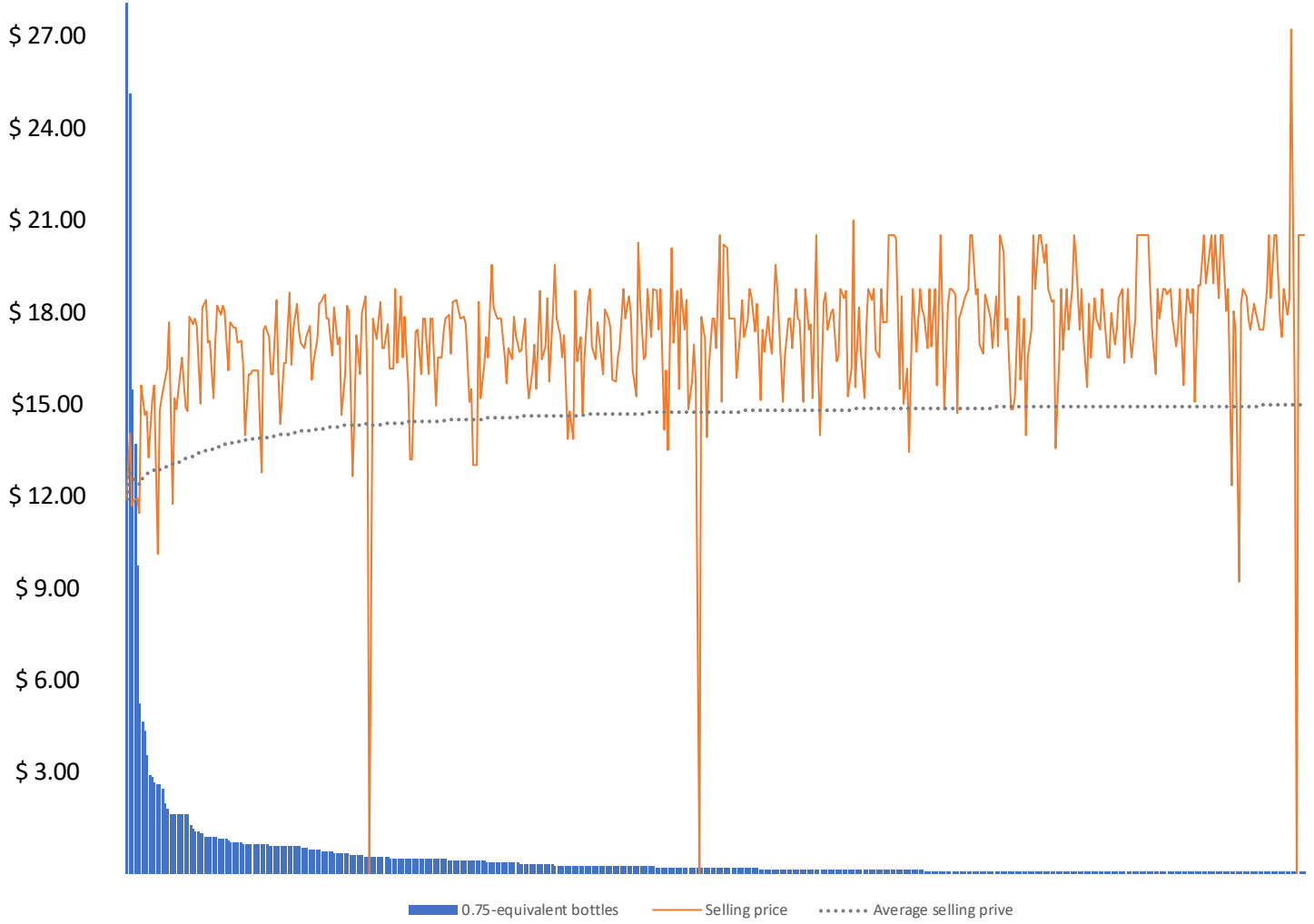
AT CAPACITY



Please note: the graph is only to provide an intuitive idea, the quantities of the different companies are not necessarily arranged in the order shown, so what matters is only the information with respect to break even prices

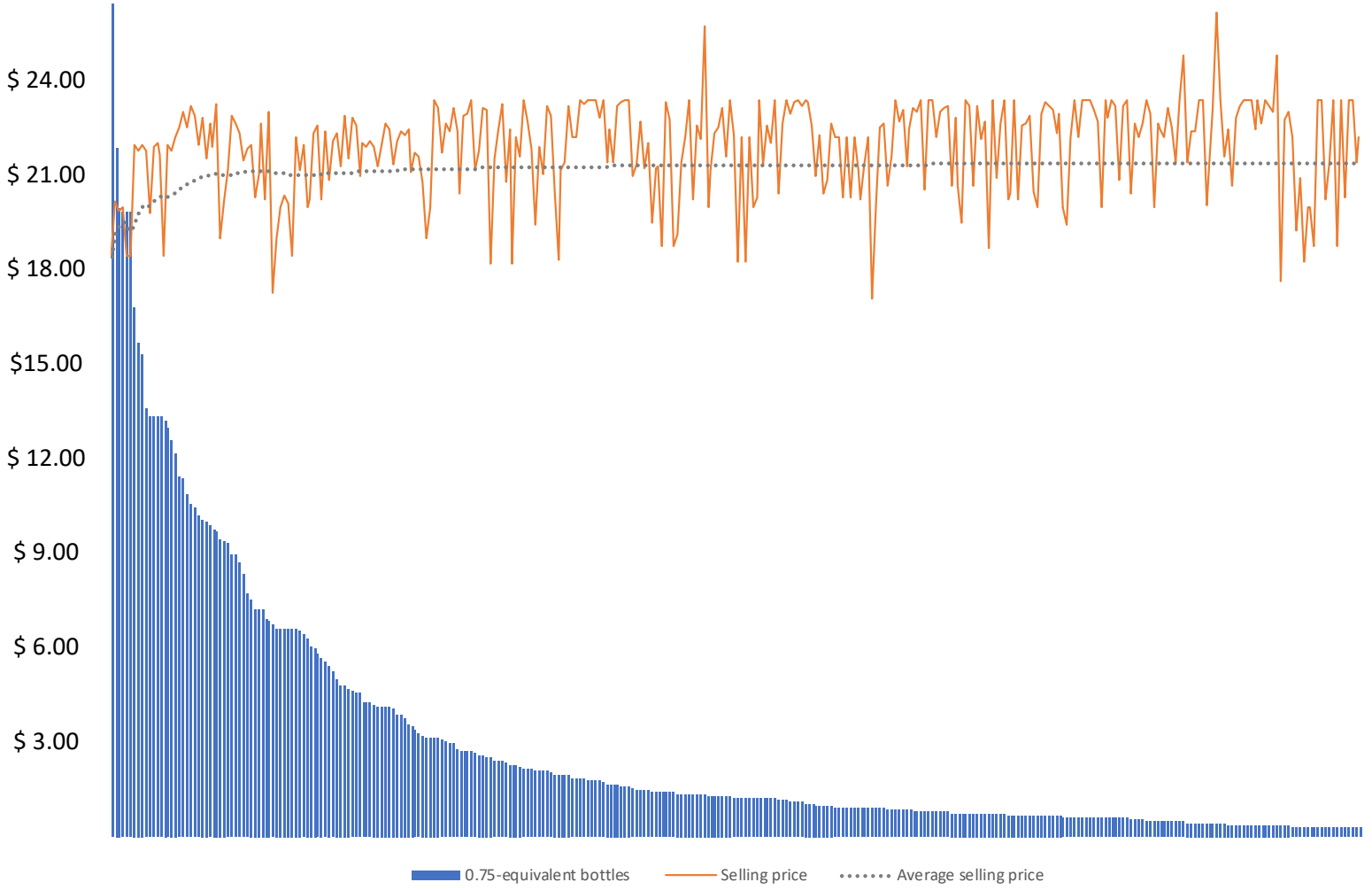
AVERAGE PRICE ANALYSIS – PRODUCT "X"

FICTITIOUS DATA



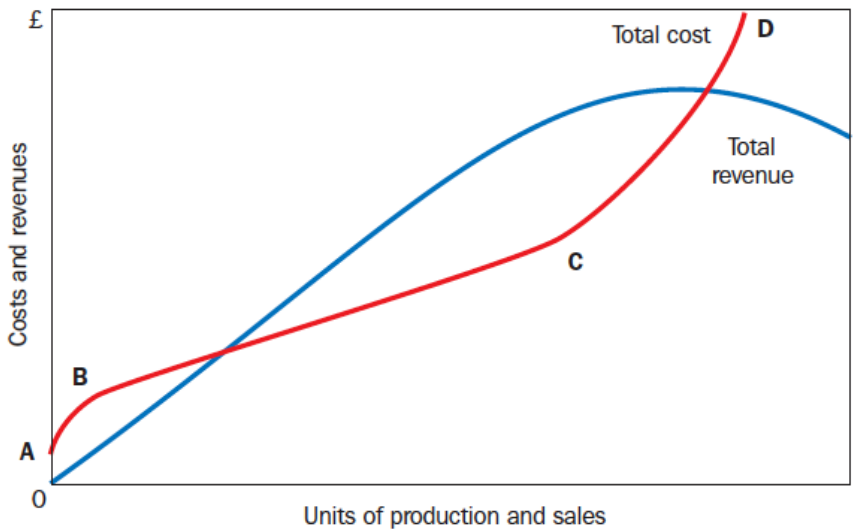
AVERAGE PRICE ANALYSIS – PRODUCT Y

FICTITIOUS DATA

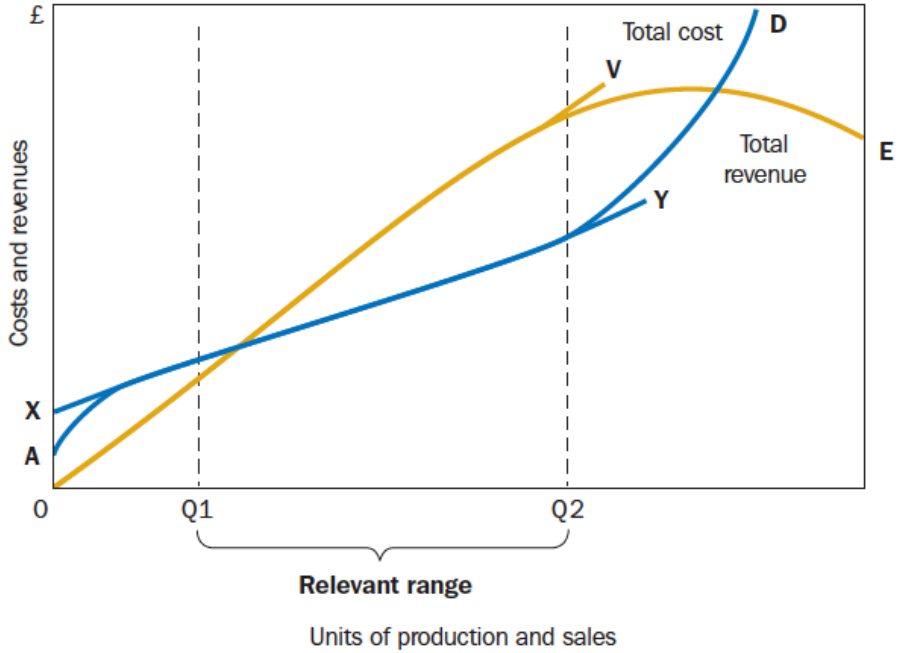


RELEVANT RANGE

ECONOMIST'S VIEW



ACCOUNTANTS'S VIEW



«Linear relationships are not intended to provide an accurate representation of total cost and total revenue throughout all ranges of output. The objective is to represent the behaviour of total cost and revenue over the range of output at which a firm expects to be operating within a short-term planning horizon. […] The term relevant range is used to refer to the output range at which the firm expects to be operating within a short-term planning horizon. This relevant range also broadly represents the output levels that the firm has had experience of operating in the past and for which cost information is available.
[Within the relevant range] the cost and revenue relationships are more or less linear. It would be unwise, however, to make this assumption for output levels outside the relevant range. CVP analysis should therefore only be applied within the relevant range. If the relevant range changes, different fixed and variable costs and selling prices must be used».

Source: Colin Drury, "Management and Cost Accounting", eighth edition, Cengage Learning

PRICE ELASTICITY OF DEMAND

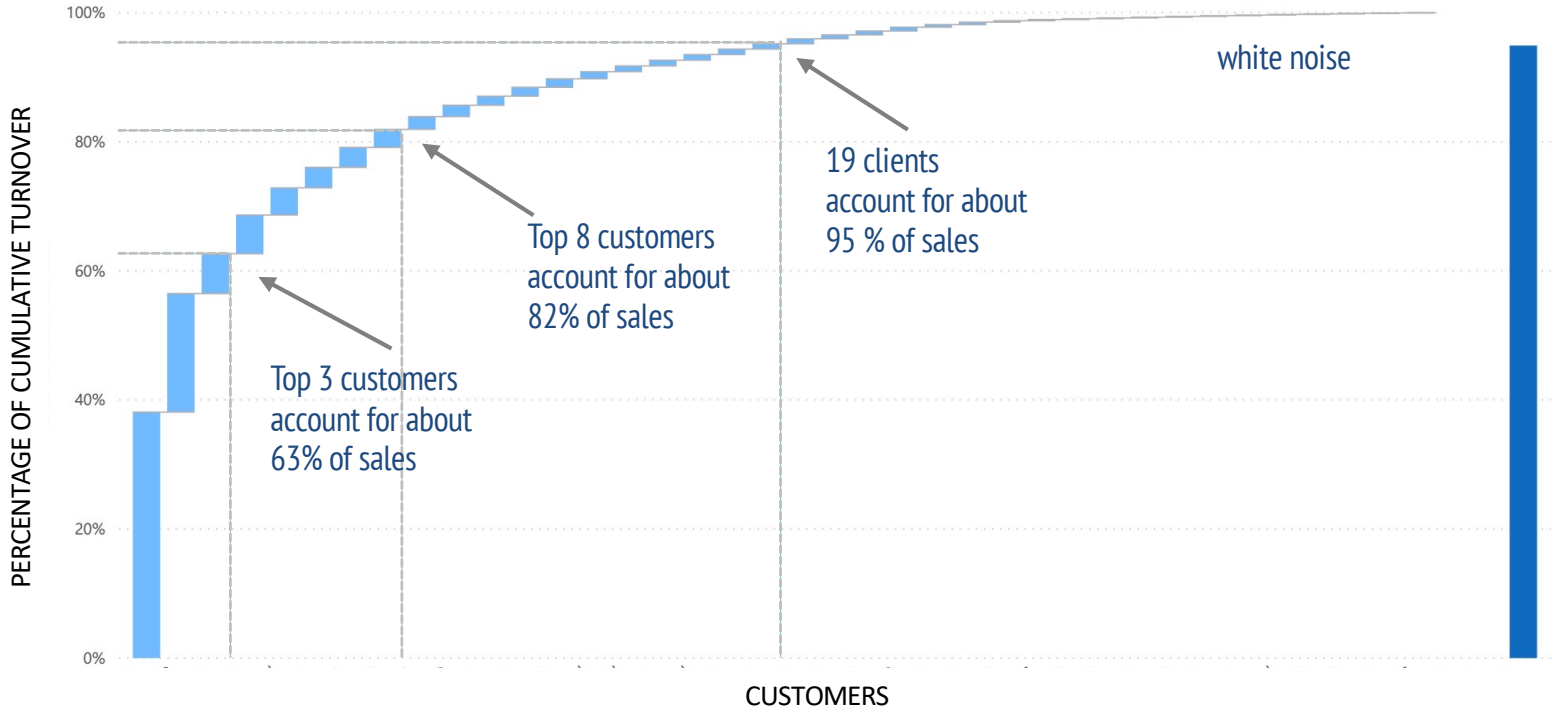
Many people point to the assumptions of constant unit variable cost and constant unit prices for all levels of volume as important limitations of CVP analysis. However, these assumptions are simplifying assumptions that are made by the analyst. If we know that unit prices are lower for higher volumes, we can incorporate that relation into the CVP analysis. The result will be a more complicated relation among costs, volumes, and profits [...]. But with analysis tools such as Microsoft Excel we can model the more complicated relations and find the break-even point (or points) if they exist.

While CVP assumptions may be violated in practice, the results of CVP analysis are often "good enough" to be quite useful. Perhaps the greatest danger lies in relying on simple CVP analysis when a manager is contemplating a large change in volume that lies outside of the relevant range. For example, a manager might contemplate increasing the level of sales far beyond what the company has ever experienced before. However, even in these situations, the model can be adjusted [...] to take into account anticipated changes in selling prices, fixed costs, and the sales mix that would otherwise violate the assumptions.

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

TURNOVER CONTROL DASH-BOARD: BREAKDOWN BY CLIENT

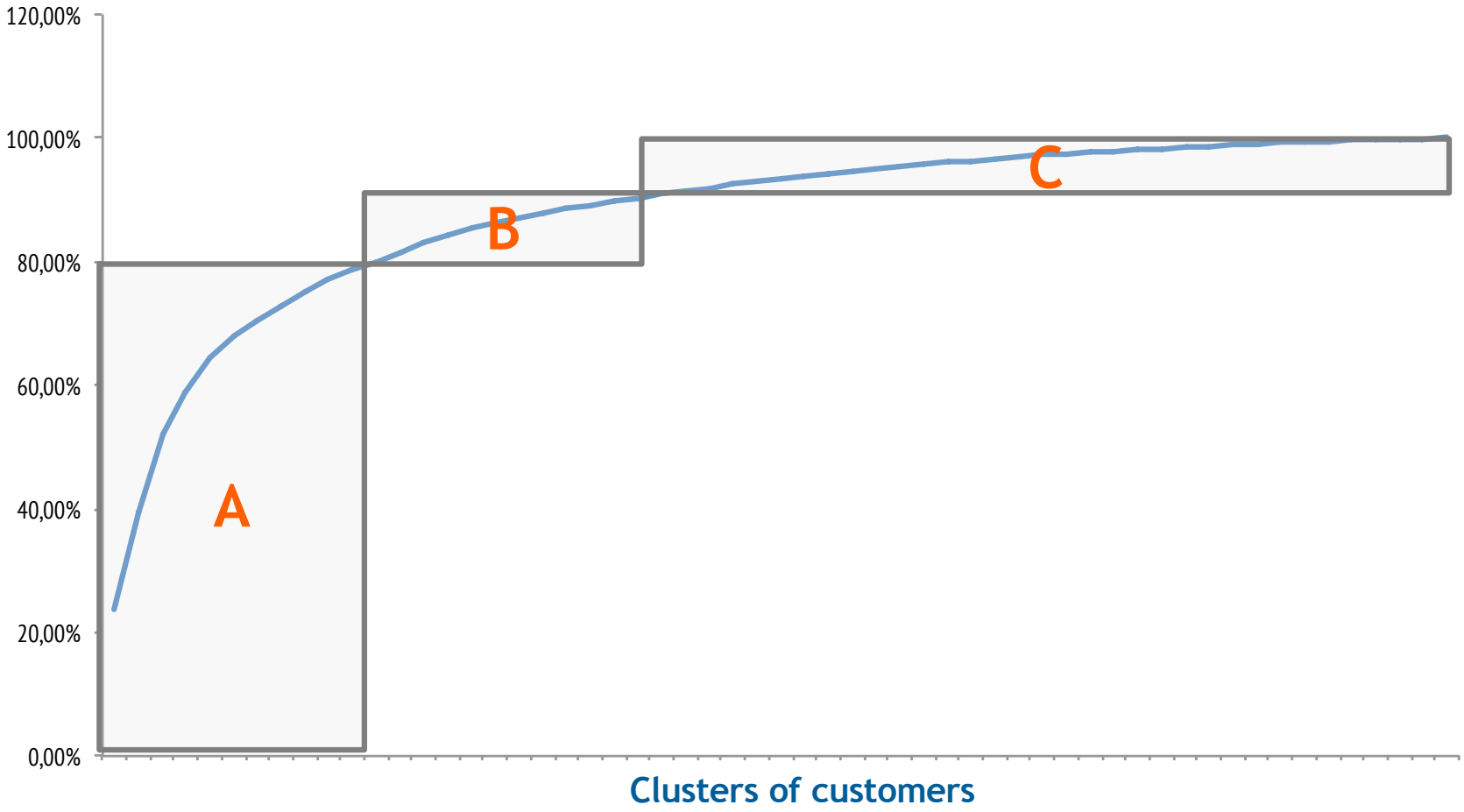
40	€ 2,03M	€ 1,89M	2,00M	0,55 €/#
CUSTOMERS	SALES REVENUE	FAMILY 1	UNITS SOLD	AVERAGE PRICE
		€ 137 K	6,87K	12,51 €/KG
		FAMILY 2	KG SOLD	AVERAGE PRICE



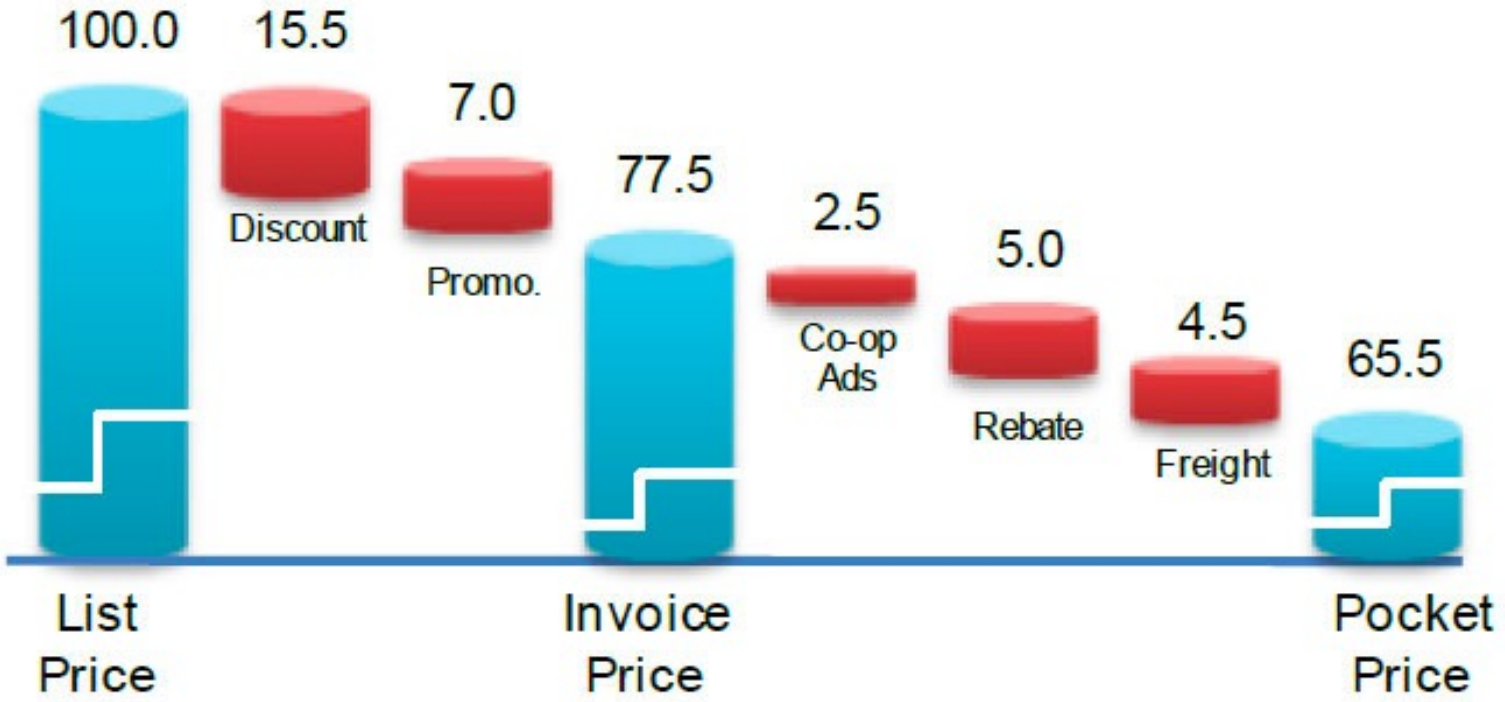
FICTITIOUS DATA

THE APPLICATION OF THE PARETO RULE

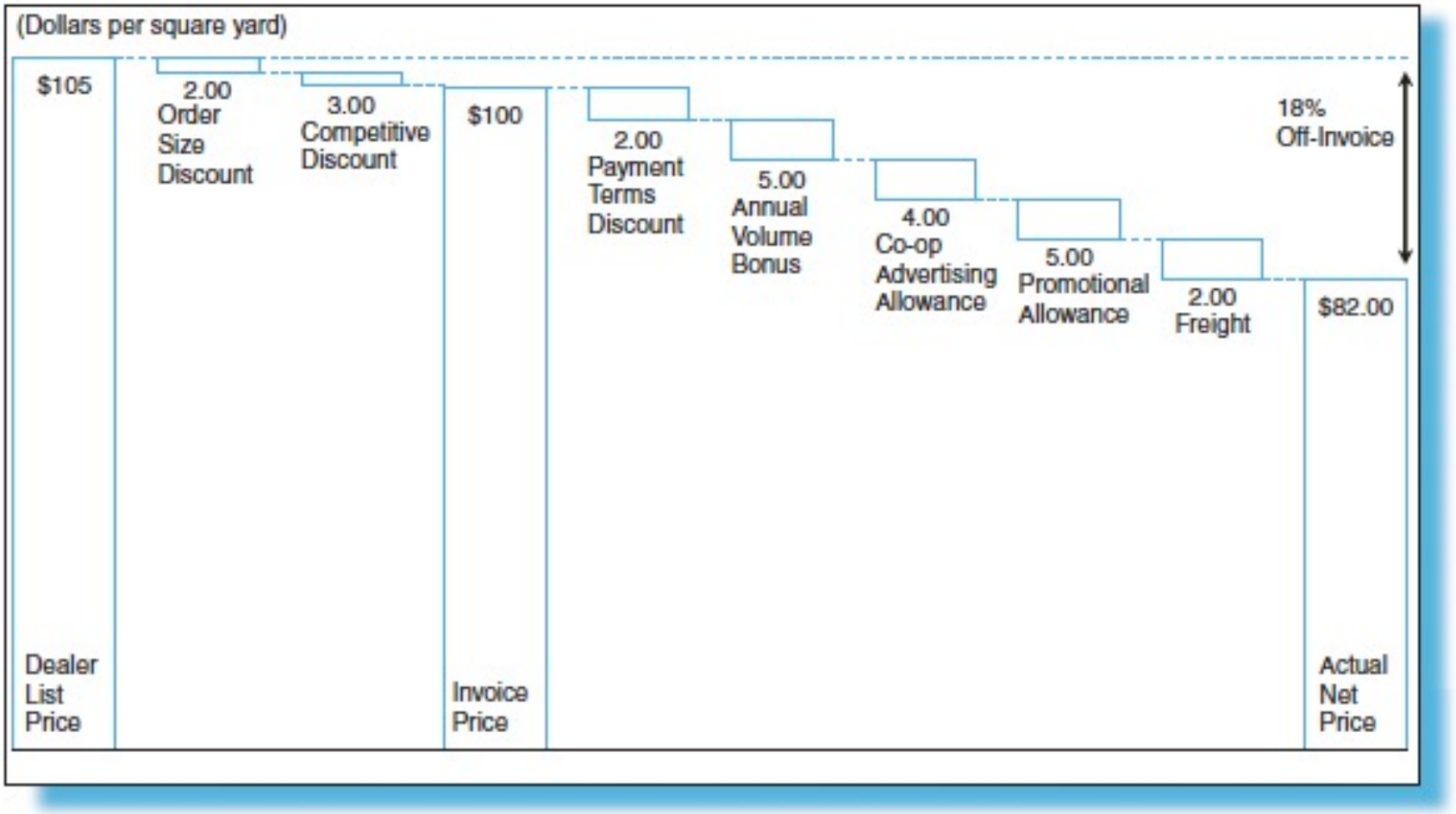
FICTITIOUS DATA



PRICE WATERFALLS



PRICE WATERFALLS CHART



PRICE WATERFALLS CHART

Heavy discounting and granting of special allowances can lead to breakeven or highly unprofitable customers.

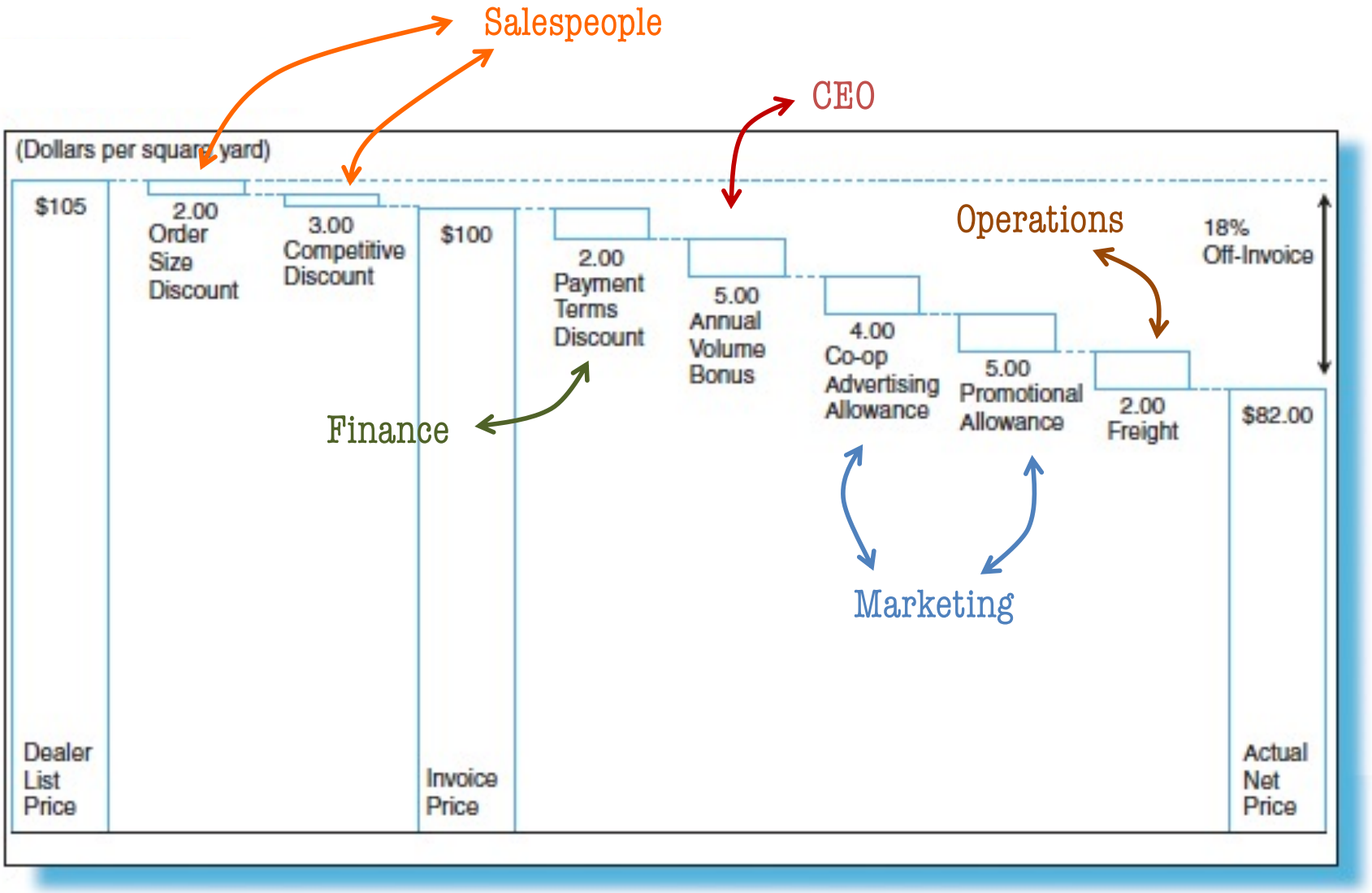
Before confronting a customer with an explicit price increase, the company should examine the many ways it has already reduced the effective price the customer actually pays.

The chart that shows the effect of total sales adjustments is commonly referred to as the **pricing waterfall** because of the multiple revenue leaks from list price caused by special allowances and discounts granted to obtain the order and build customer loyalty.
Each of these discounts and allowances seems like a small concession in order to get the order, encourage a high volume of sales, and receive payment promptly. The discounts are normally granted by different organizational units.

DIFFERENT KINDS OF SALES ADJUSTMENTS

		Customer A	% of Sales
Sales	**Total Revenues**	**1,518**	**104.8%**
	Less: Sales Adjustments		
	Sales Returns & Allowances	1	0.1%
	Sales Discounts	27	1.9%
	Service Discounts	0	0.0%
	Display Discounts	0	0.0%
	Customer Specific Program	21	1.5%
	Rebates	9	0.6%
	Restocking Fees	1	0.1%
	Returns	9	0.6%
	Other Deductions	2	0.1%
	Total Sales Adjustments	70	4.8%
Net Sales		**1,448**	100.0%

DIFFERENT LEVEL OF DECISION

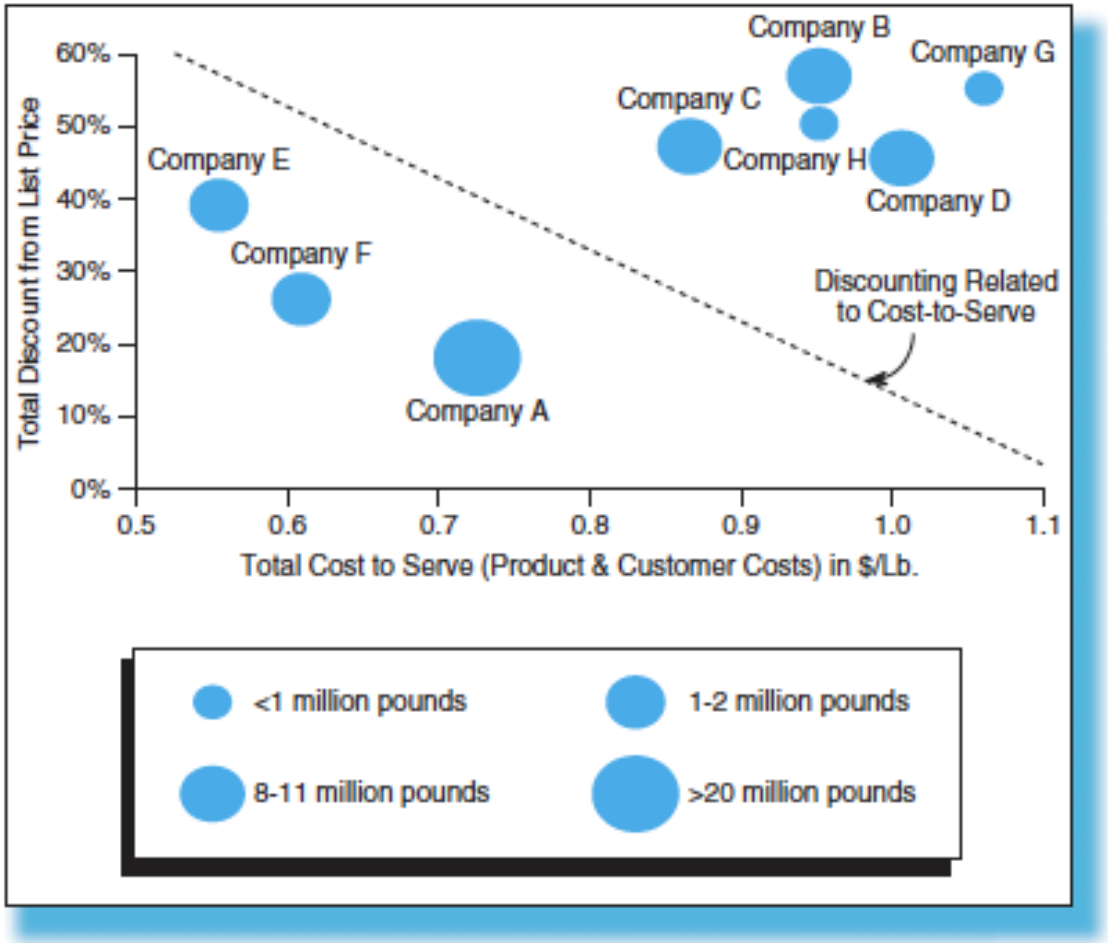


DIFFERENT SYSTEMS AND TIMES

Companies normally fail to see all of the revenue leaks from list price because they record the discounts and allowances in different systems (or different accounts) and make the revenue deductions at different times of the year.

For this reason, without a specific analysis performed by someone, **no manager generally sees the complete picture shown in the price waterfall chart** and consequently no one realizes how much revenue loss occurs with individual orders and customers.

ANALYSIS OF DISCOUNTING POLICIES



LITTLE DISCIPLINE OR ECONOMIC RATIONALITY

The previous graph shows that the quantity of discounts provided to customers bore no relationship to the volume or the cost-to-serve individual customers.

The downward sloping diagonal line suggests a plausible discounting policy in which low-cost-to-serve customers can receive discounts from list price, whereas high-cost-to-serve customers would receive little to no discounting. Yet the many companies above this diagonal line show that large discounts (some as high as 60%) had been granted to customers who had high service costs, while many customers who had low service costs (below the diagonal) received few discounts.

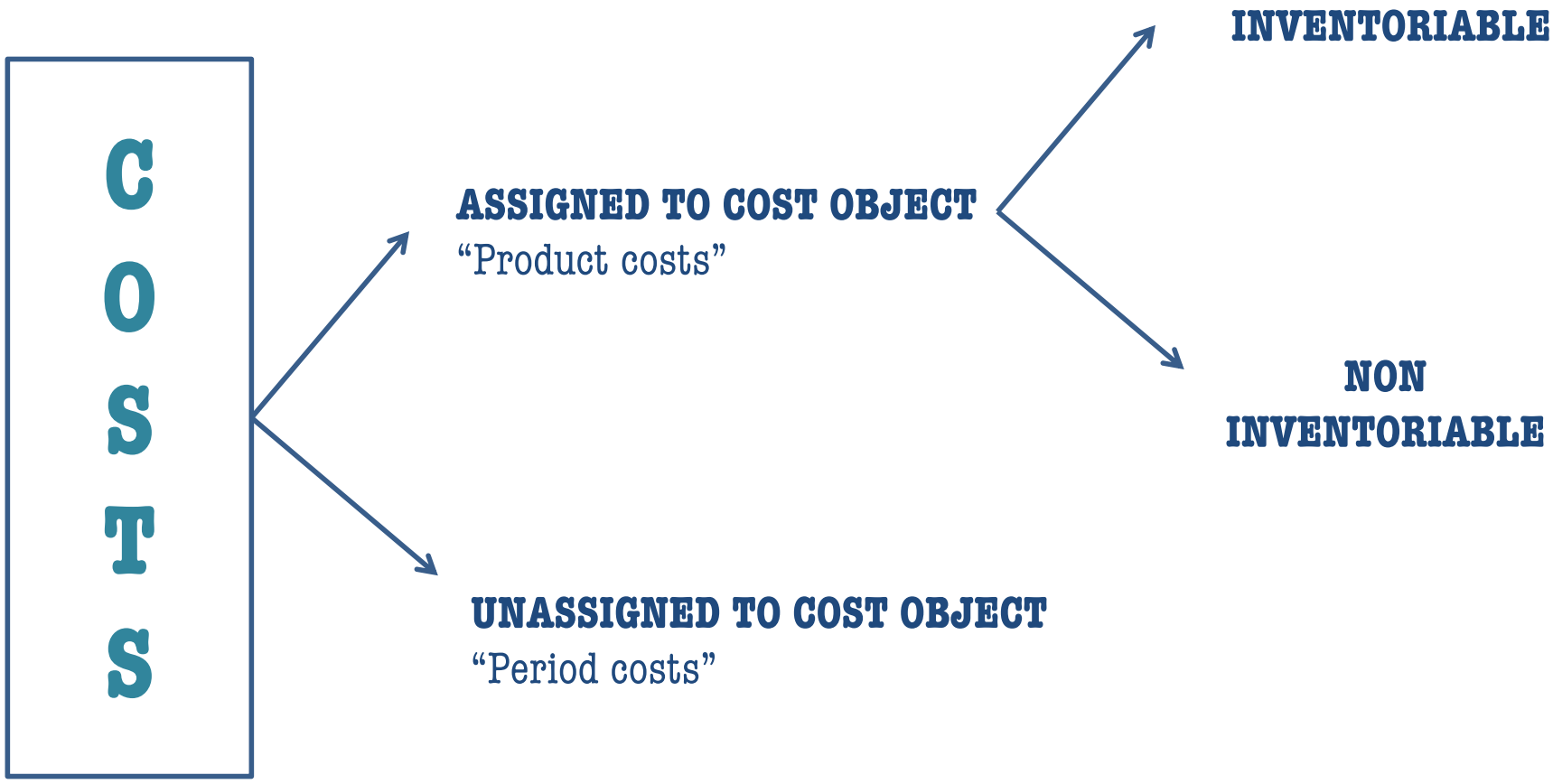
In addition, many of the high-cost-to-serve customers receiving large discounts were not the highest volume customers either (as shown by the smaller size of their circles)

This is an example of a **company with little apparent discipline or economic rationality** in its discounting policies.

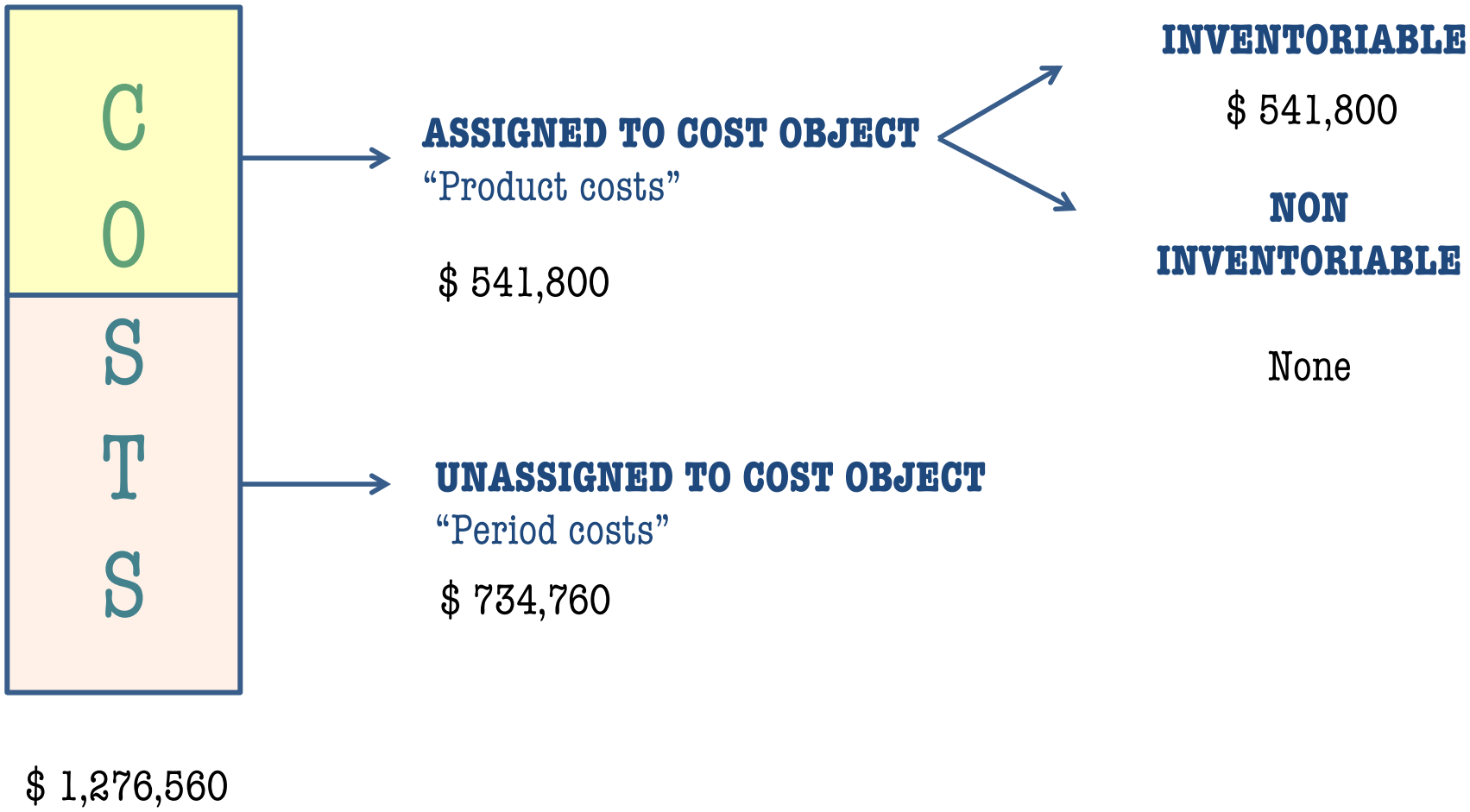
DIFFERENT COST STRUCTURES?

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

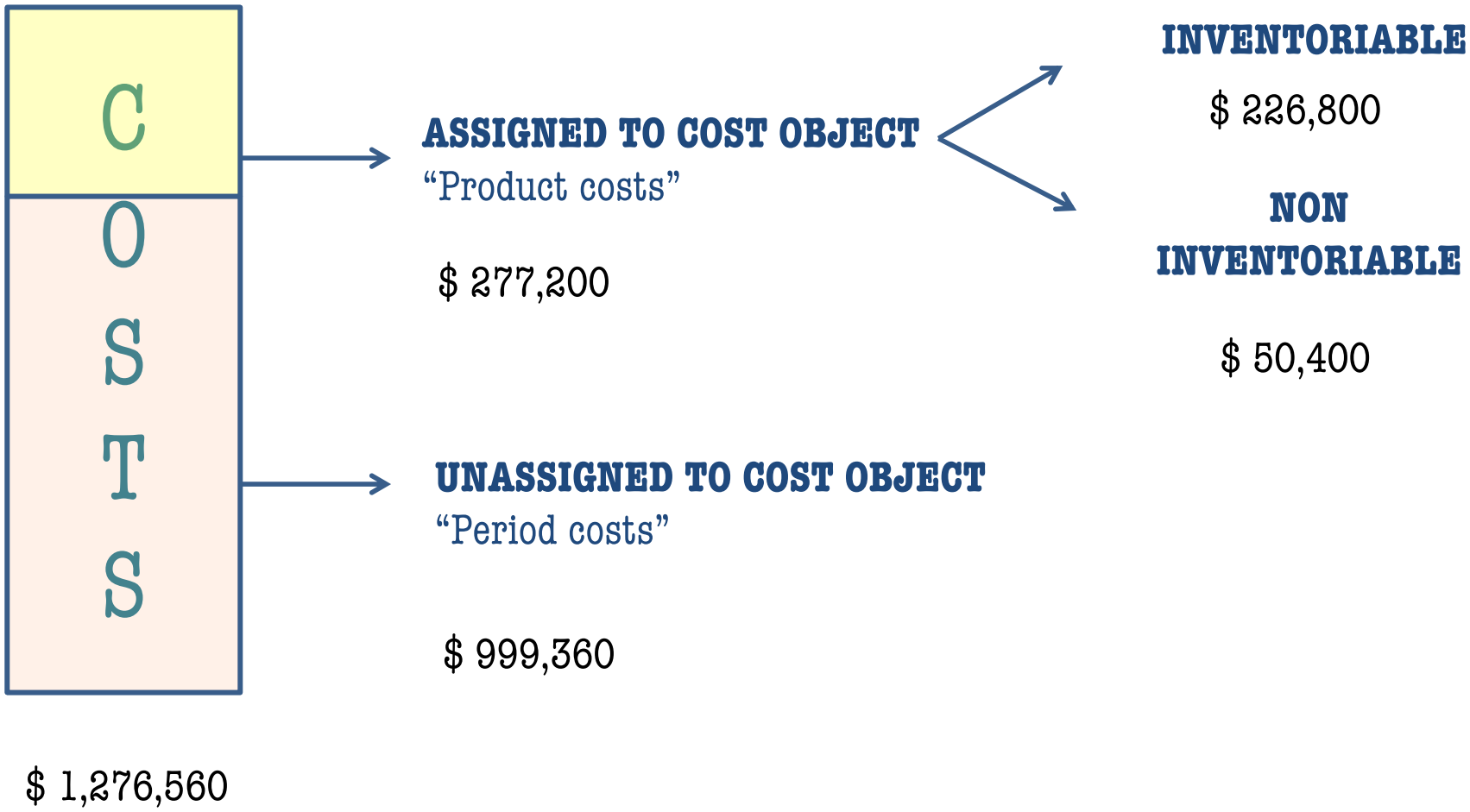
COSTS ASSIGNED & UNASSIGNED



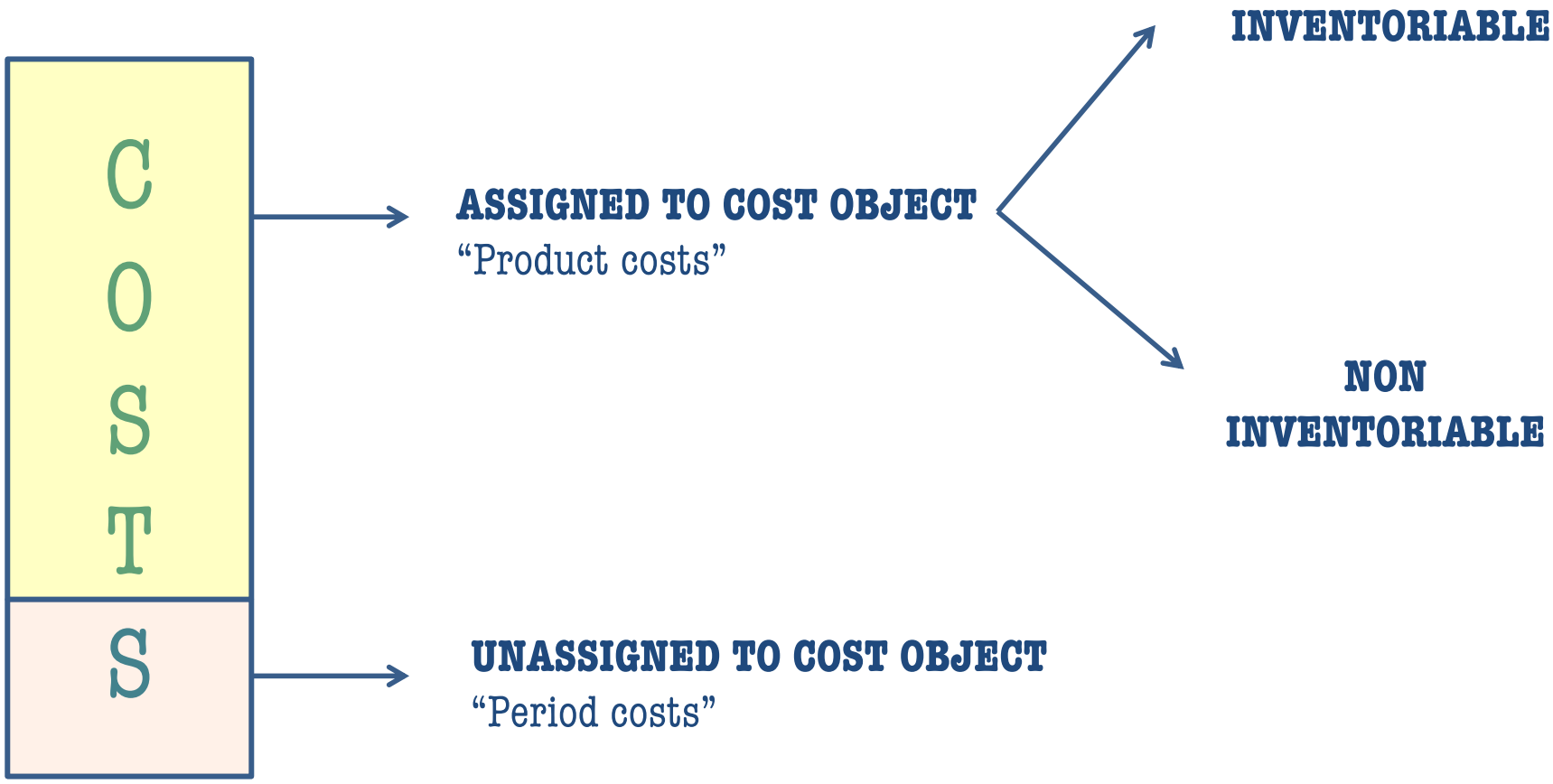
ABSORPTION COSTING (FULL COSING)



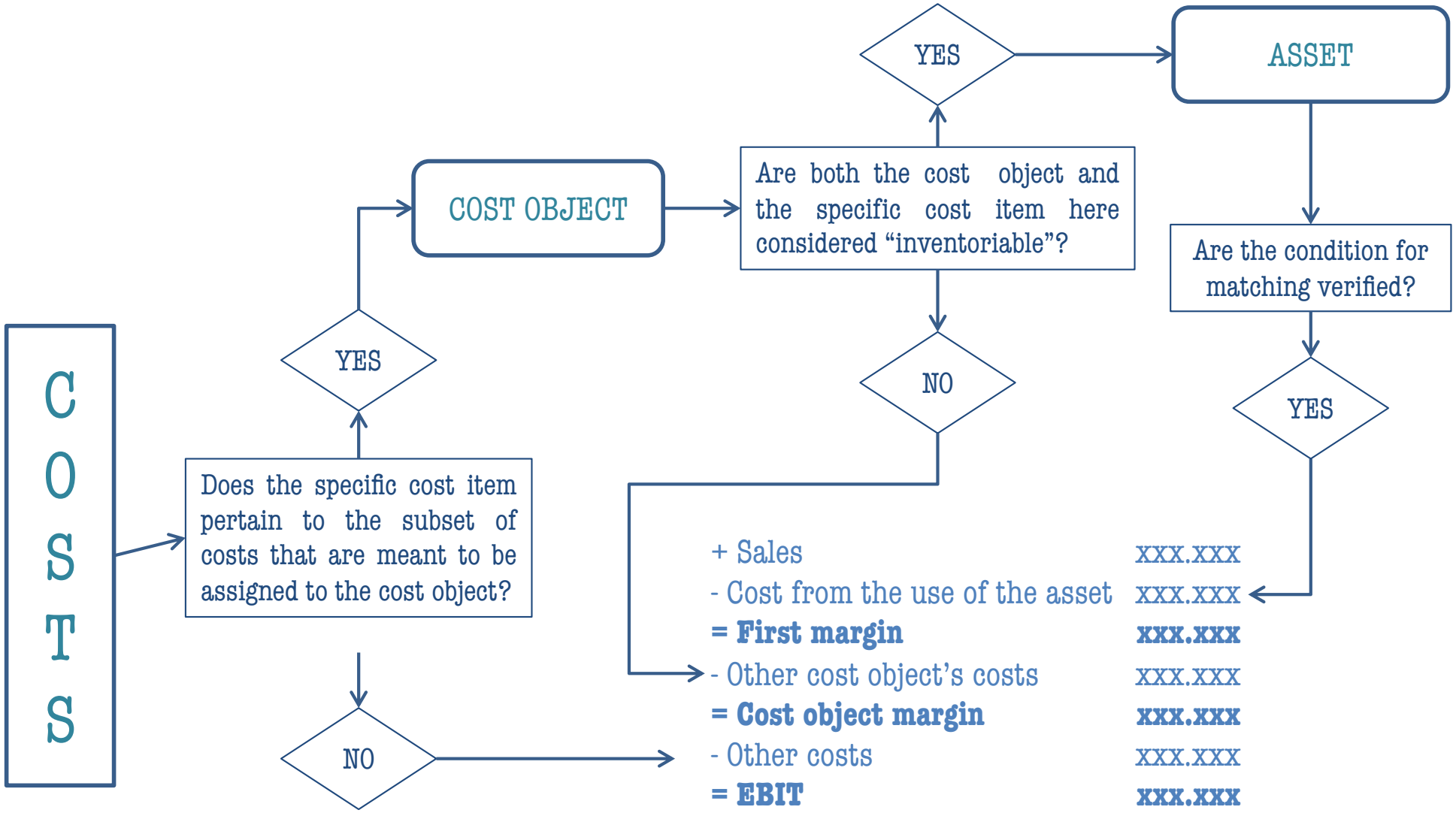
VARIABLE COSTING (DIRECT COSING)



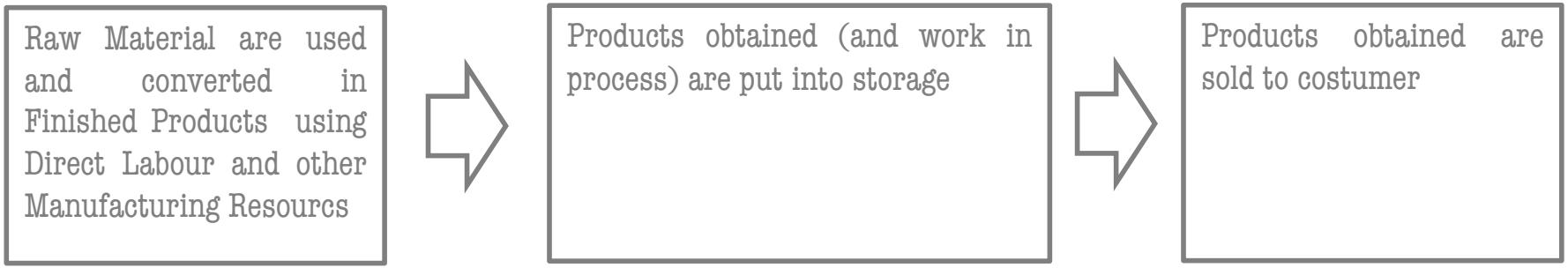
ACTIVITY BASED COSTING

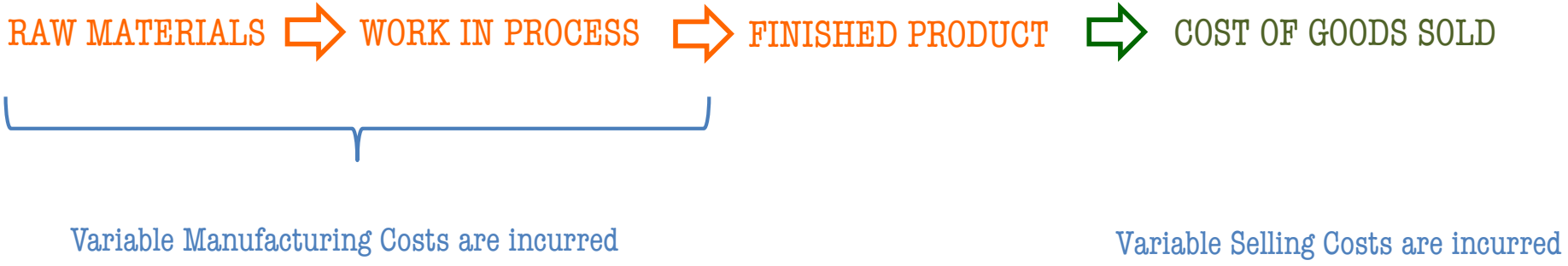


VARIABLE COSTING

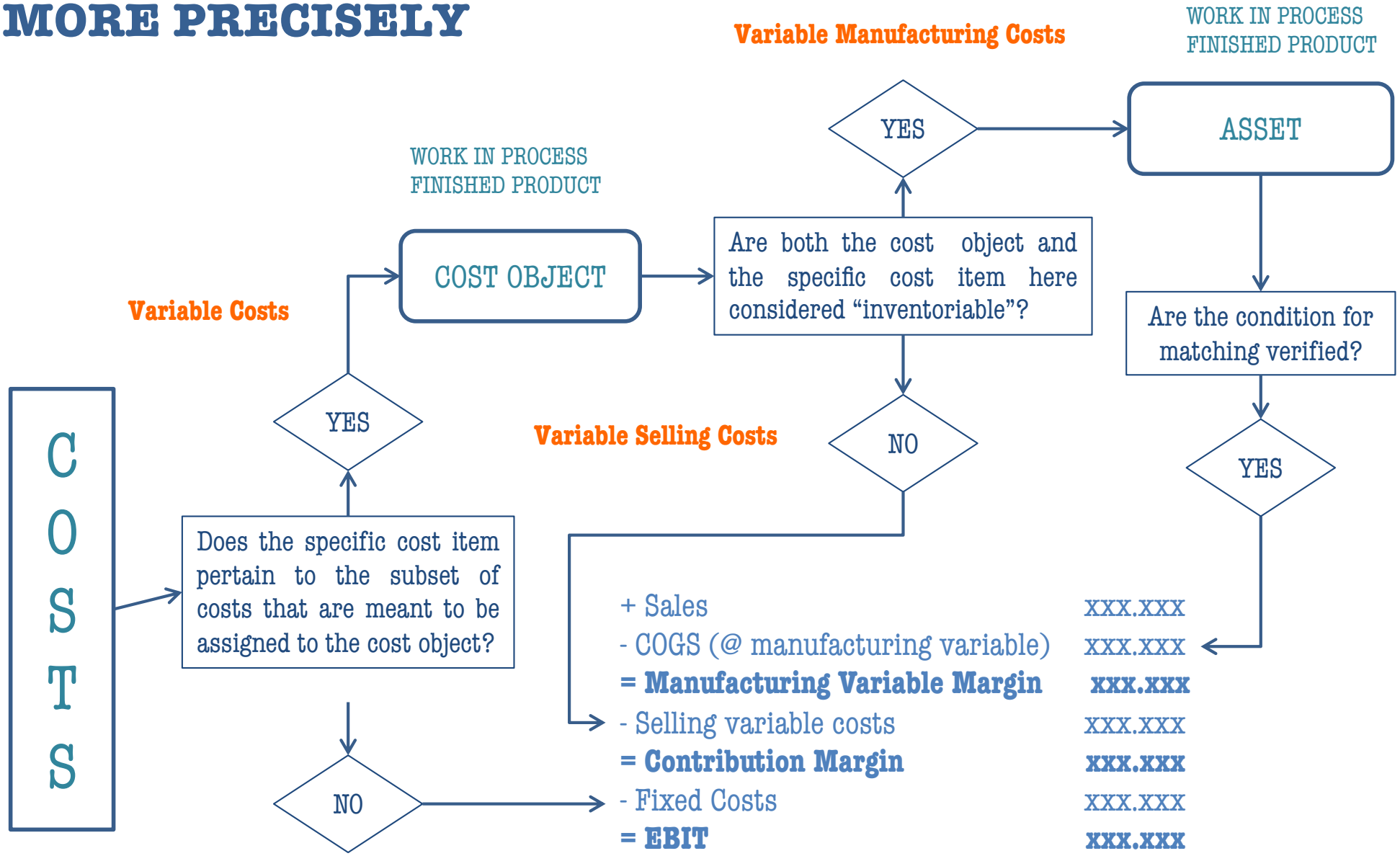


VARIABLE COSTING

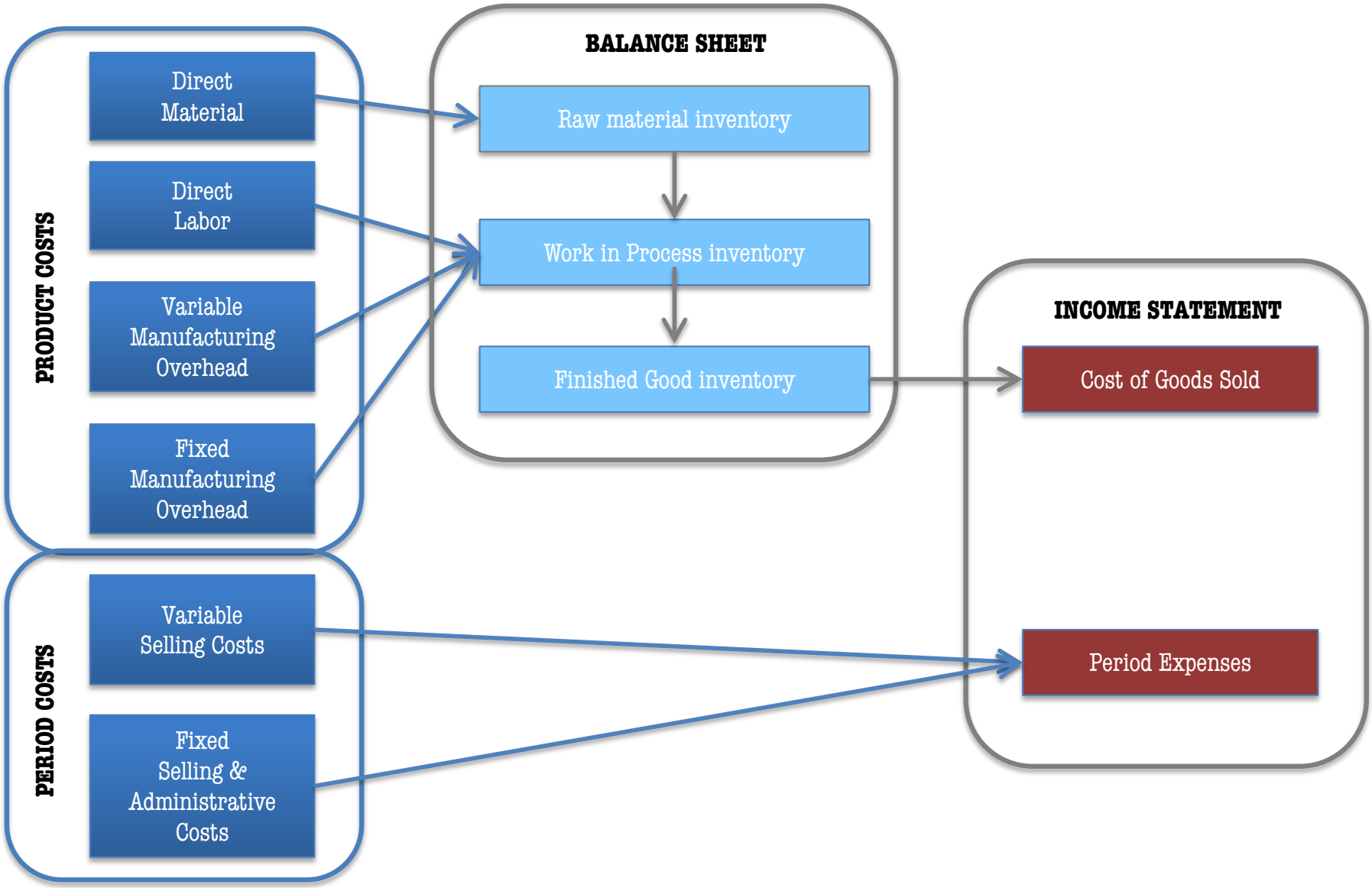




MORE PRECISELY



ABSORPTION COSTING



ABSORPTION COSTING

Variable manufacturing costs	$226.800
Fixed manufacturing costs	$315.000
Total manufacturing costs	**$541.800**
# Product made	12.600
Cost of good manufactured (per unit)	**$43,00**
# Product sold	8.400
Cost of goods sold (total)	**$361.200**

COST OF GOODS SOLD INCOME STATEMENT

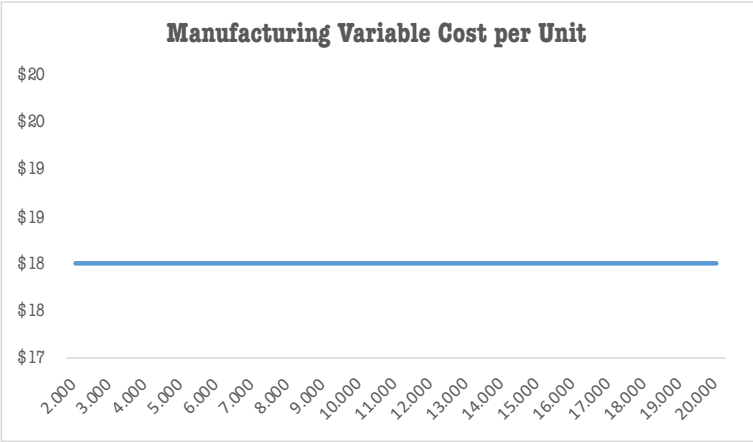
Sales Revenue	$1.218.000
- COGS (@full manufacturing - push)	-$361.200
= Gross profit	**$856.800**
+ Rent Income	$84.600
- S.G.&A. Expensnes	-$734.760
= EBIT	**$206.640**
- Interest Expenses	-$90.000
= EBT	**$116.640**

TOTAL OUTPUT INCOME STATEMENT

Sales Revenue	$1.218.000
+ Change in Finished Goods Inventory	$180.600
= Total Output (@manufacturing full - push	**$1.398.600**
- Manufacturing costs	-$541.800
= Gross profit	**$856.800**
+ Rent Income	$84.600
- S.G.&A. Expensnes	-$734.760
= EBIT	**$206.640**
- Interest Expenses	-$90.000
= EBT	**$116.640**

TWO COMPONENTS

$$\frac{\text{Manufacturing Variable Costs}}{\text{\# Product made}} + \frac{\text{Manufacturing Fixed Costs}}{\text{\# Product made}}$$



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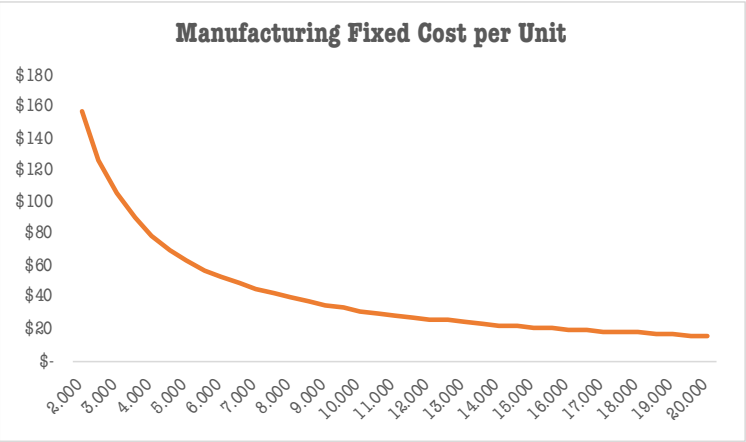
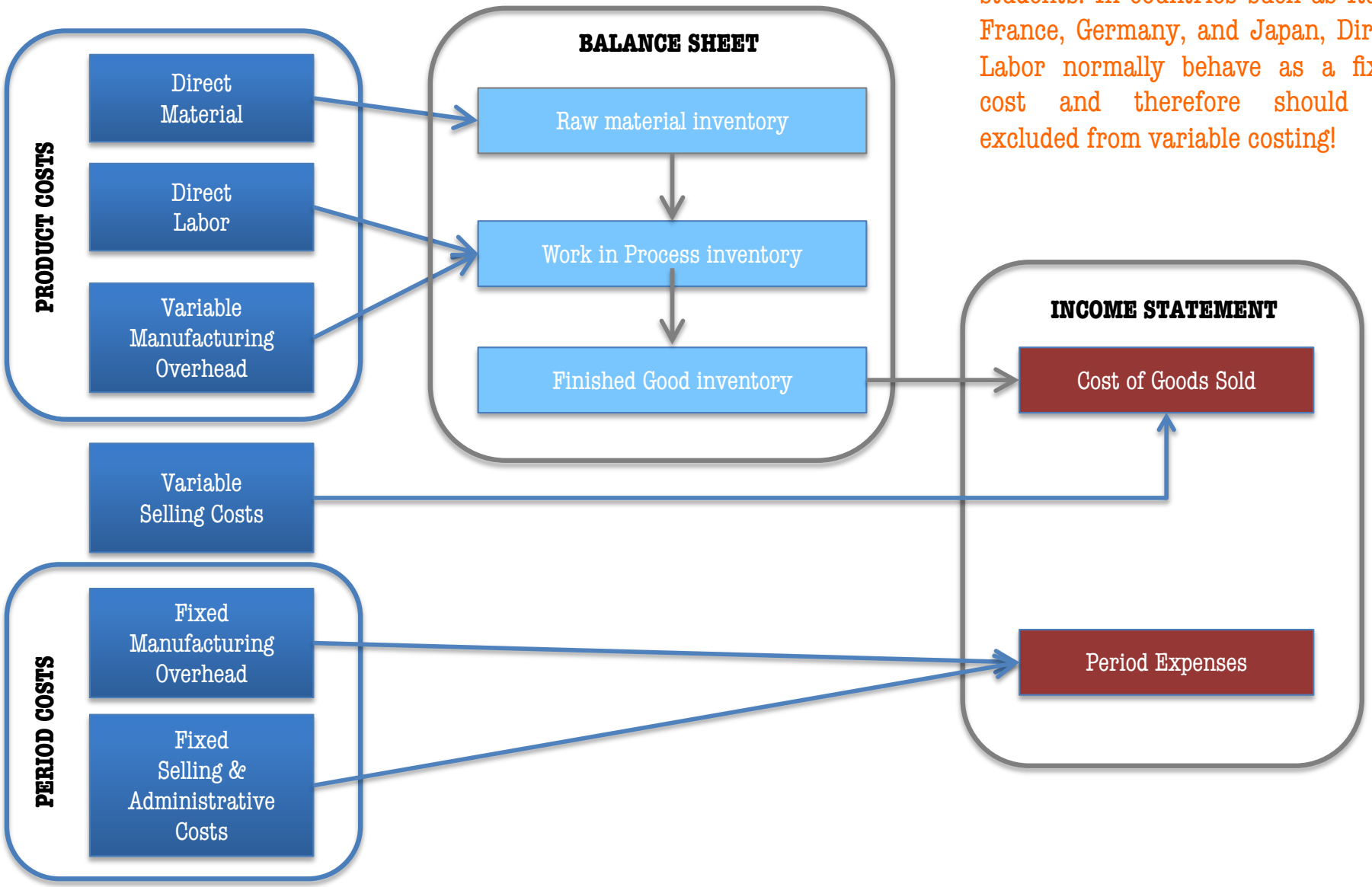


VARIABLE COSTING

Please note: this graph is taken from a textbook mainly used by USA students. In countries such as Italy, France, Germany, and Japan, Direct Labor normally behave as a fixed cost and therefore should be excluded from variable costing!



VARIABLE COSTING

Variable manufacturing costs	$226.800
# Product made	12.600
Manufacturing variable cost per unit	**$18,00**
Variable selling costs	$50.400
# Product sold	8.400
Selling variable cost per unit	**$6,00**
Manufacturing variable cost (per unit)	$18,00
Selling variable cost (per unit)	$6,00
Total variable cost per unit	**$24,00**

COST OF GOODS SOLD INCOME STATEMENT

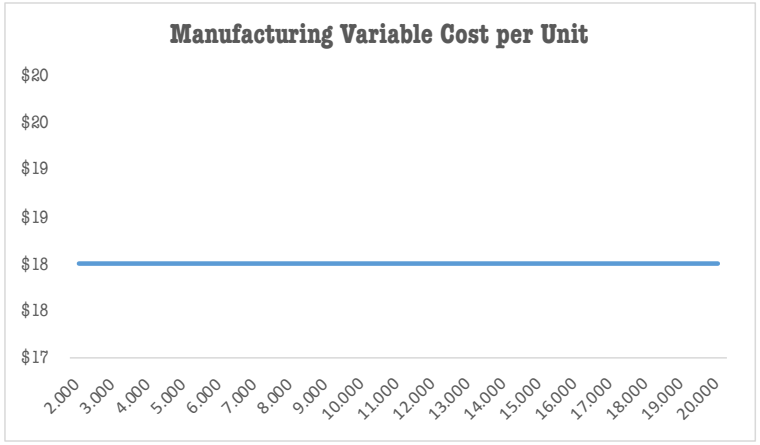
Sales Revenue	$1.218.000
- COGS (@manufacturing variable)	-$151.200
= Manufacturing variable margin	**$1.066.800**
- Selling variable costs	-$50.400
= Contribution Margin	**$1.016.400**
+ Fixed Revenues	$84.600
- Fixed Costs	-$999.360
= EBIT	**$101.640**
- Interest Expenses	-$90.000
= EBT	**$11.640**

TOTAL OUTPUT INCOME STATEMENT

Sales Revenue	$1.218.000
+ Change in Finished Goods Inventory	$75.600
= Total Output (@manufacturing variable)	**$1.293.600**
- Manufacturing variable costs	-$226.800
= Manufacturing variable margin	**$1.066.800**
- Selling costs	-$50.400
= Contribution Margin	**$1.016.400**
+ Fixed Revenues	$84.600
- Fixed Costs	-$999.360
= EBIT	**$101.640**
- Interest Expenses	-$90.000
= EBT	**$11.640**

TWO COMPONENTS

$$\frac{\text{Manufacturing Variable Costs}}{\text{\# Product made}} + \frac{\text{Selling Variable Costs}}{\text{\# Product sold}}$$



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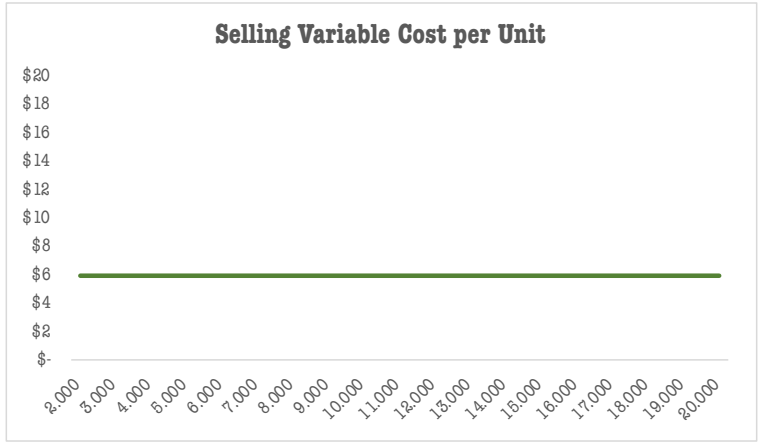


DIFFERENT RESULTS

# Product made	12.600
# Product sold	8.400

Sales Revenue	$1.218.000
+ Change in Finished Goods Inventory	$180.600
= Total Output (@manufacturing full - push	**$1.398.600**
- Manufacturing costs	-$541.800
= Gross profit	**$856.800**
+ Rent Income	$84.600
- S.G.&A. Expensnes	-$734.760
= EBIT	**$206.640**
- Interest Expenses	-$90.000
= EBT	**$116.640**

Sales Revenue	$1.218.000
+ Change in Finished Goods Inventory	$75.600
= Total Output (@manufacturing variable)	**$1.293.600**
- Manufacturing variable costs	-$226.800
= Manufacturing variable margin	**$1.066.800**
- Selling costs	-$50.400
= Contribution Margin	**$1.016.400**
+ Fixed Revenues	$84.600
- Fixed Costs	-$999.360
= EBIT	**$101.640**
- Interest Expenses	-$90.000
= EBT	**$11.640**

Even if they are aggregated in different ways the total amount of costs exposed in the two income statements is exactly the same: $ 1.276.560 of operating costs and $ 90.000 of interest expenses

RECONCILIATION OF THE TWO INCOME AMOUNTS

Units made	Units sold	Change in inventory (in units)	Cost per unit (absorption)	Cost per unit (variable)	Difference
13.000	8.400	4.600	€ 42,23	€ 18,00	€ 111.461,54
12.800	8.400	4.400	€ 42,61	€ 18,00	€ 108.281,25
12.600	8.400	4.200	€ 43,00	€ 18,00	€ 105.000,00
12.400	8.400	4.000	€ 43,40	€ 18,00	€ 101.612,90
12.200	8.400	3.800	€ 43,82	€ 18,00	€ 98.114,75
12.000	8.400	3.600	€ 44,25	€ 18,00	€ 94.500,00
11.800	8.400	3.400	€ 44,69	€ 18,00	€ 90.762,71
11.600	8.400	3.200	€ 45,16	€ 18,00	€ 86.896,55
11.400	8.400	3.000	€ 45,63	€ 18,00	€ 82.894,74
11.200	8.400	2.800	€ 46,13	€ 18,00	€ 78.750,00
11.000	8.400	2.600	€ 46,64	€ 18,00	€ 74.454,55
10.800	8.400	2.400	€ 47,17	€ 18,00	€ 70.000,00
10.600	8.400	2.200	€ 47,72	€ 18,00	€ 65.377,36
10.400	8.400	2.000	€ 48,29	€ 18,00	€ 60.576,92
10.200	8.400	1.800	€ 48,88	€ 18,00	€ 55.588,24
10.000	8.400	1.600	€ 49,50	€ 18,00	€ 50.400,00
9.800	8.400	1.400	€ 50,14	€ 18,00	€ 45.000,00
9.600	8.400	1.200	€ 50,81	€ 18,00	€ 39.375,00
9.400	8.400	1.000	€ 51,51	€ 18,00	€ 33.510,64
9.200	8.400	800	€ 52,24	€ 18,00	€ 27.391,30
9.000	8.400	600	€ 53,00	€ 18,00	€ 21.000,00
8.800	8.400	400	€ 53,80	€ 18,00	€ 14.318,18
8.600	8.400	200	€ 54,63	€ 18,00	€ 7.325,58
8.400	8.400	-	€ 55,50	€ 18,00	€ -
8.200	8.400	- 200	€ 56,41	€ 18,00	-€ 7.682,93
8.000	8.400	- 400	€ 57,38	€ 18,00	-€ 15.750,00
7.800	8.400	- 600	€ 58,38	€ 18,00	-€ 24.230,77
7.600	8.400	- 800	€ 59,45	€ 18,00	-€ 33.157,89
7.400	8.400	- 1.000	€ 60,57	€ 18,00	-€ 42.567,57
7.200	8.400	- 1.200	€ 61,75	€ 18,00	-€ 52.500,00
7.000	8.400	- 1.400	€ 63,00	€ 18,00	-€ 63.000,00
6.800	8.400	- 1.600	€ 64,32	€ 18,00	-€ 74.117,65
6.600	8.400	- 1.800	€ 65,73	€ 18,00	-€ 85.909,09
6.400	8.400	- 2.000	€ 67,22	€ 18,00	-€ 98.437,50
6.200	8.400	- 2.200	€ 68,81	€ 18,00	-€ 111.774,19
6.000	8.400	- 2.400	€ 70,50	€ 18,00	-€ 126.000,00
5.800	8.400	- 2.600	€ 72,31	€ 18,00	-€ 141.206,90
5.600	8.400	- 2.800	€ 74,25	€ 18,00	-€ 157.500,00
5.400	8.400	- 3.000	€ 76,33	€ 18,00	-€ 175.000,00
5.200	8.400	- 3.200	€ 78,58	€ 18,00	-€ 193.846,15
5.000	8.400	- 3.400	€ 81,00	€ 18,00	-€ 214.200,00
4.800	8.400	- 3.600	€ 83,63	€ 18,00	-€ 236.250,00
4.600	8.400	- 3.800	€ 86,48	€ 18,00	-€ 260.217,39
4.400	8.400	- 4.000	€ 89,59	€ 18,00	-€ 286.363,64
4.200	8.400	- 4.200	€ 93,00	€ 18,00	-€ 315.000,00
4.000	8.400	- 4.400	€ 96,75	€ 18,00	-€ 346.500,00

Note that this elucidates the difference between the $116,640 income related to the application of absorption costing and the $11,640 income produced using the variable costing rule

When the production made is equal to the production sold (and therefore there are no changes in the inventories of finished goods) the two cost rules lead to the same result

Assuming the same level of production and efficiency in the previous year and therefore the same cost per unit data in the two periods.

RECONCILIATION OF THE TWO INCOME AMOUNTS

The two operating incomes in our simple example not the same.

The differences occur because under absorption costing some fixed manufacturing overhead is capitalized in inventories (i.e., included in product costs) rather than currently expensed on the income statement.

If inventories increase during a period, under absorption costing some of the fixed manufacturing overhead of the current period will be *deferred* in ending inventories.

RECONCILIATION OF THE TWO INCOME AMOUNTS

In general, when the units produced exceed unit sales and hence inventories increase, net operating income is higher under absorption costing than under variable costing. This occurs because some of the fixed manufacturing overhead of the period is deferred in inventories under absorption costing.

In contrast, when unit sales exceed the units produced and hence inventories decrease, net operating income is lower under absorption costing than under variable costing. This occurs because some of the fixed manufacturing overhead of previous periods is released from inventories under absorption costing.

When the units produced and unit sales are equal, no change in inventories occurs and absorption costing and variable costing net operating incomes are the same

ABSORPTION VERSUS VARIABLE COSTING

Relation between production and sales	Effect on inventories	Relation between variable and absorption income
Units produced = Units sold	No change in inventories	Absorption = Variable
Units produced > Units sold	Inventories Increase	Absorption > Variable
Units produced < Units sold	Inventories decrease	Absorption < Variable

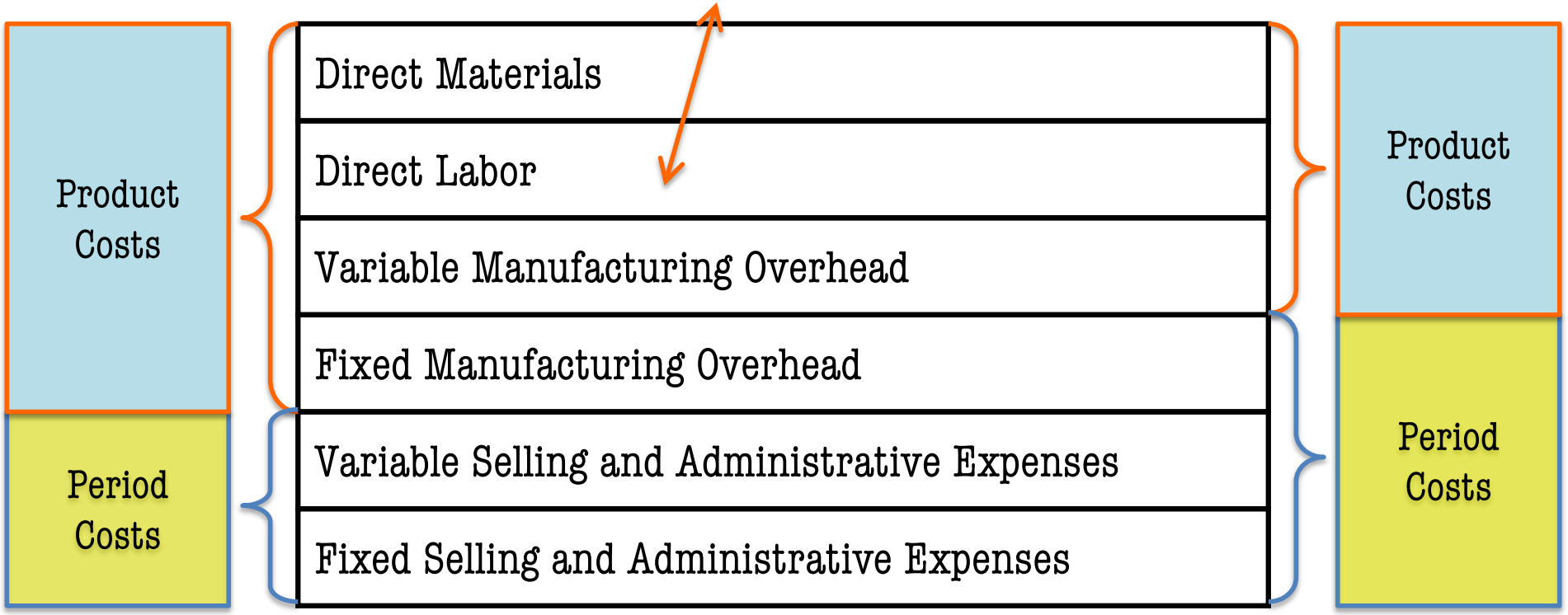
SOURCE: Noreen–Brewer– Garrison, "Managerial Accounting for Managers", Mc Graw Hill, Second Edition

ABSORPTION VERSUS VARIABLE COSTING

ABSORPTION COSTING

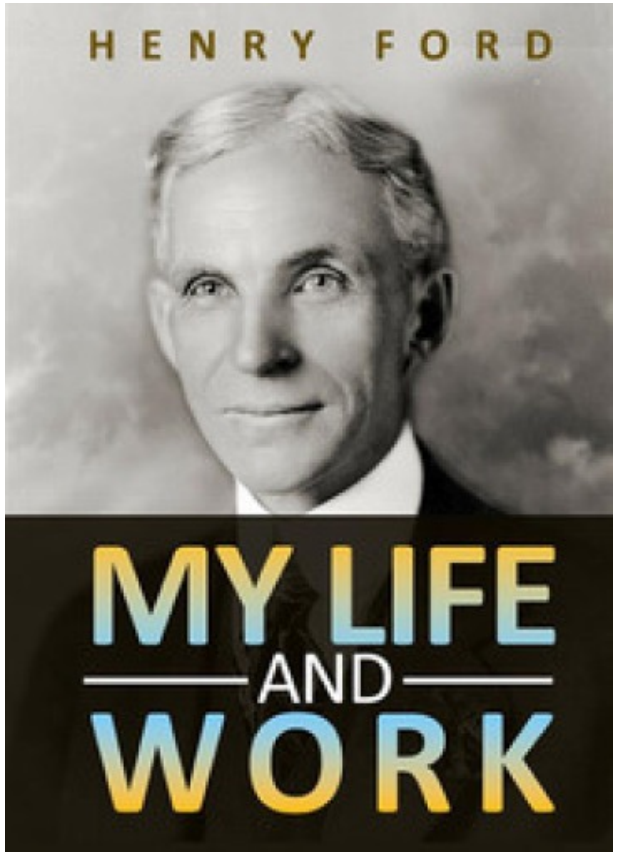
Please note: this graph is taken from a textbook mainly used by USA students. In countries such as Italy, France, Germany, and Japan, Direct Labor normally behave as a fixed cost and therefore should be excluded from variable costing!

VARIABLE COSTING



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

ANY COLOUR THAT HE WANTS SO LONG AS IT IS BLACK



<<This season demonstrated conclusively to me that it was time to put the new policy in force. The salesmen, before I had announced the policy, were spurred by the great sales to think that even greater sales might be had if only we had more models.

It is strange how, just as soon as an article becomes successful, somebody starts to think that it would be more successful if only it were different. There is a tendency to keep monkeying with styles and to spoil a good thing by changing it. The salesmen were insistent on increasing the line.

Therefore in 1909 I announced one morning, without any previous warning, that in the future *we were going to build only one model, that the model was going to be "Model T" and that the chassis would be exactly the same for all cars,* and I remarked:

"Any customer can have a car painted any color that he wants so long as it is black.">>

HIGH HOMOGENEITY – VARIABLE COSTS PREVALENCE

1

CAPTIVE MARKETS

Captive markets are markets where the potential consumers face a severely limited number of competitive suppliers; their only choices are to purchase what is available or to make no purchase at all.

Captive markets result in higher prices and less diversity for consumers.

Power is in the hands of Supplier.

SHIFT IN BARGAIN POWER

2A

EVOLUTION OF THE MARKETING CONCEPT

Production Concept

Demand for goods and services > Supply ... therefore consumers gladly purchased what was being produced. Producers have a captive market. Investment on increasing the efficiencies of production had the greatest impact on company profitability. Thus, smart businesses focused on increasing productivity, rather than understanding the consumer. Henry Ford's quote: "The customer can have any color car as long as it is black" is closely identified with this era! This is appropriate for developing countries and evolved in the US with the advent of the industrial revolution.

Sales Concept

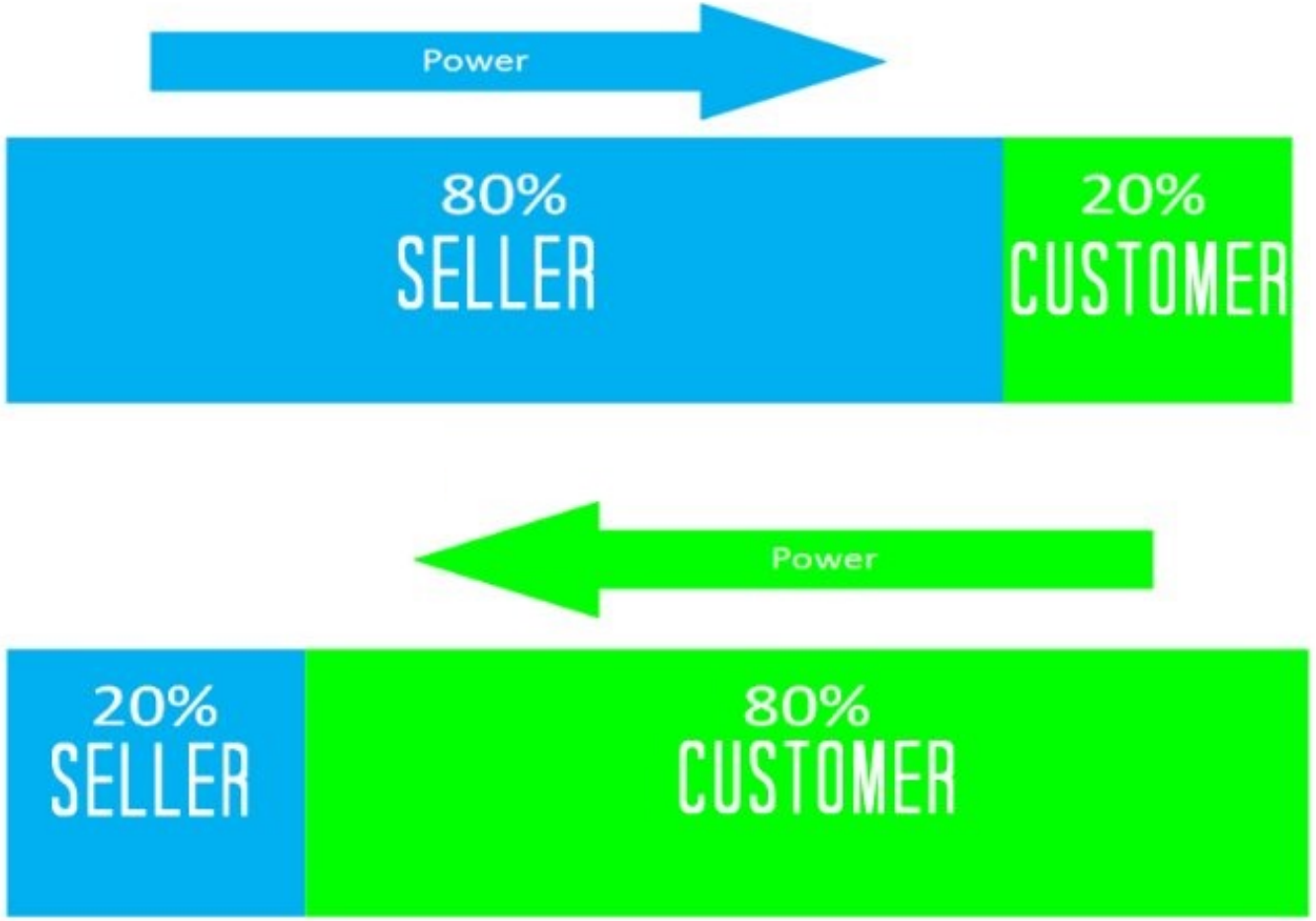
Demand = Supply ... therefore producers had to convince consumers to purchase their products. Focus of business investment starts shifting towards developing a robust sales mechanism in order to communicate with consumers. The sales concept is also relevant for products consumers do not seek out ordinarily, such as life insurance and dental treatment.

Marketing Concept

Supply > Demand ... therefore producers need to first understand what consumers wanted, then produce those products, then convince consumers to purchase those products. Target marketing and market segmentation became the new tools to increase company profitability.

SOURCE: https://www1.udel.edu/alex/market/key1.html

POWER SHIFT FROM SELLERS TO BUYERS



NEW REALITIES REQUIRE NEW MODELS

SELECTED CONCEPTS AND SELECTED RELATIONSHIPS BETWEEN THEM

DECISION MODEL (ABSTRACTION)

BUSINESS PROCESSES (REALITY)

UNSOLD PRODUCTS OR UNSOLD MERCHANDISES

WHAT DO STORES DO WITH UNSOLD MERCHANDISE?

When it comes to food, retailers throw away around 45 billion tons each year. That's about 10 percent of what's on the shelves. A lot of stores donate food that hasn't perished. Walgreens, for example gives away about 5 million pounds of food a year to charity according to Reuben Slone, who runs supply chain for the company.

But when it comes to clothing, household goods or anything with a brand name, it gets a little more complicated.

James Merwin can attest to that. It was 2008 and he had a problem. Actually, he had 30,000 problems.

Merwin was working for a bathroom fixture company at the time. This was when the housing bubble had just burst. People stopped building houses -- and they stopped buying toilets to put in them.

"You go very quickly to almost bursting at the seams with product everywhere," Merwin says. "We had to not just fill our own warehouses; we paid a premium to store it somewhere else because we didn’t have space for it."

This is something that happens in varying degrees to almost every retailer -- from a pharmacy to a big box store. It’s called the "Bullwhip effect," and it means you ramp up to meet what you think demand is going to be, and then demand falls off. It’s at its worst with seasonal stuff like plastic Christmas trees or clothes that go out of fashion.

Mark Barratt teaches operations and supply chain management at Marquette University. He says the first thing stores do is cut the price.

"Target has a pretty clear schedule of how long the product is sitting on the shelf before it gets discounted."

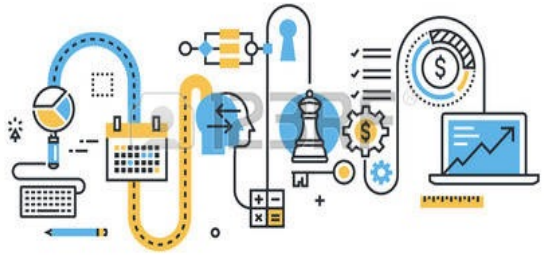
Barratt says big box stores like Target systematically cut the price until it’s roughly 70 percent off.

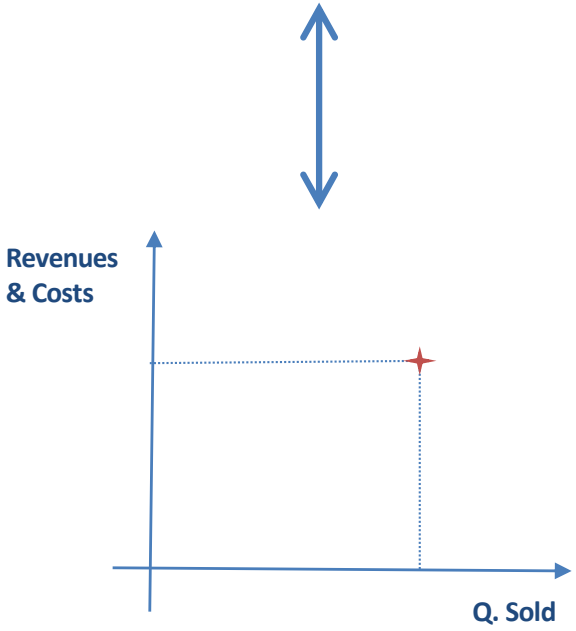
"If it's still unsold from there, they are likely to liquidate it or in some cases donate it," Barratt says. "Or sell it to one of these discount stores like T.J. Maxx or Marshalls."

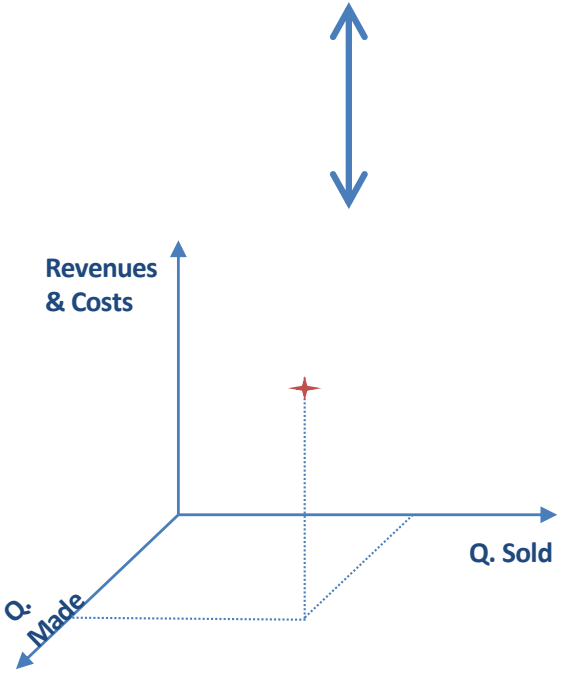
But brands can be sensitive about their products ending up in outlets or in resale shops.

SOURCE:https://www.marketplace.org/2014/03/10/what-do-stores-do-unsold-merchandise/

INCREASE IN COMPLEXITY

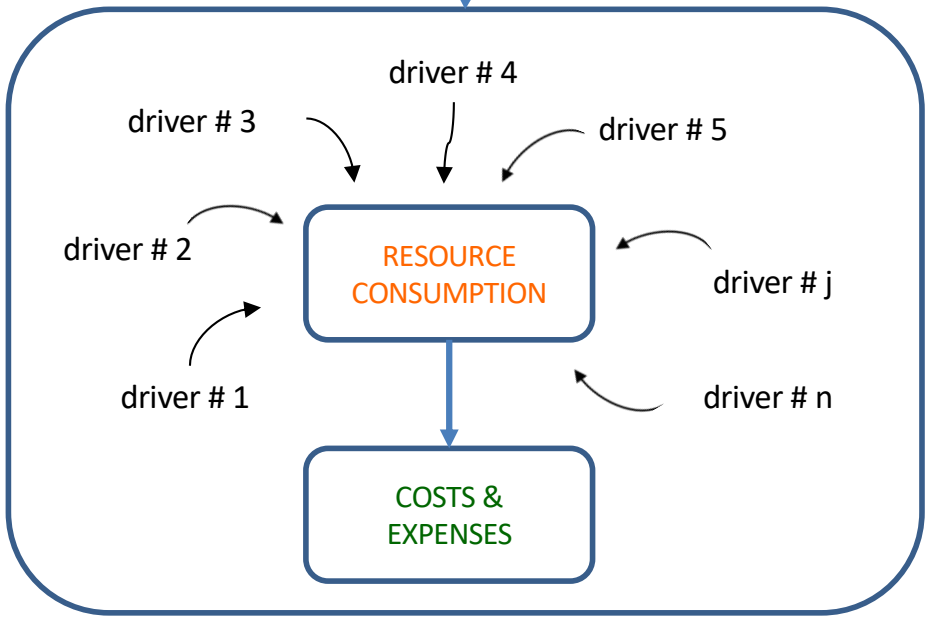




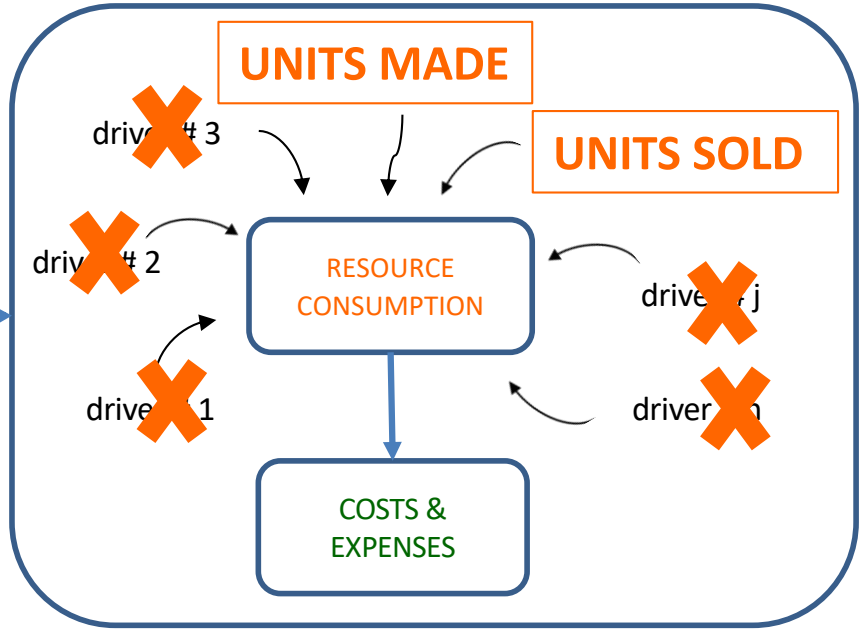


COST-VOLUME-PROFIT MODEL

SELECTED CONCEPTS AND
SELECTED RELATIONSHIPS
BETWEEN THEM



REALITY



DECISION MODEL

FIXED OR VARIABLE?

Inbound logistics

Customs duties

Direct materials

Indirect materials

Outwork

Machine electricity usage

Machine supplies

Internal logistics

Sales commissions

Outbound logistics

Provisions on doubtful debts

Volume of inputs acquired

Volume of outputs produced

Volume of outputs sold

MORE ON VARIABLE AND FIXED COSTS

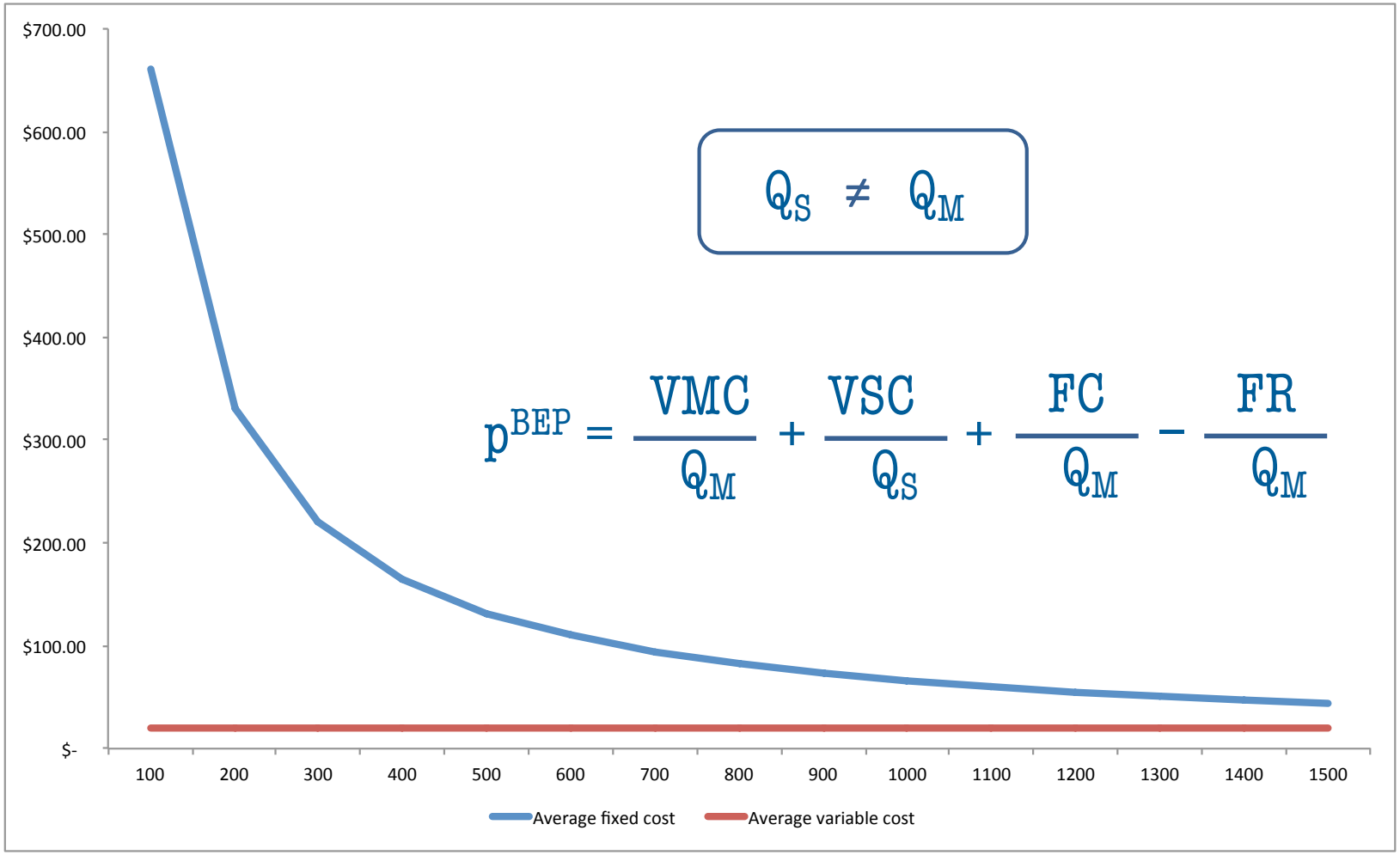
	Variable	Fixed
Manufacturing Costs	✔	✔
Selling Costs	✔	✔
Administrative Costs	negligible	✔
General Costs	negligible	✔

MORE ON VARIABLE AND FIXED COSTS

	Variable	Fixed	Total
Manufacturing	€ 60.000	€ 140.000	**€ 200.000**
Selling	€ 18.000	€ 22.000	**€ 40.000**
Administrative		€ 80.000	**€ 80.000**
General		€ 130.000	**€ 130.000**
Total	**€ 78.000**	**€ 372.000**	**€ 450.000**

Quantity made	2000
Quantity sold	1500

BREAK-EVEN PRICE

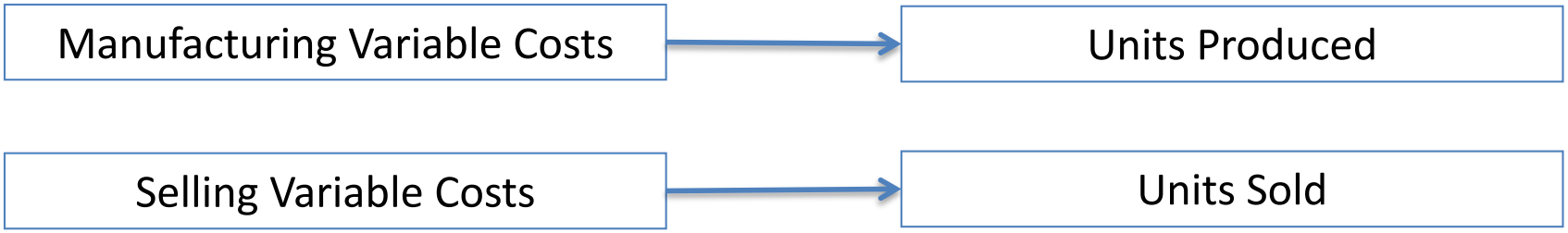


$$Q_S \neq Q_M$$

$$p^{BEP} = \frac{VMC}{Q_M} + \frac{VSC}{Q_S} + \frac{FC}{Q_M} - \frac{FR}{Q_M}$$

MORE ON VARIABLE AND FIXED COSTS

	Variable	Fixed
Manufacturing Costs	✔	✔
Selling Costs	✔	✔
Administrative Costs	negligible	✔
General Costs	negligible	✔



WINERY'S VARIABLE COSTS

Bottles
Corks
Capsules
Labels
Packing paper
Pallets
Wooden caskets
Descriptive cards
Sales commissions
Allowance for doubtful accounts
Selling transport costs
Bulk discount in goods (1/10)

WHICH IS THE CORRECT PARAMETER?

Bottles
Corks
Capsules
Labels
Packing paper
Pallets
Wooden caskets
Descriptive cards

Manufacturing Variable Costs
# of bottles produced

Sales commissions
Allowance for doubtful accounts
Selling transport costs
Bulk discount in goods (1/10)

Selling Variable Costs
# of bottles produced

A DANGEROUS EXAMPLE

Contribution Margin Income Statement

The traditional income statement for external reporting shows the functional classification of costs, that is, manufacturing costs versus nonmanufacturing expenses (or operating expenses). An alternative format of income statement, known as the contribution margin income statement, organizes the costs by behavior rather than by function. It shows the relationship of variable costs and fixed costs a given cost item is associated with, regardless of the functions.

The contribution approach to income determination provides data that are useful for managerial planning and decision making. The statement highlights the concept of contribution margin, which is the difference between sales and variable costs. The traditional format emphasizes the concept of gross margin, which is the difference between sales and cost of goods sold.

These two concepts are independent and have nothing to do with each other. Gross margin is available to cover nonmanufacturing expenses, whereas contribution margin is available to cover fixed costs. A comparison is made between the traditional format and the contribution format below.

Traditional Format

Sales		$15,000
Less: Cost of Goods Sold		7,000
Gross Margin		$8,000
Less: Operating Expenses		
Selling	$2,100	
Administrative	1,500	3,600
Net Income		$4,400

Contribution Format

Sales		$15,000
Less: Variable Expenses		
Manufacturing	$4,000	
Selling	1,600	
Administrative	500	6,100
Contribution Margin		$8,900
Less: Fixed Expenses		
Manufacturing	$3,000	
Selling	500	
Administrative	1,000	4,500
Net Income		$4,400

Beware of examples like this one: the two results are equal only because it is assumed that the quantities sold are exactly equal to the quantities produced. This example is consistent with the simplifying assumptions of the C-V-P model but is completely unrealistic for real manufacturing firms.

A SOPHISTICATED BUT DANGEROUS EXAMPLE

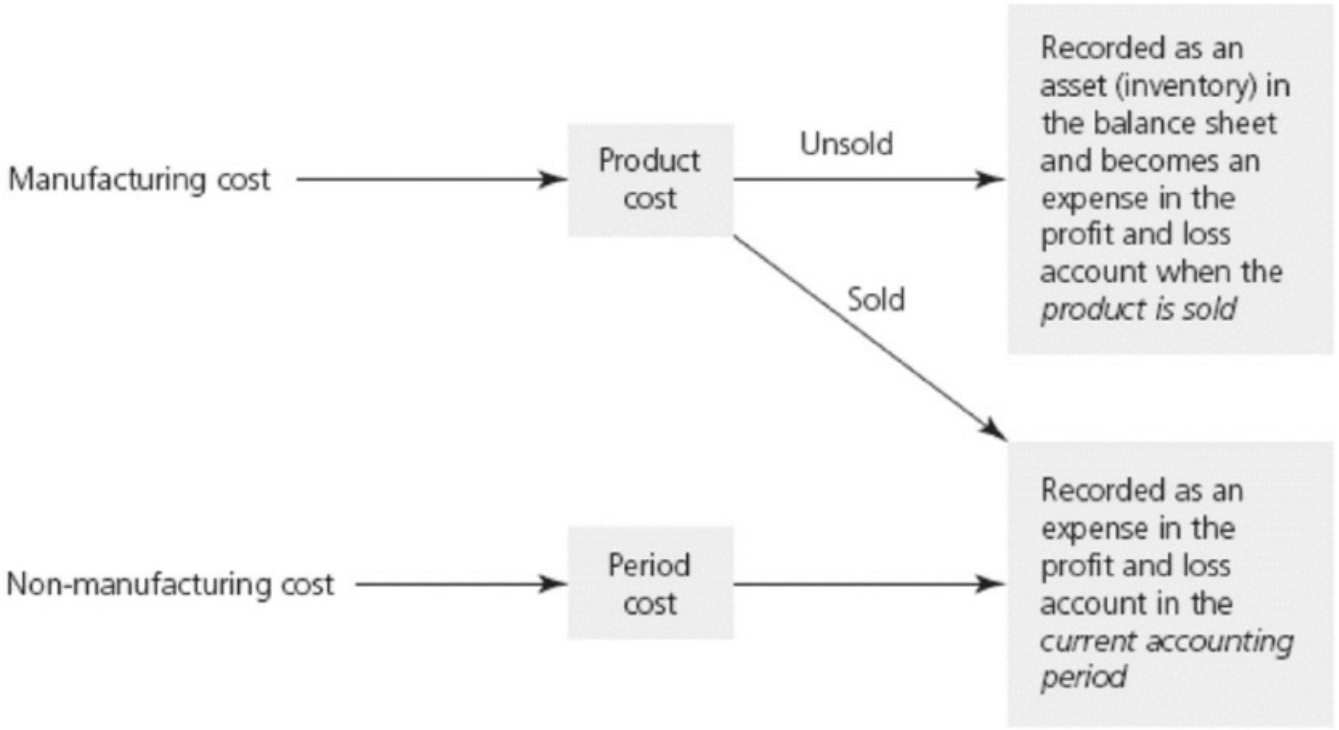
VARGO VIDEO COMPANY
CVP Income Statement
For the Month Ended June 30, 2010

	Total		Per Unit
Sales		$800,000	$500
Variable expenses			
Cost of goods sold	$400,000		
Selling expenses	60,000		
Administrative expenses	20,000		
Total variable expenses		480,000	300
Contribution margin		**320,000**	**$200**
Fixed expenses			
Cost of goods sold	120,000		
Selling expenses	40,000		
Administrative expenses	40,000		
Total fixed expenses		200,000	
Net income		**$120,000**	

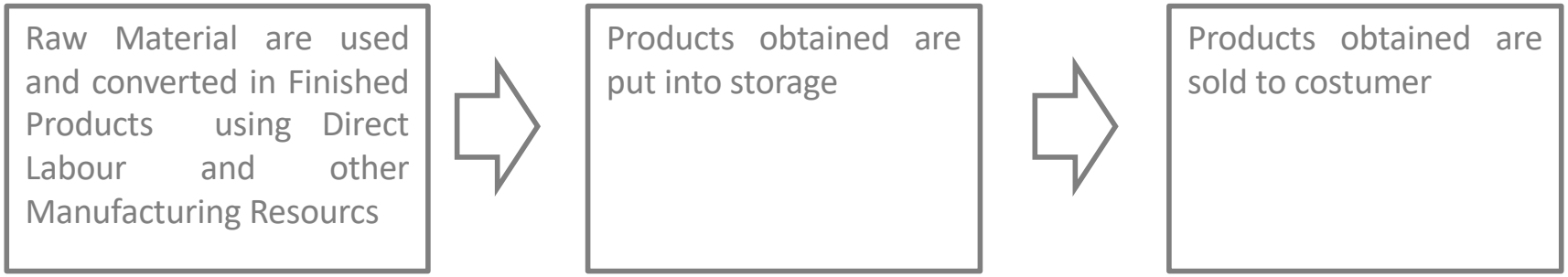
In this example, the cost of sales (evidently estimated using a "full" type of cost rule, most likely "absorption costing") was separated into the two components (variable and fixed) so that the contribution margin could be calculated. Note also that administrative variable cost components were considered.

This example is interesting, but dangerous because the format chosen for the income statement (COGS format) "hides" the change in finished goods inventory (which must also be broken into two). It should be clear, in fact, that while contribution margin is calculated correctly with this format, the same is not true for net income. More precisely the latter relates to the cost rule by which total cost of sales is calculated. The amount of manufacturing fixed costs included in the COGS (that are expenses for the period) may be different from the amount of the manufacturing fixed costs incurred during the period.

ABSORPTION COSTING



VARIABLE COSTING



RAW MATERIALS ⇨ WORK IN PROCESS ⇨ FINISHED PRODUCT ⇨ COST OF GOODS SOLD

Variable **Manufacturing** Costs are incurred

Variable **Selling** Costs are incurred

SHIFT IN BARGAIN POWER

2B

DIFFERENT PRODUCTS

TELESCOPIC HANDLERS

MIXER WAGON

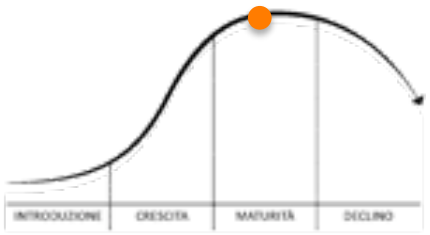
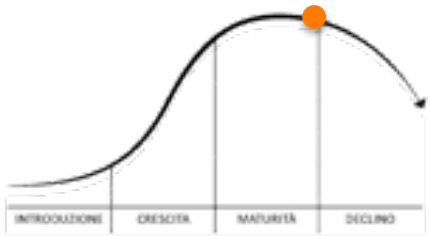
LEADER MONO STANDARD	LEADER MONO ECOMIX	LEADER MONO ECOMODE
Semovente 1 coclea verticale	Semovente 1 coclea verticale	Semovente 1 coclea verticale
1100 Standard 1400 A Standard 1400 B Standard 1700 A Standard 1700 B Standard 2000 Standard	1100 Ecomix 1400 A Ecomix 1400 B Ecomix 1700 A Ecomix 1700 B Ecomix 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 2600 Standard 3000 Standard 3300 Standard	1600 Ecomix 2200 Ecomix 2600 Ecomix 2600 Ecomix 3000 Ecomix 3300 Ecomix	1300 Ecomode 2200 Ecomode 2600 Ecomode 2800 Ecomode 3000 Ecomode 3300 Ecomode

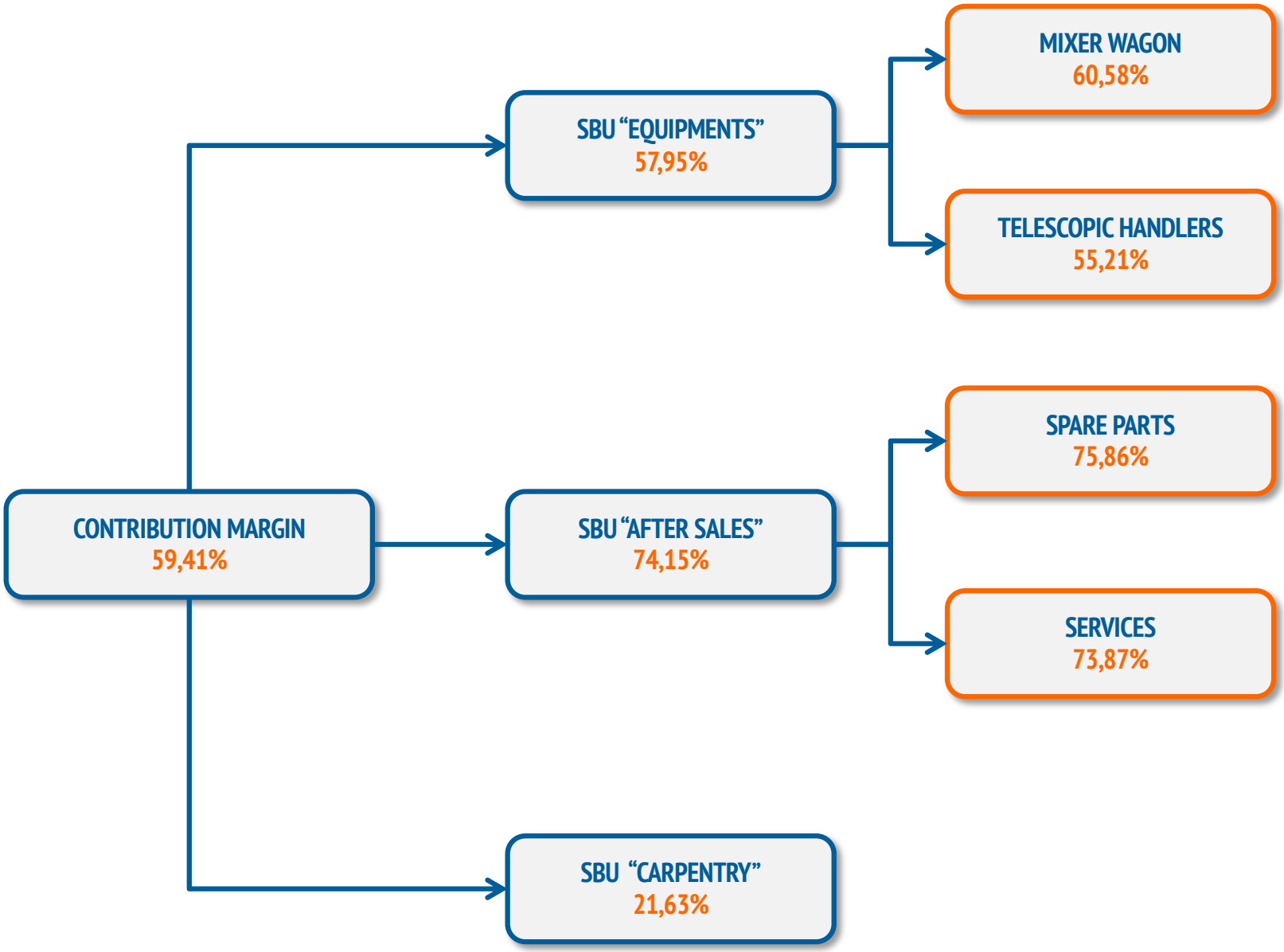
LEADER MONO COMPACT STANDARD	LEADER MONO COMPACT ECOMIX
Semovente 1 coclea verticale	Semovente 1 coclea verticale
1200 Standard 1400 Standard 1600 Standard	1200 Ecomix 1400 Ecomix 1600 Ecomix

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

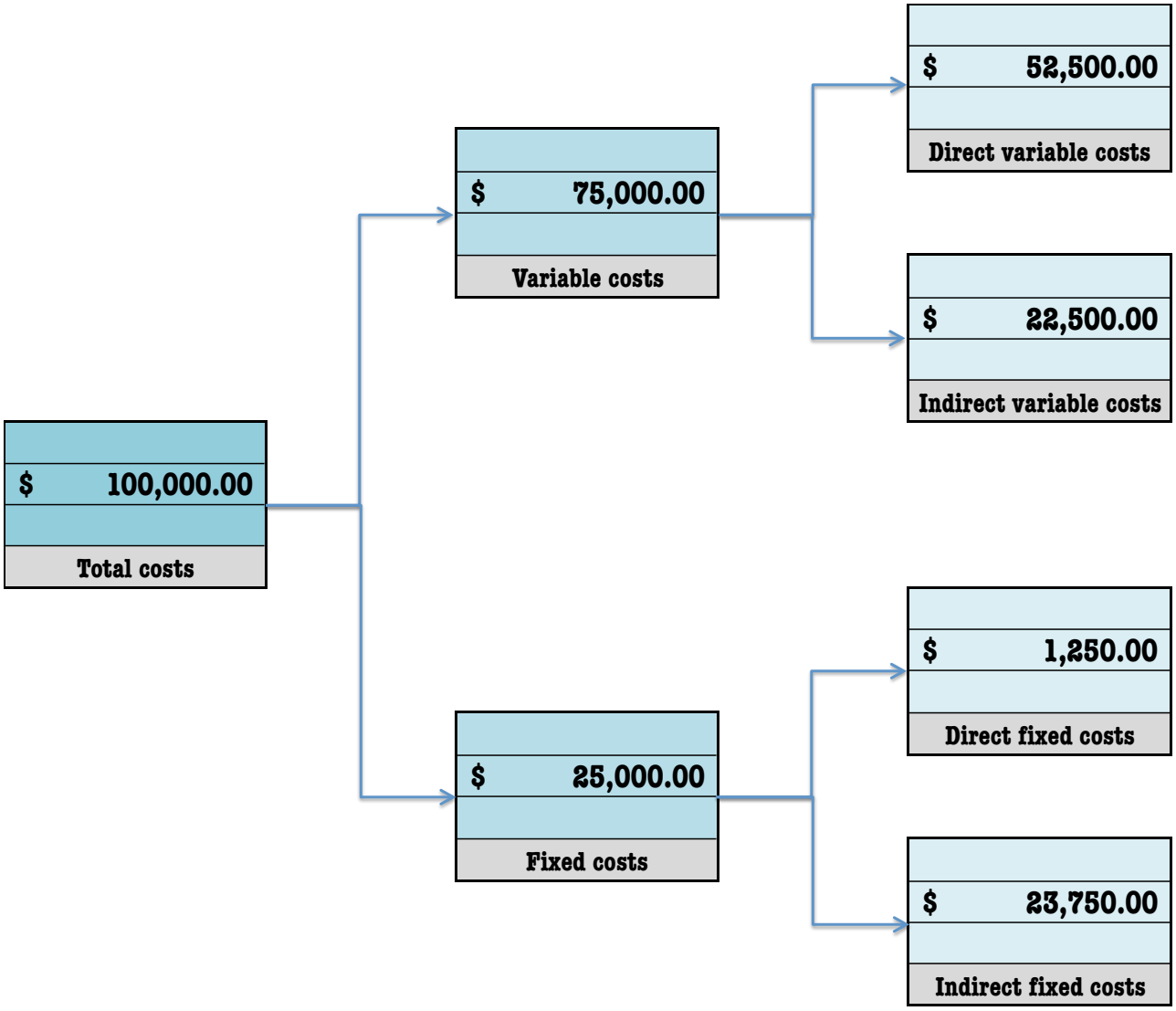
DIFFERENT MARKETS

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 SBU



INCREASE IN HETEROGENEITY



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.

TOTAL VOLUME

30 #

10 #

20 #

20 #

30 #

10 #

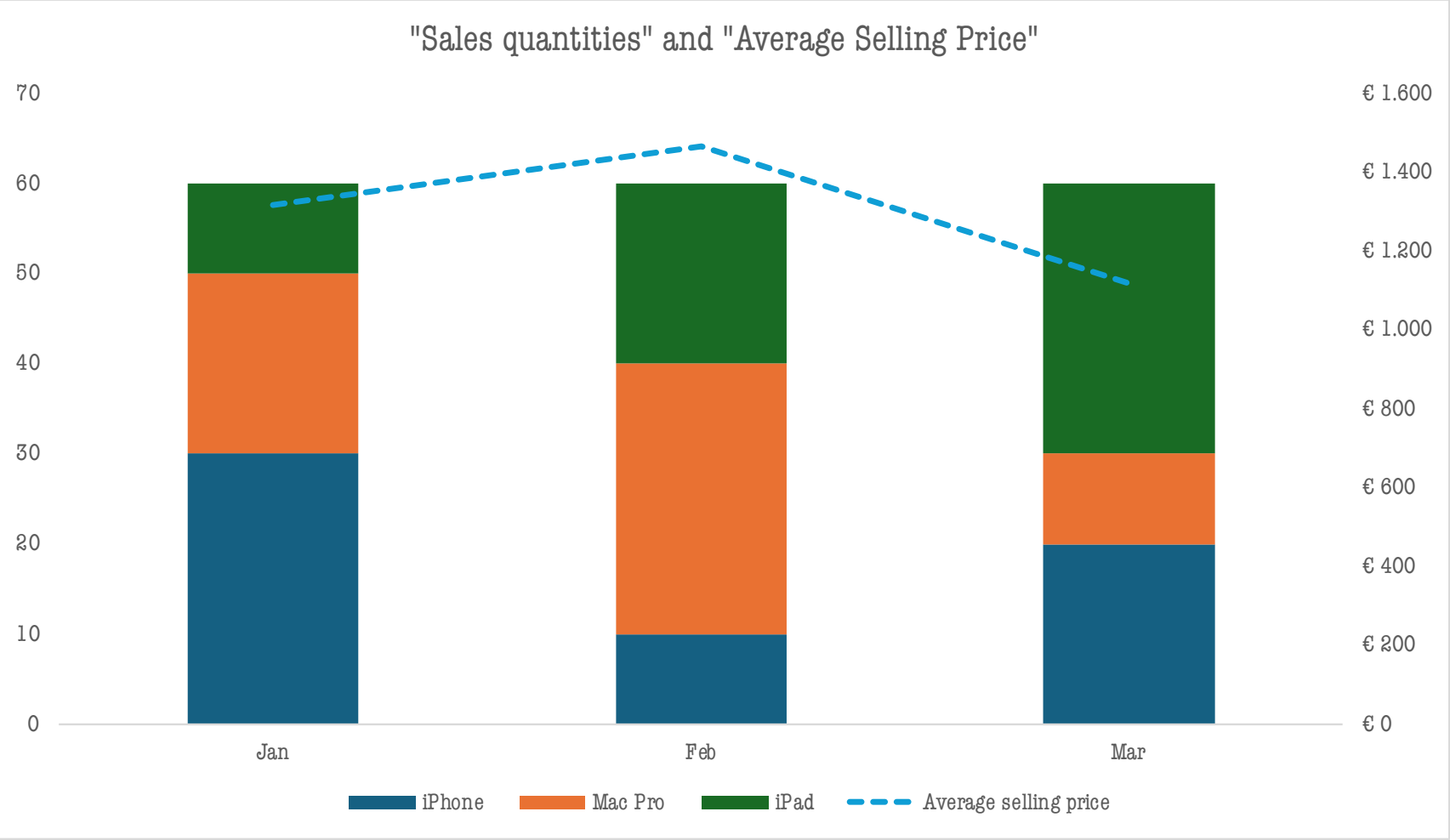
10 #

20 #

30 #

DEVICES?

ADDING UP DIFFERENT THINGS TOGETHER



Note that the volume seems to be stable and the average price seems to be changing, while the prices of the three items remained exactly the same over the three months: a phenomenon concerning "volume" sold over the three months is interpreted as a phenomenon concerning price.

PRICE AS A HOMOGENIZING FACTOR

$ 1,000

1 iPhone

$ 2,000

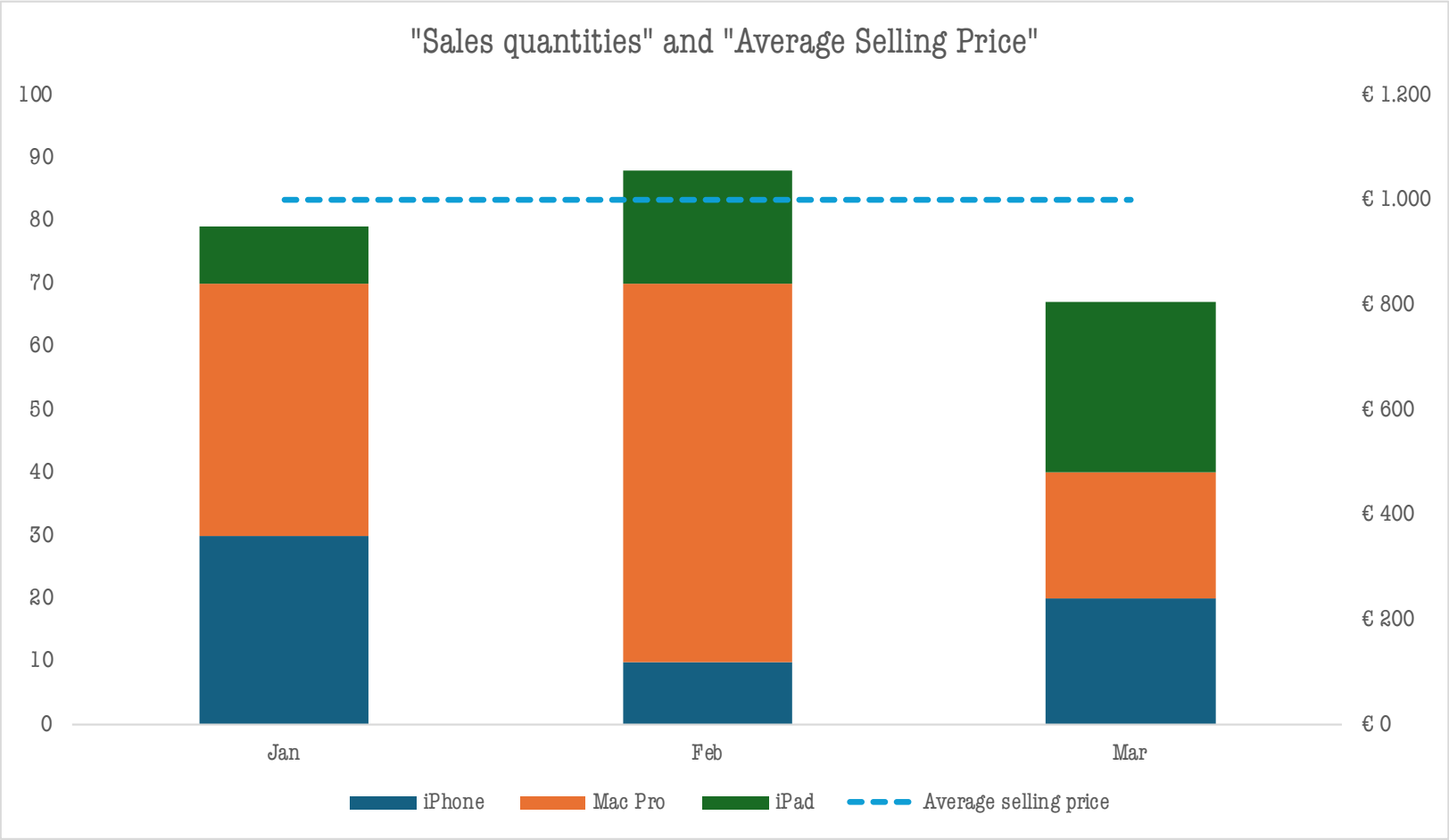
2 iPhone equivalent

$ 900

0,9 iPhone equivalent

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

ANALYSIS DEVELOPED IN TERMS OF EQUIVALENT GOODS



Note that the analysis this time accounts for the fact that different things were sold in different months with clear effects on overall volume. It is no longer taken for granted that selling a Mac Pro is equivalent to selling an iPad, because the two items are different from each other not only from a technical point of view but also-and especially as far as this analysis is concerned-from an economic point of view

UNEVENNESS IN THE RESOURCES DEPLOYED

Surgenon

Nurse

Laboratory technician

CAN MINUTES OF DIFFERENT "RESOURCES" BE ADDED TOGETHER?

	Hypothesis 1	Hypothesis 2	Hypothesis 3
	30'	10'	20'
	20'	30'	10'
	10'	20'	30'
	?	?	?

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.

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

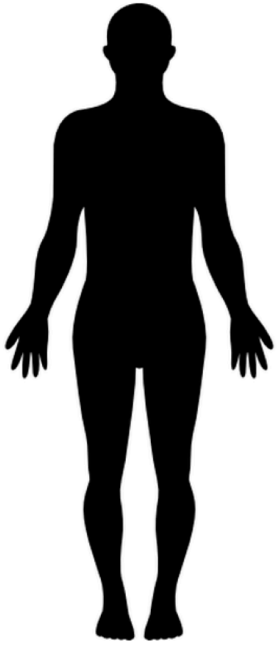
In order to consider the sales mix when calculating the breakeven point in units for multiple products, you must determine a *weighted average* contribution margin ratio which considers the differing selling prices, variable costs per unit, and number of units for each products.

BREAK-EVEN CALCULATIONS FOR TWO PRODUCTS: AN EXAMPLE

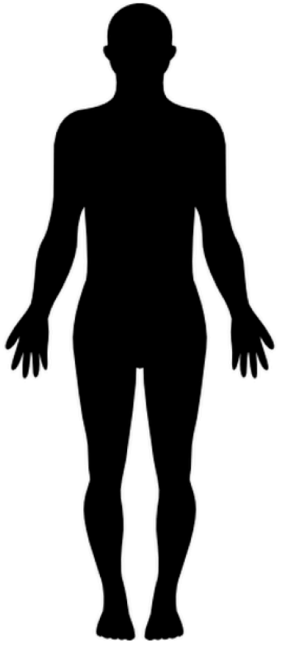
Average selling price	€	10.00	€	50.00
Variable cost per unit	-€	4.00	-€	38.00
Contribution margin	**€**	**6.00**	**€**	**12.00**

Fixed costs	€	500,000

MAKING COMPARISONS

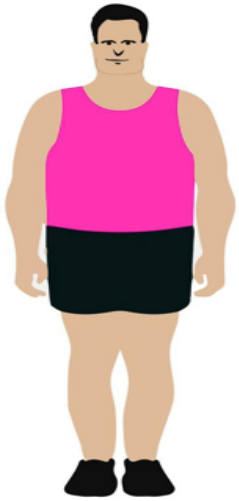


148 lbs.



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

A RANGE OF POSSIBLE SOLUTIONS

This is the range of possible solutions, each of which depends on a different composition of the sales mix. The concrete solution of the break-even point for a multiproduct company therefore requires one more assumption: one that determines in what proportions the individual products that make up the supply portfolio will be sold

If our turnover is lower than € 833,333 irrespective of what the sales mix is, we will not be able to cover fixed costs

If our turnover is lower than € 2,083,333 irrespective of what the sales mix is, we will be able to cover fixed costs

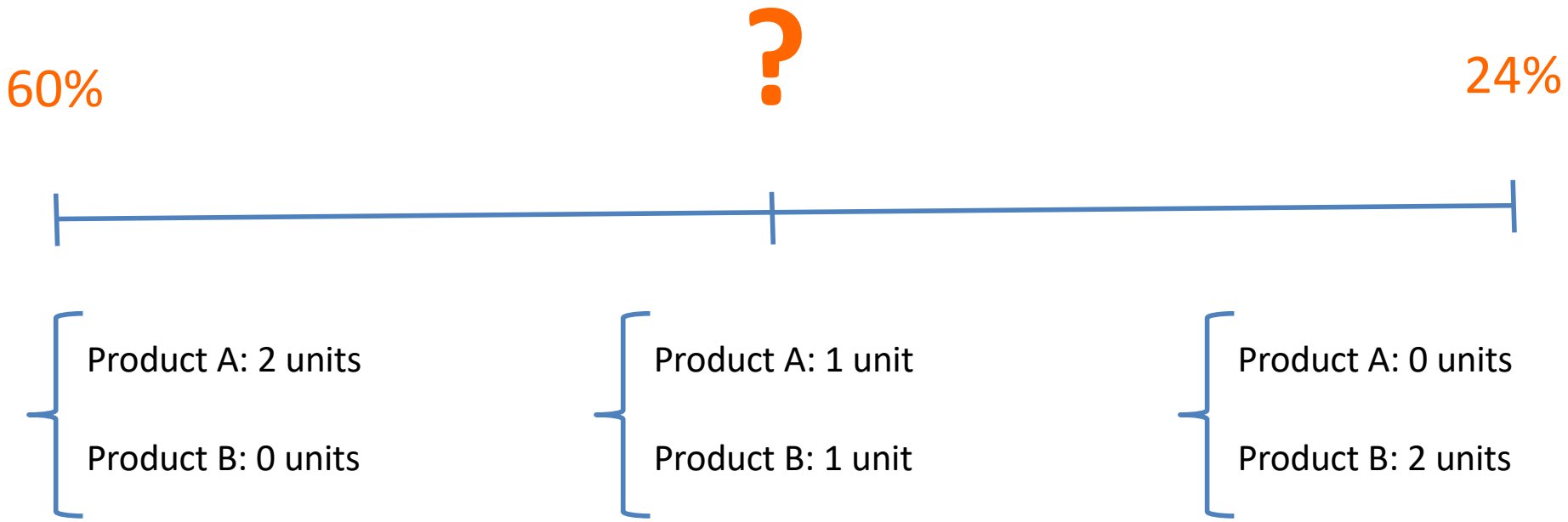
€ 833,333 of Sales Revenues

83,334 units of Product A

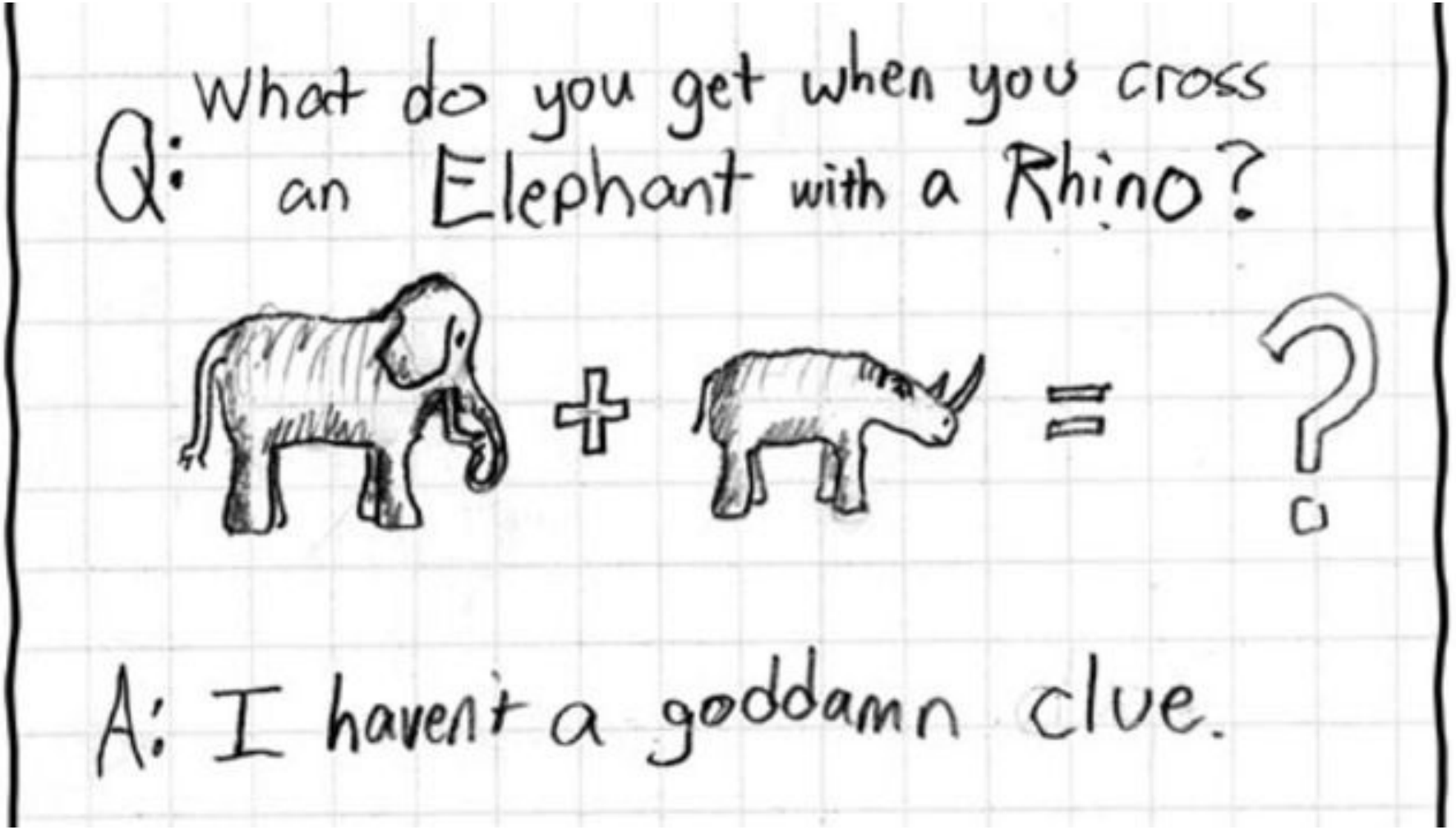
€ 2,083,333 of Sales Revenues

41,667 units of Product B

AN IMPORTANT CONSIDERATION



THE PROBLEM WITH HETEROGENEITY



WELL, I HAVE IT!

AN IMPORTANT CONSIDERATION

60% **30%** 24%

Product A: 100%

Product B: 0%

Product A: 0%

Product B: 100%

Since the average of the margins of the two products cannot be weighted by quantities (since the quantities of different items cannot be added together) it must necessarily be weighted in some other way. as already stated, the solution proposed by the C-V-P model is to homogenize the different products through their prices: the average will therefore be weighted using turnovers (sales revenues).

Product A: **16,67%**

Product B: **83,33%**

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

Numbers of "bundles" $= \dfrac{\text{Break Even Sales}}{41667} = \dfrac{€\ 1.666.667}{€\ 60,00} = 27.778$

Number of A	27.778
Numbers of B	27.778

A DIFFERENT SCENARIO: THE BUDGETED SALES MIX

	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

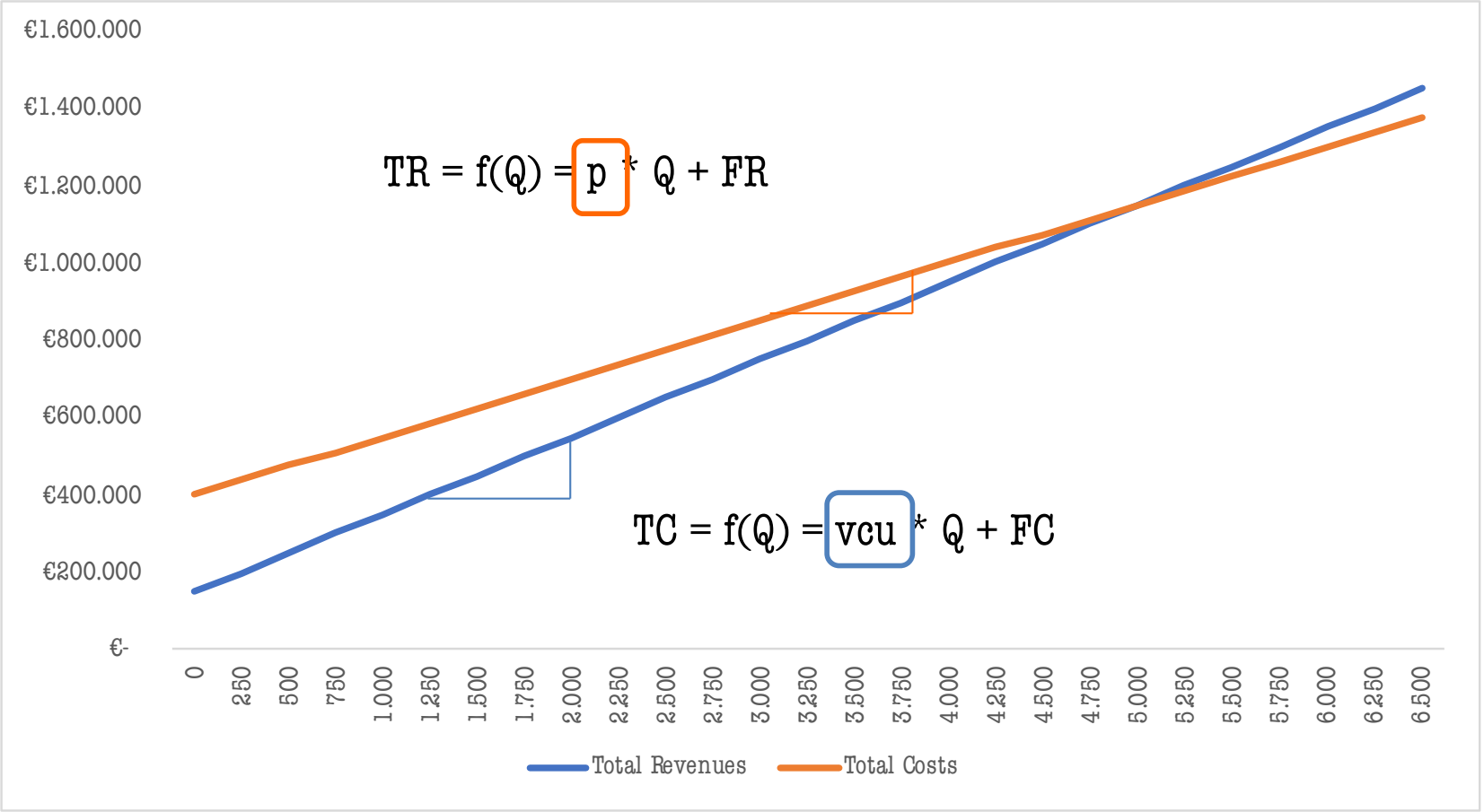
$$\frac{\text{Fixed Costs}}{\text{Contribution margin ratio}} = \frac{€\ 500{,}000}{35.45\%} = €\ 1{,}410{,}256$$

Numbers of "bundles"

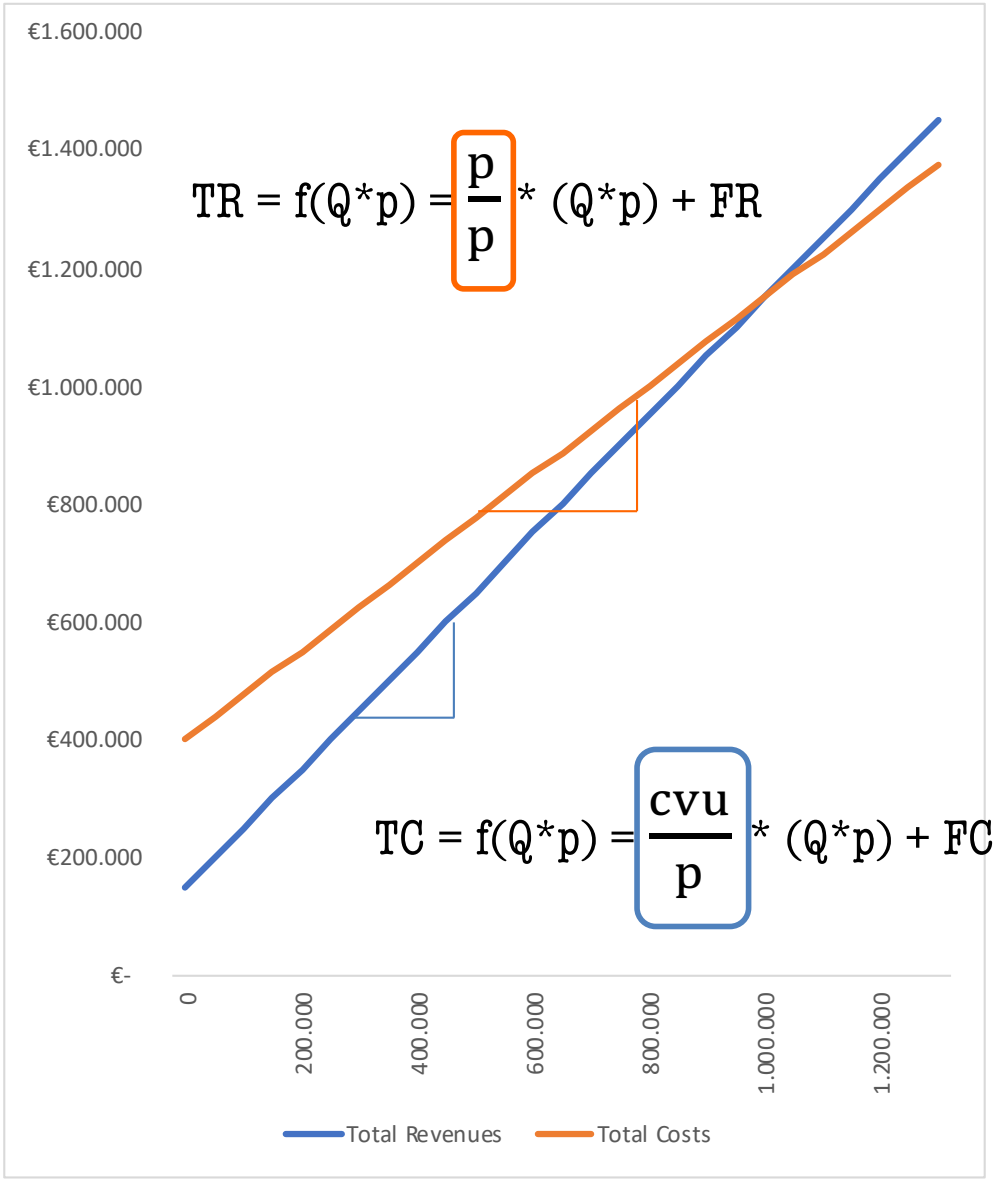
$$\frac{\text{Break Even Sales}}{41667} = \frac{€\ 1{,}410{,}256}{€\ 220.00} = 6{,}411$$

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

FROM THIS


€1.600.000
€1.400.000
€1.200.000
€1.000.000
€800.000
€600.000
€400.000
€200.000
€-
TR = f(Q) = p * Q + FR
TC = f(Q) = vcu * Q + FC
0
250
500
750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000
6.250
6.500
Total Revenues
Total Costs

TO THIS


€1.600.000
€1.400.000
€1.200.000
€1.000.000
€800.000
€600.000
€400.000
€200.000
€-
0
200.000
400.000
600.000
800.000
1.000.000
1.200.000
Total Revenues
Total Costs
TR = f(Q*p) = p/p * (Q*p) + FR
TC = f(Q*p) = cvu/p * (Q*p) + FC

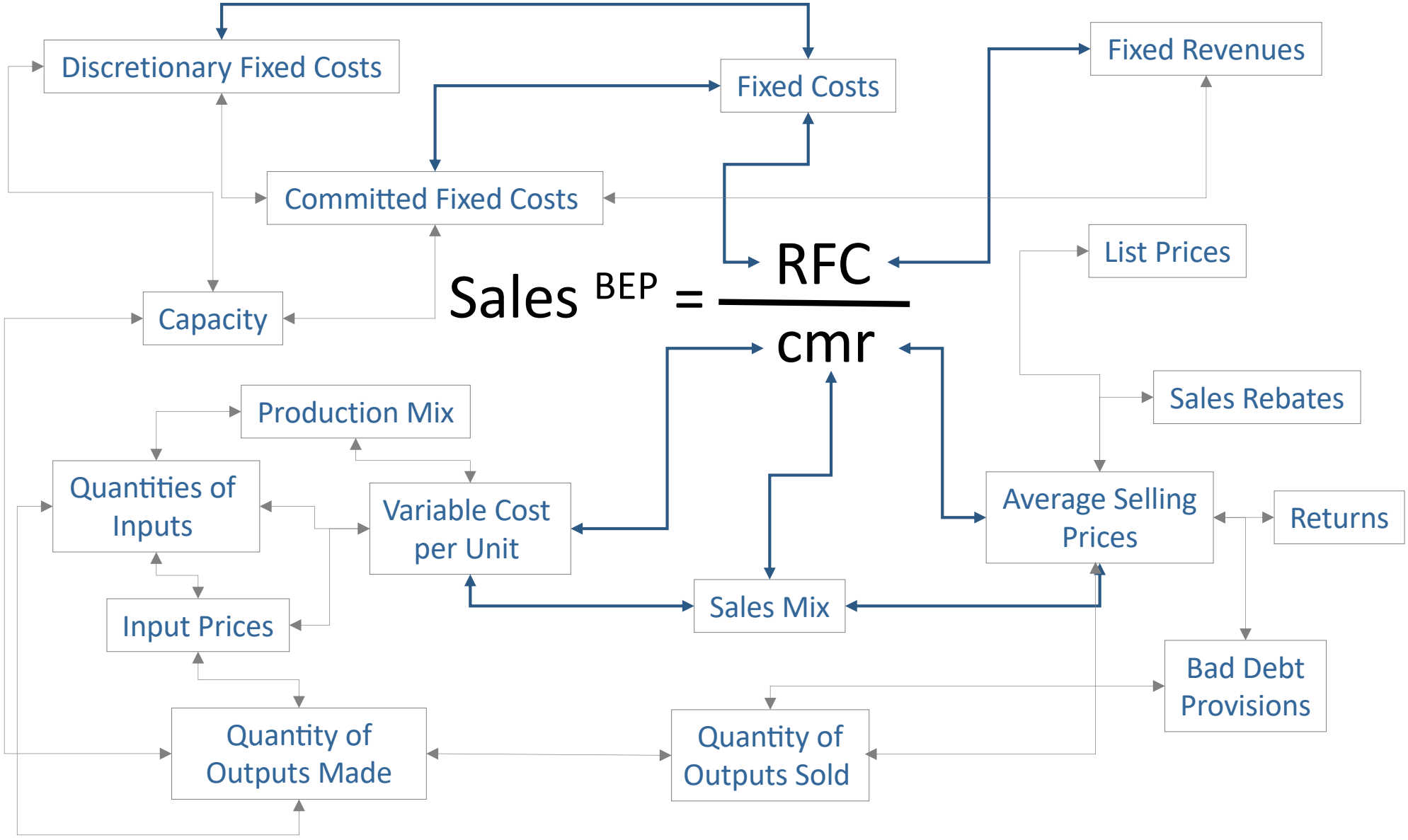
ASSUMPTIONS OF CVP ANALYSIS: A SUMMARY

A number of assumptions commonly underlie CVP analysis:

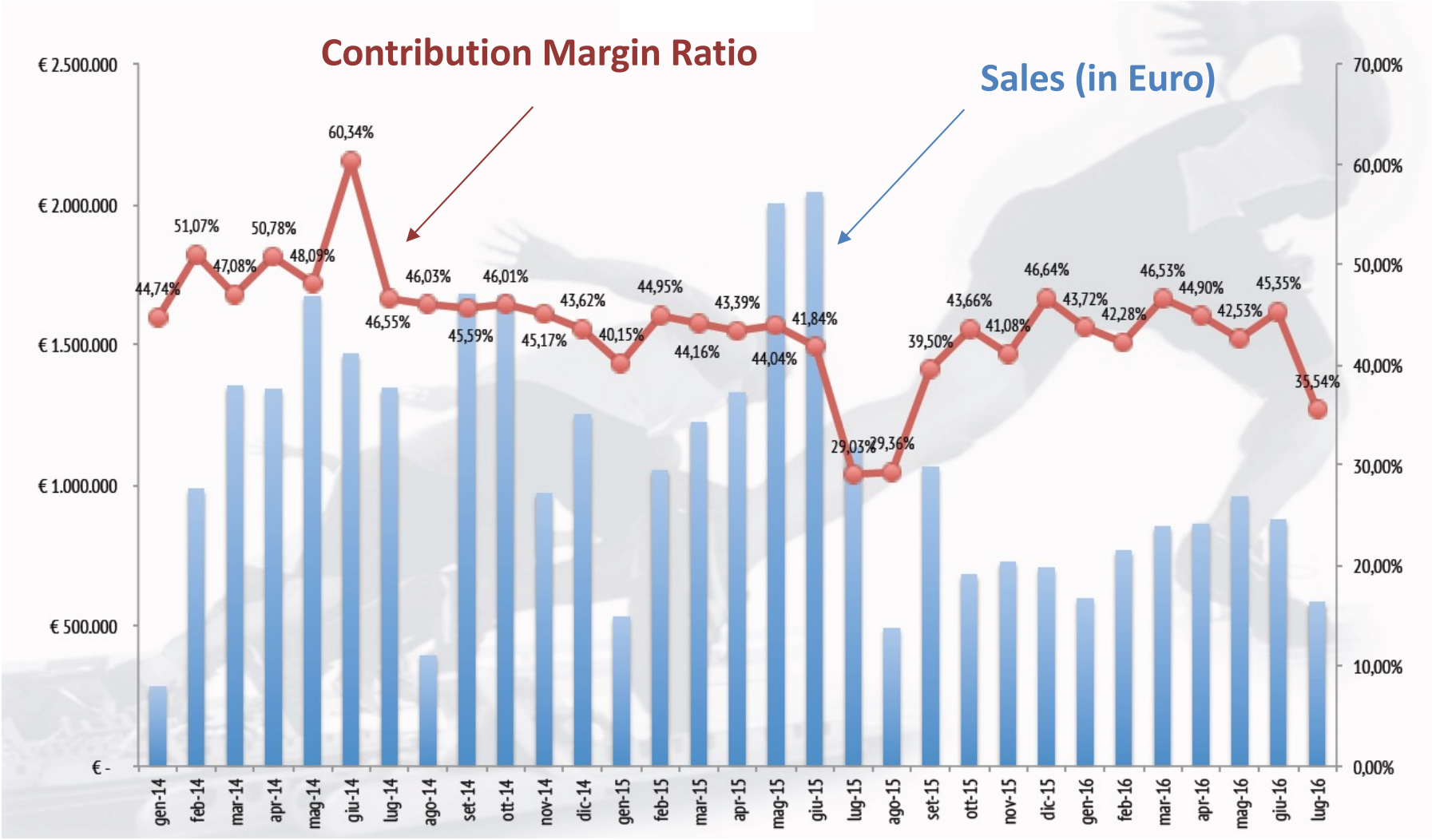
- ✧ Changes in activity are the only factors that affect costs.
- ✧ The behavior of both costs and revenues are linear throughout the relevant range of activity; therefore:
  - Selling price is constant. The price of a product or service will not change as volume changes.
  - The variable element is 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

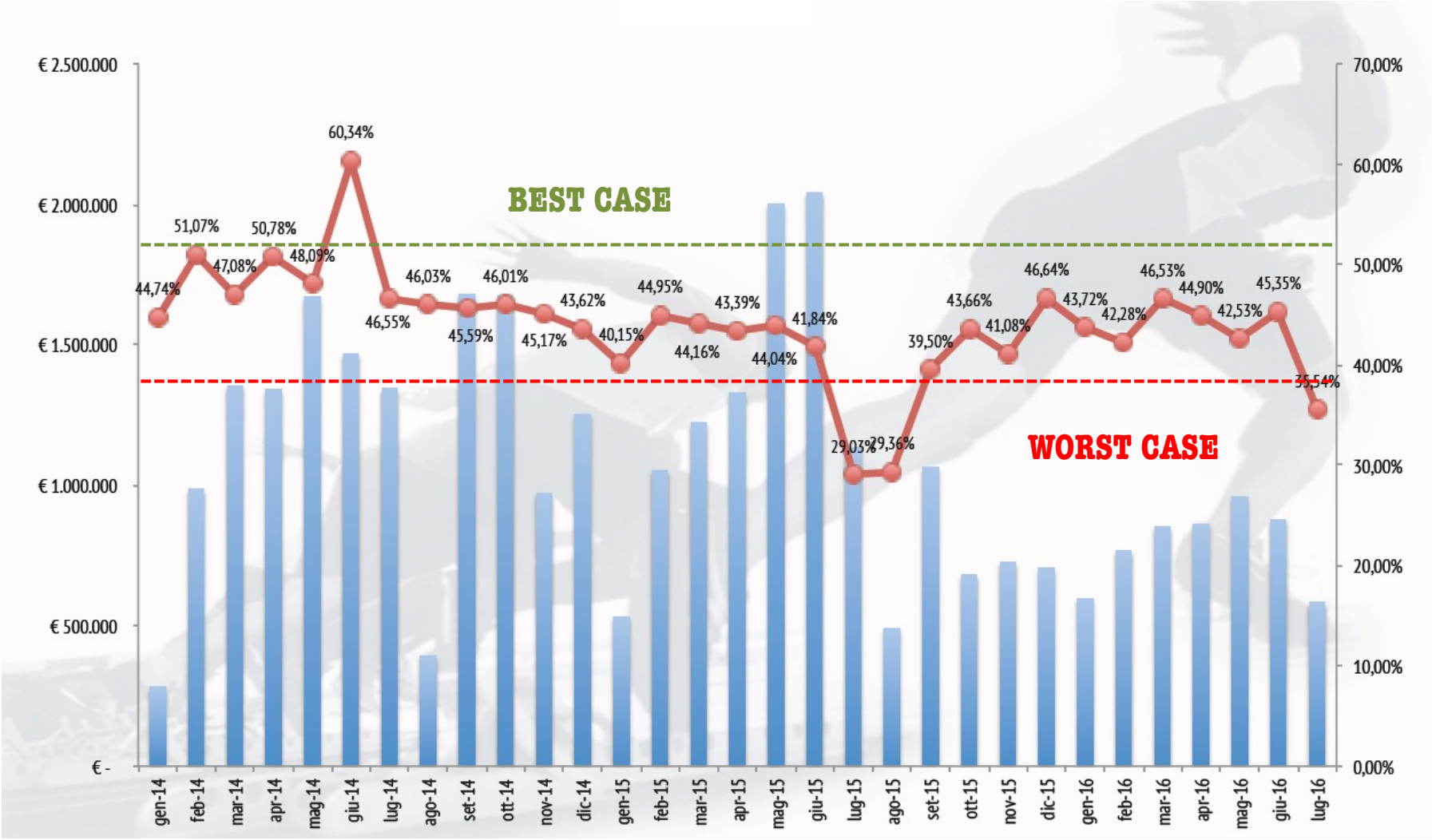
DRIVERS OF BREAK-EVEN SALES



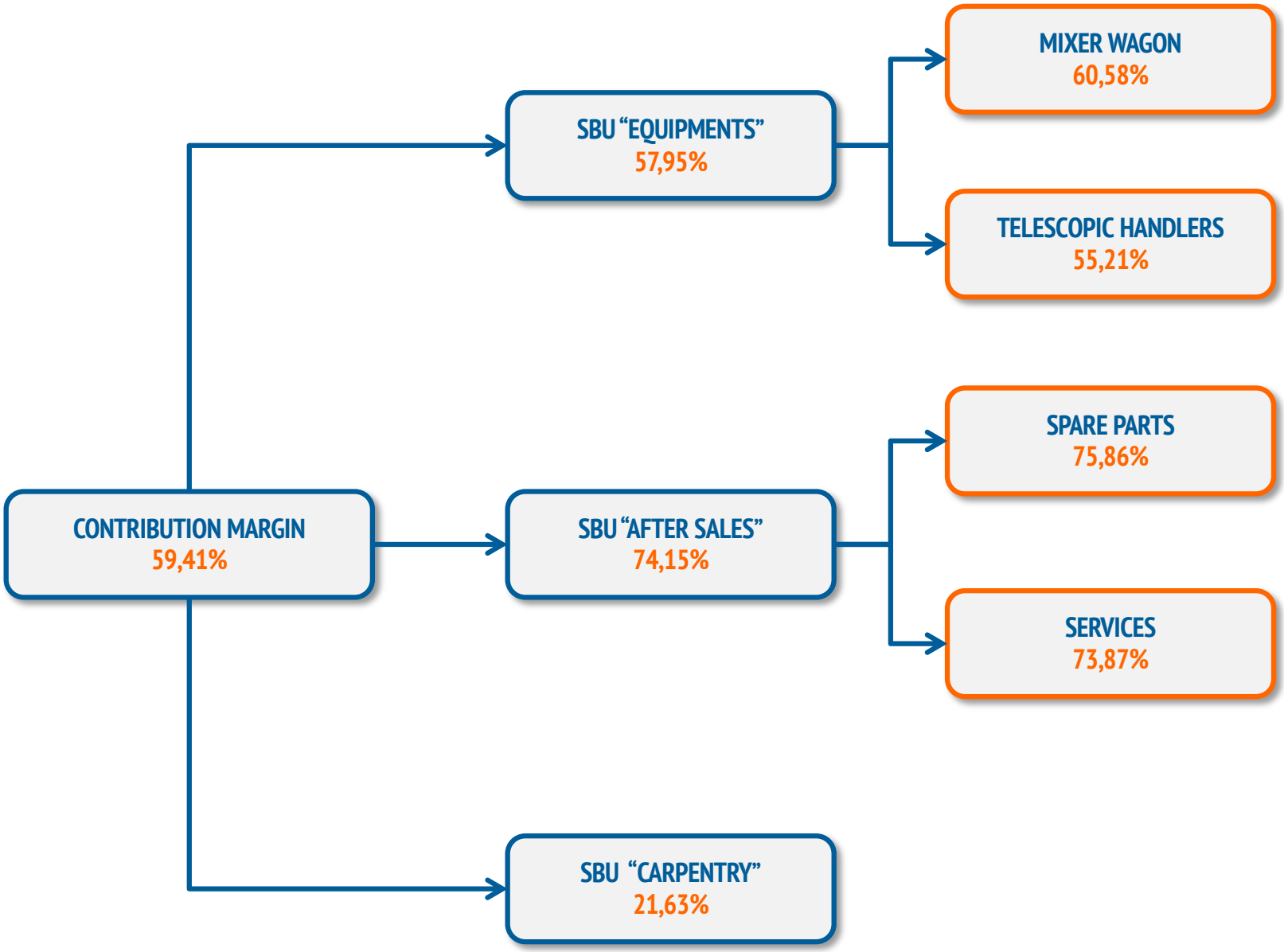
REAL LIFE ANALYSIS



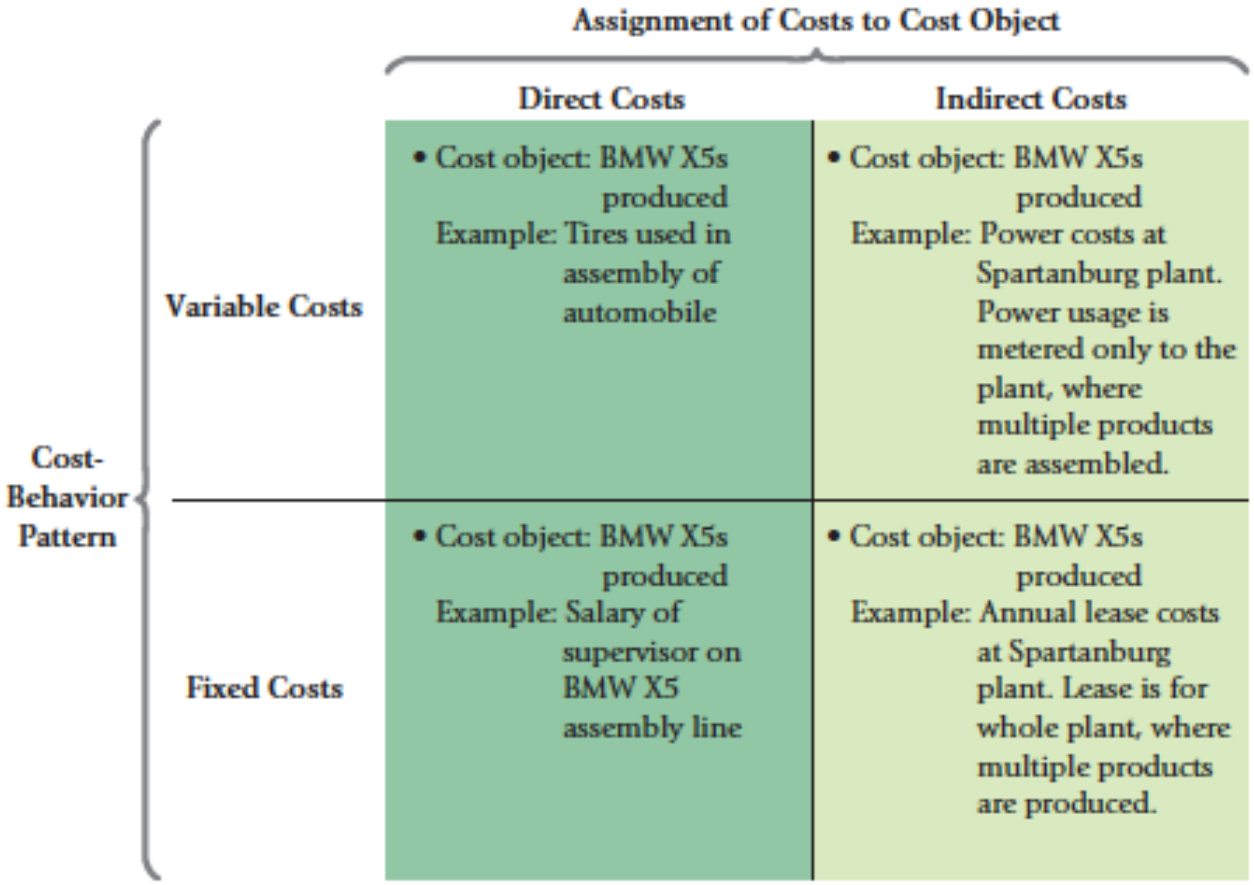
REAL LIFE ANALYSIS: YOU NARROW THE RANGE



A WEIGHTED AVERAGE OF DIFFERENT SBU



ANOTHER PROBLEM



FONTE: Horngren–Datar–Rajan, "Cost Accounting. A Managerial Emphasis", Fourteenth Edition

EASYTWO CORPORATION

EASYTWO Corporation, which operates in the USA, produces two different products: "X" and "Y". The company has provided the following operational and financial data concerning its actual operations for the year:

	Product "X"	**Product "Y"**
Units made and sold	8,000	1,200
Average selling price	10 US$	50 US$
Quantity of raw material used (in liters)	16	60
Direct labor hours	0.25	2.00

The raw material price per liter is 0.125 US$. The direct labor cost rate per hour is 10.00 US$. Variable indirect costs are 11,000 US$ as a total for this level of production. Total fixed costs are 60,000 US$, while fixed revenues are $8,000. The company employs 3 workers; each of them could potentially work 7 hours daily 220 days per year.

REQUIRED: determine the break-even quantities for both products, assuming alternatively the following hypothesis:

1. Next year the sales mix will be the same.
2. The new sale mix will be as follows Product "X" 6,000 units; Product "Y" 1,400 units.

QUESTION # 1

INCOME STATEMENT	Product "X"	Product "Y"	Company
Units made and sold	8.000 #	1200 #	
+ Sales revenues	**$ 80.000**	**$ 60.000**	**$ 140.000**
- Raw marterial costs	$ -16.000	$ -9.000	$ -25.000
- Direct labor costs costs	$ -20.000	$ -24.000	$ -44.000
= Direct variable margin	**$ 44.000**	**$ 27.000**	**$ 71.000**
- Variable overhead			$ -11.000
= Contribution margin			**$ 60.000**
+Fixed revenues			$ 8.000
- Fixed costs			$ -60.000
= EBIT			**$ 8.000**

$$\frac{\$\,60.000 - \$\,8.000}{\dfrac{\$\,60.000}{\$\,140.000}} = \frac{\$\,52.000}{42{,}86\%} = \$\,121.325{,}25 \qquad \frac{\$\,121.325{,}25}{20^{*}\,\$10 + 3^{*}\,\$50} \simeq \mathbf{347\ bundles}$$

CORRECTNESS CHECK

347 * 20

347 * 3

INCOME STATEMENT	Product "X"	Product "Y"	Company
Units made and sold	6940 #	1041 #	
+ Sales revenues	**$ 69.400**	**$ 52.050**	**$ 121.450**
- Raw marterial costs	$ -13.880	$ -7.808	$ -21.688
- Direct labor costs costs	$ -17.350	$ -20.820	$ -38.170
= Direct variable margin	**$ 38.170**	**$ 23.423**	**$ 61.593**
- Variable overhead			$ -9.543
= Contribution margin			**$ 52.050**
+Fixed revenues			$ 8.000
- Fixed costs			$ -60.000
= EBIT			**$ 50**

By definition indirect variable costs (so called "variable overheads") must also vary in accordance with the change in volume. Assuming constancy in the mix and thus constancy in the resource utilization ratio this means that the percentage incidence of this class (7,86%) relative to turnover must remain constant

QUESTION # 2

Please note: to solve this question **we must identify a method for assigning indirect variable costs to the two products**. We will discuss this later in the course.

INCOME STATEMENT		Product "X"		Product "Y"		Company
Units made and sold		8.000 #		1200 #		
+ Sales revenues	**$**	**80.000**	**$**	**60.000**	**$**	**140.000**
- Raw marterial costs	$	-16.000	$	-9.000	$	-25.000
- Direct labor costs costs	$	-20.000	$	-24.000	$	-44.000
= Direct variable margin	**$**	**44.000**	**$**	**27.000**	**$**	**71.000**
- Variable overhead	$	-5.000	$	-6.000	$	-11.000
= Contribution margin	**$**	**39.000**	**$**	**21.000**	**$**	**60.000**
+Fixed revenues					$	8.000
- Fixed costs					$	-60.000
= EBIT					**$**	**8.000**

$$\frac{\$\ 39.000}{\$\ 80.000} = 48{,}75\% \qquad \frac{\$\ 21.000}{\$\ 60.000} = 35{,}00\%$$

QUESTION # 2

1 bundle

30 # Product "X"	30* $10 = $300	46,15% * 48,75% = 22,50%
7 # Product "Y"	7* $50 = $350	53,85% * 35,00% = 18,85%
	$ 650	41,35%

$$\frac{\$\ 52.000}{41{,}35\%} = \$\ 125.755{,}74 \qquad \frac{\$\ 125.755{,}74}{\$\ 650} \simeq \textbf{194 bundles}$$

- **5.820 # Product "X"**
- **1.358 # Product "Y"**

CORRECTNESS CHECK

INCOME STATEMENT		Product "X"		Product "Y"		Company
Units made and sold		5820 #		1358 #		
+ Sales revenues	**$**	**58.200**	**$**	**67.900**	**$**	**126.100**
- Raw marterial costs	$	-11.640	$	-10.185	$	-21.825
- Direct labor costs costs	$	-14.550	$	-27.160	$	-41.710
= Direct variable margin	**$**	**32.010**	**$**	**30.555**	**$**	**62.565**
- Variable overhead	$	-3.638	$	-6.790	$	-10.428
= Contribution margin	**$**	**28.373**	**$**	**23.765**	**$**	**52.138**
+Fixed revenues					$	8.000
- Fixed costs					$	-60.000
= EBIT					**$**	**138**

Since the mix has changed this results in a different relative consumption of the set of resources whose use determines the incurrence of indirect variable costs. Therefore, the percentage weight of this category in relation to turnover changes. The incidence is now 8.27%.

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