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A piece
of corporate
finance

Table of contents

EXPLANATION OF HANDBOOK RESOURCES

Types of information

The handbook uses different types of information, which are divided according to their nature and colour-coded.

#definition – definition of the issue

#note   – relevant content, pay close attention to it

#issues   – "real life" examples illustrating a given theoretical issue in practice

#formula   – mathematical formula necessary to calculate a certain value

#method   – type of method used

Types of resources

In addition to traditional resources such as drawings, diagrams, tables and photos, the handbook also includes resources of an interactive nature.

#answers   – answers to tasks

We have created this ebook by combining our passion for the world of finance and the work of a lecturer. It is free, because in this way we want to contribute to the prevention of social exclusion.

If you find any error, or you think that we should discuss some issue in more detail, please send us an e-mail:

• in matters related to financial liquidity: kku@zie.pg.gda.pl;

• in matters related to CVP analysis: jaroslaw.zietarski@zie.pg.gda.pl.

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Part I

Liquidity, or how to survive and no fail

CHAPTER 1
INTRODUCTION. CASE STUDY

4 minutes of reading

In this chapter, you will learn:

- what this part of the handbook will be useful for
- in what situations you will encounter liquidity issues

INTRODUCTION

The purpose of the first part of this handbook is to present you liquidity issues. Subsequent chapters take a closer look at various aspects of corporate liquidity in both theoretical and practical terms. Theoretical issues are illustrated with references to potentially operating companies. Each chapter ends with examples and tasks to consolidate the knowledge gained.

In order to properly introduce you to the topic of corporate liquidity, a practical perspective on liquidity issues in the form of a case study was presented as an introduction to further chapters. This study will give you an understanding of situations in which companies operating in the market may face problems related to liquidity.

CASE STUDY

Since 2004, Poland has seen growth in the construction and infrastructure sector. The „Operational Programme Infrastructure & Environment for the years 2007–2013"[1], co-financed by EU funds, sets development priorities for the construction sector. They were detailed in a document entitled. „National Road Construction Programme for the years 2008–2012"[2]. From 2006 to 2008, construction output increased by more than 50%, as shown in the graphs in the figures below.
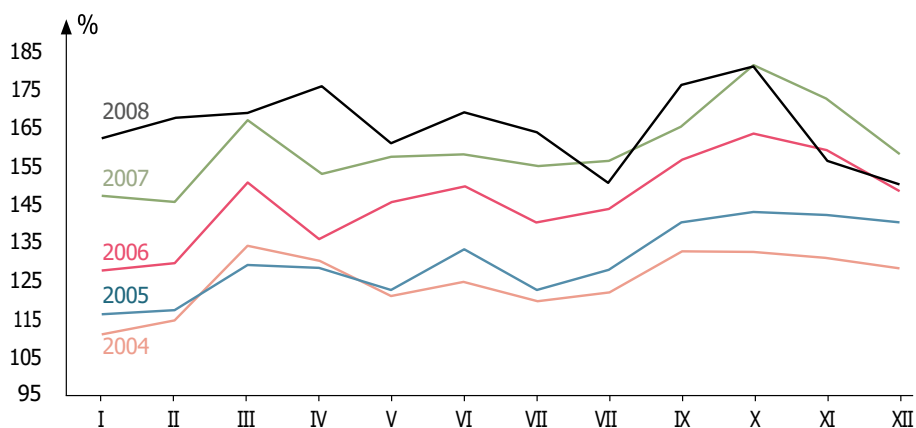

Figure 1.1. Industrial output sold
Source: study based on the data of Statistics Poland, https://stat.gov.pl/en/metainformation/glossary/

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[1]   https://www.pois.gov.pl
[2]   https://www.gov.pl/web/gddkia
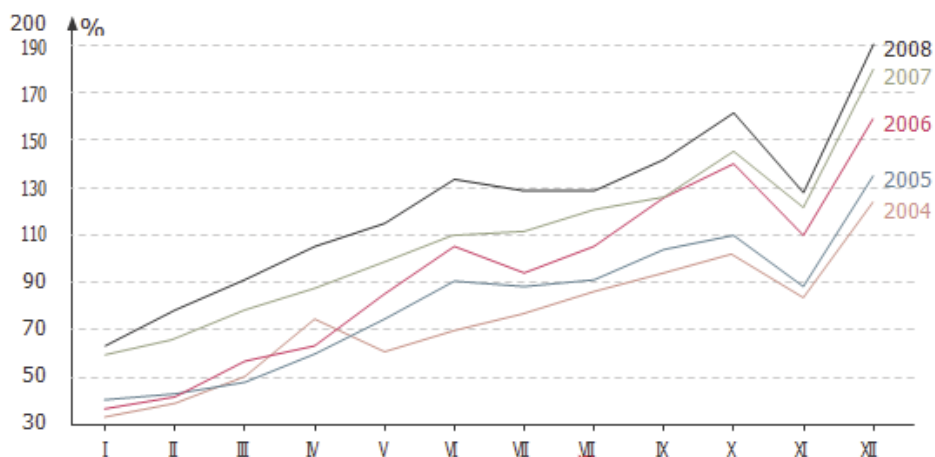
Figure 1.2.   Assembly and construction output in Poland
Source: study based on the data of Statistics Poland, https://stat.gov.pl/en/topics/industry-construction-fixed-assets/construction/index-numbers-of-construction-and-assembly-production-in-january-2021,8,27.html

After several years of slowdown due to the effects of the subprime financial crisis, in 2011, the value of the construction market was estimated at PLN 190 billion at current prices. Construction output was 12% higher than a year earlier and 16% higher at companies with more than 9 employees. At the same time, the construction labour market has recovered, wages have risen (especially in companies carrying out infrastructure projects). A small but steady increase in construction output prices was recorded. At the same time, the financial condition of companies began to deteriorate.

So where did the problems of construction companies come from? It was all due to contracts for the construction of roads, motorways and railroads. The problems were caused by a price war that broke out between companies, deliberately fuelled by public investors (especially the General Directorate for National Roads and Motorways) organising tenders. Participants were required to complete investments at an express pace (in order to make it in time for the European Football Championship – EURO 2012), with high quality and at the lowest price. Companies got caught up in it because the Polish public investor had a huge amount of money to spend – the value of the infrastructure sector amounted to approx. PLN 115 billion.

Bidders were eager to participate in tenders without hedging against rising prices of raw materials and construction materials. In 2009, the tender for the construction of two key sections of the A2 motorway from Łódź to Warsaw with a total length of 50 kilometres was won by COVEC. The company won because it offered a price of PLN 1.3 billion – half the cost estimate.

Problems also arose with regard to labour supply, the number of sub-contractors, and access to transportation. The design of contracts with the public investor transferred

all risk to contractors, taking it off the shoulders of the public investor. As a result of price increases, in June 2011, COVEC reported the need to increase the value of the contract. But the General Directorate for National Roads and Motorways did not agree to such conditions.

In addition, small companies with little potential and experience, as well as so-called "fly-by-night" companies, which assumed that if they won the tender, they would hire sub-contractors and the sub-contractors would build what they needed, were allowed to participate in large, high-value and complex tenders. There were 149 sub-contractors working for COVEC.

The role of the various entities participating in the investment process is shown in Figure 1.3.

INVESTOR	CONTRACTOR	SUB-CONTRACTOR
• holds a tender for motorway construction • expects the lowest price for a given quality	• it lacks a capital resources in the face of cost increases • often has insufficient experience, so it has to hire sub-contractors • is unable to carry out tasks due to lack of organizational and logistical preparation	• executes orders under time and cost pressure • hopes to make a quick profit • hopes that raw material prices will not rise

Figure 1.3.   The role and problems of the various entities
Source: own elaboration

Large companies tried to bail out by not paying smaller sub-contractors, raw material suppliers or transportation companies. Payment gridlocks[3] were dragging everyone down.

Profitability of construction companies decreased; the share of unprofitable companies increased; payment gridlocks arose; debt increased; companies in financial distress took out short-term loans, which grew exponentially.

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[3]   Payment gridlock – a situation created by the accumulation of debts and their passing on to subsequent interrelated counterparties; more at: https://www.investopedia.com/terms/b/backlog.asp.

INVESTOR	CONTRACTOR	SUB-CONTRACTOR
• enters into a fixed-price contract with a contractor • makes payments according to schedule	• accounts for the various stages of the contract • cannot renegotiate the contract in the face of rising material prices • lacks the funds for payments to sub-contractors	• performs the service commissioned • reduces costs • issues an invoice • does not receive payment

Figure 1.4. The good and bad sides of cooperation between different companies
Source: own elaboration

Many companies have desperately struggled to maintain liquidity, or the ability to finance ongoing operations. And it was the loss of liquidity that became the construction industry's biggest problem at the time. In addition, banks and factoring companies (which, prior to the completion of the work, pay the amount due that the contractor is guaranteed under the contract) became extremely vigilant and, upon hearing the slogan „infrastructure construction", were not interested in starting cooperation by granting loans or buying invoices. Thus, bankruptcies in the construction sector became contagious.

Before you move on to of this part of the handbook, think about and try to answer the following questions. Thinking about these issues will allow you to get into the problem of corporate liquidity.

• What mistakes did Polish companies make when entering tenders after the financial crisis and before EURO 2012?
• Who bore all the risk of public investor contracts?
• How would you define liquidity?

CHAPTER 2

CORPORATE LIQUIDITY – BASIC ISSUES

10 minutes of reading

In this chapter, you will learn:

- what liquidity is
- what the differences between solvency and liquidity are
- how the concept of financial liquidity is related to the concept of asset liquidity

LIQUIDITY
#definition

Liquidity is the ability of a company to meet (pay) its most mature (short-term) obligations on time. This means that the company pays its current liabilities on time, without unnecessary delays, e.g. for utilities consumed, for the supply of resources and materials, to contractors for products and services, payment of wages, etc.

Liquidity is equated with the structural ability to pay, which is based on the ability to convert owned assets into cash (without incurring losses), to the extent that it enables the payment of maturing liabilities no later than their maturity date. This is related to the liquidity of economic resources, meaning the ease with which an asset item is converted into another easily disbursed form, with little or no loss of value.

Another definition of liquidity is a company's ability to pay current liabilities on time, determined by the amount of short-term debt and the level of current assets.

LIQUIDITY VS. SOLVENCY

Solvency is a concept that is confused with liquidity. However, these terms are not synonymous.

Solvency is defined as a company's ability to pay its total liabilities on time. This means that solvency is a broader concept than liquidity (Figure 2.1) and refers to paying off all debts, both in the short and the long term.
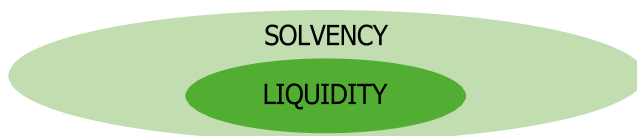
Figure 2.1. Solvency vs. liquidity of a company
Source: own elaboration

A company may have a permanent inability to pay its liabilities, resulting from the fact that their size exceeds the value of its assets. Such a situation is referred to as insolvency.

#note

Liquidity is most often referred to as ability to pay, while solvency is equated with income balance.

The table below shows the differences between solvency and liquidity.

Table 2.1. Solvency vs. liquidity – differences

Solvency	Liquidity
the ability of a company to pay its debts in full on time	the ability of a company to pay its short-term liabilities on time
the ability to repay all of the company's liabilities, both short- and long-term ones, at their maturity dates	the ability to repay only liabilities with a maturity of up to 12 months
solvency as financial capacity in the long term is also called income balance, which refers to the excess of future cash receipts over total expenses	financial liquidity is most often deferred to as financial capacity in the short term

Source: own elaboration

In distinguishing between the two concepts, the following questions arise:

- Is an entity that has liquidity always solvent?
- Is lack of liquidity tantamount to insolvency?

Note:

- Financial liquidity does not always guarantee an entity's solvency.
- A business entity may have liquid assets to pay off current liabilities without having sufficient assets to pay all liabilities.
- On the other hand, however, a company can be solvent and at the same time lack short-term liquidity. This means that a solvent company does not necessarily have cash available at all times.
- However: a lack of cash or fast-moving assets means liquidity problems. Consequently, the entity will undoubtedly become insolvent in the long term as a result of its lack of liquidity.

#note

A short-term lack of liquidity in a company is not equivalent to its insolvency.

LIQUIDITY OF ASSETS

Linked to the concept of corporate liquidity is the concept of asset liquidity. Asset liquidity is the ability of assets to be converted into cash quickly, easily and without excess.
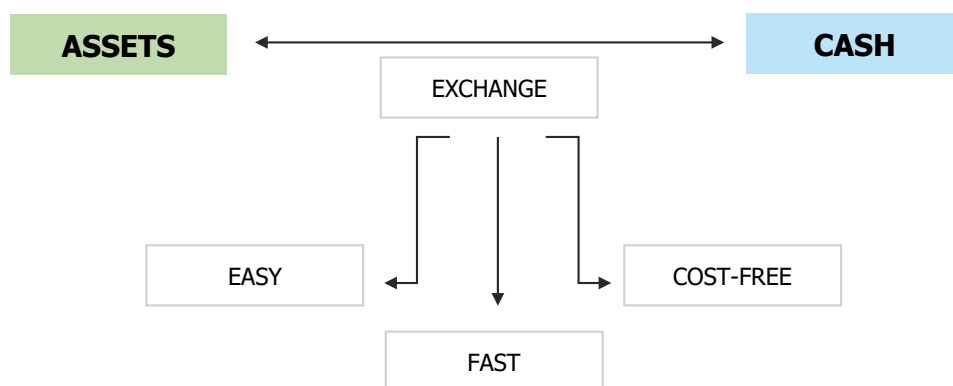
Figure 2.2. Asset liquidity
Source: own elaboration

Liquidity depends on the nature and type of market for the assets in question and the type of assets (e.g. their level of specialisation). Only cash has full liquidity. Asset liquidity occurs when assets are in the form of cash assets or can be quickly converted into cash at relatively low cost.

Tangible or financial assets may sometimes be subject to some type of temporary blockade or may constitute a collateral for other company contracts. Assets are recognised in the accounting balance sheet according to the principle of increasing liquidity. The Polish balance sheet presents fixed assets (the least liquid assets) first, followed by current assets (the most liquid assets) (Table 2.2).

#definition

Liquidity level (or level of liquidity) is cash available in the short term. These are the resources of such assets of a company that can be mobilised without major time or money losses to settle liabilities.

Liquidity of assets affects their market price. For two assets with the same characteristics but different liquidity, the difference in market price can be treated as a liquidity price – the so-called liquidity premium.

Table 2.2. Development of financial statements – the balance sheet of a company

Specification of assets	Asset balance as of:	
	at the beginning of the year	at the end of the year
1	2	3
A. FIXED ASSETS	**0.00**	**0.00**
I. Intangible assets		
II. Tangible fixed assets		
III. Long-term receivables		

IV. Long-term investments		
V. Long-term prepayments and accruals		
B. CURRENT ASSETS	**0.00**	**0.00**
I. Inventories		
II. Short-term receivables		
III. Short-term investments incluing cash and cash equivalents		
IV. Short-term prepayments		
Total assets	**0.00**	**0.00**

Source: own elaboration

We distinguish assets with:

- the highest liquidity – cash held and readily marketable securities (e.g. bills of exchange, checks),
- medium liquidity, i.e. medium- and long-term securities, as well as account receivables (these are amounts owed by customers, for example for purchases on credit),
- low liquidity, i.e. fixed assets – material inventories as well as work in progress and finished production.

Table 2.3. Liquid and illiquid assets

Liquid assets	Illiquid assets
bonds investment fund shares currency raw materials	real estate antiques art furniture

Source: own elaboration

- Company assets have varying degrees of liquidity.
- **Cash** has the **highest liquidity**.
- **Intangible assets** have the **lowest liquidity**.

How liquid are the various assets?

Table 2.4. Liquid and illiquid assets

MOST LIQUID	QUITE LIQUID	LEAST LIQUID
cash	shares	cryptocurrency
bank accounts	corporate bonds	real estate
derivative financial instruments	foreign currencies	metals
US treasury bonds	investment funds	art and antiques

Source: own elaboration

Liquidity is related to the speed of conversion of assets into cash, but it is also used in other areas of finance as, for example, collateral liquidity, inventory liquidity (a collateral for an operating loan in a dairy is milk inventory).

When looking at the statement of assets by liquidity, it is still important to keep in mind changing economic conditions and the specific nature of the assets in question. During certain periods of economic prosperity, there may be no demand for a particular asset, such as a cryptocurrency, so it becomes a low-liquidity asset, while at other times it will be a highly liquid asset.

The same is true of art and antiques. There is an entire branch of finance called art investing, which deals solely with investments in art, where one invests both through investment funds and by acquiring specific works of art. Some of them are very liquid, causing their price to continually rise.

#issues

REAL LIFE EXAMPLE – ANNA'S CAFÉ

Anna runs a café that has been hit hard by the COVID19 pandemic. As a result of the economic lockdown, fewer customers are coming to cafés. The decline in the number of customers has translated into a drop in cake sales. The loss of profit resulted in the café's inability to pay its bills to the utility provider.

Anna's company has lost liquidity and must try to negotiate with the utility provider to postpone payments.

Despite the difficulties with sales, it can be assumed that the café will remain solvent. This will happen either because it will manage to get cash by lowering the price of the cakes offered to attract buyers or, as a last resort, it will be forced to sell off its own fixed assets (such as the café's furnishings) in order to pay off the debt.

However, it should be noted that if the company used equipment that provided collateral for the repayment of the loan to the bank, or if the equipment was leased and Anna had no other assets that she could sell, her company would likely become insolvent. Typically, liquidity troubles reveal solvency problems (excessive use of third-party capital) and can lead to bankruptcy of the company. A sudden drop in profitability in a crisis (in the example described above – due to a collapse in demand for the goods or services offered) could be the genesis of such a scenario.

REAL LIFE EXAMPLE – ADAM'S RESTAURANT

Adam runs a restaurant in rented premises. In 2020, the restaurant underwent a major renovation, replacing all kitchen and restaurant room equipment. For this purpose, Adam took out a loan of PLN 100,000, the repayment of which is secured by the above equipment. The restaurateur leases a van, which he uses to buy supplies for the restaurant and deliver the catering ordered. The restaurant is awaiting receivables in

the amount of PLN 4,000 from a consulting company to which it delivers 20 meals a day month after month.

Adam bought a supply of frozen raw meat, paying PLN 30,000 in cash. As a result of the emergence of a competing restaurant on the same street, Adam has lost 80% of his guests and the turnover at his restaurant has dropped to PLN 300 a day, making him unable to pay his employees.

Which restaurant asset has the highest degree of liquidity and which has the lowest?

REAL LIFE EXAMPLE – ROBERT'S CARPENTRY SHOP

Carpenter Robert took over the carpentry business from his father. He employs 10 people and has just signed a 3-year agreement for the supply of desks with a chain of furniture stores, with a 3-month settlement period. This means that he won't have to look for individual customers (as his father has done so far) and there will be no need to rearrange production lines or purchase different materials. Production at the plant will focus on one type of wooden desk, with three drawers with plastic handles. The material will be purchased from a sawmill that offers the lowest prices, with prepayment required. The remaining components will continue to be supplied by a wholesaler with whom the plant has been working for years. However, due to the high demand for its goods, the wholesaler reduced the deferred payment period from one month to seven days. In addition, Maciej has to pay other bills: utilities, salaries. This takes place in the first decade of each month.

The figures for the carpentry shop are as follows:

• sales revenue: PLN 600,000
• own cost of sale: PLN 245,000

In addition, it is known that the average value of receivables is PLN 150,000, while current liabilities amount to PLN 20,000.

Questions

• What is the liquidity situation of Robert's carpentry shop under the new conditions?
• Can Robert have a liquidity problem?

Solution

Deadlines for the payment of liabilities and receivables:

• Payment term for material – prepayment
• Payment term for screws, handles – 7 days
• Payment term for other bills – the first decade of the new month
• Payment term for the customer – 3 months

The situation of Robert's carpentry shop does not seem very good as the payment terms of its obligations are very short, while the collection of receivables is postponed. During the 3-month period when Robert is waiting for the customer to pay, he himself must:

• pay his employees 3 times
• pay for utilities 3 times
• pay for handles and screws
• pay for the material

It is worth specifying the length of the period for collecting receivables and settling liabilities.

$$C_{receivables} = \frac{\text{average receivables}}{\text{sales revenue}} * 365$$

$$C_{receivables} = \frac{150000}{600000} * 365 = 91,25 \text{ days}$$

$$C_{liabilities} = \frac{\text{short} - \text{term liabilities}}{\text{own cost of sales}} * 365$$

$$C_{liabilities} = \frac{20000}{245000} * 365 = 29,8 \text{ days}$$

This means that the company receives payments in approx. 91 days and settles its obligations on average 3 times faster, in 30 days.

Conclusion

The data confirms that liquidity risk has increased as a result of signing a contract with a large customer under new terms. The shop has to pay its liabilities in 3 times less time than it collects receivables. In the meantime, it must have access to funding sources (either its own or third-party sources) to operate.

#issues

REAL LIFE EXAMPLE – JOHN'S PRINT SHOP

John runs a small service centre offering copying and printing of documents. So far, he has only served individual customers who paid in cash. He sourced his supplies from a paper wholesaler, where he negotiated a one-month deferred payment. He also paid the utility invoice with a one-month deferred payment.

John has just received an offer to take on a very lucrative partnership with a business customer that offers a 30% increase in revenue but at the same time expects one-month deferred payments. At the same time, John negotiated discounts of 20% on the price of utilities and materials with the new utility provider and wholesaler, although with a shortened invoice payment period.

The figures for the service point prior to the new offers are as follows:

• sales revenue: PLN 60,000
• own cost of sales: PLN 24,500

In addition, it is known that the average value of receivables is PLN 100, while short-term liabilities amount to PLN 2,000.

Questions

- Is it profitable for John to accept both offers?
- How will they affect the liquidity of his service point?

Solution

It is worth specifying the length of the period for collecting receivables and settling liabilities.

$$C_{receivables} = \frac{average\ receivables}{sales\ revenue} * 365$$

$$C_{receivables} = \frac{100}{60000} * 365 = 0{,}61\ days$$

$$C_{liabilities} = \frac{short - term\ liabilities}{own\ cost\ of\ sales} * 365$$

$$C_{liabilities} = \frac{2000}{24500} * 365 = 29{,}8\ days$$

This means that the company receives payments in approx. 1 day and settles its obligations on average 3 times faster, in 30 days. From this point of view, the situation is safe as John collects receivables much faster than he has to settle his own obligations.

How will the situation change if John accepts:

- the utility provider's offer (1),
- the new customer's offer (2),
- both offers at the same time (3)?

Let's analyse these situations in the table below:

Data / offer	(1)	(2)	(3)
revenues from sales	PLN 60,000	PLN 78,000 = 60,000 × 130%	PLN 78,000 = 60,000 × 130%
own cost of sales	PLN 19,600 =24,500 × 80%	PLN 31,850 =24,500 × 130%	PLN 25,480 =24,500 × 80% × 130%
average value of receivables	PLN 100	PLN 15,000	PLN 15,000
average value of short-term liabilities	PLN 500	PLN 2,000	PLN 500
$C_{receivables}$	0.61 day	70.91 days	70.91 days
$C_{liabilities}$	9.31 days	22.92 days	7.16 days

The analysis shows that the acceptance of discounts from the utility provider and wholesaler will reduce the payment term from 30 days to 10 days. On the other hand, the establishment of cooperation with a business customer will result in a 2.5-month extension of the collection period and a simultaneous reduction in the payment period by one week. The simultaneous acceptance of both offers will result in an extension of the collection period to 70 days and the fastest payment of liabilities, only within 7 days.

Conclusion

This means that from the point of view of liquidity, the most favourable situation (generating the lowest liquidity risk) is situation 1, as John will receive payments from customers very quickly while settling his liabilities much later. Unfortunately, this will come at the expense of not achieving higher profits. This proves that the reduction of risk (in this case – liquidity risk) decreases the ability to generate increased profit.

Task 2.1

Decide which of the following economic events changes liquidity (L) and which changes solvency (S).

		L	S
1	A shoe store has cash to pay electricity invoices		
2	A family-owned ice cream factory bought a new production machine on credit		
3	A grocery store sold an unneeded delivery truck		
4	A service company received payment from a customer		
5	A developer issued bonds to purchase property on which it will build an office building		
6	A home design company offered to defer the payment for a developer's estate design		
7	A restaurateur bought a 3-month supply of raw meat with cash		
8	A shoe manufacturing company obtained a loan to finance the purchase of leather		

#answers

CLICK or SCAN

Task 2.2

Determine the liquidity level of each asset, where (1) represents the lowest, (2) moderate and (3) the highest level of liquidity:

		1	2	3
1	Land			
	• plot located in the city centre			
	• plot located along a new motorway			
	• plot located in the floodplain of the Vistula River			
2	Copyright and related rights			
3	Computer programs			
4	Licences and subsidies. rights to inventions, patents, trademarks, utility models, decorative designs, know-how, costs of completed development work, goodwill			
5	Buildings, premises, warehouses – office in the highest skyscraper in the city centre, warehouse on the outskirts of the city			
6	Equipment, machines			
7	Means of transport			
8	A stockpile of expired flour at a bakery			
9	A stockpile of uncut gemstones at a jeweller's shop			
10	Fabric stock for winter dresses at a factory			
11	Short-term trade receivables: overdue			
12	Short-term trade receivables: on-time			
13	Cash			

#answers

CLICK or SCAN

CHAPTER 3
DETERMINANTS OF FINANCIAL LIQUIDITY

6 minutes of reading

In this chapter, you will learn:

- what groups of factors affect liquidity
- which factors are beyond the control of the company
- which factors can be influenced by companies

MACROECONOMIC, SECTORAL AND MICROECONOMIC FACTORS

The liquidity of a company is very complex and depends on many factors, among which three main groups can be distinguished (Fig. 3.1). These are:

- macroeconomic factors, which are beyond the control of the organisation and are related to the economy as a whole,
- sectoral (industry) factors, beyond the control of the organisation and associated with a specific segment of the economy,
- microeconomic factors, which are related to economy and effective management of the organisation's resources.

MACROECONOMIC FACTORS	• ECONOMIC SITUATION • MONETARY POLICY • FISCAL POLICY • CURRENCY POLICY • DEVELOPMENT OF THE FOREIGN EXCHANGE MARKET • LABOUR COSTS
SECTORAL FACTORS	• INDUSTRY DEVELOPMENT • SECTOR RISK LEVEL • SECTOR INNOVATION • DEVELOPMENT POTENTIAL • PRICES OF PRODUCTION FACTORS
MICROECONOMIC FACTORS	• COMPANY'S POSITION IN THE MARKET • PRICING STRATEGY AND TRADE CREDIT RULES • WORKING CAPITAL MANAGEMENT • IMPLEMENTATION OF INVESTMENT PROJECTS • VOLATILITY OF CASH FLOWS • POTENTIAL DISRUPTION TO OPERATIONS

Figure 3.1 Factors affecting liquidity
Source: own study.

Macroeconomic factors

Economic situation is one of the most significant factors affecting the liquidity of companies. Due to the volatile economic environment, the maintenance of liquidity is an essential task for any entrepreneur. Today, this environment is not perfect or easily predictable, as the post-2008 financial crisis and the Covid-19 crisis proved. It is characterised by volatility and, consequently, by uncertainty in many areas, such as demand, market prices, quality, etc. An economic downturn may result in longer receivables turnover or inventory turnover, as well as the need to increase internal liquidity reserves. The economic situation of the environment is influenced by such areas as:

- monetary policy and interest rates,
- fiscal policy and tax rates,

- currency policy and exchange rate volatility,
- labour costs and all sorts of regulations related to hiring employees.

The type of monetary policy pursued in an economy will affect the cost of credit that companies can obtain from the bank. The interest rate affects asset prices, including non-financial assets, investment returns, as well as inflation expectations in the economy and exchange rate volatility.

The introduction of an additional levy, tax or excise on selected product groups can result in a decline in production, imports, labour and investment. A company with low profitability and large financial needs may not be able to cope with the new macroeconomic situation. Additional excise duties and other taxes will significantly adversely affect its operations by requiring it to build up financial reserves and increasing its tax liabilities.

Fluctuations in exchange rates can be contingent, for example, on rising interest rates and the country's unstable political situation. Their changing level can affect both the company's receivables and liabilities. A country's membership in international organisations is also an important factor affecting exchange rate fluctuations The availability of financial instruments resulting in an acceleration of the receivables turnover ratio is also an important factor.

Labour costs affect a company's cost of operations, which can lead to a deterioration in the company's financial performance by increasing operating costs. An increase in labour costs generates the need to accumulate higher financial reserves to settle them.

Sectoral factors

Sectoral factors, or the so-called „near environment", will also affect a company's liquidity.

Intense competition in developed industries means that it can be increasingly difficult for a company to stay in that particular industry. This may also be caused by fluctuations in demand. High demand for a company's services and goods means high income and the ability to pay its liabilities. Unfortunately, demand often fluctuates, and even the best-managed entities cannot control this phenomenon. Moreover, the need to constantly develop innovations will cause the company's risk to increase.

Another particularly important factor is the selection of broadly understood business partners – suppliers, contractors, etc. This factor can also be influenced by the company, although the overriding issue is the choice itself. It is difficult to predict how a partner will behave after a certain period of time. Thorough verification of contractors before establishing cooperation can save many problems. An insolvent customer or a customer who pays late can contribute to a company's problems, as can a cheap but unreliable supplier.

Microeconomic factors

Microeconomic factors are internal factors that depend on how a company operates. These include: the ability to manage receivables and inventories, the ability to generate sales, as well as the technology used and the organisation of the production process, and attention to the company's reputation as a debtor. In this way, the company will be able to work only with reliable partners and will not have to make uncomfortable or difficult decisions. It should be emphasised that microeconomic conditions can hardly be considered in isolation from the specific sector in which the company operates or the company's position in the market. This is due to the fact that they affect the liquidity of current assets, sources of financing, as well as the financial strategy adopted, the volatility of cash flows and the risks taken.

FACTORS DEPENDENT AND INDEPENDENT OF THE COMPANY

According to the criterion of type, the factors shaping liquidity should be divided into factors dependent on and independent of the company (Fig. 3.2). Both dependent and independent factors affect all or only some components of the working capital.
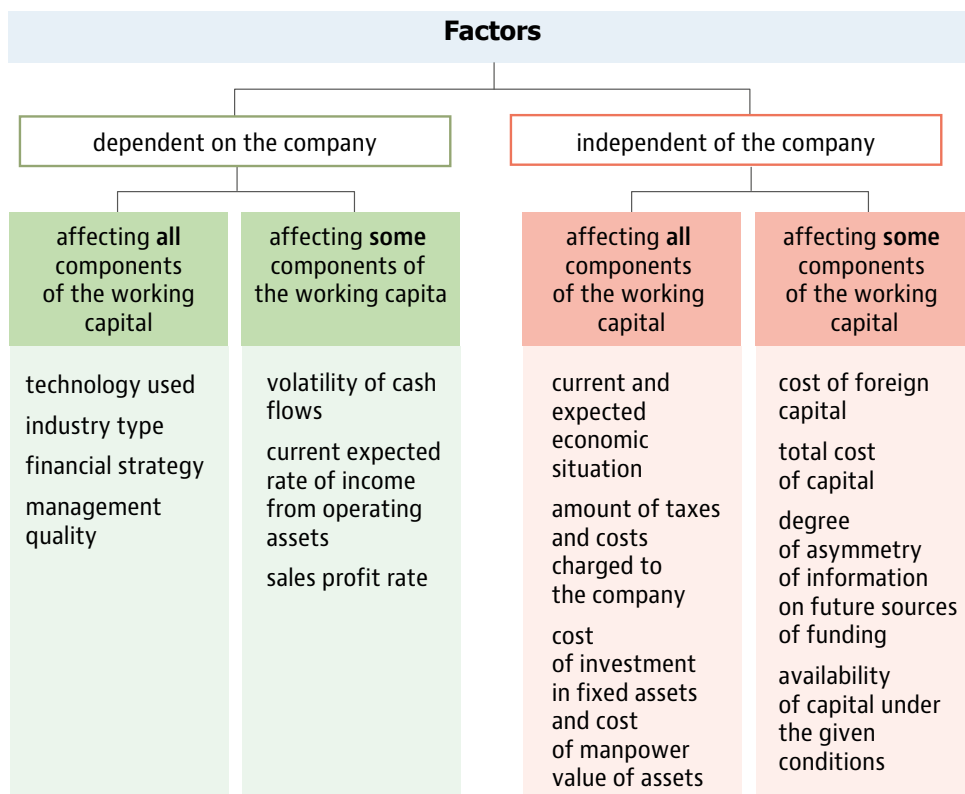

Figure 3.2. Determinants of corporate liquidity
Source: own study.

It should be noted that most factors are linked to decisions made by the company's management. The efficiency and qualifications of the management and the organisation of the company are essential. Liquidity management requires prudent decisions and a look at all economic categories related to the business. A manager in charge of a company's finances should be able to reconcile maintaining liquidity with achieving the planned level of profitability, while meeting the main objective of the company's operations, that is profit maximisation.

A company's liquidity is also determined by its financial strategy. It is an internal factor which can be fully controlled by company managers. What matters here is not only access to external financing but also the cost of such capital. Easier access and lower interest rates on investment or operating loans will support liquidity, lowering the risk of the company's operations.

A company's liquidity level is affected by:

• the structure of the company's assets,
• the structure of the company's liabilities,
• the value of current assets,
• the efficiency of working capital management.

Liquidity stems from the amount of cash held, which is the primary medium of exchange necessary to complete various economic transactions. The method of maintaining liquidity depends on the proportion of cash in the company's total assets, as well as the ease with which the company can obtain additional cash resources by selling other assets (i.e. converting them into cash). Cash is one of those corporate assets that secure liquidity in the event of a shortfall in income. This phenomenon is referred to as a liquidity reserve.

Liquidity depends on those factors that shape a company's financial capacity, which means they are related to the sphere of incomes and expenses. These are:

• the value of sales,
• the quality of goods and services sold,
• sales and procurement policies and activities.

Incomes and expenditures, which are generated by the company's operating activities, are related to the level of liquidity. Incomes depend on sales volumes and customer credit policies. The higher the sales, the higher the potential income – depending on the payment terms accepted. The deferral of payments means that the date of sale does not coincide with the receipt of payment. Customer lending causes the company's financial capacity to be reduced, as the company has short-term receivables instead of cash.

As time passes and accounts receivable become overdue, the financial situation of the company becomes unfavourable. Problems arise in enforcing payments and there is a need to use the financial reserve until the receivables are collected. Moreover, the lack of certainty as to the timing and amount of incoming receivables makes it

far more difficult to manage the company's assets and develop long-term income and expense policies.

For factors related to the company's expenses, the following elements are mentioned:

- employee salaries,
- purchase of raw materials and supplies for operations,
- utility fees.

An important area of a company's assets affecting liquidity is inventory, which can have both a positive and negative impact. The need to replenish inventories of finished goods or production materials entails expenses and a depletion of cash resources. Purchasing large inventories forces a company to seek new cash flows. In addition, inventory management also generates operating costs, hence it is increasingly common for companies to maintain only the necessary and minimum inventory levels.

TASKS

Task 3.1

How will a company's liquidity be affected (will there be a decrease (D) or increase (I) in liquidity?) by the following events:

Business events	D	I
1 tax increase		
2 reduction in interest rates		
3 greater exchange rate volatility		
4 introduction of innovation in operations by a direct competitor		
5 weak competition in the sector		
6 emergence of a new supplier in the market		
7 collapse of the company's largest customer		

#answers

CLICK or SCAN

Task 3.2

Assign the following economic events to the listed determinants (factors) of liquidity (note that many events can be assigned to more than one factor):

Determinants of financial liquidity

A	Macroeconomic
B	Industrial
C	Microeconomic
D	Independent of the company
E	Dependent on the company

1. Economic situation
2. Decrease in the GDP growth rate from 5% y/y to 2% y/y
3. Economic recession – GDP decline of –10% y/y
4. Introduction of a new tax
5. Increase in interest rates on investment loans from 10 to 13%
6. Minimum wage increase of 10% y/y
7. Elimination of the Social Security contribution
8. Change of employment contracts from full-time to B2B
9. A new "player" in the market – a strong foreign competitor
10. Collapse of a direct competitor
11. Merger of two direct competitors
12. Broken supply chains of raw materials for production due to embargoes
13. Crisis in the local currency market
14. Increase/decrease in the quotation of the local currency in relation to major international currencies
15. Increase in prices of raw materials necessary for production due to their depletion by 15% y/y
16. Decrease in raw material prices by 15% y/y
17. Tightening of customer credit policy
18. Collapse of a major customer
19. Termination of a contract with a major customer
20. Doubling an order by the main customer
21. Strike of the company's staff
22. Fire in the manufacturing floor
23. Purchase of new technology

24. Leakage of sensitive data on company customers
25. Black marketing practiced by competitors
26. Decrease in the price of the final product due to the dumping practices of competitors
27. Impact of overdue payment from customer
28. Favourable court ruling on the amount of compensation owed by a customer
29. IPO

#answers

CLICK or SCAN

Task 3.3

Do the following (micro and macro) business events affect the company's liquidity? Type "Y" (yes) or "N" (no) next to each event

Business events		Y	N
1	Increase in inflation		
2	Increase in interest rates		
3	Liberalisation of access to credit		
4	Tightening of banks' credit policies		
5	Tax increase		
6	Tax reduction		
7	Introduction of duty on exports		
8	Reduction of duty on exports		
9	Introduction of duty on substitutes		
10	New competitor in the market		
11	Economic lockdown		
12	Decline in the unemployment rate		
13	Export embargo		
14	Poland's accession to the EU		
15	Strengthening of the Polish zloty in relation to foreign currencies		

| 16 | Fire in a certain part of the manufacturing floor | | |
| 17 | Flood in the region | | |

#answers

CHAPTER 4
WAYS TO TAKE CARE OF THE LIQUIDITY OF COMPANIES

7 minutes of reading In this chapter, you will learn:

- how to take care of liquidity
- what factoring is and what benefits it provides to companies
- how to improve a company's liquidity

METHODS RELATING TO A COMPANY'S OPERATING MODEL

Monitoring of revenue and cost information

Monitoring of revenue and cost information is an important element of conducting business activities that companies often forget. It is essential to keep an eye on the company's finances to identify potential liquidity problems at short notice. An important issue in running a business is constant access to information on sales volumes. Such information should be analysed on a regular basis, taking into account not only the balance at the end of the month but also the flows during a given accounting period. This will allow to assess the scale of profitability of specific projects, recalculate profits and predict future financial results. Such management of the company's finances will reduce the risk of losing liquidity

Counterparty verification

In order to maintain liquidity, a company should keep a close eye on its contracting parties. For this purpose, it should establish cooperation with such companies that have adequate liquidity, i.e. do not have problems with timely payment of their liabilities (obligations), as even small delays in the collection of receivables may affect the loss of liquidity.

In order to secure the liquidity, a company should introduce provisions in contracts specifying payment deadlines, the need for an advance payment, the application of contractual penalties, as well as establishing collateral in kind (such as a mortgage or pledge) or a blank promissory note.

In the event of insolvency/ illiquidity of contracting parties that results in liquidity problems, it is worth immediately applying tools to improve the situation.

Use of prepayment

In order to maintain control over payments from contracting parties and to take care of the company's liquidity, pre-payment can be used. This is one of the safeguards against the possible risk of contracting parties' insolvency. Already at the stage of negotiating the terms of the cooperation agreement, it is worth defining the rules related to payment and enforcement of receivables. Establishing these rules at the very beginning of cooperation can positively affect the timely payment of obligations by the customer and help avoid unnecessary problems.

Many companies, especially young ones, are concerned about the reaction of customers to the provision on the use of prepayment. They believe it may weigh on the decision to reject cooperation. It is then worth treating the issue as a subject of negotiation – it is possible to give up on some provisions, i.e. abandoning the requirement for a 100% pre-payment in favour of a down payment.

Control of payment terms

The main reason for payment gridlocks is the failure of contracting parties to make timely payments of receivables resulting from invoices. This means that controlling the expiration of payment terms and sending prompt notes by the company is very important in view of securing its own liquidity. In this way, it can increase the likelihood of recovery of funds. It is important to remember that the longer the waiting time for payment, the greater the risk of not collecting the receivables. And an occasional liquidity crunch can be caused even by slight delays in the collection of receivables. In order to prevent such problems, it is necessary to analyse the cycles of maturity of accounts payable and accounts receivable collection.

Invoices issued on different dates

When working with more than one contracting party, invoices should be issued on different days of the month. This will maintain the principle of regular inflows of receivables to the company's bank account, which will allow the company to pay its liabilities (obligations) on time. If a contract consists of several stages or parts, it will also be helpful to have a system of invoicing after each stage performed rather than waiting until the entire task is completed.

Control of inventory management methods and inventory reduction

It is worth paying attention to the company's inventory. If the inventory is extensive, it is good to use up stocks in the current term to avoid ordering more products/goods. It is necessary to create an optimal level of supply so as not to unnecessarily tie up cash in inventory, as it may be needed to pay other obligations. Maintaining the right resources level will allow the company to manage its finances effectively.

Therefore, it is necessary to regularly monitor the warehouse inventory and limit the amount of goods the sale of which is too slow or ineffective. When there are too many goods in stock, there is no room for new inventory. As a result, there is no room for goods that could generate a higher profit.

METHODS RELATING TO THE SOURCES OF FINANCING OF A COMPANY
Bank loan an credits

The capital held has a key impact on the economic processes of any company. The most common way to raise capital from external sources is through a bank loan or credit. Bank loans and credits can be divided according to various criteria, i.e. by:

- the manner of leaving funds at the disposal of the borrower (overdrafts and credit accounts);
- the purpose of the loan and credits (working capital loans / credit and investment loans / credit);
- loan / credit period (short-term, medium-term and long-term loans / credit);
- the currency of the loan / credit (gold and foreign exchange loans / credit);

- the form of loan / credit (discount loans / credit, acceptance loans / credit, revolving and non-revolving credit lines, rollover loans / credit, bridge loans / credit);
- the method of transfer of funds (cash loans/ credit and non-cash loans/ credit);
- the type of interest rate charged (fixed-rate, variable-rate, fixed-variable-rate loans / credit);
- the method of repayment (loans / credit with fixed installment, diminishing installment).

However, it should be emphasised that a bank loan / credit is a solution for companies whose financial situation is stable. In cases of serious payment gridlocks, the bank may refuse to grant a loan / credit. That is why it is a good idea to consider such a solution earlier, before liquidity problems arise.

Factoring as a way to improve liquidity

Factoring is a modern form of invoice financing used by an increasing number of companies. It is otherwise known as a "loan for repurchase of invoices". It involves the purchase of receivables resulting from the performance of a service or delivery of goods. The purchaser is referred to as a factor. Most often, the number of invoice recipients is limited, while the recipients themselves are analysed by the factor for insolvency risk. Thus, this service involves the sale of receivables held by a company, before the due date. These receivables are most often short-term receivables. The figure shows how the factoring service works and the entities involved.
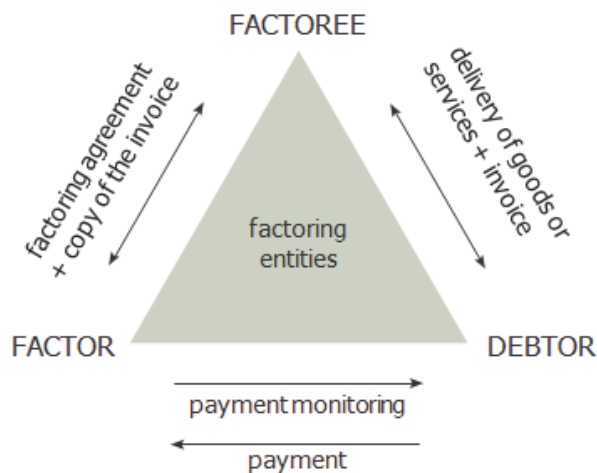
Figure 4.1. The procedure of the factoring service

Due to the ease of obtaining such financing (relative to, for example, a standard line of credit) and the lack of need to build an in-house debt collection unit, the SME sector is eager to use factoring. Companies with a large number of customers for services or products, especially those operating in industries where it is standard practice to settle on the basis of invoices with long payment terms, can thus provide

a sense of security with regard to maintaining liquidity. Thus, the benefits of choosing this type of financing include:

- improvement of the payment discipline of recipients;
- minimisation of the number of overdue receivables;
- faster receipt of payments for invoices issued;
- protection against recipients' insolvency;
- possibility of reducing costs associated with debt management services by entrusting it to a factor;
- possibility of reducing costs associated with debt collection through risk analysis conducted by the factor;
- ability to offer longer payment terms to customers.

Several forms of factoring can be distinguished on the market, allowing companies to tailor the solution to the specifics of their business and to their needs and expectations. Factoring is a flexible form of financing. Due to multiple criteria, the factor is able to tailor the service offer to the customer's needs.
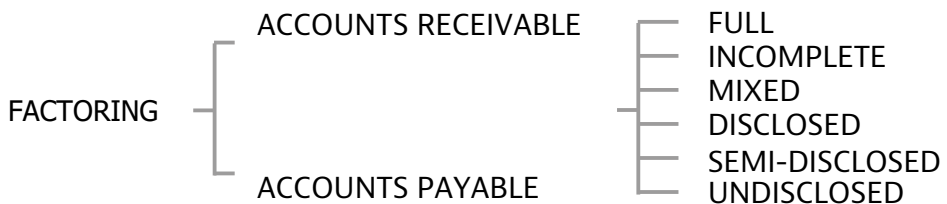
Figure 4.2. Types of factoring due to different criteria
Source: author's own elaboration

Based on the form and purpose of provision of financing, two basic categories of factoring can be distinguished: accounts receivable (standard) factoring and accounts payable (reverse) factoring.

Accounts receivable factoring is divided into six types:

1. **Full factoring** (**proper factoring**) involves the assumption of the risk of the debtor's insolvency by the factor. The debtor bears the full credit risk, while the factoree, upon the transfer of the invoice, transfers of all the seller's rights regarding the subject of the sale to the factor;
2. **Incomplete** (**improper**) **factoring** involves the purchase of receivables from the factoree with the factor's simultaneous right to claim repayment of the receivables by the factoree in the event of the debtor's insolvency;
3. **Mixed factoring** combines features of full factoring and incomplete factoring. It involves transferring part of the liability associated with the risk of debtor insolvency to the factor.
4. **Disclosed** (**notified**) factoring involves immediately notifying the debtor of the factoring of receivables and sending a request for payment to the factor;

5. **Semi-disclosed** (**semi-open**) **factoring** involves notifying the debtor of the factoring of receivables shortly before the due date;

6. **Undisclosed factoring** implies a complete lack of notification to the debtor of the factoring of a given receivable during the term of the contract.

Reverse factoring (**accounts payable factoring**) is a way of financing customers rather than vendors. It is based on the fact that it is the factor (usually a bank) that makes payment to the supplier's account on the basis of an invoice received from the recipient of the good or product (the invoice payer). In practice, it looks as follows: a supplier issues an invoice for the delivery of goods/products/services and delivers the product to a customer. The customer (factoree) then presents the invoice for repurchase to a factor (bank), which pays the supplier the entire amount. Later, the repurchase amount plus interest is repaid by the factoree (customer) to the factor (bank) within a specified period. Such a solution allows the entrepreneur (customer) to pay obligations related to the purchase of goods or services over a longer period of time.

Reverse factoring helps improve a company's liquidity. With this solution, after receiving an invoice from a supplier, the company can forward it for financing to a factor, who will send the funds even on the same day. The invoice repurchase amount, together with interest, shall be repaid to the factor on the agreed date. This gives the company the time and image of a stable partner, and even the opportunity to receive discounts from the supplier for early payment.

Leasing

Leasing is an external form of financing for a company's day-to-day operations. It is classified as a foreign medium-term financing method. Its appeal lies in the ability to use the item and achieve economic benefits without having to commit the full amount of money to purchase it.

The most common subjects of lease agreements are transportation equipment, including boats and airplanes, machinery, process lines and real estate.

Leasing transactions can be divided into many forms and types using comparative criteria. The criteria for distribution may include:

- the number of parties to the agreement;
- the subject matter of the agreement;
- the term of the agreement;
- the depreciation of expenses;
- the placing of cost burden on the object of lease;
- the direction of movement of the object of lease;
- the legal nature of the agreement.

The main benefit that prompts companies to choose leasing over other business financing options is the ability to reduce the tax base by the actual costs incurred by the lessee. In the case of a loan or credit, only depreciation charges and interest can be

deducted from the tax base, the total of which is much lower than the actual expenses incurred. By choosing leasing as a form of investment financing, an entrepreneur can tailor the terms of the agreement to its current financial standing.

Decapitalization by owner or investor support

The last option for improving liquidity, although not always possible or desirable for a business owner, is to decapitalize the company. It can be done by the owner or by an outside investor. When it is done by an investor, in addition to improving liquidity, the company's chances for growth can be increased. This is usually combined with a share split or other influence from the investor. Therefore, business owners opt for this opportunity driven by the desire for growth. However, it is also a good way to deal with problems arising from the loss of liquidity, which could lead to the collapse of the company. In addition to cash, an investor can also bring new ideas, experience, or proven solutions to the company. As an outsider, the investor will be able to objectively evaluate all aspects of business management and introduce changes.

Task 4.1

Explain what you could do in a situation where...?

1. Your supplier raises the price of semi-finished products by 10%.
2. The cost of transportation from the supplier increase by 50% as a result of extended route due to the closure of the Panama Canal.
3. Your employees demand salary increases of 10%.
4. The supplier shortens the length of your trade credit.

#answers

CLICK ᴏʀ SCAN

Task 4.2

Explain what you could do in a situation where...?

1. An opportunity arises to purchase semi-finished products for 30% of the market price, subject to payment in cash.
2. Your main competitor takes over the company that supplies you with semi-finished products.
3. The period for refunding overpaid tax is extended.
4. A lockdown is introduced for your industry due to the pandemic.

#answers

CHAPTER 5
EXCESS LIQUIDITY AND THE LOSS OF LIQUIDITY – IMPLICATIONS FOR COMPANIES

5 minutes of reading

In this chapter, you will learn:

- what liquidity loss and excess liquidity are
- what the lack of liquidity or excess liquidity results in for the company

Liquidity can be compared to a tub of water.

No one wants to bathe in a bathtub with too little water because they will get cold. When there is too much water in the tub, it will start to overflow and go to waste. So how much water should there be in the bathtub? Neither too much nor too little. Enough for taking a bath and not too much so that it does not go to waste.

The same is true of liquidity: when there is insufficient liquidity, there will be a risk of losing it, resulting in **illiquidity**. And when there is too much liquidity, a company will be **over-liquid**, which is not the best thing either.

LOSS OF LIQUIDITY AND ITS CONSEQUENCES
#definition

Loss of liquidity is the inability of business entities to cover their operating and financial expenses from the revenues of their current operations and funds accumulated in the course of management.

Temporary problems with financial capacity do not always have to carry serious consequences. However, low liquidity or complete lack of liquidity will increase the likelihood that a company may soon be unable to pay its current obligations. Such a situation puts a strain on the company, and when it lasts longer, it may result in bankruptcy.

What happens when the company loses liquidity?

• the company's market position compared to its competitors is deteriorating;
• a need arises to negotiate an extension of the term of repayment of liabilities;
• the possibility of flexible financial management is lost;
• the costs of obtaining additional sources of business financing are increasing;
• contracting parties refrain from granting a trade credit;
• problems with supplies and the sale or distribution of goods arise;
• it becomes necessary to enforce the receivables immediately;
• as a result of an increase in operating costs, and as a result of a decline in sales, the financial performance of the company deteriorates;
• due to limited capital to pay liabilities, there is a loss of flexibility in decision-making;
• there is a reduction in potential of the company's development due to the loss of its ability to meet its obligations, as well as to take on new ones.

In business practice, all these symptoms give contracting parties and creditors a clear signal of the company's financial problems, leading to a loss of reputation and credibility in the environment. The panic of contracting parties and funders in situations of payment problems piles up the effects of inability to pay, which can even lead to bankruptcy or insolvency.

REAL LIFE EXAMPLE – EVE AND HER COMPANY

Eve's company is an ice-cream enterprise. Her main customer is a hotel chain in Warsaw. As a result of a manufacturing error and the delivery of a wrong flavour of ice-cream, the customer broke its contract with the company. Moreover, it did not pay for an earlier batch of deliveries, explaining it away with its financial problems.

Question

What problems, resulting from the loss of liquidity, might Eve's company now face?

Possible answers

1. Eve will have a problem paying for raw materials for ice cream production, such as cream and frozen fruit.
2. Eve may have a problem paying invoices for utilities: water, electricity, Internet, as well as paying salaries to employees.
3. Eve will not be able to pay the installment of the investment loan taken out to buy a new ice cream machine.
4. The ice cream packaging supplier will not want to extend the payment term in the future.
5. The bank may not be interested in negotiating loan terms.

EXCESS LIQUIDITY AND ITS EFFECTS

In a situation where there are more funds available than liabilities, there is excess liquidity in a company. And while on the surface it appears to be a positive development – the company has more reserves, meaning that it is in good shape – In effect, it can work against the company.

In simple terms, **excess liquidity** can be explained as a situation in which a company's cash reserves are greater than its liabilities and expenses.

Excess liquidity may seem like a desirable phenomenon. After all, a company operates impeccably, keeping its finances strong. Large cash reserves are saved for unexpected situations and incidents of sudden economic downturns. Therefore, it may seem that every company would like to achieve such a state and that it has no negative effects. So what is the danger in this?

Often, financial managers take a very precautionary approach to spending. They save by paying only the necessary fees. However, excess liquidity should not be considered as a management success. Excess liquidity can be a trap of sorts - one may feel that

the company is prospering better than usual. However, in reality, excess liquidity means that the company is not making the most of its opportunities. Turnover that has not been properly managed most often accumulates in a bank account, without generating profits.

This conservative financial policy results in reduced profitability. If not invested, large sums accumulated in a company account do not gain in value. Assets are not being used efficiently, and avoiding investment hinders development. The company ceases to grow and proverbially „rests on its laurels," failing to profit from its investments. Risk-taking seems essential for business to grow stronger and generate more and more revenue. Excess liquidity inevitably leads to the trap of reducing the efficiency of current assets.

Task 5.1

How would you evaluate the performance of the company based on the following balance sheet? What should the company do?

ASSETS	2019	LIABILITIES	2019
Fixed assets	150,000.00	Equity	200,000.00
Current assets	600,000.00	Long-term liabilities	480,000.00
• Inventories	200,000.00	Short-term liabilities	70,000.00
• Trade receivables	200,000.00	• Loans receivables	50,000.00
• Cash	200,000.00	• Liabilities to suppliers	20,000.00
TOTAL	**750,000.00**	**TOTAL**	**750,000.00**

Solution

Assessment of the company's situation

From a preliminary comparison of current assets and short-term liabilities (especially liabilities to suppliers), the company's excess liquidity is apparent. Total current assets are several times greater than total short-term liabilities. In addition, the company maintains a high level of cash, exceeding its liabilities to suppliers by a factor of 10. All this is indicative of the company's excess liquidity.

What could be the consequences of such a condition?

On the one hand, the company gives up the opportunity to increase profit by not committing financial surpluses, but on the other hand, for example in a deep demand crisis, this situation will protect the company from serious liquidity problems. Therefore, it is difficult to unequivocally determine whether it is a good or bad situation. The level of liquidity risk at the expense of profitability should be indicated instead.

Task 5.2

Please determine whether the following business events will lead to illiquidity (I) or excess liquidity (E) for the company:

	Business events	I	E
1	Worse financial situation		
2	Impact of a large payment from a customer		
3	Customer's failure to pay on time for the delivery of products		
4	Bank's refusal to grant a loan		
5	Increase in insurance premium by insurer for property insurance		
6	Purchase raw materials for the coming quarter at a discount, for cash		
7	Increase in social security contributions of employees		
8	Competitor's withdrawal from the market		
9	Extension of trade credit by the supplier		
10	Reduction of preferential interest rates on investment loans by the bank		
11	Bank spreads the repayment of investment loan over a longer period of time		

#answers

CLICK or SCAN

CHAPTER 6
METHODS OF MEASURING LIQUIDITY

25 minutes of reading

In this chapter, you will learn:

- how to measure liquidity
- which indicators are most commonly used to assess liquidity
- what the cash adequacy ratios are

LIQUIDITY IN FINANCIAL STATEMENTS

Liquidity is measured using ratios that present a company's financial situation. These ratios are developed on the basis of selected data derived from financial statements. Sources of basic information showing how the company's liquidity is managed are:

- **balance sheet**, i.e. a statement of assets held (property) and liabilities (sources of financing that property);
- **cash flow statement,** i.e. a financial statement that provides summary data on all cash inflows the company receives from current operations and external sources of investment;
- **profit and loss account**, i.e. a statement of financial operations carried out over a specified period of time (usually one year). The difference between revenue and expenses shows whether the company has incurred a profit or a loss over a given period of time.

The data necessary to measure liquidity can be found in individual statements, as well as the company's financial documents. Many of these sources can be combined as presented in Table 6.1.

Table 6.1. Data necessary to measure liquidity and their sources

BALANCE SHEET	PROFIT AND LOSS ACCOUNT
Inventory Receivables Securities Cash Short-term liabilities	Revenues from sales Operating expenses
CASH FLOW	ANALYTICAL DATA
Cash flow Sources of cash generation Closing balance of cash	Customer invoices Supplier invoices Warehouse documents Bank statements

Source: author's own elaboration based on financial statements

Financial ratios are characterised by three key features:

- **Measurability** means that the ratios use data that can be measured in some way and these data are recognised in the financial statements;

- **Comparability** indicates that the result obtained based on financial ratios can be compared to the result obtained using another time, industry or planning approach;
- **Interpretability** means that the result obtained based on financial ratios can and should be interpreted and lead to conclusions.

Liquidity can be measured on the basis of:

- **cash flows** in the period for which the cash flow statement was prepared;
- **current assets** and **current liabilities** at the beginning and end of the reporting period.

Liquidity is examined:

- **based on the cash flow statement;**
- **based on ratios**:
  - using the **static** approach,
  - using the **dynamic** approach.

MEASURING LIQUIDITY BASED ON THE CASH FLOW STATEMENT

An increase in cash from operating activities better expresses the soundness' of a company than the amount of profit alone.

M. Sierpińska[4]

The **cash flow statement** includes cash received by a company from **various types of activities, including operations**, **investments** and **financing**, the sum of which is called **net cash flows**. The cash flow statement consists of three main parts and shows the related inflows and outflows, as shown in Figure 6.1. The first section of the statement is cash flows from operating activities, which include transactions from all business operations. Cash flows from investment activities constitute the second part of the cash flow statement and are the result of gains and losses on investments. Cash flows from financing activities are the last section that provides information on cash used from debt and equity.

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[4]   M. Sierpińska, D. Wędzki, Zarządzanie płynnością finansową w przedsiębiorstwie, PWN Warszawa 1997, s. 52.
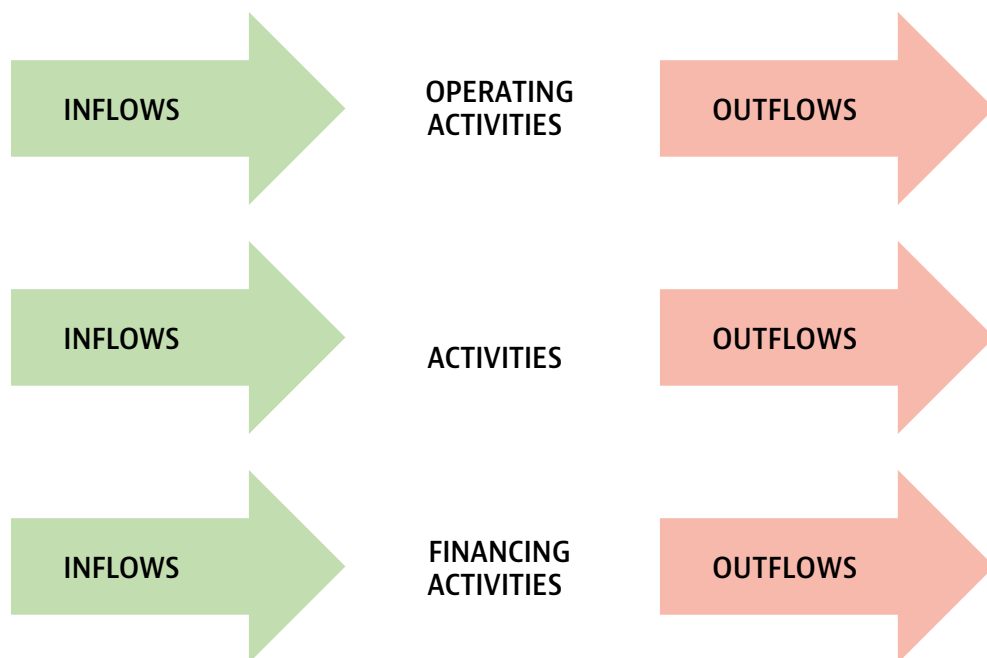
Figure 6.1. Cash flows in a company
Source: author's own elaboration

Net cash flows from operating activities are the first part of the cash flow statement. This section shows cash flows and outflows that result directly from the company's core business activities, which may involve the production and sale of goods or services, including the purchase and sale of inventory and consumables, as well as the payment of salaries to employees. In practice, operating activities are the largest part of a company's business. All other forms of inflows and outflows, such as investments, debts and dividends, are not included. A company should be able to generate sufficient positive cash flows for operational growth. If they are not sufficient, the company may need external financing to ensure its growth, which will be included in subsequent areas of its operations. It is important to remember that investors prefer to invest in enterprises that generate cash flows from their business activities rather than through investment and financing activities.

Net cash flows from investment activities are the second part of the cash flow statement, which relates to cash flows from investments and is the result of gains and losses on investments. This section also includes cash spent on tangible fixed assets. An increase in capital expenditure usually means a reduction in cash flows. But this is not always a negative phenomenon, as it can indicate that a company invests in its future business. Enterprises with high capital expenditure are usually those that are growing. Positive cash flows in this section can be generated through the sale of fixed assets.

Net cash flows from financing activities are the last part of the cash flow statement. It provides a summary of cash used to finance companies, e.g. taking out or repaying

loans, issuing bonds or shares. Cash flows from financing measure the flow of cash between the company and its owners and creditors, the source of which is usually debt or equity. Analysts use them to determine how much cash was paid out through dividends or the repurchase of shares. This section also shows how funds are raised for the operational development of a company. When the value of cash flows from financing activities is positive, it means that more money is coming into the business than is going out. A negative value means that the company is repaying debt or paying dividends and/or repurchasing shares.

The analysis of the cash flow statement makes it possible to assess the financial standing of the company. Taking this into account, there are eight possible outcomes for a company at the end of the accounting period, as presented in the Table 6.2.

Table 6.2. Assessment of the company's standing based on cash flow statement

No.	Cash flow from			Assessment of the company's standing
	operating activities	investing activities	financing activities	
1	+	+	+	The company is probably raising funds for future investments
2	+	−	−	The company is generating high profits, which it uses to invest and repay its liabilities
3	+	+	−	The company probably is in restructuring
4	+	−	+	The company is developing
5	−	−	+	The company is new and just growing
6	−	+	+	The company may have temporary operational difficulties
7	−	+	−	The company sells assets due to lack of cash
8	−	−	−	The company is at risk of bankruptcy

#issues

REAL LIFE EXAMPLE – JANE'S SCOOTERS

Jane's company buys and sells motor scooters. The scooters are imported from Lucy and sold in Poland to retail and institutional customers, such as courier companies. Jane received an offer from her business partner to buy 30 scooters at an attractive price, subject to a prepayment of 100%. After including all costs (transport, customs), Jane spent PLN 100,000 on the purchase of the scooters. At the same time, a newly opened branch of a nationwide courier company in Jane's town made an offer to

buy 30 scooters for PLN 120,000 with deferred payment. Jane resold the scooters, but her company did not receive any money until the end of the year.

Question

What is the situation of Jane company from an accounting and corporate finance perspective?

Solution

Profit and loss account as at 31 December:

Revenue – 120,000

Expense – 100,000

Profit   –   20,000

This result means that the company made a profit, so it can, for example, pay dividends or invest.

Cash flow statement as at 31 December:

Cash inflows   – 0

Cash outflows – 100,000

Cash flows   – 100,000

This result means that, from the point of view of liquidity management, the company's situation is bad.

#issues

REAL LIFE EXAMPLE – PETER'S CAKES

Peter's company bakes and sells cakes. The company has kitchen equipment consisting of ovens, food processors and refrigerators. The company entered into a van lease agreement. Thanks to its previous lucrative cooperation with a large shop, it managed to save money in the deposit account.

During the lockdown, the restaurant, which so far had been purchasing 80% of Peter's production, terminated the contract and informed him that it might not be able to pay an invoice for the previous month. And yet Peter has to pay his employees and settle invoices he received for the previous month – for utilities used and raw materials purchased.

Peter is worried about losing liquidity in his company.

Question

What can Peter do to prevent the loss of liquidity?

Solution

Peter can take a variety of actions, but each of them will have specific consequences.

Let us look at the possible solutions and analyse what consequences they will have for the company:

Peter can sell some of the kitchen equipment.

1. Peter can withdraw from the lease agreement.
2. Peter can withdraw funds from the deposit account.

And here are the consequences of these decisions:

1. The company's production capacity will decrease, so it will need to buy the missing equipment when it returns to full operation.
2. The company will have to pay contractual penalties for early termination of the lease agreement.
3. The company will lose the accrued interest due to the early withdrawal of funds from the deposit account.

#issues

REAL LIFE ECAMPLE – LUCY'S GO-KARTS

Five years ago, Lucy set up a go-kart track in the centre of a tourist town. She had many customers during the summer season. Customers pay in cash only, whereas Lucy settles most of her bills with monthly deferred payments. Lucy put surplus funds into deposit accounts in foreign currencies because she wanted to buy go-karts from an Asian contractor. After another very successful season, Lucy decided to lease additional go-karts and a super car for herself. At the same time, she took out an investment loan to purchase an adjacent plot to convert it into an additional go-kart track.

However, the next three years were not so profitable. The reason for this was:

- competition that appeared in Lucy's town,
- decreasing number of tourists,
- new tourist attractions (bungee jumping, paragliding and funfair),
- appreciation of Polish zloty.

Question

How can Lucy save her company given the worsening present conditions?

Solution

Lucy can make various decisions, but they will have certain consequences. Here are examples of actions Lucy can take:

1. Termination of the lease agreement: regarding go-karts or the company car.

2. Sale of the plot of land purchased – to be converted into the new go-kart track.

3. Withdrawal of funds from the deposit account or currency translation.

The consequence of the actions taken will be as follows:

1. Lucy will have to pay contractual penalties for early termination of the lease agreement.

2. Lucy will have to incur additional costs associated with the sale of the property and will not be able to recover the capital invested. Selling the plot also means giving up future income and possibly having the plot taken over by competitors.

3. Lucy will lose accrued interest as a result of the withdrawal of funds from the deposit account and may also incur losses due to unfavourable exchange rate differences.

REAL LIFE EXAMPLE – ALICE'S, BARBARA'S AND CINDY'S COMPANIES

In the 2020 financial year, Alice's, Barbara's and Cindy's companies achieved the following financial results:

Type of data	COMPANY A	COMPANY B	COMPANY C
Cash at the end of the year (in thousand PLN)	1,500	1,500	1,500

The table below shows the structure of cash flows of these companies:

Type of data	COMPANY A	COMPANY B	COMPANY C
Cash at the end of the year (in thousand PLN)	1,500	1,500	1,500
Cash flows			
from operating activities	1,200	−200	100
from investment activities	−200	1,000	−100
from financial activities	500	700	1,500

Questions

- How can the financial standing of these three companies be assessed?
- Which company is in the best situation and which one is in the worst?
- Can this assessment be carried out only based on the first table?

Solution

At the end of the year, each company has the same amount of cash, as shown in the first table. However, it does not provide enough information to clearly assess their financial standing.

To be able to do this, it is necessary to analyse them from the point of view of cash flows and their structure.

Taking cash flows from various activities into account, we can see that Alice's company generated a cash surplus from operating activities.

Barbara's company, on the other hand, probably achieved its surplus cash through the sale of some fixed assets or as a result of non-operating cash inflows generated from its financial assets. However, in the operational area, its activities are inefficient, as evidenced by the negative cash balance at the end of the year.

Cindy's company is likely to take out a loan or credit, which will result in a cash outflow in future periods, as such actions generate costs (interest, dividends, repayment of loans and credits). Note that if it is not able to pay its liabilities with operating cash, it may have a liquidity problem in the future.

Therefore, based on the above analysis, we can clearly state that Alice's company is in the best financial situation.

#note

Although the above examples simplify things, they confirm the thesis that **an increase in cash, mainly from operating activities, is a better representation of the financial standing of a company and its efficiency on the market than its financial result and the value of total cash held**.

An increase in cash from operating activities is more objective than profit or cash balance, as it is nothing more than the difference between the related inflows and outflows that have actually occurred in a given enterprise. Cash flows from operating activities represent cash inflows and outflows from the company's core business activities defined in its Articles of Association.

Companies A, B and C continued to operate for another year. Let us now take a look at the amount of funds accumulated at the end of this previous year:

Type of data	COMPANY A	COMPANY B	COMPANY C
Net cash flows	−1,300	−1,300	1,300
Net cash flows	−3,900	−130	−390
Net cash flows	5,200	910	−1,040
Cash	1,500	1,500	1,500

Questions

1. What will be the balance of cash in each company?
2. What could be the reason for negative cash flows from financing activities in Cindy's company? Explain why or why not.
3. After analysing the financial standing of Alice's and Barbara's businesses, which one would you like to own and why?
4. Could the assessment of Cindy's cash flow statement be a cause for concern for the company's management board and owners? Explain why or why not.

Solutions

1.

Type of data	COMPANY A	COMPANY B	COMPANY C
Cash at the end of the year	−1,500	980	1,370

1. Cindy's company granted more loans than it took out, it purchased more shares than it issued, or a combination of these two causes occurred.

2. As shown by its cash flows from financing activities, Alice's company is developing. This is confirmed by negative cash flows from operating activities, as receivables and inventory generally increase during the company's growth.

   Barbara's company is stagnant. The negative cash flow from operating activities is presumably due to losses incurred or due to a relative increase in receivables and inventories compared to the level of sales. In this case, we get a signal of mismanagement of current assets in the company.

3. As far as Cindy's company is concerned, there are essentially no grounds for concern. It is a credible company recording a relatively modest growth. With surpluses from operating activities, it can afford to pay off debts, buy shares, pay dividends or opt for a combination of all these.

Task 6.1

Answer how the following economic events affect liquidity? Do they increase it (**YES**) or do nor increase it (**NO**)?

Business events		YES	NO
1.	Amortisation and depreciation		
2.	Foreign exchange gains (realised)		
3.	Foreign exchange losses (settled)		
4.	Dividends earned from 10% shareholding in company X (interest and profit shares received)		
5.	Interest on investment loan taken out (interest paid)		
6.	Reduction in sales as a result of the termination of a major customer contract (inventory build-up)		
7.	Faster production rates due to the automation of production lines		
8.	Sale of inventories due to increased demand (decrease in inventories)		
9.	Acquisition of a new customer through an extended payment period (increase in short-term receivables)		
10.	Effective debt collection (decrease in short-term receivables)		
11.	Conclusion of a loan agreement for an operating loan (increase in short-term liabilities)		
12.	Repayment of credit line (decrease in short-term liabilities)		
13.	Sale of patent for anti-wrinkle cream formula (disposal of intangible assets)		

14.	Sale of redundant machinery from the production department (disposal of tangible fixed assets)		
15.	Sale by a campsite of part of a campground previously purchased from a private owner (disposal of real estate investment)		
16.	Sale by a shoe company of shares in a shoe factory – disposal of financial assets (foreign shares, bonds, treasury bills)		
17.	Receipt of dividends on shares held in company X (dividends and profit shares)		
18.	Repayment of a loan for private purposes by the President of the Management Board (repayment of loans granted)		
19.	Recovery of penalty interest on outstanding debt (interest received)		
20.	Purchase of a tiger by a zoo (purchase of livestock)		
21.	Purchase of antivirus software licences (acquisition of intangible assets)		
22.	Acquisition by a campsite of a new plot of land previously owned by a neighbour with a plan to adapt it for tourism purposes (investment in real estate)		
23.	Taking out an investment loan for the purchase of a new production machine (credits and loans)		
24.	Issue of 3-year bonds to finance the construction of a new warehouse (issue of debt securities)		
25.	Shareholders' decision at the General Shareholders Meeting to distribute dividends from company profits (dividends paid and other distributions from net profit)		
26.	Decision to leave the stock exchange – acquisition of own shares (stocks)		
27.	Redemption of issued 5-year bonds at maturity (redemption of debt securities)		
28.	Repayment of the last instalment of the investment loan taken out for the construction of the new warehouse (repayment of loans and borrowings)		
29.	Payment of car fleet leases by a car rental company		
30.	Interest paid on management board members' credit card debt (interest paid)		

#answers

CLICK or SCAN

Task 6.2

Evaluate the company's liquidity position by analysing the states the company is in. Identify whether, in the following states, the company is liquid, solvent, or has to fight to maintain this state, or is insolvent and has lost liquidity?

Company state	Liquidity assessment
1. The company is probably raising funds for future investments	?
2. The company earns high profits, which it uses to invest and repay liabilities	?
3. The company is probably in restructuring	?
4. The company is developing	?
5. The company is new and just growing	?
6. The company may have temporary operational difficulties	?
7. The company sells assets due to cash shortage	?
8. The company is at risk of bankruptcy	?

#answers

STATIC RATIOS IN LIQUIDITY MEASUREMENT

An assessment of a company's liquidity based on balance sheet data is static in nature. It is determined on the basis of resource volumes (as at the balance sheet date), using selected items from the balance sheet.

Table 6.3. Static ratios and their formulae

Ratio name	Ratio formula
Current ratio	$\dfrac{\text{current assets}}{\text{current liabilities}} = <1,2;>$
Quick ratio	$\dfrac{\text{current assets} - \text{inventories}}{\text{current liabilities}} = 1$
Cash liquidity ratio I	$\dfrac{\text{current assets} - \text{inventories} - \text{current receivables}}{\text{current liabilities}} = 0,2$
Cash liquidity ratio II	$\dfrac{\text{cash}}{\text{current liabilities}} = 0,1$

The Fig. 6.2 shows the use of individual data from the company's assets and liabilities to build static liquidity ratios.
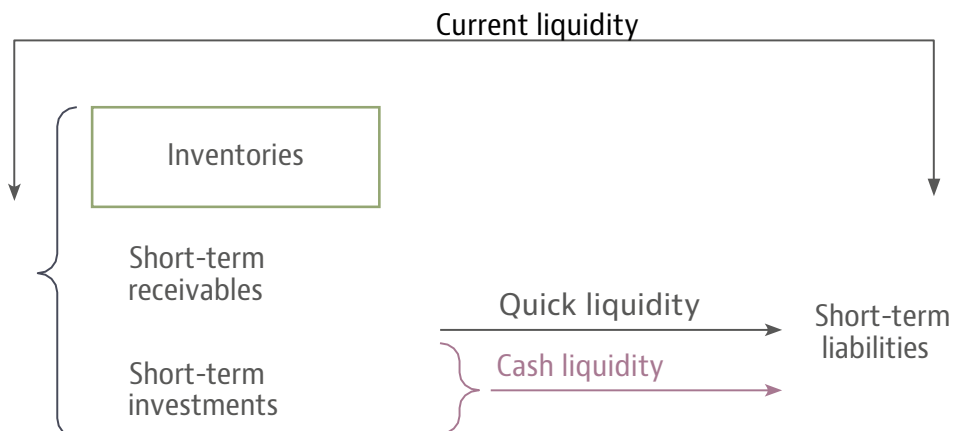
Figure 6.2. Use of balance sheet data in static ratios for assessing company liquidity

The denominators in the static ratios are the same (the value of short-term liabilities) and only the values of the numerators change, as:

- the value of current assets (current ratio) is greater than the value of short-term receivables and short-term investments (quick ratio);
- short-term receivables and short-term investments (quick ratio) are greater than short-term investments (cash ratio).

#note

This means that:

$$\textbf{Current ratio} \quad > \quad \textbf{Quick ratio} \quad > \quad \textbf{Cash ratio}$$

#definition
Current ratio

Current ratio indicates whether and to what extent current assets cover current liabilities. This ratio shows whether the company has sufficient funds invested in current assets to cover its current liabilities.

For financial balance, it is assumed that the ratio should be between 1.2 and 2.0. Total current assets should exceed total current liabilities by between 20% and a maximum of two times. If there was a sudden need to settle all short-term liabilities, then the company would have enough current assets (but at the same time not too many) to sell them at short notice (including at a discount) and settle these liabilities.

A low level of the ratio may mean that the company may not have enough current assets to settle current liabilities. On the other hand, too high a level of the ratio may indicate that the company is not currently financing its operations through

short-term liabilities, which are the cheapest source of financing, or is holding on to unengaged current assets that could generate returns if invested.

Quick ratio

Quick ratio indicates whether and how liquid assets (i.e. current assets less the value of inventories) cover the company's current liabilities. In the calculation of this ratio, inventories are eliminated due to their lower degree of liquidity compared to the remaining current assets. For this reason, quick ratio will always be lower than current ratio.

- If the company has little or no inventory, the ratios will be equal or the difference between them will be small.
- When the ratio is around 1.0, it means that the company is able to cover its current liabilities with these assets.
- A large difference between the current and quick ratios means that the company has a high level of inventory, which may mean that some capital is tied up unproductively.

Cash ratio I (cash)

The purpose of cash ratio is to indicate how much of the company's current liabilities can be repaid with assets in the form of cash or short-term investments. For this ratio, neither inventories nor short-term receivables are considered, only those assets that can settle liabilities as quickly as possible are considered, which means that cash ratio I will always be lower than quick ratio.

When the ratio is around 0.2, it means that the company is able to cover its current liabilities with cash or short-term investments.

A large difference between cash I and quick ratios means that the company has a high level of short-term receivables, which may indicate an unproductive tying up of some capital.

If cash ratio I is very low, this may suggest that the company does not have cash and short-term investments, which may lead to losses due to the inability to make new transactions. In contrast, excess cash and short-term investments (high cash ratio I) can lead to costs.

Cash ratio II (immediate liquidity)

Immediate liquidity ratio shows the ratio of cash (or cash equivalents, i.e. the most liquid asset elements) from which cash can be recovered within up to 3 months in relation to liabilities falling due in the next 3 months. It is impossible to determine how high such a ratio should be - its assessment is based on comparing values over time.

A large difference between cash ratios I and II indicates that the company has a high level of short-term investments, which may mean that some capital is being tied up unproductively If cash ratio II is very low, this may suggest that the company does not

have cash, which may lead to losses due to the inability to make new transactions. In contrast, excess cash (high cash ratio II) can lead to unjustified costs resulting from the unproductive accumulation of cash on hand or in a bank account.

TASKS

LIQUIDITY IN DIFFERENT ECONOMIC SECTORS

Although static liquidity ratios have their normative values, it should be borne in mind that their average value will depend on the sector of the economy and the economic climate (see Chapter 3). The tables you will find on the following pages show the value of static liquidity ratios by selected economic sectors for the period 2006–2019.

Using the data from the tables, evaluate the liquidity of companies in different economic sectors and identify the reasons for the changes observed. To this end, it is worth answering the following questions:

- What was the economic situation (GDP growth, inflation rate, unemployment rate) in each year?
- What was the situation in the financial system (interest rate, bank lending policy)?

What are the reasons for the differences in liquidity levels between the different economic sectors?

Table 6.3. Current ratio in different economic sectors

Type of data	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
IN TOTAL	1.456	1.444	1.478	1.483	1.485	1.507	1.452	1.472	1.465	1.484	1.445	1.366	1.434	1.403
Industry	1.447	1.432	1.502	1.486	1.494	1.53	1.493	1.488	1.514	1.481	1.472	1.339	1.479	1.468
Construction	1.657	1.692	1.658	1.711	1.63	1.578	1.567	1.552	1.579	1.755	1.738	1.646	1.693	1.521
Trade	1.398	1.375	1.397	1.381	1.373	1.364	1.323	1.319	1.32	1.311	1.289	1.296	1.301	1.322
Transport	1.496	1.531	1.538	1.641	1.541	1.446	1.418	1.333	1.357	1.33	1.276	n/a	n/a	1.079
Accommodation and catering	1.535	1.192	1.262	1.092	1.039	1.048	0.988	0.876	1.078	1.224	0.954	1.401	1.564	1.428
Information and communication	1.628	1.631	1.43	1.534	1.257	1.522	1.283	1.48	1.569	1.851	1.72	n/a	n/a	n/a
Education	1.927	1.728	1.733	1.563	1.592	1.635	1.626	1.716	1.82	2.003	1.978	2.475	2.473	2.044

Health care	1.318	1.26	1.31	1.387	1.408	1.161	1.326	1.203	1.151	1.211	1.341	1.397	1.405	1.348
Activities related to culture	1.357	1.526	1.885	1.582	1.469	1.352	1.376	1.48	1.472	1.289	1.051	n/a	n/a	n/a

Source: Own study based on data from Statistics Poland

Table 6.4 Quick ratio in different economic sectors

Type of data	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
IN TOTAL	0.994	0.984	1.029	1.034	1.056	1.072	1.024	1.035	1.041	1.075	1.03	0.951	1.008	1.012
Industry	0.957	0.95	1.022	1.011	1.011	1.046	1.007	0.989	1.036	1.045	1.032	0.909	1.006	1.019
Construction	1.13	1.127	1.122	1.199	1.161	1.094	1.062	1.019	1.044	1.198	1.163	1.213	1.236	1.166
Trade	0.823	0.807	0.851	0.832	0.814	0.806	0.795	0.796	0.816	0.822	0.784	0.769	0.792	0.845
Transport	1.366	1.399	1.404	1.505	1.43	1.334	1.312	1.227	1.232	1.197	1.138	n/a	n/a	0.965
Accommodation and catering	1.398	1.074	1.118	0.946	0.928	0.92	0.849	0.766	0.876	1.05	0.8	1.219	1.364	1.241
Information and communication	1.414	1.407	1.247	1.338	1.109	1.345	1.106	1.281	1.354	1.633	1.503	n/a	n/a	n/a
Education	1.765	1.605	1.606	1.41	1.455	1.405	1.407	1.516	1.618	1.749	1.73	2.252	2.264	1.828
Health care	1.199	1.138	1.193	1.257	1.283	1.049	1.202	1.09	1.042	1.107	1.228	1.287	1.292	1.244
Activities related to culture	1.263	1.424	1.772	1.474	1.355	1.252	1.296	1.387	1.375	1.174	0.965	n/a	n/a	n/a

#issues

REAL LIFE EXAMPLE – LIQUIDITY ASSESSMENT OF ALAMAKOTA Ltd.

The table shows the elements of assets and liabilities of ALAMAKOTA Ltd. Co. Using the financial data provided, please calculate the current ratio, quick ratio and cash ratio, and carry out an assessment of liquidity in this company.

Type of data	Year 1	Year 2	Year 3
Inventories	PLN 150,000	PLN 180,000	PLN 220,000
Receivables	PLN 120,000	PLN 150,000	PLN 80,000
Securities	PLN 20,000	PLN 16,000	PLN 15,000
Cash and cash equivalents	PLN 10,000	PLN 8,000	PLN 5,000
Current assets	PLN 300,000	PLN 354,000	PLN 320,000
Current liabilities	PLN 150,000	PLN 160,000	PLN 200,000

Solution

After calculating the ratios based on the formulas discussed earlier in the chapter, the following values were obtained:

	Year 1	Year 2	Year 3
Current liquidity ratio	2.00	2.21	1.60
Quick ratio	1.00	1.09	0.50
Cash ratio	0.20	0.15	0.10

Conclusions

In year one, the ratios are at an appropriate level.

In the second year, two liquidity ratios, i.e. the current ratio and the quick ratio, continue to improve, which can be assessed positively.

In the third year, all ratios decrease, which means that the company's liquidity level is lower. The quick ratio decreased the most due to a decrease in the level of receivables relative to current liabilities. In the future, the company may have problems settling liabilities due to their significant increase, opposite to the change in receivables. The company is likely to offer its customers more liberal payment terms than it receives from its suppliers.

DYNAMIC RATIOS IN THE ASSESSMENT OF A COMPANY'S LIQUIDITY

Dynamic liquidity ratios are constructed as the relationship between selected items from the cash flow statement as well as selected items from the balance sheet and income statement. These ratios can be divided into two groups:

- Cash coverage ratios;
- Cash efficiency ratios.

Dynamic ratios are used for in-depth liquidity analysis. They are based on cash flows from the cash flow statement. They investigate the reasons for changes in these resources. In business practice, it is assumed that important financial decisions are based on the results of the cash flow statement. This enables financial planning from the point of view of growth strategies for shareholders, assessment of the effectiveness of investment projects, valuation of the company, and forecasting of the company's bankruptcy.

Cash coverage ratios

The cash coverage ratios group indicates the relationship of the cash flows generated from operating activities to selected balance sheet items and related expenditure. This applies, in particular, to the repayment of debts, dividend payments to owners and investment expenditure. These ratios answer the question of the extent to which operating cash flows cover selected items from the balance sheet. Thus, an

increase in the value of cash coverage ratios means an improvement in the security for repayment of these balance sheet items.

1. Overall operating cash coverage ratio

The amount of the overall operating cash efficiency ratio measures a company's financial capacity and shows whether it has generated cash from its core operating activities in sufficient amount to cover expenses for the repayment of loans and borrowings, payment of dividends, purchase of tangible and intangible assets. A ratio higher than 100% indicates sufficient cash to finance the expenditure shown. When the ratio is less than 100%, the company must support itself with positive flows from the other two activities, i.e. investment and financing. The solution is also to reduce expenditure on dividend payments or to reduce expenditure on the purchase of tangible and intangible assets

#note

Remember! A value of at least 100% for the overall operating cash efficiency ratio means that the company has full payment capacity.

$$\frac{\text{CF from operating activities}}{\text{repayment of long-term liabilities + payment of dividends + investments}} * 100\%$$

2. Debt service coverage ratio

The operating cash efficiency ratio for the repayment of total debts measures whether the company has generated sufficient cash from its core operating activities to cover total liabilities. The ratio answers the question of the extent to which total liabilities are funded by cash from operating activities. An increase in the value of this ratio demonstrates a greater ability to settle total liabilities with cash generated from operating activities.

$$\frac{\text{CF from operating activities}}{\text{total liabilities}} * 100\%$$

3. Long term debt service coverage ratio

The operating cash efficiency ratio for the repayment of long-term debts indicates what proportion of long-term liabilities can be settled by operating cash flow. This ratio answers the question of the extent to which long-term liabilities are financed by operating cash flow. An increase in the ratio confirms a higher degree to which long-term liabilities are hedged by cash flows from operating activities. Furthermore, it demonstrates a higher efficiency of long-term liabilities in generating operating cash flows.

$$\frac{\text{CF from operating activities}}{\text{long term liabilities}} * 100\%$$

4. Short term debt service coverage ratio

The operating cash efficiency ratio for the repayment of current liabilities indicates what proportion of current liabilities can be financed by cash flows from operating activities. The higher the ratio, the higher the degree to which current liabilities are covered by cash generated from operating activities. In addition, the ratio provides information on the efficiency of current liabilities in generating operating cash flow.

$$\frac{\text{CF from operating activities}}{\text{current liabilities}} * 100\%$$

5. Fixed-charge coverage ratio

The operating cash efficiency ratio for the repayment of interest-bearing liabilities indicates the level of interest-bearing liabilities that can be settled by cash flows from operating activities. An increase in the ratio confirms a higher degree of cash collateral for these liabilities. In addition, this ratio provides information on the efficiency of interest-bearing liabilities in generating operating cash flow.

$$\frac{\text{CF from operating activities}}{\text{interest}-\text{bearing liabilities}} * 100\%$$

Cash efficiency ratios

Cash efficiency ratios are based on cash flows from operations. They report on the relation of cash generated from operations to sales revenue, operating profit and financial resources. An increase in the value of the ratios in this group means an increase in cash efficiency, as it is more beneficial to have cash rather than profit recorded in the income statement.

1. Operating cash flow margin

The turnover cash efficiency ratio shows the ratio of cash from operating activities to sales revenue and measures the share of sales for cash. This ratio shows how much cash the company generated through sales revenue. The higher the ratio, the more cash was generated from sales and the higher the chance of maintaining liquidity.

$$\frac{\text{CF from operating activities}}{\text{sales revenue}} * 100\%$$

2. Cash assets efficiency ratio

The cash productivity ratio of assets determines the ability of owned assets to generate cash and, consequently, informs how much cash from operating activities was generated by the (fixed and current) assets of the company. It informs about the cash

$$\frac{\text{CF from operating activities}}{\text{assets}} * 100\%$$

3. Fixed assets cash efficiency ratio

The cash efficiency ratio of fixed assets is used for an in-depth assessment of a company's asset performance in comparison with the cash efficiency ratio of total assets (No. 3). In this case, the size of the assets is limited to a selected asset of the company, such as fixed assets. This ratio measures the cash efficiency of fixed assets and answers the question of the value of cash generated by fixed assets alone. The company should strive for an increase in the value of this ratio as it will demonstrate the high cash efficiency of fixed assets and the efficiency of the management of the selected asset, at the same time confirming the decreasing liquidity risk.

$$\frac{\text{CF from operating activities}}{\text{fixed assets}} * 100\%$$

4. Current assets cash efficiency ratio

Interpretation of the cash efficiency ratio of current assets is similar to the cash efficiency ratio of total assets and the cash efficiency ratio of fixed assets. The difference is the reference only to assets directly involved in the core business, i.e. current assets. This ratio answers the question concerning the value of cash generated from operating activities through current assets. Both components of this ratio are directly involved in current operations and the high value confirms the low liquidity risk.

$$\frac{\text{CF from operating activities}}{\text{current assets}} * 100\%$$

Summary

After reading the first part of this handbook, you should be able to answer the following questions:

- what is liquidity?
- what are the differences between solvency and liquidity?
- what factors affect liquidity?
- how can a company improve its liquidity?
- what can the consequences of illiquidity or excess liquidity be for a company?
- how can a company's liquidity be improved?

Reminder

The term "company's liquidity" usually refers to the company's ability to use its current assets to pay its current or short-term liabilities. Every company must have enough cash to pay its financial obligations. However, holding too much cash can limit the company's ability to make important investments and development opportunities. Measuring liquidity helps to find the right balance. For this purpose, the financial situation of the company should be monitored and positioned for strategic development (Chapters 2 and 5).

The level of liquidity depends on a number of macroeconomic, sectoral and microeconomic factors, which may be dependent or independent of the company's operations. This is why monitoring and identifying the main determinants affecting the company's ability to pay its financial obligations on time is so important for liquidity management (Chapter 3).

Fortunately, the company has the capacity to improve its liquidity. The average time necessary to collect receivables from customers is important in order to plan the company's cash position accordingly for the purposes of paying its short-term liabilities. Obtaining a line of credit or factoring can be tools that will help to maintain liquidity. Another way is to monitor all assets, such as machinery and equipment, in order to determine whether the company does not hold any that are unnecessary. Selling them for cash may be a good option (Chapter 4).

The company can measure the level of liquidity based on a cash flow statement, which shows the value of cash generated from operating, investment and financing activities. Another method of measuring the level of liquidity is the ratio analysis carried out using static ratios (based on the financial statements, i.e. balance sheet) or dynamic ratios (based on the financial statements, i.e. balance sheet and cash flow statement) (Chapter 6).

Jarosław Ziętarski

Part II

CVP analysis

CHAPTER 1
INTRODUCTION TO ANALYSIS

Why do companies such as Spotify, Slack, Snapchat or AiRBnB operate without profit?

#issue

REAL LIFE EXAMPLE

Hardly anyone can still remember the Polish passenger car company. The Automobile Factory for Passenger Cars (FSO) was founded in 1948. Initially, it was to manufacture cars in cooperation with Italian Fiat, but for political reasons, it was decided that it should work with the Soviet Automobile Plant. The result of this agreement was the production of the M-20 Pobieda car (a Soviet design modelled on the Ford of the time). The model of this car manufactured in Poland was called the *Warszawa M-20*. Between 1951 and 1973, more than 250,000 *Warszawa* cars were produced in various body versions (saloon, station wagon, pick-up and ambulance). The first fully Polish passenger car developed and produced at FSO was *Syrena* model 101. In later years, collaboration with Fiat was undertaken for the manufacture of other car models. FSO cars were known not just in Poland. They were also exported to other countries including Bulgaria, Hungary, China, Turkey, Colombia, Guinea, Myanmar, Mongolia and Ecuador. Not even the investor Daewoo was able to prevent its bankruptcy. FSO's bankruptcy was primarily due to two phenomena that resulted in the lack of profit: firstly, declining sales and secondly, an increase in fixed costs. This chapter deals precisely with the issue of making (or not making) a profit as a company.

In a 2019 issue of a magazine for CEOs[5], an article was published on companies that are not making a profit. Surprisingly, some of them are the world's largest businesses, such as Uber, Spotify, Slack, Snapchat and AirBnB. What the aforementioned companies have in common is that they invest with a focus on the goal of increasing the value of the company rather than on immediate profit. The above example shows us two facts about companies:

1. they have more than one objective,

2. this objective (or overarching objective) does not necessarily have to be to make „immediate" profit.

Therefore, can companies operate without profit?

A company that does not make money can continue to operate until its money runs out. The more money a company has (e.g. from investors, or from banks), the longer it is able to operate without profit. Some companies make their first profit

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5   https://www.ceotodaymagazine.com/2019/11/5-of-the-worlds-biggest-companies-that-are-making-zero-profit/

after many years. In the case of Twitter, it only happened after 12 years, and in the case of Amazon after as many as 14 years.

Since companies can only operate without profit for a limited period of time, we should explain what profit is. The simplest measure to assess the performance of any company is its financial performance. Positive performance is called **profit** and negative performance is called **loss**.

#definition

> **Profit is the positive financial performance of a company, it means that the company has more revenue than the expenses of generating it**. The opposite of profit is loss, which reflects the opposite situation, i.e. one in which expenses exceed revenue.

If the revenue generated from sales is greater than the costs incurred, then the company makes a profit. If this is not the case (i.e. when costs are higher than revenues), a loss occurs. Profit is therefore the excess of the value of sales over the costs incurred. The document that provides this information is the profit and loss account (P&L). It is there (in the P&L) that a summary of the company's revenues (i.e. realised sales) and its costs over a specific period, usually the past year, can be found. Making a profit indicates that the activity of a particular business is profitable. There are the following types of profit (earnings) in a company:

revenues	PLN 100
– expenses[6]	PLN – 60
= *operating profit* (EBIT[7])	PLN 40
– financial costs (I[8])	PLN – 10
= *gross profit* (EBT[9])	PLN 30
– income tax (T[10])	PLN – 6
= *net profit* (EAT[11])	PLN 24

As can be seen from the above statement, the company realised an operating profit of PLN 40, a gross profit of PLN 30 and a net profit of PLN 24. Each is decreased by another value.

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[6] The word "cost" has a broader meaning than expense. Expense in mainly used in financial accounting. Cost is used in managerial accounting. In this book, both words will be used interchangeably.

[7] **E**arnings **B**efore deducting **I**nterest and **T**ax

[8] **I**nterest

[9] **E**arnings **B**efore deducting **T**ax

[10] **T**axes (in this case income tax of 19% of gross profit)

[11] **I**ncome **A**fter **T**ax (income tax)

REAL LIFE EXAMPLE

Task 1.1

Alicja runs her own café. At the end of the year, she summed up her revenues and expenses, which amounted to PLN 10,000 (revenue) and PLN 7,000 (expenses). At the beginning of the year, Alicja took out a PLN 12,000 loan from the bank, which she intends to repay next year. The loan carries an interest rate of 10% per annum. Income tax is 19%. What is the net profit generated by the café run by Alicja?

A. PLN 3,000

B. PLN 1,200

C. PLN 1,800

D. PLN 1,458

Solution

The correct answer is D. The café run by Alicja generated PLN 3,000 (PLN 10,000 – PLN 7,000) in operating profit (answer A). Financial costs PLN 1,200 (PLN 12,000 × 10% – answer B). From this it follows that the gross profit is PLN 1,800 (PLN 3,000 operating profit – PLN 1,200 interest on loan – answer C). On gross profit, a tax of PLN 342 (PLN 1,800 × 19%) must be paid. The net profit is therefore PLN 1,458 (PLN 1,800 – PLN 342 – answer D).

The first level of profit is calculated from operations (EBIT), followed by gross profit (EBT) and net profit. This means that a company can be without profit even at the level of its operations (i.e. what it does is not profitable). If goods are bought at a higher price than they are sold, such a business will not make a profit. Such a business makes no economic sense. Sometimes, the <u>operating</u> profit might be lower than the financial costs incurred. The company will then incur a loss, but this will be due to excessive financial costs. In other words, what it is doing makes an operating profit (it is buying goods cheaper than it is selling them) but the financial costs it incurs are consuming all of it. In both cases, the company will not pay income tax because there is no income (i.e. gross profit).

Also, it is possible that the revenue from the sale of goods and/or services is exactly as much as the sum of all expenses.

Revenue – expenses = PLN 0 (no longer a loss, not yet a profit)

In this particular case, a company will not make a loss, but neither will it make a profit. Its financial result will be PLN 0. Since zero doesn't mean profit, the company shouldn't pay income tax. This unusual case is called the break-even point[12].

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[12]   Break-even or break-even point

Once this point is exceeded, the company will report profit, before reaching this point, it will report a loss.

The absence of profit means profitability absence. But why do so many companies show a loss and still operate in the market?

The lack of profit in a company can only make sense in a transitional period (preferably planned in advance). Since the company is not making a profit, this means that (colloquially speaking) it is putting its own money into the business. Any company not making a profit, even if it is the largest company in the world, will eventually run out of money to settle its own obligations (i.e. mainly various expenses and loan or credit repayments). Then there will be further problems of the company, which may end in its bankruptcy. As in the case of the FSO whose story opened this chapter. A further implication is that making a profit is one of the company's objectives (the classical approach is about maximising economic profits).

Note at this point in the discussion about profit in an enterprise, one may be confronted with the argument that profit cannot be one of the objectives of enterprises

because, after all, there are enterprises that on purpose (and therefore in pursuit of their specific objective) incur losses (or minimise the profit generated). Why do they do that? This is, after all, going in the opposite direction to profit maximisation.
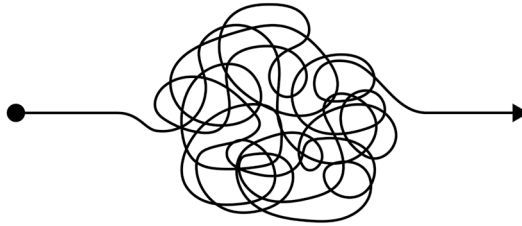
Source: Pixabay.

No income (gross profit) also means no income tax is payable and a small income means a correspondingly small amount of income tax is payable. Income tax rates can be (and very often are) different depending on the country. For example, the income tax rate that applies to entrepreneurs in Saudi Arabia is 5 per cent, in North Macedonia it is 10 per cent, in Poland it is usually 19 per cent[13], in France larger companies are charged a rate of 33.33 per cent.

An entrepreneur (i.e. a business owner) who avoids paying income tax can realise their private intention (maximisation of their own private financial benefit) precisely by understating their company's gross profit, or even „concealing" it – in other words, they represent the financial result of their company (mainly to the tax office) as worse than it actually is. However, it is important to bear in mind that in both cases (understatement and concealment of profit) the company's officially presented financial results will not reflect its true nature. Only if the venture in question makes it possible to achieve a profit does it make logical (though not necessarily ethical) sense to consider aiming for lower tax or no tax at all. Companies that do not generate income do not undertake such efforts, as such efforts make no sense (a company that has no income does not pay income tax). The question is whether income tax avoidance is possible, ethical and, above all, legal? Let me present two examples (out of many) to illustrate how this works.

#issue

REAL LIFE EXAMPLE

Profit transfer

Let us assume that a company in Poland buys goods from China and then sells them on the domestic market (in Poland). For the complete year, it made a gross profit of PLN 1 million. On this, it will be liable to pay income tax of 19 per cent, i.e. PLN 190,000. The business owner found out that a significantly lower income tax

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[13]   It is 9% for small enterprises.

(5%) is charged in Saudi Arabia. As a result, in Saudi Arabia he opens a company which becomes an intermediary between the companies in Poland and China. This type of strategy is called *tax optimisation*. Although the goods are coming from China straight to Poland, the purchase is registered as if three entities were involved. This is shown in Figure 1.1.
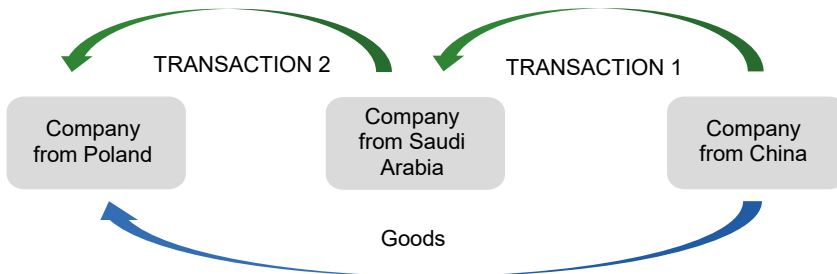

Figure 1.1. Purchase of goods including an intermediary
Source: own elaboration

Transaction 1 is a sale carried out by a company from China to an intermediary, a company in Saudi Arabia that is owned by the same proprietor as the company in Poland. Transaction 2 is the sale of goods by a company in Saudi Arabia to a company in Poland. The original profit of PLN 1 million is now distributed between two entities. Let us assume that the owner of both companies (in Poland and Saudi Arabia) has set the selling prices (to their respective companies) in such a way that the company in Saudi Arabia makes a profit of PLN 900,000 while the company in Poland makes only PLN 100,000. The owner of both companies will be required to pay income tax in two different countries. In Saudi Arabia he will pay PLN 45,000 (PLN 900,000 × 5% = PLN 45,000) and in Poland PLN 19,000 (PLN 100,000 × 19% = PLN 19,000). In total, the entrepreneur will pay income tax of PLN 64,000 (PLN 45,000 + PLN 19,000) in both companies, which is a significantly lower amount compared to the situation where all the profit is reported in Poland, i.e. PLN 190,000 must be paid.

In this example, the owner has deliberately underestimated the value of the gross profit in his company in Poland with a view to paying less income tax (when viewed through the prism of both companies) – and therefore having more money at his disposal. In this way, the owner (at the expense of profit in the Polish company) maximises his own financial benefit. Such tax avoidance raises well-founded ethical concerns. Saudi Arabia earns tax revenue from business (which is carried out in Poland) only because Poland has a higher income tax rate. The entrepreneur in the example above understated the profits in his company in Poland to save PLN 126,000 (PLN 190,000 – PLN 64,000).

However, it is difficult to argue in this case that this entrepreneur is not interested in maximising profits. He simply distributed them between two entities. Therefore, considering only the situation of the entity in Poland, one might conclude that the profit of this business is insignificant, as the financial situation of this entity does not

reflect the entire venture which is also pursued through the entity in Saudi Arabia. Despite ethical objections, many transactions are carried out exactly in this way.

> One of the best examples of the extent of such behaviour is Ireland's 26% increase in GDP in 2015, which was mainly explained by the transfer of profits made by corporations to Ireland, specifically because of the low income tax rate.[14]

#issue

REAL LIFE EXAMPLE

Decrease of profit

Source: Jon Tyson on Unsplash

The New York Times described a company owned by former US President Donald Trump which deliberately (i.e. in pursuit of its specific goal) reported losses for 18 years in order to avoid paying US income tax[15]. Donald Trump admitted that he was reporting losses in order to... avoid tax (it couldn't have been said more simply :), i.e. not because the venture was not profitable. It can be deduced from the rather general explanation that in this case, the applicable regulations were applied, but they allowed losses to be shown by increasing expenses. In this case, it is much more difficult to make an ethical assessment of such conduct. After all, such an entrepreneur can say that they acted in accordance with the applicable regulations, which, after all, were not set by them. He also made use of so-called tax optimisation.

Looking at both situations, it is possible to conclude that the purpose of the ventures (in both situations) was to make profits, but also to avoid paying high taxes by certain companies. After all, no profits means no income tax, so the so-called tax optimisation only makes sense if companies demonstrate a profit. It was the owners of both companies who maximised their financial benefit by understating the value of gross profit in their companies. It should be remembered that it was

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[14] http://www.bankier.pl/wiadomosc/Irlandia-wzrost-PKB-o-26-MF-studzi-entuzjazm-3559036.html
[15] https://www.ft.com/content/183f0c8a-712e-11e9-bf5c-6eeb837566c5

because the companies showed a profit that the owners could reap their benefits. This is one of the reasons why it can sometimes be argued that the achievement of profit (by default in the country of operation) is not the purpose of a company. To understand this, it is important to remember that entrepreneurs choose to run their own companies not because they want their companies to be rich (i.e. to make significant profit), but because the entrepreneurs (owners) want to derive various benefits, including financial ones, through their companies. This, in turn, leads to the conclusion that business owners seek to maximise their benefits (as owners) through the business they own.

It is also important to consider a situation in which a company's management consciously foregoes profit in the near term (or foregoes profit maximisation in the short term) by deciding to make investments that will allow the company to operate in the future. Without these investments, the company could make an „immediate" profit, but it would have difficulty operating in subsequent years, e.g. due to a lack of appropriate technology. Nokia is an example of a company that used to lead the mobile phone market but today is no longer a leader precisely due to a lack of appropriate technology. For the above reasons, profit maximisation in the short term not only cannot be the sole objective of a company that plans to operate in the long term, but it is also often not its main objective. After all, it can be perversely argued that if profit maximisation in the short term were the goal of a company, the company should reduce all expenses, preferably to zero (that is, e.g. cease production, give up advertising, employees etc.) and monetise all its assets (e.g. sell the machinery on which it will no longer be able to produce in the future). Such an action will certainly result in profit maximisation in the short term, but it also marks the end of this enterprise.

As can be seen from the above discussion, profit (or loss) in a company results from the scale of expenses (costs) incurred and revenue generated. First, let's look at expenses. There are **fixed, variable, semivariable and stepped fixed costs[16]**.

Task 1.2

Check your knowledge – true or false test.

		True	False
1	Profit is when income exceeds expenses		
2	Gross profit is otherwise referred to as income		
3	Operating profit includes financial expenses		
4	Gross profit includes financial expenses		
5	Gross profit is referred to by the abbreviation EBT		
6	Operating profit is described by the abbreviation EBIT		

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[16] The word "cost" has a broader meaning than expense. Expense is mainly used in financial accounting. Cost is used in managerial accounting. In this book, both words will be used interchangeably.

7	The value of income tax is described by the letter I		
8	The value of income tax is calculated on operating profit		
9	Financial expenses are described by the letter I		
10	Operating profit is gross profit less value of income tax		

#answers

CLICK ᴏʀ SCAN

Explanation to task 1.2

Profit (or income) occurs when revenue exceeds expenses. Operating profit (EBIT) doesn't include financial costs (and financial revenues). It is gross profit (EBT) that takes them into account. The value of income tax is described by the letter T from the word tax. The value of income tax is calculated from the gross profit (EBT) sometimes called net profit before income tax. Operating profit (EBIT) is gross profit (EBT) plus financial costs (I).

CHAPTER 2
BUSINESS COSTS

Have you wondered why companies like Apple, Walt Disney, Bloomberg, Hewlett-Packard and Harley-Davidson started out in a garage?

2.1. Fixed costs

#definition

> **Fixed costs are the costs that a company incurs regardless of whether it produces something or not** (or whether or not it is buying finished goods for resale – if it does not carry out manufacturing). Fixed costs do not depend on the volume of production and are incurred even when the company does not produce anything.

These include management costs, depreciation costs, part of the salaries (e.g. administration salaries), insurance (e.g. for machinery or buildings) or rent for premises. Even though fixed costs do not depend on the volume of production, the larger the production, the lower the value of fixed costs per product. This relationship is shown in the graphs below (Graph 2.1).
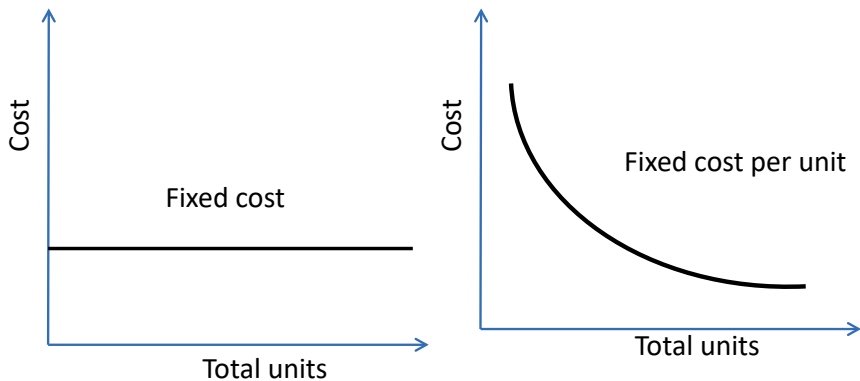
Graph 2.1.   Change in fixed costs in relation to production
Source: own elaboration

As can be seen from the graph above (first from the left), the level of fixed costs does not change with the volume of production. Analysing what proportion of fixed costs falls per unit produced (graph on the right), it can be noted that these costs (per unit of production) decrease as production increases. This is confirmed by the following example:

Let us assume that the level of fixed costs is PLN 100. A company can produce 10, 100 and 1,000 pcs. of a particular item. Whether it produces 10, 100 or 1,000 pcs., the fixed costs are the same at PLN 100. However, if we calculate how much of the fixed costs corresponds to a unit produced, the situation is as follows: when a company produces 10 pcs., the fixed costs for each of the 10 pcs. will be PLN 10 (PLN 100 / 10 pcs.= PLN 10); if the company produces 100 pcs., then the fixed costs for each of the 100 pcs. will be PLN 1 (PLN 100 / 100 pcs. = PLN 1); whereas when 1,000 pcs. are produced, the fixed costs per 1,000 pcs. will be PLN 0.10 (PLN 100 / 1,000 pcs. = PLN 0.10). This observation leads to the conclusion that the larger the production, the lower the fixed cost per unit of production, which in practice means that

as production increases, it becomes easier to cover fixed costs (it is easier to cover a fixed cost of PLN 100 by selling 1,000 pcs. of goods than 10 pcs.). This relationship is shown in Table 2.1.

Table 2.1. Change in fixed costs and fixed costs per unit of production

Total fixed costs (a)	Number of products (b)	Fixed costs per unit of production (a/b)
PLN 100	1 pc.	PLN 100
PLN 100	10 pcs.	PLN 10
PLN 100	100 pcs.	PLN 1
PLN 100	1,000 pcs.	PLN 0,10
PLN 100	10,000 pcs.	PLN 0.01

Source: own elaboration

The analysis of fixed costs per unit of production in the table above (last column) leads to the conclusion that the more products a company produces, the lower the fixed costs per unit of production, although the level of fixed costs as such (first column) will not change.

It can also be concluded that the higher the value of a company's fixed costs, the more such costs falls per unit produced. Have a look at what happens when the fixed cost is PLN 1,000,000 in the company from the previous example:

Table 2.2. Change in fixed costs and fixed costs per unit of production

Total fixed costs (a)	Number of products (b)	Fixed costs per unit of production (a/b)
PLN 1,000,000	1 pc.	PLN 1,000,000
PLN 1,000,000	10 pcs.	PLN 100,000
PLN 1,000,000	100 pcs.	PLN 10,000
PLN 1,000,000	1,000 pcs.	PLN 1,000
PLN 1,000,000	10,000 pcs.	PLN 100

Source: own elaboration

Assuming that 10,000 pcs. of a product are produced, the fixed costs per piece of the product have increased from PLN 0,01 (in the case of fixed costs of PLN 100) to PLN 100 (in the case of fixed costs of PLN 1 million). Increasing costs per piece of product necessitate a corresponding increase in its price. It is for this reason that many companies choose to start their operations in a garage – to reduce the level of fixed costs.

#issue

REAL LIFE EXAMPLE

Task 2.1

Adam is planning to open a company that will design interiors. Friends advise him to rent an office in the city centre. Such an office would make a good impression on his clients. Its rental would cost up to PLN 3,500 per month. On top of these charges, there is an Internet bill, a subscription to a design programme, other licences for programmes used to serve clients – totalling PLN 1,000 per month. The alternative is to have the office... at home. Adam would then not have to pay the monthly rent, only the other fees related to computer programmes and Internet, which will not change (amounting to PLN 1,000). Each design is printed in 2 copies and given to the client in a folder with Adam's company logo, the total cost of which is PLN 30. Adam expects to do four projects a month at the start of his business. However, he fears that beginning his business he may have fewer than four clients (projects) per month. For that reason, he would like to estimate the fixed costs per each of the four presumed projects. This will help him set a price that, with four projects, will cover his fixed costs.

Instructions:

(1) What is the fixed cost per project for both options (i.e. in the case of renting premises and operating from home).

(2) If Adam rented the premises in the city centre, how many projects would he have to complete (sell) in order for the fixed cost per project to be as much as in the option where he would run the business from home (which included 4 projects)?

Solution

(1) In both cases, there are fixed costs that do not depend on the premises, they are related to the use of the Internet and various computer programmes and amount to PLN 1,000 per month. In the case of renting premises in the city centre, a monthly rent of PLN 3,500 per month is added to these costs. The cost of printing and packaging the project is not a fixed cost, as its value will depend on the number of printed quotations. The situation is as follows:

	Rental of premises in the city centre	Conducting business at home
Software and Internet costs per month	PLN 1,000	PLN 1,000
Costs of premises per month	PLN 3,500	–

Total fixed costs per month	PLN 4,500	PLN 1,000
Fixed costs per project	**PLN 1,125** (4,500 / 4)	**PLN 250** (1,000 / 4)

To summarise: doing business from home will incur a PLN 250 fixed cost per month for each project. If Adam decides to rent premises in the city centre, the fixed cost per month for each of the four projects will increase to PLN 1,125.

(2) Let us calculate the number of projects needed to equal the value of the fixed cost per project to that received when running the business from home (i.e. PLN 250/project) using the following equation:

$$\frac{Fixed\ cost}{Number\ of\ projects} = Fixed\ cost\ per\ number\ of\ projects$$

After transformation the result is:

$$\frac{Fixed\ cost}{Fixed\ cost\ per\ number\ of\ projects} = Number\ of\ projects$$

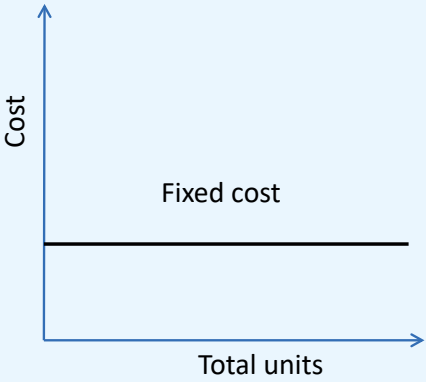After substituting to the formula, the result is:

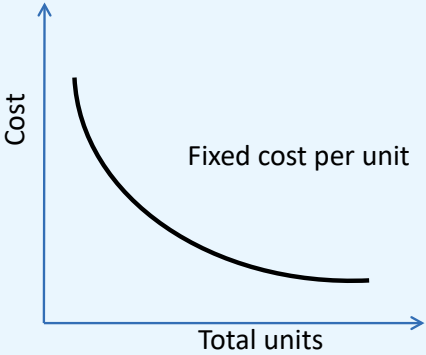$$\frac{4\ 500\ zł}{250\ zł} = 18\ projects$$

Verification:

$$\frac{4\ 500\ zł}{18\ projects} = PLN\ 250\ per\ project$$

If Adam wanted to rent premises in the city centre and have fixed costs per project of PLN 250, he would need to complete (sell) 18 projects.

Task 2.2

Check your knowledge – true of false test.

		True	False
1	The graph below refers to fixed costs per unit		

Cost

Fixed cost

Total units

| 2	The graph below refers to fixed costs per unit		
3	Fixed costs do not change with changes in the production (purchase) of goods		
4	Fixed costs per unit do not change with changes in the production (purchase) of goods		
5	Fixed costs relate, for example, to the maintenance of management and administration		
6	Fixed costs pertain to the purchase of products		
7	Lower fixed cost means higher fixed cost per unit of product		
8	With 1,000 pcs. of product, the fixed cost per unit is less than with 10 pcs.		
9	Fixed cost per unit does not depend on the number of pieces produced		
10	Fixed cost does not depend on production volume		

#answers

2.2. Variable costs

Is it possible to increase product sales without changing costs?
#definition

> The second type of cost is **variable costs**. Unlike fixed costs, **variable costs depend on the volume of production, i.e. they change as the number of products produced by the company changes**. If the company does not produce anything, but only buys finished products and then resells them, also in this case the variable costs will depend on the scale of the company's operations (i.e. the more products it buys, the higher the variable costs will be).

They can change <u>proportionally</u> (that is, the decrease or increase in these costs is directly proportional to the change in production), <u>progressively</u> (costs change faster than production change) or <u>degressively</u> (costs change more slowly than production). In this case, as production increases, variable costs increase, and when production decreases variable costs also decrease. Importantly for proportionally variable costs, per unit of production they are exactly the same (fixed), regardless of how many pieces of the product are produced. The above relationship is shown in Graph 2.2 (proportionally variable costs are shown in black).
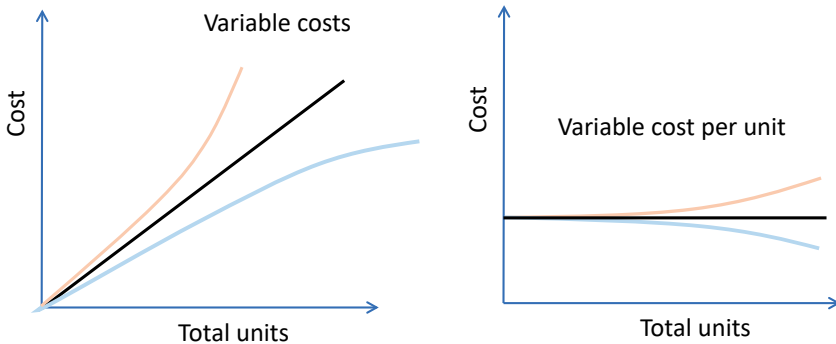
Graph 2.2. Change in variable costs in relation to production
Source: own elaboration

#issue

REAL LIFE EXAMPLE

Task 2.2.1

Source: Mika Baumeister on Unsplash

To better understand the graphs 2.2, let us assume that a company produces (or buys for resale) surgical masks and that the production (purchase) cost of one mask is PLN 1. If the company produces (buys) 10 masks it will incur a variable cost of PLN 10 (10 pcs. × PLN 1 = PLN 10), if the company produces (buys) 100 masks it will incur a variable cost of PLN 100 (100 pcs. × PLN 1 = PLN 100); and if the company produces (buys) 1,000 masks, it will incur a variable cost of PLN 1,000 (1,000 pcs. × PLN 1 = PLN 1,000). This (proportional) increase in costs is shown in Graph 2.2 on the left (in black). In each case, the variable cost per mask (i.e. one product) is PLN 1 (graph 2.2 on the right in black).

Let us assume that a company sells masks (1,000 pcs.) to one hospital. The company's variable costs will amount to PLN 1,000 (1,000 pcs. × PLN 1/pc.). After some time, the company won a tender to supply masks to two more hospitals (1,000 each). The company will now supply 3,000 masks to three hospitals (1,000 each). The company's variable costs will increase to PLN 3,000 (3,000 pcs. × PLN 1/pc.).

In addition to variable costs, the company will also incur fixed costs (related, for example, to management and administration) which, in turn, will not depend on the number of masks produced.

Change in variable costs and variable costs per unit of production is shown in Table 2.3.

Table 2.3. Change in variable costs and variable costs per unit of production

Variable cost per unit of production (a)	Number of products (b)	Total variable costs (a × b)
PLN 1	1 pc.	PLN 1
PLN 1	10 pcs.	PLN 10
PLN 1	100 pcs.	PLN 100
PLN 1	1,000 pcs.	PLN 1,000
PLN 1	10,000 pcs.	PLN 10,000

Source: own elaboration

An analysis of the result of the above calculations will lead to the conclusion that no matter how many masks are produced (or bought for resale) the (proportionally) variable cost per mask is exactly the same. However, total variable costs (proportionally) increase with the number of products.

Task 2.3

Ela runs a company that prints wedding invitations. Classify each of the following costs for this company by breaking down the fixed and variable costs in relation to the number of invitations produced.

A. Costs of packaging (needed for the delivery of invitations)

B. Sales commissions (for companies that recommend Ela's company)

C. Property tax (of the office where Ela runs her business)

D. Costs of delivering invitations to customers

E. Straight-line depreciation of hardware and printer

F. Ela's salary

G. Salary for the employee who prints the invitations

H. Accountant's salary

I. The cost of the call centre that on behalf of Ela's company calls the customer after delivery asking them how satisfied they are with their order

J. Hardware and printer servicing costs

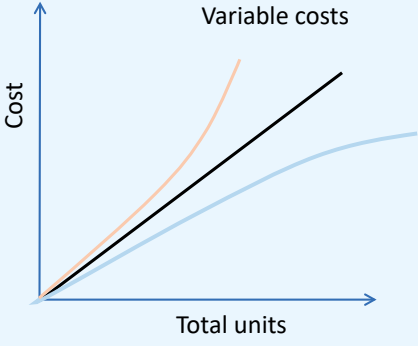K. Cost of an advertising folder sent with each delivered order

Solution

Fixed costs are: C, E, F, G and H; variable costs are: A, B, D, I, J and K.

Task 2.4

Check your knowledge – true or false test.

		True	False
1	Variable costs depend on the volume of production		
2	Variable cost increases as production increases		
3	Variable cost per unit increases as production increases		
4	Progressively variable cost grows with increasing production faster than proportionally variable cost		
5	Degressively variable cost grows with increasing production faster than proportionally variable cost		
6	Proportionately variable cost per unit is fixed and does not depend on the volume of production		
7	As production increases, variable costs also increase		
8	The value of proportionally variable cost per unit will be lower for a production of 1,000 pcs. compared to a production of 10 pcs.		

9	The graph below shows variable cost per unit of production		
10	Variable cost increases when production increases		

#answers
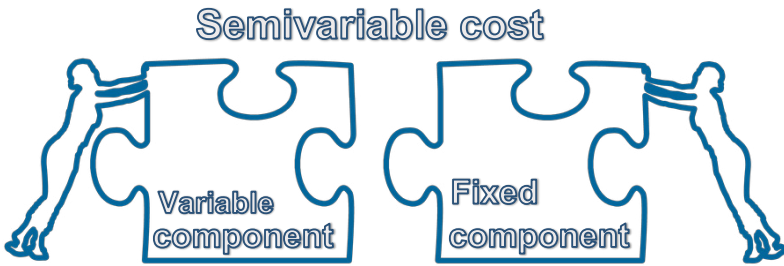

2.3. Mixed costs

2.3.1. Semivariable costs

What to do when the cost in your company is neither fixed nor variable? What's more – it has the features of both mentioned costs?

We have already found out which costs can be classified as fixed and which as variable costs. In which group, therefore, should the costs of telephone calls and Internet use be classified, for which there is a fixed part – the monthly subscription – and a variable part – calls and Internet use above the limit available under the subscription?

In this case, it is very likely that this type of cost will have a different value each month.

#definition

> **Semivariable cost consists of a fixed part and a variable part**. Therefore, it is not possible to clearly determine whether it is fixed or variable These type of costs is called semivariable or mixed costs. Semivariable (mixed) costs consist of both a fixed and a variable component.

This type of cost partly behaves like a fixed cost and partly like a variable cost. In the graph below (Graph 2.3), it can be observed how the semivariable cost behaves depending on the level of use of a service.
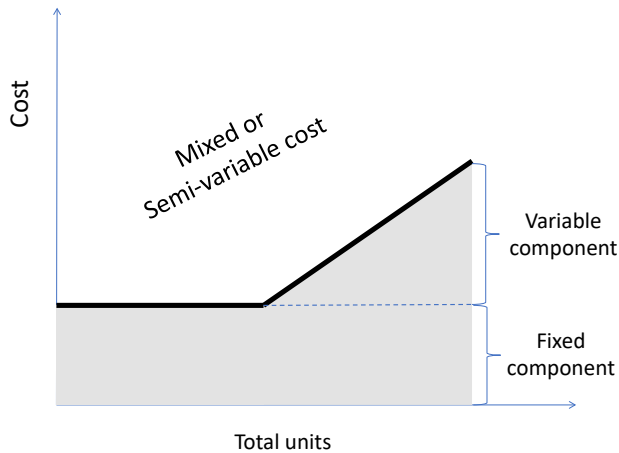
Graph 2.3. Semivariable costs depending on the degree of use of the service – option I
Source: own elaboration

As can be seen in the graph above, it is only above a certain level of service that additional charges begin to be added, increasing the total cost incurred for that service. In practice, there is also a type of variable cost which changes as follows:
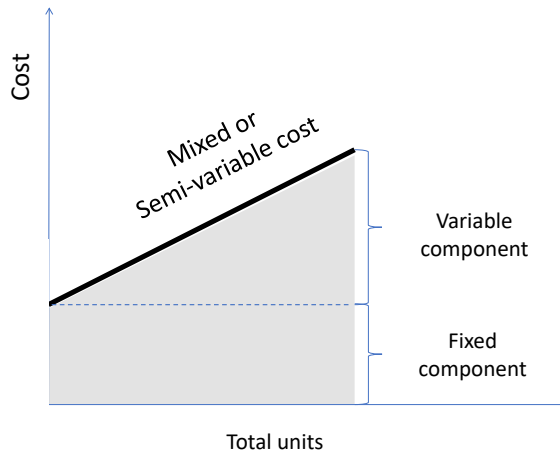
Graph 2.4. Semivariable costs depending on the degree of use of the service – option II
Source: own elaboration

This time, failure to use the service results in a fixed fee. Using the service in turn adds further costs to the said fixed fee. If there is increased use of the service, the total semivariable cost will also be higher. This relationship is described by the following equations:

#formula

$$\text{TSC}^{17} \; = \; \text{Fixed component of the cost} \; + \; \text{Variable component of the cost}$$

$$\text{TSC} \; = \; \text{Fixed component of the cost} \; + \; \left(\text{Variable cost per unit} \; \times \; \text{Number of units} \right)$$

Mixed costs are usually only a proportion of the total costs in a company that also incurs fixed costs. The sum of these costs is therefore included in the formula below:

$$\text{Total cost} \; = \; \text{Fixed costs} \; + \; \text{Mixed costs}$$

If the above formula is extended to include the components of mixed costs, it will look as follows:

$$\text{Total cost} \; = \; \text{Fixed costs} \; + \; \text{Fixed component of the mixed cost} \; + \; \text{Variable component of the mixed cost}$$

---

[17]   Total semivariable cost

As can be seen, in the above formula, there are two occasions when costs are fixed. Therefore, managers usually aggregate the fixed component of the mixed cost with other fixed costs and consider the variable component of the mixed cost as a separate item. The formula for total costs then looks like this:

$$\text{Total cost} = \boxed{\text{New total fixed cost}} + \text{Variable component of the mixed cost}$$

$$\boxed{\text{New total fixed cost}} = \text{Fixed costs} + \text{Fixed component of the mixed cost}$$
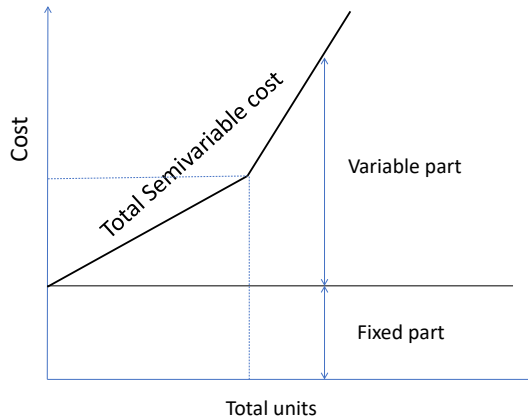
The variable element of the mixed cost can change in different ways. For example, if the variable element of the mixed cost grows more slowly in excess of a certain production value, the graph 2.5) will be as follows:
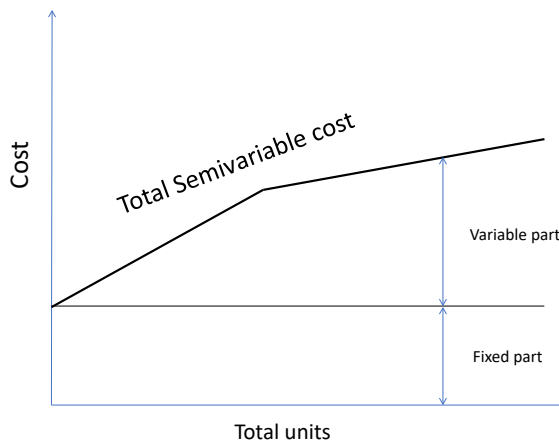
Graph 2.5. Behavior of semivariable costs with a slower increase in costs
Source: own elaboration

If the variable component of the mixed cost grows faster above a certain production value, the graph (2.6) will be as follows:

Graph 2.6. Behavior of semivariable costs with a faster increase in costs
Source: own elaboration

As can be seen in both graphs, no matter how the variable component of the mixed cost changes, its fixed component remains the same.

By now you have probably learnt how to classify a telephone and Internet bill that has a fixed component (subscription) and a variable component (use in excess of the subscription limit).

#issue

REAL LIFE EXAMPLE

Task 2.5

Marcel intends to offer his clients with services for which software is required. The licence for this software assumes periodic (monthly) fees, which include a fixed fee (PLN 300 per month) and a variable fee depending on the level of use of software functions. As part of the fixed fee, Marcel can use 10 software features at no extra charge. For each additional function above the ten mentioned, Marcel is required to pay PLN 30 for each additional function. What cost will Marcel incur in a month in which he used 15 functions?

A. PLN 300

B. PLN 350

C. PLN 450

D. PLN 750

Solution

Marcel will pay PLN 450 (answer C), including the PLN 300 fixed fee (fixed component of mixed cost) within which he will use 10 features, and an additional PLN 150 (variable component of mixed cost) because he will use an additional 5 features (above the limit of 10 within the subscription) each costing PLN 30 (5 × 30 = PLN 150).

Task 2.6

Check your knowledge – true or false test.

		True	False
1	Mixed cost is the sum of total cost and variable cost		
2	Mixed cost consists of a fixed and a variable element		
3	The total fixed cost in a company is the sum of the fixed cost and the fixed component of the mixed cost		
4	The total variable cost in a company is the sum of the variable cost and the variable component of the mixed cost		
5	Mixed cost is the sum of all costs in the company		

#answers

CLICK OR SCAN

2.3.2. High-low method

Did you know that when there are many semivariable costs, you do not need to analyse each of them separately?

We already know how to divide mixed costs into a part that is fixed and a part that changes. This is fairly simple if there is, for example, one such case per month, which is 12 per year. However, what happens when there are mixed costs that occur several times a day?

#issue

REAL LIFE EXAMPLE

Source: Pixabay.

Imagine a company that provides transport services, such as helping people with removals. To provide this type of service, he hires vans or trucks. Hiring each of the cars mentioned means incurring a mixed cost, in which there is a fixed part – the fee for hiring the car per day; and a variable part – which depends on the number of kilometres travelled. This is shown in the Fig. 2.1:
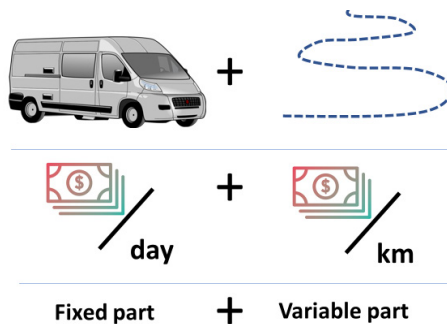

Figure 2.1. Mixed cost – car rental
Source: own study

Now, imagine that the company provides several such services a day (to different clients) using multiple vehicles. Due to the different number of kilometres travelled for each client, the cost of car hire will vary. At the end of the year, analysing the cost of hiring each car would be very time-consuming, as it would require breaking down the several hundred car rental costs incurred into fixed and variable components of the mixed cost. The division into fixed and variable costs is important for reasons such as break-even analysis. So how do you make this breakdown with a large or very large number of cases?
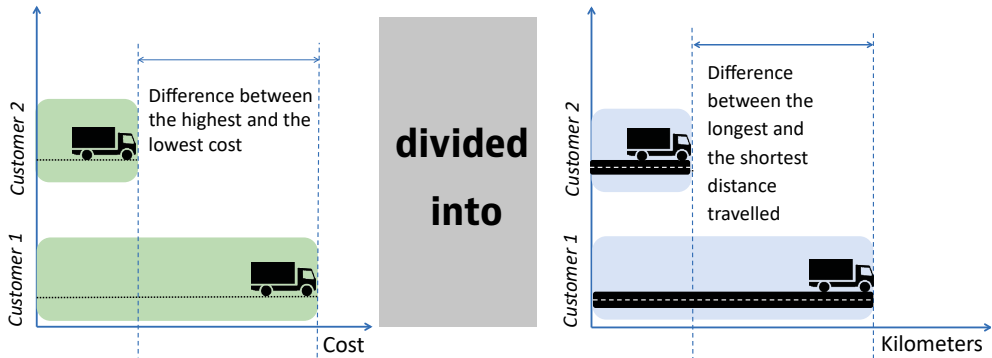
#method

An alternative to the case-by-case analysis presented in Part One is to use the high-low method[18]. **In the high-low method, each point relates to an extremely different cost**

---

[18]   This method is called the high-low method.

associated (**in our case**) **with hiring a car**. The first one will be about the lowest cost, the second about the highest cost. In other words, out of all the bills (representing the cost of car rental for each customer) accumulated from the entire year, the one whose value is the lowest and the one whose value is the highest will be identified. Instead of an analysis of hundreds of bills, only two will be dealt with. The difference between these costs will represent the variable cost incurred in the company.

#formula

Why this method? The high-low method uses the assumption that variable cost changes with the number of goods produced or services provided. Since the difference between the cost of providing the service for client 1 and client 2 is known, the calculated difference can be compared to the difference in mileage resulting from the services provided to both clients. Such a comparison will reveal what the unit variable cost is – that is, per kilometer. In this way, the calculations made can be simplified as much as possible, taking into account only the total costs resulting from the services provided incurred in a particular month. This can best be demonstrated using the example of the transport company mentioned.

Let us assume that our company has the following costs taking into account the number of kilometers driven per month.

Table 2.4. Costs and kilometers in a transport company

Month	The number of kilometers	Cost incurred	Month	The number of kilometers	Cost incurred
January	19,000	PLN 25,300	April	50,000	PLN 62,500
February	40,000	PLN 48,000	May	30,000	PLN 42,500
March	34,500	PLN 49,000	June	43,000	PLN 59,500

Source: own study.

Each of the months listed includes a number of separate costs corresponding to services provided to individual customers. Instead of analyzing all of them individually,

we can only analyse six of them (from January to June). They can be represented graphically (2.7) as follows:
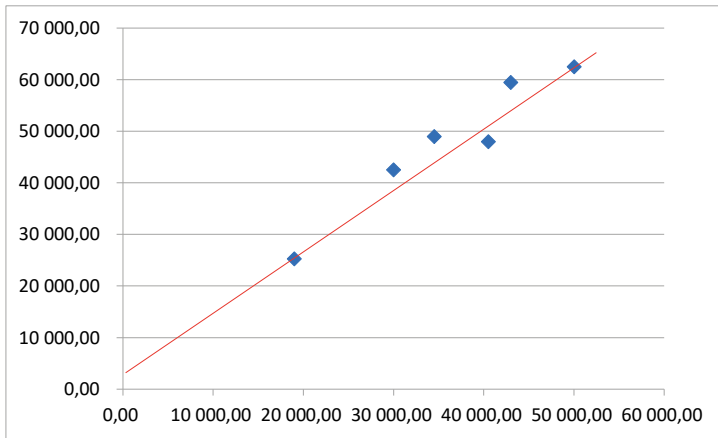
Graph 2.7.   The distribution of mixed costs in the high-low method

In the graph above, the lowest and highest costs for the month are combined. As can be seen, not all points are on the line defined by the two points (lowest and highest). This means that the analyses will be made with some approximation. The red line will represent the equation that will be used in the high-low method. In other words, the red line will make it possible to estimate the amount of the individual (fixed and variable) components in the mixed costs. As mentioned earlier, this will be to some extent a simplification, which means that the method is not very precise.

Let us return to the two points that determine the red line. The highest one means travelling 50,000 km in April and the lowest one means travelling 19,000 km in January. The cost incurred in these two cases was PLN 62,500 in April and PLN 25,300 in January. This is shown in the Table 2.5:

Table 2.5. The highest and lowest cost and kilometers value

Months	Number of kilometers travelled	Cost incurred
April (the highest point)	50,000	62,500
January (the lowest point)	19,000	25,300

Source: own study.

To determine the variable part of the cost per unit[19], divide the difference between the two costs above by the difference between the kilometres travelled. This is shown by the following formula:

#formula

Variable cost per unit $= \dfrac{Cost\ incurred_{the\ largest\ number\ of\ kilometers} - Cost\ incurred_{the\ smallest\ number\ of\ kilometers}}{Number\ of\ kilometers\ travelled_{the\ largest} - Number\ of\ kilometers\ travelled_{the\ smallest}} =$

$$= \dfrac{The\ difference\ between\ the\ two\ extreme\ costs}{The\ difference\ between\ the\ extreme\ amounts\ of\ kilometers\ traveled}$$

Let us now insert the data relating to our company into the above formula:

$$\text{Variable portion of cost per unit} = \dfrac{PLN\ 62{,}500 - PLN\ 25{,}300}{50{,}000\ km - 19{,}000\ km} = \dfrac{PLN\ 37{,}200}{31{,}000\ km} = \text{PLN } 1.20\ /\ km$$

We now know that, using the high-low method, the variable cost of hiring a car is PLN 1.20 per kilometre travelled. Let us now calculate what is the fixed part of the mixed cost determined using this method. We already know that the total cost is the sum of the fixed cost and the variable cost:

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

To determine the value of the fixed cost, we need to transform the above formula as follows:

$$\text{Fixed cost} = \text{Total cost} - \text{Variable cost}$$

Since:

$$\text{Variable cost} = \text{variable unit cost} \times \text{number of units}$$

then, after substitution into the previous equation, the result is:

$$\text{Fixed cost} = \text{Total cost} - (\text{variable unit cost} \times \text{number of units})$$

Now that the formula necessary to determine the fixed part of the mixed cost for the month is established, let us choose some point to calculate it. First, let us consider the highest point:

Months	Number of kilometers travelled	Cost incurred
April (the highest point)	50,000	62,500

$$\text{Fixed cost }_{(for\ the\ highest\ point)} = \text{PLN } 62{,}500 - (\text{PLN } 1.20/km \times 50{,}000\ km) =$$
$$= \text{PLN } 62{,}500 - \text{PLN } 60{,}000 = \text{PLN } 2{,}500$$

We already know that the fixed part of the mixed cost calculated for the highest point (highest number of kilometers travelled) is PLN 2,500. Let us now calculate the value of the same part of the fixed part of the mixed cost for the lowest point (lowest number of kilometers travelled).

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[19]   In this case, the unit shall be one kilometer.

Month	Number of kilometers travelled	Cost incurred
January (the lowest point)	19,000	25,300

Fixed cost $_{\text{(for the lowest point)}}$ = **PLN 25,300** – (PLN 1.20/km × **19,000 km**) =
= PLN 25,300 – PLN 22,800 = PLN 2,500

As can be seen, it does not matter whether the fixed part of the mixed cost is calculated for the highest or lowest point. Its value calculated using the high-low method is exactly the same. In this case, it amounts to PLN 2,500.

With the above data, a formula can be established to represent the monthly costs incurred by the transport and removal company.

Monthly rental cost of vans =
= PLN 2,500 + (PLN 1.20 PLN/km × number of kilometers travelled)

Using the high-low method, we were able to determine that the fixed part of the mixed cost is PLN 2,500 and the variable part of the mixed cost is PLN 1.20 per kilometer travelled. The resulting formula can be used to forecast the level of costs to be incurred by that company in the future. For example, it is possible to determine what van rental costs the company will incur in a particular month if the vans travel 25,000 kilometers:

Monthly rental cost of vans =

= PLN 2,500 + (PLN 1.20/km × 25,000 km) = PLN 2,500 + PLN 30,000 =
PLN 32,500

If 25,000 kilometers are travelled, the estimated costs associated with hiring vans will be PLN 32,500.

The high-low method has its advantages and disadvantages which are worth mentioning. This method assumes a linear relationship between the two extreme mixed costs. It is therefore quite simple to use and gives a quick indication of the development of cost levels in a company based on just two observations. As the two extremes of the mixed cost are taken into account, the results obtained will be approximations and the extreme values may significantly deviate from other values. There is therefore a risk that these extreme values are not representative of that particular undertaking. For this reason, it may turn out that other points (other than the mentioned extremes) will more accurately describe the mixed cost relationship in a specific case.

#issue

REAL LIFE EXAMPLE

Task 2.7

https://unsplash.com/photos/JnJZwYsWY7o

Arek runs a company that installs charging stations for electric cars. Arek's customers can charge their electric car in some of the country's largest cities. The main cost associated with the service offered is electricity. Part of this cost is fixed (independent of electricity consumption), the rest depends on the amount of electricity used. Arek's company has collected the following data on mixed cost:

Months	Units consumed (kWh)	Cost of electricity (PLN)
March	30,000	18,150
April	28,600	16,850
May	30,800	20,400
June	28,000	19,420
July	29,500	15,050

Instructions:

A. Calculate the variable and fixed component of the cost using the high-low method

B. Estimate the cost of electricity if (1) electricity consumption falls to 25,000 kWh and rises to 35,000 kWh.

Solution

A. The variable component of the cost of electricity is PLN 0.35 because:

(PLN 20,400 – PLN 19,420) / (30,800 kWh – 28,000 kWh) = PLN 980 / 2,800 kWh =
= PLN 0.35 / kWh

The fixed component of the cost of electricity is PLN 9,620, because:

PLN 20,400 – (30,800 kWh × PLN 0.35) = PLN 20,400 – PLN 10,780 = PLN 9,620

or:

PLN 19,420 – (28,000 kWh × PLN 0.35) = PLN 19,420 – PLN 9,800 = PLN 9,620

B. (1) if 25,000 kWh are consumed, the cost of electricity will be PLN 18,370, because:

Estimated cost = fixed component of the cost + variable component of the cost, that is:

Estimated cost of 25,000 kWh = PLN 9,620 + (PLN 0.35 × 25,000 kWh)= PLN 9,620 + PLN 8,750 = PLN 18,370

(2) if 35,000 kWh are consumed, the cost of electricity would be PLN 21,870, because:

Estimated cost of 35,000 kWh = PLN 9,620 + (PLN 0.35 × 35,000 kWh)= PLN 9,620 + PLN 12,250 = PLN 21,870

Task 2.8

Check your knowledge – true or false test.

|		True	False
1	The high-low method makes it possible to estimate the fixed and variable component of mixed costs		
2	The high-low method involves using any two values to estimate an equation representing the changes of mixed costs in a company		
3	The fixed cost for the highest and lowest points is the same when it is calculated using the high-low method		
4	The high-low method assumes a linear relationship between the two extreme mixed costs		
5	The high-low method is complicated, which is its main disadvantage		
6	The disadvantage of the high-low method is the approximate value of the estimated costs		
7	Only the two extreme points are always the most representative of the mixed cost in the high-low method		

#answers

CLICK or SCAN

2.4. Step fixed costs

Did you know that fixed costs are almost never fixed in the long run?

#definition

> What still remains to be discussed is **step fixed costs**. **The name of these costs sounds strange, because either something is fixed or it changes. Meanwhile, what we are about to discuss at this point are fixed costs that change in a step-wise manner**. The term captures a phenomenon that occurs in many companies.

As they develop, fixed costs (i.e. costs that do not depend on production) change (usually increase) in a stepwise manner. This phenomenon is shown in the graph 2.8:
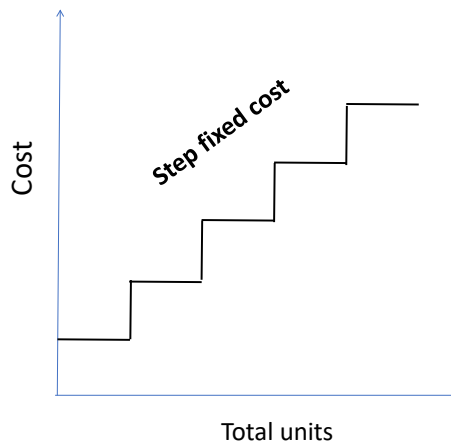
Graph 2.8. Behavior of step fixed costs depending on the production volume of machines
Source: own study.

The graph above requires some explanation. I have just said that fixed costs (including step fixed costs) do not depend on production. The graph above suggests quite the opposite. Here is why – fixed costs do not depend on the volume of production, i.e. we can change the volume of production and the fixed costs will not change. Production can be increased until the available infrastructure is no longer sufficient to produce more. Imagine having equipment that produces 24 hours a day, 7 days a week, for the entire month. This equipment is not capable of producing more products. In order to increase production, we need to buy additional equipment and this is the point at which the fixed costs associated with acquiring new equipment increase in a stepwise manner. Note that it is not the number of additional products that are produced on the new equipment but the acquisition of the equipment that (in a stepwise manner)[20] increases fixed costs. The new equipment of course makes

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[20]   The increase in fixed costs will be related to higher depreciation, insurance of the equipment, lease instalments or the cost of the employees who operate the equipment and whose salary does not depend on the number of products produced on the equipment.

it possible to increase production. Due to the productive capacity of the machine, there will be stepped increases in fixed costs more or less frequently, as shown in the graphs (2.9) below:
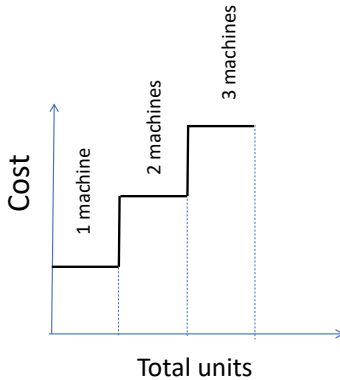
Lower capacity   **Higher capacity**
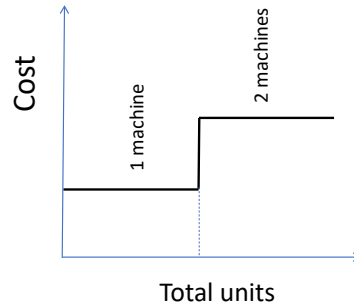
Graph 2.9. Step-by-step increase in fixed costs depending on the production capacity of the machines
Source: own study.

Now we can see that in the graph on the left the equipment has lower productive capacity and therefore has to be purchased more often for increasing production compared to the situation shown in the graph on the right.

Increasing capacity in a company that wants to produce more seems reasonable. And did you know that it is not always economically viable to increase production?

As the fixed cost increases, the value of the fixed cost per unit of production will change, and it will change in a rather surprising way. Let us check this using an example.

#issue

REAL LIFE EXAMPLE

Imagine you own a company that manufactures mobile phone stands (holders). You use a 3D printer for production, which costs PLN 300 per month. Other fixed costs are PLN 600. Your total fixed cost incurred each month is PLN 900.

The printer is capable of printing 10 holders per day, which is approximately 300 holders per month. The 300 pcs. per month is the maximum production capacity of your printer. Assuming you are using your printer to its full capacity, the fixed cost per holder (per unit) will be PLN 3:

PLN 900 / 300 pcs. = **PLN 3 per holder**

If you only used part of the printer's production capacity, your fixed cost per unit of production would be as follows:

Table 2.6. Fixed cost, fixed cost per unit and number of units

Fixed cost	Number of units	Fixed cost per unit
900	1	PLN 900
900	50	PLN 18
900	100	PLN 9
900	200	PLN 4.5
900	300	PLN 3

Source: own study.

As can be seen from the table above, the worst option is to have a printer that has the capacity to produce 300 holders per month and be printing only one, as the fixed cost per holder is the highest (at PLN 900).

The following month it turns out that there are more orders than the production capacity of the available printer. For this reason, the decision is made to buy a second one. Your fixed costs currently amount to PLN 1,200.

Let us see what happens if you produce 301 holders in the next month, 300 on one printer and an additional (just) one piece on the other printer:

PLN 1200 / 301 pcs. = **PLN 3.99 per holder**

As can be seen, your fixed costs per unit (one holder) have risen from PLN 3 when producing 300 pcs. using one printer to almost PLN 4 (PLN 3.99) when producing 301 pcs. using two printers. But what happens when you use the maximum capacity of both printers?

PLN 1200 / 600 pcs. = **PLN 2 per holder**

Note that using the maximum capacity of both printers, your fixed cost per unit (holder) has reduced to PLN 2. The step fixed costs per unit (unit of product) for the purchase of the second, third and fourth printers in this case will change accordingly:
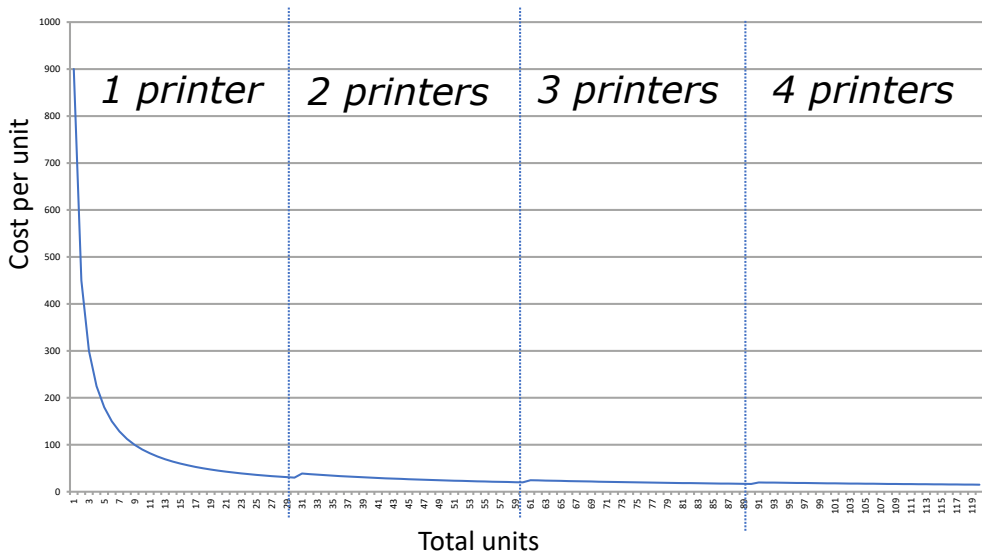
Graph 2.10. Step fixed costs per unit
Source: own study.

An analysis of the changes in step fixed cost per unit(s) of production leads to several conclusions:

• they reach their maximum value after an incremental increase in fixed cost and the production of one additional piece,

• each time a new printer is purchased, the fixed cost per unit increases, in this case more and more each time.

Now have a look at what happens to the fixed cost per unit when the maximum productive capacity of all printers is used:

Table 2.7. Fixed cost, fixed cost per unit and number of units at maximum production

Fixed cost	Number of units at maximum production	Fixed cost per unit
PLN 900	300	PLN 3
PLN 1,200	600	PLN 2
PLN 1,500	900	PLN 1.67
PLN 1,800	1,200	PLN 1.5

Source: own study.

Analyzing the table above, an additional conclusion can be reached according to which – the more printers a company has that use their total production capacity, the lower the fixed costs per unit of product will be.

For this reason, it will not always be worth buying another printer if what is needed is printing just one or a few more pieces. It will be most cost-effective to purchase the equipment (which will result in an increment in step fixed cost) when its capacity is fully utilized.

#issue

REAL LIFE EXAMPLE

Task 2.9

Source: Jan Antonin Kolar on Unsplash.

Agnieszka is the owner of a company that offers the possibility of collecting parcels using parcel lockers. Agnieszka's company is increasing the number of parcel lockers each year. Below are data from the last three years of operations. In the second year of operation, managers decided to do a discounted price related to parcel handling, based on a fixed cost per parcel. Agnieszka is frustrated because the figures for the third year showed that, contrary to the predictions made in year two, the cost per parcel has actually increased instead of decreasing. This situation necessitates

a change in the company's development plans, which will result in postponing the installation of further parcel lockers, but above all, it requires increasing the price of parcel handling.

Type of data	Year 1	Year 2	Year 3
Number of delivered parcels (pcs.)	110,520	291,950	326,845
Number of operating parcel lockers	9	20	32
Number of couriers using parcel lockers	1	2	4
Cost of leasing parcel lockers	PLN 324,000	PLN 720,000	PLN 1,152,000
Cost related to courier service for parcel lockers	PLN 72,000	PLN 144,000	PLN 288,000
Cost of renting space for a parcel locker	PLN 216,000	PLN 480,000	PLN 768,000
Other fixed costs	PLN 150,000	PLN 150,000	PLN 150,000

One parcel locker can handle a maximum of 40 parcels per day, or 14,600 parcels per year. One courier is able to provide services for a maximum of 10 parcel lockers.

Instructions:

A. Indicate costs that are step fixed costs.

B. What is the value of total costs per parcel in each of the three years?

C. Calculate how step fixed costs have changed in terms of percentage and amount.

D. Referring to the concept of step fixed costs, explain why the fixed cost per parcel increased in Year 3.

Solution

A. Leasing costs for parcel lockers, costs related to the courier(s) operating the parcel lockers and the cost of renting space for the parcel lockers are all step fixed costs.

B. The total costs per parcel were (total cost/number of parcels delivered): **PLN 6.89** in Year 1; **PLN 5.12** in Year 2; and **PLN 7.21** in Year 3.

Type of data	Year 1	Year 2	Year 3
Number of delivered parcels (pcs.)	110,520	291,950	326,845
Cost of leasing parcel lockers	PLN 324,000	PLN 720,000	PLN 1,152,000
Cost related to courier service for parcel lockers	PLN 72,000	PLN 144,000	PLN 288,000
Cost of renting space for a parcel locker	PLN 216,000	PLN 480,000	PLN 768,000
Other fixed costs	PLN 150,000	PLN 150,000	PLN 150,000
Total fixed costs	**PLN 762,000**	**PLN 1,494,000**	**PLN 2,358,000**

Fixed cost per parcel	PLN 6.89 (762,000 /110,520)	PLN 5.12 (1,494,000 /291,950)	PLN 7.21 (2,358,000 /326,845)

C. At Agnieszka's company, step fixed costs are changing incrementally in two cases:

    1. when another parcel locker is installed (plus the cost of leasing this locker and the cost of renting space for its location);

    2. when another courier is hired to handle parcel lockers

The number of parcel lockers and the number of couriers are linked, but they change differently. We will therefore analyse the two situations separately.

The costs of leasing parcel lockers and renting space for their location were changing as follows:

Type of data	Year 1	Year 2	Year 3
Cost of leasing parcel lockers	PLN 324,000	PLN 720,000	PLN 1,152,000
Cost of renting space for a parcel locker	PLN 216,000	PLN 480,000	PLN 768,000
In total	**540,000**	**1,200,000**	**1,920,000**
Change in%	–	122.22%	60%
Change in PLN	–	660,000	720,000

As can be seen from the table above, the increase in costs expressed as a percentage was much lower in Year 3 (as it was 60% over Year 2) than in Year 2 (an increase of 122.22% over Year 1), although in absolute terms Year 2 costs increased by PLN 660,000 and Year 3 costs increased by PLN 720,000. This situation is typical of newly established companies. Changes in the percentage of incremental costs usually represent a significant proportion in small or new businesses, as they pertain to relatively small amounts.

The costs associated with maintaining couriers were changing as follows:

Type of data	Year 1	Year 2	Year 3
Cost related to courier service for parcel lockers	PLN 72,000	PLN 144,000	PLN 288,000
Change in%	–	100%	100%
Change in PLN	–	PLN 72,000	PLN 144,000

This time, the percentage increase in the consecutive years was the same. In years 2 and 3, courier costs increased by 100 per cent, with an increase of PLN 72,000 in Year 2 and PLN 144,000 in Year 3.

The total step fixed costs were changing as follows:

Type of data	Year 1	Year 2	Year 3
Cost of leasing parcel lockers	PLN 324,000	PLN 720,000	PLN 1,152,000
Cost of renting space for a parcel locker	PLN 216,000	PLN 480,000	PLN 768,000
Cost related to courier service for parcel lockers	PLN 72,000	PLN 144,000	PLN 288,000
In total	612,000	1,344,000	2,208,000
Change in%	–	119.60%	64.8%
Change in PLN	–	PLN 732,000	PLN 864,000

Step fixed costs at Agnieszka's company increased by PLN 732,000 and 119.60 per cent in Year 2 and PLN 864,000 and 64.28 per cent in Year 3.

D. Now let's look at the use of each parcel locker.

1. parcel locker can handle a maximum of 14,600 parcels. Therefore, in the consecutive years, the maximum number of parcels that can be handled is:

- in Year 1: 9 parcel lockers × 14,600 = 131,400 parcels
- in Year 2: 20 parcel lockers × 14,600 = 292,000 parcels
- in Year 3: 32 parcel lockers × 14,600 = 467,200 parcels

The percentage use of parcel lockers in the consecutive years is:

- in Year 1:

    131,400 – 100%

    110,520 – x

    X = (110,520 × 100%) / 131,400 = 84.11%

- in Year 2: X = (291,950 × 100%) / 292,000 = 99.98%
- in Year 3: X = (326,845 × 100%) / 467,200 =69.96%

The above figures are provided in the table:

Type of data	Year 1	Year 2	Year 3
Number of delivered parcels (pcs.)	110,520	291,950	326,845
Maximum number of parcels that can be handled with the company's parcel lockers	131,400	292,000	467,200
Use of parcel lockers in%	84.11%	99.98%	69.96%
Wiersz do uzupełnienia			

As can be seen from the use of the parcel lockers in percentage terms, the decision to reduce the price per parcel was made in a year in which the parcel lockers were almost fully used (99.98%), so in line with the concept of step fixed costs, the fixed cost per parcel was low (PLN 5.12). In the following year (3), the use of parcel lockers

dropped to 69.96%. If it is assumed that the parcel lockers, in Year 2, were almost fully utilised, then the capacity of the additional 12 parcel lockers (32 in Year 3 – 20 in Year 2) installed in Year 3 was not fully used.

Since the number of parcels delivered in Year 3 is 326,845 and the maximum capacity of one parcel locker is 14,600, it follows that this number of parcels could be handled by 23 parcel lockers (because 326,845 / 14,600 = 22.38≈23). As there were a total of 32 parcel lockers in Year 3, it could have turned out that nine of them (32–23=9) did not handle parcels at all, or did so to a negligible extent compared to their capacity. The reason for this could be, for example, their inconvenient location, poor communication with customers (who may not have been aware of the location of the lockers), or an incorrect assessment of the increase in parcels delivered due to the price discount applied (no demand for this type of service). In this case, the nine parcel lockers generated additional costs that were not distributed over the additional number of parcels that should have been delivered according to the assumption made in Year 2.

The same applies to couriers.

Type of data	Year 1	Year 2	Year 3
Number of couriers	1	2	4
Number of parcel lockers	9	20	32
Maximum number of parcel lockers that can be handled by couriers (number of couriers × 10)	10	20	40
Percentage of use of courier capacity	90%	100%	80%

As in the case of the newly installed parcel lockers, so, similarly, in the case of courier service costs, Year 2 saw 100% utilisation of their capacity. This resulted in a low fixed cost per parcel. In Year 3, a newly recruited courier served only 2 parcel lockers (one courier can serve a maximum of 10 parcel lockers). Therefore, the cost associated with having an additional courier did not result in a reduction in fixed costs per parcel, as the courier only met 20% of their capacity.

To summarise – Agnieszka's company decided on a price discount in a year when the capacity of parcel lockers and couriers was fully used (99.98% for parcel machines and 100% for couriers). This situation involves the lowest cost per unit (parcel). In Year 3, step fixed costs increased, and the utilisation of parcel lockers and the new courier was not full, resulting in an increased cost per parcel.

Task 2.10

Check your knowledge – true or false test.

		True	False
1	Step fixed costs are related to the change in productive capacity in a company		
2	Each change in production results in a change in step fixed cost		
3	Step fixed cost decreases with each produced unit of product		
4	Step fixed cost increases with each produced unit of product		
5	At the maximum use of productive capacity, fixed cost per unit is the lowest		
6	After a stepped increase in fixed cost and an increase in production by one piece (with an additional productive capacity of 1,000 pcs.), the fixed cost per unit of product will increase		

#answers

CLICK or SCAN

2.5. Cost structure

Did you know that you can run the same project with a different cost structure?
#definition

> Every company has fixed costs and variable costs. Their proportion in relation to total costs is called the **cost structure**.

#issue

REAL LIFE EXAMPLE

Let us illustrate this with an example. If a company has fixed costs of PLN 600 and variable costs of PLN 400, its cost structure will be as follows:

Table 2.8. Cost structure as a percentage

Type of cost:	Value in PLN	Structure as a percentage
Fixed cost	PLN 600	60%
Variable cost	PLN 400	40%
Total cost	PLN 1,000	100%

Source: own study.

Therefore, as you can see, cost structure is information about what proportion of total costs is represented by fixed costs and what by variable costs. You might be wondering what this information is needed for? Let me explain this with an example.

Imagine that you are going to open your own pizza restaurant. A great opportunity to do so is presenting itself, as the only pizza restaurant in town has just been closed down by its previous owners who have decided to travel the world for the rest of their lives. The idea seems promising, especially as you would be using premises that everyone already knows. One of the first decisions you have to make is about the delivery of the pizza.

Do you decide to lease four cars and employ four drivers or do you employ people with their own cars for pizza delivery?

Let us consider both options. Owning new leased cars:

• will have a positive impact on the image of the restaurant,
• will reduce the risk of car breakdowns and therefore the number of disappointed customers who would not get a pizza due to a breakdown,
• will increase fixed costs because you will have to pay leasing instalments whether these cars are delivering pizzas or not.

Employing workers with their own cars:

• will be quite as appealing to customers,
• will increase the risk of car breakdowns and therefore the number of dissatisfied customers who do not get their pizza because of a breakdown,
• will increase variable costs, as you will have to pay for the delivery of each pizza.

As the Table 2.9 shows, from the point of view of the company's image and the risk of car breakdown, it seems a better option to lease new cars.

Table 2.9. Comparison of own transport and third-party transport

Own means of transport	Third-party means of transport
Positive company image	No impact on image
Lower risk of breakdown	Higher risk of breakdown
Higher fixed costs	Higher variable costs

Source: own study.

The above example illustrates just one of the many decisions an entrepreneur must make that will result in different levels of fixed and variable costs. In other words, the cost structure will be different in these two cases. Let's take a closer look at this.

Suppose you aim to sell 60,000 pizzas a year. This is possible because the previous owners sold a similar number (around 165 per day). If you decide to lease new cars your fixed cost will be PLN 240,000 and the cost of producing one pizza will be PLN 6. As you intend to sell 60,000 pizzas a year, your variable cost will be 360,000 (60,000 × PLN 6) Your total costs are the sum of your fixed and variable costs, that is PLN 600,000 (PLN 240,000 + PLN 360,000).

On the other hand, if you pay for the transport of the pizzas, your fixed costs will be much lower, at only PLN 120,000, and the cost of producing one pizza will increase by the cost of delivery to PLN 8.

Depending on whether you choose to lease the cars or pay for pizza delivery, your cost structure will be as follows:

Cost structure with 60,000 pizzas sold per year

Table 2.10. Comparison of own and third party transport costs for 60,000 pizzas

Type of cost	Own means of transport	Structure in%	Third-party means of transport	Structure in%
Variable cost	**PLN 360,000** (60,000 × PLN 6)	60%	**PLN 480,000** (60,000 × PLN 8)	80%
Fixed cost	PLN 240,000	40%	PLN 120,000	20%
Total cost	PLN 600,000	100%	PLN 600,000	100%
Unit variable cost	PLN 6		PLN 8	

Source: own study.

As you can see, despite the same total costs of PLN 60,000, there are two different cost structures: the first one with 60% variable costs and 40% fixed costs, and the second one with 80% variable costs and 20% fixed costs. Lower fixed costs are associated with higher variable unit costs and, conversely, higher fixed costs mean lower variable unit costs.

Now, let's explore what this means for your pizza restaurant. It is best to illustrate this with an example. So far, we have assumed that you will sell 60,000 pizzas a year. But what if you sold more of it, or less of it? Let's simulate two additional versions: a pessimistic one in which you sell half of what you assumed so far, i.e. 30,000 pcs. (60,000 / 2 = 30,000 pcs.), and an optimistic one in which you sell twice as much as you initially assumed, that is 120,000 pcs. (2 × 60,000 pcs. = 120,000 pcs.). The situation for the pessimistic version will be as follows:

Pessimistic version: Cost structure with 30,000 pizzas sold per year

Table 2.11. Comparison of own and third party transport costs for 30,000 pizzas

Type of cost	Own means of transport	Structure in%	Third-party means of transport	Structure in%
Variable cost	PLN 180,000 (PLN 6 × 30,000)	Change from 60% to about **43%**	PLN 240,000 (PLN 8 × 30,000)	Change from 80% to about **67%**
Fixed cost	PLN 240,000	Change from 40% to about **57%**	PLN 120,000	Change from 20% to about **33%**
Total cost	PLN 420,000	100%	PLN 360,000	100%
Unit variable cost	PLN 6		PLN 8	

Source: own study.

As you can see, when the volume of production changes, the cost structure changes too. With a reduction in production, the share of variable costs in total costs also decreased. This means that when there is less production, the share of fixed costs in total costs increases.

In the case of the pessimistic version, in which you sell only 30,000 pizzas a year, the option with third-party pizza delivery (using other people's cars) will be better, because it will save you PLN 60,000 (total cost with own means of transport – total cost with third-party means of transport, that is PLN 420,000 – PLN 360,000 = PLN 60,000). PLN 60 000 is a lot of money to save.

Now let's see what the more optimistic version will look like:

Optimistic version: cost structure with 120,000 pizzas sold per year (this is possible with the same number of cars because, first, previously cars would sometimes be parked waiting for an order from a customer, and second, customers could start ordering two or even several pizzas).

Table 2.12. Comparison of own and third party transport costs for 120,000 pizzas

Type of cost	Own means of transport	Structure in%	Third-party means of transport	Structure in%
Variable cost	PLN 720,000 (PLN 6 × 120,000)	Change from 60% to about **75%**	PLN 960,000 (PLN 8 × PLN 120,000)	Change from 80% to about **89%**
Fixed cost	PLN 240,000	Change from 40% to about **25%**	PLN 120,000	Change from 20% to about **11%**
Total cost	PLN 960,000	100%	PLN 1,080,000	100%
Unit variable cost	PLN 6		PLN 8	

Source: own study.

As you can see, in this scenario, the cost structure has changed too. This time, in both cases, the share of variable costs in total costs has increased, which means that the share of fixed costs in total costs has decreased.

This time, the scenario with your own transport has proved better. It will save you as much as PLN 120,000 (PLN 1,080,000 – PLN 960,000 = PLN 120,000). You will admit that it is good to know how to save PLN 120,000.

#note

It is time to summarise both simulations and draw conclusions. The dilemma described above shows an example where **higher fixed costs** mean **lower variable costs per unit**. This in turn results in **more savings when production is higher**. On the other hand, **lower fixed costs** mean **a higher variable cost per unit**, and this will allow **more savings when production decreases**.

Given the above conclusions, what do you think is better from a pizza restaurant owner's perspective – to buy own vehicles to deliver pizzas to customers or to pay for pizza delivery?

As you will have seen by now, the correct answer to this question depends on whether we are expecting an increase or decrease in production. There is no one correct cost structure. As we have seen from the example with the pizza restaurant, each has its advantages and disadvantages. The manager should be aware of the change in cost levels under both scenarios.

#issue

REAL LIFE EXAMPLE

Task 2.11

Below is an analysis of two competing companies operating in the same market. New Candle is an importer, and Good Flame a manufacturer of cemetery lamps. Both companies sell the same type of cemetery lamps at an identical price.

New Candle Ltd.			Good Flame Ltd.		
Type of cost	PLN	%	Type of cost	PLN	%
Variable costs (5,000 pcs. × PLN 900)	4,500,000	90%	Variable costs (5,000 pcs. × PLN 400)	2,000,000	40%
Fixed costs	500,000	10%	Fixed costs	3,000,000	60%
Total costs	5,000,000	100%	Total costs	5,000,000	100%

Which of the above companies would you prefer to own if you knew that each of the above companies planned to double its production next year?

Solution

As production increases, a better cost structure is the one in which fixed costs account for a higher proportion. Comparing the level of fixed costs in both companies (10% in New Candle and 60% in Good Flame) and the variable unit cost (PLN 900 in New Candle and PLN 400 in Good Flame) we would prefer to own Good Flame. Let's check it out:

If production is doubled, the cost structure in both companies will be as follows:

New Candle Ltd.			Good Flame Ltd.		
Type of cost	PLN	%	Type of cost	PLN	%
Variable costs (10,000 pcs. × PLN 900)	9,000,000	94,7%	Variable costs (10,000 pcs. × PLN 400)	4,000,000	57.1%
Fixed costs	500,000	5.3%	Fixed costs	3,000,000	42.9%
Total costs	9,500,000	100%	Total costs	7,000,000	100%

As you can see, if production is doubled, New Candle will have total costs of PLN 9.5 million and Good Flame only PLN 7 million. As both companies sell their products at the same price, we would prefer to own Good Flame, as the total costs incurred by this company will be lower by EUR 2.5 million compared to New Candle.

Task 2.12

Check your knowledge – true or false test.

|		True	False
1	Information on the percentage of total costs represented by fixed costs and variable costs is called cost structure		
2	Higher fixed costs enable more savings if production declines		
3	There is no single best (benchmark) cost structure		
4	The same company can operate under two different cost structures		
5	The cost structure does not change with changing production values		
6	If fixed costs increase in tandem with a decrease in unit variable cost, this situation will lead to a better financial result when production increases		
7	If fixed costs decrease in tandem with an increase in unit variable cost, this situation will lead to a better financial result when production increases		

#answers

CLICK or SCAN

CHAPTER 3
CONTRIBUTION MARGIN

If two companies produce a similar product, such as electric scooters, and sell them at the same price, does the sale of each unit generate the same contribution margin for both companies?

Imagine two competitors in a local market. They have a (local) market share by volume of 40% each. The same share by volume[21] means that they sell the same number of products in the local market, amounting to 40% (for each company) of all products sold in that market. This is shown in the graph below:
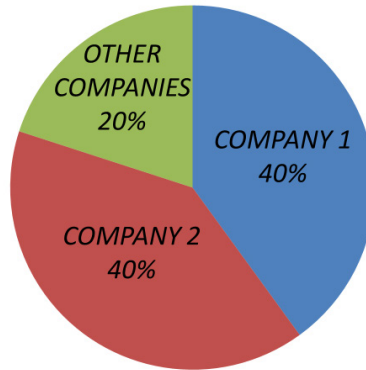
Graph 3.1. Quantitative share of companies on the local market
Source: own study.

Now imagine that the market share by value for both companies is as follows: for Company 1: 60%, for Company 2: 30%, and for other companies: 10%. Market share by value refers to the value of the products sold, not to their number (as was the case with share by volume).[22] The structure of sales by value is shown in the graph below:
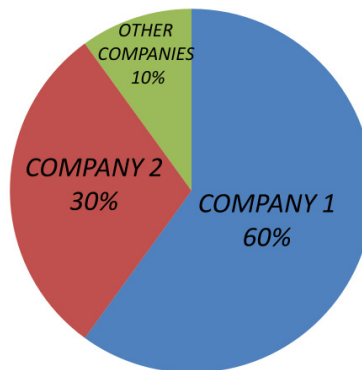
Graph 3.2. Value share of companies on the local market
Source: own study.

Even though Company 1 and Company 2 sell the same quantity of products (and have the same market share by volume) they sell this product for different prices.

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[21]   Market share by volume is the number of units of a product sold by a company in a particular period in relation to the total sales of units of that product in the entire market in the same period; if this is multiplied by 100 %, then the percentage market share is obtained.

[22]   Market share by value is the ratio of the value of products sold by a company in a particular period to the total value of sales generated by the product in the market in the same period; if this is multiplied by 100 %, the percentage value is obtained.

As a result, the value of sales of the same number of products is higher for Company 1 because this company sells the product at a higher price than Company 2. Does this mean that Company 1 will generate higher profits than Company 2? Not necessarily. The first question that should be asked is about the variable unit cost of the product in both companies. It is the difference between the price of a product and its cost that ultimately decides which company has made more operating profit for the same number of products sold. This difference is called the contribution margin.

#definition

> **Contribution margin is revenue less variable costs** (the income tax will not be taken into account). More precisely, the contribution margin could be defined as a figure reflecting the amount available from each sale, after deducting all variable costs associated with the units sold.

This can be expressed using the following equation:

#formula

$$\text{Total Contribution Margin = Revenue – Variable Costs}$$

The contribution margin is calculated mainly for use by company managers. It is rarely found in reports published by companies. It can be calculated in 3 different ways: as an aggregate value, value per unit (e.g. per piece of merchandise) and as a ratio. Let us check this using an example. Below are three situations (examples) that only differ in the level of sales.

#issue

REAL LIFE EXAMPLE

A contribution margin equal to the cost

Suppose our company is in the business of selling souvenirs and that we have sold 1,000 of them. The price at which we sell each souvenir is PLN 1 and the

variable cost of each piece is PLN 0.40. Since we have sold 1,000 pieces, our sales will be PLN 1,000 (1,000 pieces × PLN 1 each) and our variable costs will be PLN 400 (1,000 pieces × PLN 0.40 each). The total contribution margin in this case is PLN 600 (PLN 1,000 – PLN 400). Suppose also that our fixed costs are also PLN 600. Our simplified profit and loss account will be as follows:

Table 3.1. Profit and loss account – value in PLN

Type of data	Value in PLN
Sales (1,000 × PLN 1)	1,000
Variable costs (1,000 × PLN 0.40)	400
Total contribution margin (PLN 1,000 – 400)	600
Fixed costs	600

Source: own study.

Since the value of the total contribution margin and the fixed costs are the same, one can say that the contribution margin covers the fixed costs.

We know the value of the contribution margin per unit (it is indicated in the example) so we can compare it with the aggregate value:

Table 3.2. Profit and loss account – aggregate and per unit value

Type of data	Aggregate value in PLN	Value per unit (piece)
Sales (price)	1,000	1
Variable cost	400	0.40
Contribution margin (PLN 1 – PLN 0.4)	1,000 – 400 = 600	1 – 0.4 = 0.60
Fixed costs	600	–

Source: own study.

There is no need to calculate the value of fixed costs per souvenir in the above statement, which is why this was omitted. In our company selling souvenirs, the aggregate (total) value of the contribution margin is PLN 600 and the unit value of the contribution margin is PLN 0.60.

Let us now calculate the contribution margin represented as a ratio. To do this, we need to choose which values will be taken for the calculation (aggregate or per unit). For the result it makes no difference, as it will be exactly the same, as you can see:

In the first case, we assume that sales are 100% (for the value per unit approach, we assume that the price is 100%). In the next step, we determine what proportion is represented by aggregate variable costs (or, in the value per unit approach, unit variable cost).

In the case of aggregate value data:

$$PLN\ 1,000 - 100\%$$

$$\text{PLN } 400 - x$$

$$X = \frac{400 \text{ zł } x \text{ } 100\%}{1\,000 \text{ zł}} = 40\%$$

In the case of value per unit data:

$$\text{PLN } 1 - 100\%$$

$$\text{PLN } 0.40 - x$$

$$X = \frac{0,40 \text{ zł } x \text{ } 100\%}{1 \text{ zł}} = 40\%$$

As can be seen, in both cases the variable cost (aggregate and per unit) is 40% of the sales value (when aggregate values are calculated) or the price (when value per unit is calculated). What remains is to calculate the contribution margin ratio, which is the difference between sales and variable costs, namely:

$$100\% - 40\% = 60\%$$

The contribution margin ratio is 60%.

The Table 3.3.shows in three different ways the contribution margin of a company selling souvenirs:

Table 3.3. Profit and loss account – aggregate, per unit and ratio value for sales equal to PLN 1,000

Type of data	Aggregate value in PLN	Unit value in PLN	Ratio
Sales	1,000	1	100%
Variable costs	400	0.4	40%
Contribution margin	**600**	**0.6**	100% − 40% = **60%**
Fixed cost	600	–	–

Source: own study.

Now that we know how the value of the contribution margin can be presented, let us turn to example 3.2.

#issue

REAL LIFE EXAMPLE

A contribution margin greater than costs

This time, our souvenir company will sell twice as many souvenirs, i.e. 2,000 pieces. The price per souvenir as well as its variable cost have not changed This is shown in the following table:

Table 3.4. Profit and loss account – aggregate, per unit and ratio value for sales equal to PLN 2,000

Type of data	Aggregate value in PLN	Unit value in PLN	Ratio
Sales	2,000 (2,000 × PLN 1)	1	100%
Variable cost	800 (2,000 × PLN 0.40)	0.40	40%
Contribution margin	1,200 (PLN 2,000 – PLN 800)	0.60	60%
Fixed costs	600	–	–

Source: own study.

It can be seen from the table above that the contribution margin expressed as a value per unit and ratio have not changed. What has changed is only the aggregate value of the contribution margin. This is worth remembering. In making this comparison, it is worth noting that in Situation 1 the value of the aggregate contribution margin was equal to the value of the fixed costs. In Situation 2, it is higher than the value of the fixed costs. This means that not only has it covered the fixed costs in full, but there will also be some money left over – which is very good news for our souvenir business.

Let us now turn to example 3.3, in which we sell half of what we sold in example 3.1.

#issue

REAL LIFE EXAMPLE

A CONTRIBUTION MARGIN LESS THAN COSTS

Table 3.5. Profit and loss account – aggregate, per unit and ratio value for sales equal to PLN 500

Type of data	Aggregate value in PLN	Unit value in PLN	Ratio
Sales	500 (500 × PLN 1)	PLN 1	100%
Variable cost	200 (500 × PLN 0.40)	PLN 0.40	40%
Contribution margin	PLN 300 (PLN 500 – PLN 200)	PLN 0.60	60%
Fixed cost	600	–	–

Source: own study.

Again, the contribution margin expressed as value per unit and as ratio did not change. What has changed is the aggregate value. This time, the aggregate value of the contribution margin is less than the value of the fixed costs. This is not good news for our souvenir business, as the contribution margin earned is not able to cover the fixed costs, not to mention the fact that we would like some money to be left over.

Summarising the above three situations, the following conclusions can be drawn:

1. a change in the value of sales only changes the aggregate value of the contribution margin,
2. a change in the value of sales does not change the contribution margin expressed as value per unit and as a ratio,

#issue

REAL LIFE EXAMPLE

Task 3.1

How will the variable cost at Zosia's company change if sales fall to PLN 1 million from PLN 1.5 million if the contribution margin ratio is 40%. What will be the aggregate value of the contribution margin in both cases? Will the contribution margin cover the fixed costs of PLN 0.5 million in both cases?

Solution

In this case, in the first place we are able to calculate what proportion of sales is represented by variable costs (100% – 40% = 60%). We can then proceed to calculate the value of the variable costs in both cases, assuming that they represent 60% of the sales value. By analogy, the aggregate value of the contribution margin is calculated, as follows:

Type of data	Aggregate value in PLN	Aggregate value in PLN	Ratio
Sales	1,500,000	1,000,000	100%
Variable cost	**900,000** (1,500,000 × 60%)	**600,000** (1,000,000 × 60%)	**60%** (100% – 40%)
Contribution margin	**600,000** (1,500,000 × 40%) or (1,500,000 – 900,000)	**400,000** (1,000,000 × 40%) or (1,000,000 – 600,000)	40%

Answer: if the value of sales in Zosia's company is PLN 1.5 million then the value of variable costs is PLN 0.9 million and the value of contribution margin is PLN 0.6 million. If sales fall to PLN 1 million then variable costs fall to PLN 0.6 million and contribution margin falls to PLN 0.4 million. The contribution margin would only cover the

fixed costs if sales were PLN 1.5 million (the contribution margin is PLN 0.6 million and the fixed costs are PLN 0.5 million, so there would still be PLN 0.1 million left over). When sales fall to PLN 1 million, the contribution margin will not cover fixed costs (contribution margin is PLN 0.4 million and fixed costs are PLN 0.5 million).

Task 3.2

Check your knowledge – true or false test.

		True	False
1	Contribution Margin = Revenue – Total Costs		
2	Contribution Margin = Revenue – Variable Costs		
3	Contribution Margin = Revenue – Fixed Costs		
4	Value of contribution margin per unit = unit price – variable unit cost		
5	The contribution margin ratio reflects the percentage share of contribution margin in sales		
6	The contribution margin ratio reflects the percentage share of contribution margin in the unit price		
7	The contribution margin ratio reflects the percentage share of contribution margin in the variable costs		
8	The contribution margin ratio reflects the percentage share of contribution margin in the total costs		
9	The contribution margin ratio reflects the percentage share of contribution margin in the fixed costs		

#answer

CLICK ᴏʀ SCAN

CHAPTER 4
CVP ANALYSIS

Do you know why managers need to know fixed cost, variable cost and price?

With information on the variable unit **cost** of a **product** or service, its **price** and the value of **fixed costs**, it is possible to see what their impact is on a company's financial result at different **scale** of its operation.

(1)   **C**osts

(2)   **V**olume

(3)   **P**rofit or **P**rice

This type of analysis is called: **C**ost – **V**olume – **P**rofit analysis or **C**ost – **V**olume – **P**rice analysis. The first use of the abbreviation CVP is rather unfortunate, as it does not take into account the price, which can change, regardless of other factors, affecting the value of the profit. For this reason, despite the identical abbreviation CVP, it is advisable to associate it with the second use, where the word price is used instead of profit. In Polish, the equivalent of the CVP analysis is the „Production – Cost – Profit" analysis. The Polish version not only lacks the „price" in the name (which, after all, the analysis is about), but also the volume[23]. Instead, the term *production* was introduced, which suggests that the analysis is about manufacturing companies, which is not necessarily true. This type of analysis can be successfully used for commercial companies that do not produce anything. In order not to coin new abbreviations, this handbook uses the term CVP, which has been adopted in managerial accounting and which primarily allows the break-even point and target profit to be estimated.

Task 4.1

Check your knowledge – true or false test.

		True	False
1	CVP analysis looks at the impact of price, fixed cost and variable cost on a company's profit at different scales of operation		
2	CVP analysis looks at the impact of price, fixed cost and variable cost on a company's profit at different scales of operation only in production companies		
3	CVP analysis looks at the impact of a company's profit on its costs at different scales of operation		
4	CVP analysis allows the break-even point to be estimated		
5	CVP analysis allows the target income to be estimated		

---

[23]   The Polish language presents additional challenges in devising an abbreviation for this analysis, as the term *number* should be used for countable products (such as toys, buckets, hats, doughnuts, tickets, TVs, etc.) and *amount* should be used for uncountable products (such as sand, meat, fuel, etc.).

#answers

CHAPTER 5
BREAK-EVEN POINT

Do you know how many products or services you need to sell to cover all fixed costs?

#definition

> The term „**break-even**" refers to the scale of business at which a company stops incurring a loss but does not yet make a profit. In other words, **it is the level of sales at which the financial result (revenue – costs) is zero**.

#formula

This can be expressed with the following equation:

(1) Sales – Variable Costs[24] – Fixed Costs[25] = 0

Because we also know that:

(2) Sales – Variable Costs = Contribution Margin

Formula (1) can be modified as follows:

(3) Contribution Margin – Fixed Costs = 0[26]

The graph below will make it possible to indicate where the break-even point is.
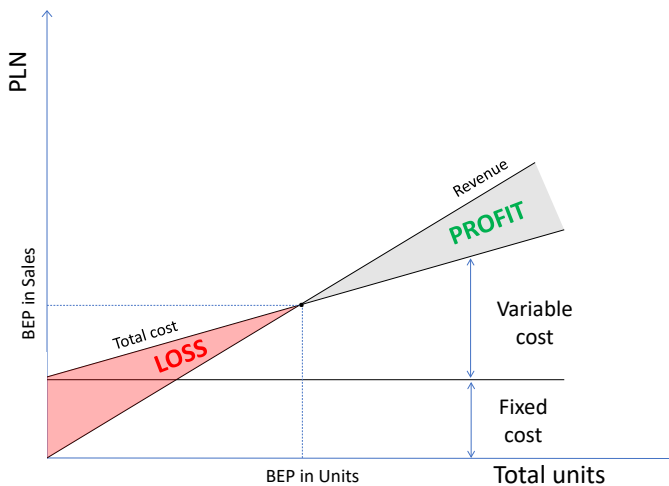
Graph 5.1.   Break-even point
Source: own study.

In the graph above, the break-even point is at the intersection of two curves: one reflecting the level of sales and the other indicating total costs. This unusual case is called the break-even *point* precisely because of its representation on the graph. This phenomenon can be described in two ways (which is also indicated in the chart), as a break-even point:

---

[24]   In this case, it concerns proportionately variable costs.
[25]   This equation can be extended to include financial costs, in which case it would be as follows: revenue – variable costs – fixed costs – financial costs = 0.
[26]   If the formula is expanded to include financial costs, then it will be as follows: contribution margin – fixed costs – financial costs = 0.

- in units (identifying the necessary number of products or services to be sold to cover all costs), and
- in sales volume (identifying the necessary value of sales of products or services needed to cover all costs).

If fewer units are sold (compared to those indicated by the break-even point in units) then a loss will be recorded, the value of which is shown in red. The less we sell, the greater the loss. If our sales are above the level indicated by the break-even point in units, then we start to make a profit, which will increase with the number of products or services sold. The same is true for break-even point in sales value, only this time instead of units we look at the value of sales.

#issue

REAL LIFE EXAMPLE

Let us calculate both break-even points (in units and sales value) using an example. Suppose I am buying goods paying PLN 5 apiece and selling them for PLN 20. My fixed cost is PLN 150.

What we know:

Variable unit cost: PLN 5/pc.

Price: PLN 20/pc.

Fixed cost: PLN 150

To calculate the break-even in sales, we need to compare the value of sales revenue achieved to the value of all (fixed and variable) costs. This looks like this:

$$\text{Sales Revenue} = \text{Fixed Costs} + \text{Variable Costs}$$

Sales revenue is the number of products sold multiplied by their price. Variable costs, on the other hand, are the number of products sold multiplied by their variable unit cost. Substituting this into the formula gives the following:

$$\text{Number of products} \times \text{Product price} = \text{Fixed costs} + \left(\text{Number of products} \times \text{Unit variable cost} \right)$$

If we leave fixed costs on one side of the equation, then we get:

$$\left(\text{Number of products} \times \text{Product price} \right) - \left(\text{Number of products} \times \text{Unit variable cost} \right) = \text{Fixed costs}$$

It can also be presented as follows:

$$\text{Number of products} \times \left(\text{Product price} - \text{Unit variable cost} \right) = \text{Fixed costs}$$

After leaving the number of products on one side of the equation, we get:

$$\text{Number of products} = \frac{\text{Fixed costs}}{\text{Product price} - \text{Unit variable cost}}$$

The formula for the break-even point in units is thus derived, which (given that the difference between the price of a product and its unit variable cost represents the value of the unit contribution margin) can be presented in a shortened form, i.e.:

#formula

$$\text{Break-even in units} = \frac{Fixed\ costs}{Unit\ contribution\ margin}$$

Let us now substitute the data from the example above into this formula. Since I buy the goods for PLN 5 and sell them for PLN 15, the contribution margin of each piece is:

$$\text{PLN } 20 - \text{PLN } 5 = \text{PLN } 15.$$

Now let's look at how many such products I need to sell to break-even:

$$\text{Break-even point in units} = \frac{150\ zł}{15\ zł/szt.} = 10 \text{ pcs}$$

I need to sell 10 pieces to break-even. Let's check it out. Our sale is PLN 200 (10 pcs. × PLN 20/unit), variable costs are PLN 50 (10 pcs. × PLN 5/unit), and fixed costs are PLN 150. Let us substitute this into equation (1):

$$\text{Sales} - \text{Variable Costs} - \text{Fixed Costs} = 0$$
$$\text{PLN } 200 - \text{PLN } 50 - \text{PLN } 150 = 0$$

or using an abbreviated version of formula (3), except that this time PLN 150 will be substituted for the contribution margin (since contribution margin is sales (PLN 200) less variable cost (PLN 50): PLN 200 – PLN 50 = PLN 150):

$$\text{Contribution Margin} - \text{Fixed Costs} = 0$$
$$\text{PLN } 150 - \text{PLN } 150 = 0$$

Since we already know the break-even point in units (which is 10 pieces) we can very easily calculate the break-even point in sales. Simply multiply all 10 pieces by the price for one piece:

$$10 \text{ pcs.} \times \text{PLN } 20/\text{pc.} = \text{PLN } 200$$

The formula for the break-even point in units has already been derived. To calculate the break-even point in sales, the contribution margin ratio will be substituted in the denominator instead of the unit contribution margin.

Let us calculate the break-even point in sales value using the following formula:

#formula

$$\text{Break-even point in sales} = \frac{Fixed\ costs}{Contribution\ margin\ ratio}$$

In order to substitute the relevant data, we must first calculate the contribution margin ratio.

Table 5.1. Contribution margin ratio

Nagłówek do uzupełnienia	Unit value in PLN	Ratio
Price	20	**100%**
Cost	5	**25%**
Contribution margin	15 (20 − 5)	75% (100% − 25%)

Source: own study.

We already know that in our case the contribution margin ratio is 75%. Let us now substitute everything into the formula:

$$\text{Break-even point in sales} = \frac{Fixed\ costs}{Contribution\ margin\ ratio} = \frac{150\ zł}{75\%} = \frac{150\ zł}{0,75} = \text{PLN } 200$$

Calculations using the formula also showed that the break-even point in sales was PLN 200. All in all, we know that in order to reach the break-even point in the example above, we need to sell 10 pieces of goods (break-even point in units) or sell these 10 pieces for PLN 200 (break-even point in sales value). This is shown in the graph below:
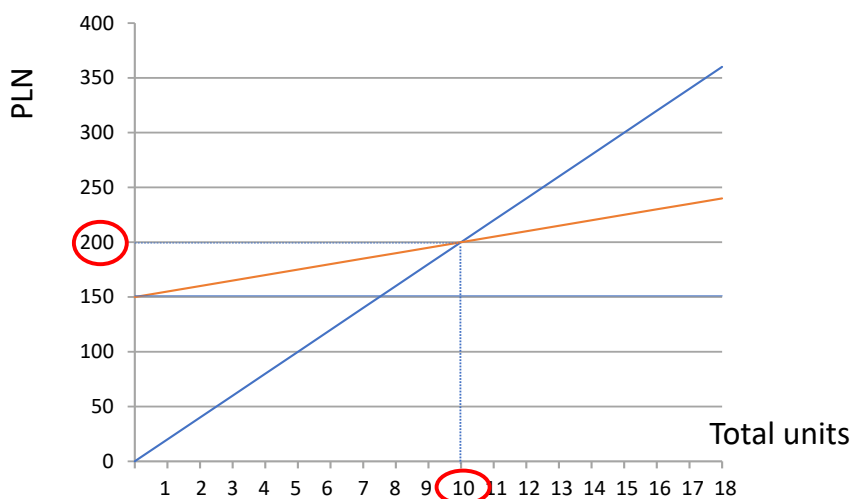
Graph 5.2. Break-even point for the discussed example.
Source: own study.

If we sell less (e.g. 9, 8, 7 etc.) pieces, which means a sales value lower than PLN 200, the company will incur a loss as the contribution margin will not cover the fixed costs. If we sell more (e.g. 11, 12, 13, etc.) pieces, which means a sales value greater than PLN 200, the company will make a profit, as the contribution margin will not only cover the fixed costs, but there will also be some money left over.

#issue

REAL LIFE EXAMPLE

Task 5.1

We can buy products at PLN 12 apiece and sell them for PLN 16 apiece. Our fixed costs are PLN 150,000. (1) How many pieces do we need to sell to break-even? (2) What must the sales value be to break-even?

Solution

What we know:

Variable unit cost = PLN 12

Price = PLN 16

Fixed costs = PLN 150,000

(1)   The break-even point in units is:

$$\text{Break-even point in units} = \frac{\text{Fixed costs}}{\text{Unit contribution margin}} = \frac{150\,000\ zł}{(16\ zł/szt. - 12\ zł/szt.} = \frac{150\,000\ zł}{4\ zł/szt.} = 37,500\ \text{pcs.}$$

(2)   The break-even point in sales value is:

37,500 pcs. × PLN 16/pc. = PLN 600,000

or:

Type of data	Unit value in PLN	Ratio
Price	16	100%
Cost	12	75%
Contribution margin	4 (16 − 12)	25% (100% − 75%)

$$\text{Break-even point in sales value} = \frac{\text{Fixed costs}}{\text{Contribution margin ratio}} = \frac{150\,000\ zł}{25\%} = \frac{150\,000\ zł}{0,25} = \text{PLN 600,000}$$

Task 5.2

Check your knowledge – true or false test.

		True	False
1	The break-even point informs about the scale of activity at which a company achieves a financial result equal to 0 PLN		
2	The break-even point informs about the scale of activity at which a company achieves an assumed financial result, for example 10% of the value of revenue		

3	The breakeven in units is the ratio of fixed costs to the unit contribution margin		
4	The breakeven in units is the ratio of variable costs to unit contribution margin		
5	Breakeven in sales value is the ratio of fixed costs to the contribution margin ratio		
6	Breakeven in sales value is the ratio of variable costs to the contribution margin ratio		
7	Breakeven point indicates how many products should be sold and breakeven in sales value – for how much they should be sold		
8	Breakeven in sales value indicates how many products should be sold and breakeven in units – for how much they should be sold		
9	Breakeven in sales value can be calculated by multiplying the product price by the breakeven in units volume		
10	Break-even in units can be calculated by multiplying the product price by the breakeven in sales value		

#answers

CLICK OR SCAN

CHAPTER 6
TARGET INCOME

Do you know how many products or services you need to sell to earn exactly what you want?

Reaching the break-even point allows you to go one step further, that is to generate income. This time, we will analyse how many pieces we have to sell to reach the target income (TI[27]). To do this, we have to modify the break-even equations accordingly, taking into account the value of the target income, as presented below:

This time, the target income will be derived from what remains after deducting all costs from the required sales revenue, i.e.:

$$\text{Target income} = \text{Required sales revenue (sales)} - \text{Variable costs} - \text{Fixed costs}$$

The target income is presented in the graph below:
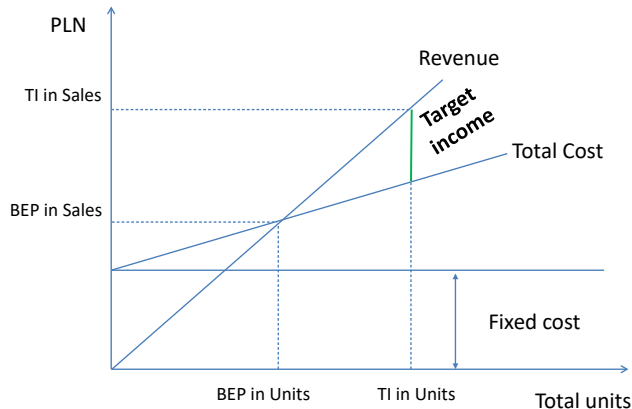
Graph 6.1. Target income
Source: own study.

As can be seen from the graph above, it is only when the break-even point is exceeded that a specific - target - income can be planned, as the value of sales revenue will be greater than the sum of fixed and variable costs.

This time (compared to the break-even point), sales revenue must cover not only fixed and variable costs but also the value of the target income. It can be presented as follows:

#formula

Sales revenue = Fixed costs + Variable costs + Target income

After developing the above equation, the following formula is obtained:

$$\text{Number of products} \times \text{Product price} = \text{Fixed costs} + \left(\text{Number of products} \times \text{Unit variable cost} \right) + \text{Target income}$$

If we leave fixed costs and target income on one side of the equation, we will obtain:

---

[27] (TI)

$$\left(\text{Number of products} \times \text{Product price} \right) - \left(\text{Number of products} \times \text{Unit variable cost} \right) = \text{Fixed costs} + \text{Target income}$$

It can also be presented as follows:

$$\text{Number of products} \times \left(\text{Product price} - \text{Unit variable cost} \right) = \text{Fixed costs} + \text{Target income}$$

After leaving the number of products on one side of the equation, we get:

$$\text{Number of products} = \frac{\text{Fixed costs} + \text{Target income}}{\text{Product price} - \text{Unit variable cost}}$$

The above formula can be simplified even more, because the unit price of a product minus the unit variable cost is, after all, the unit contribution margin. After simplifying again, the formula looks like this:

$$\text{Number of products} = \frac{\text{Fixed costs} + \text{Target income}}{\text{Unit contribution margin}}$$

#formula

As mentioned earlier, there are different types of profit (operating, gross and net profit after income tax) in a company. This section of the handbook will discuss each of them. Let's start with operating profit. The formula for target **operating profit** is as follows:

$$\text{TI in units} = \frac{Fixed\ costs + Target\ income_{operating}}{Unit\ contribution\ margin}$$

As you can see, this time (compared to the break-even point) the contribution margin must cover not only fixed costs but also the operating profit we want to achieve. Similarly, we will modify the formula for target profit value by inserting the contribution margin ratio into the denominator:

$$\text{TI in sales value} = \frac{Fixed\ costs + Target\ income_{operating}}{Contribution\ margin\ ratio}$$

Again, the contribution margin ratio must cover not only fixed costs but also the target operating profit (income).

Let's now move on to **gross profit** (sometimes referred to as net profit before income tax)**.** In the case where there are no financial costs[28], the gross profit will be the same as the operating profit, so you can use the formulas given above. However, if there are financial costs in the company, the value of gross profit will be lower as the financial costs must be deducted from the operating profit:

---

[28]   This applies not only to financial expenses but also to financial income.

Operating profit (EBIT) – Financial cost (I)[29] = Gross profit (EBT[30])

So:

Operating profit (EBIT) = Gross profit (EBT) + Financial cost (I)

#formula

To use the formula for target profit, if we want to use gross profit, we need to insert (in the numerator) the corresponding value of gross profit plus financial costs in place of operating profit. Therefore, both formulas should be modified as follows:

$$\text{TI in units} = \frac{Fixed\ costs + Target\ income_{gross} + Financial\ costs}{Unit\ contribution\ margin}$$

$$\text{TI in sales value} = \frac{Fixed\ costs + Target\ income_{gross} + Financial\ costs}{Contribution\ margin\ ratio}$$

As you can see, in the event of any financial costs, the contribution margin must cover not only fixed costs and the value of gross profit but also the value of financial costs.

Let's now move on to **net profit** (after income tax). Once again, both formulas should be modified. Net profit is gross profit less the value of income tax. So:

Gross profit (EBT) – Income tax (T) = Net profit (EAT[31])

Or

Gross profit (EBT) = Net profit (EAT) + Income tax (T)

If we wanted to put the value of net profit into the numerator instead of the value of gross profit in the above formulas, we would also have to add the value of income tax, which should be covered by the contribution margin, and this would mean that the result would still give the value of gross profit (Net profit + Income tax = Gross profit). In order to avoid having to additionally calculate the value of income tax, we can use a formula that will reflect gross profit on the basis of net profit. Take a look – we calculate the value of income tax by multiplying the income tax rate and the amount of gross income:

Income tax amount = Gross profit × T (income tax rate)

e.g.: PLN 19 = PLN 100 × 19%

If the gross income is PLN 100 and the value of income tax is PLN 19, the value of net income is PLN 81 (PLN 100 – PLN 19).

We can also write this equation this way:

Gross profit – (Gross profit × T) = Net profit

After transformation the result is:

---

[29]   They are usually called interest, hence the abbreviation "I".
[30]   **E**arnings **B**efore **T**ax (income tax).
[31]   **E**arnings **A**fter **T**ax.

$$\text{Gross profit} \times (1-T) = \text{Net profit}$$

i.e.: PLN 100 × (1 − 19%) = PLN 100 (1 − 0.19) = PLN 100 × 0.81 = PLN 81

As you can see, using the second equation, we can determine the value of net profit much faster. Let's use it, transforming it a little:

If: Gross profit × (1−T) = Net profit,

Then, after the transformation, we get:

Gross profit = $\frac{Net\ profit}{(1-T)}$

Let's check it using an earlier example:

$$\frac{81\ zl}{(1-0.19)} = \frac{81\ zl}{0.81} = \text{PLN } 100$$

Thus, we can quickly count net and gross profit. Returning to the formula for target net income, this time we will insert an equation using net profit instead of gross profit (i.e. Gross profit =):

#formula

$$\text{TI in units} = \frac{Fixed\ costs + \frac{Target\ income_{net}}{(1-T)} + Financial\ costs}{Unit\ contribution\ margin}$$

and:
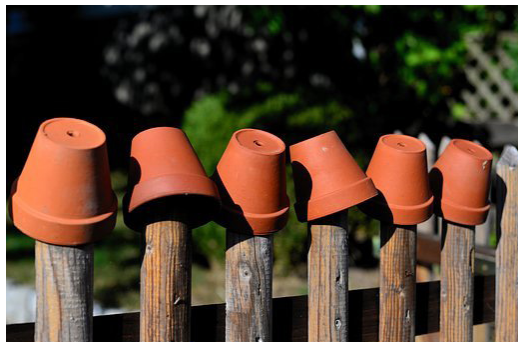
$$\text{TI in sales value} = \frac{Fixed\ costs + \frac{Target\ income\ _{net}}{(1-T)} + Financial\ costs}{Contribution\ margin\ ratio}$$

#issue

REAL LIFE EXAMPLE

Sale and profit

Now let's check the formulas obtained using an example.

Source: Gartenzaun Blumentöpfe Tontöpfe - Kostenloses Foto auf Pixabay?

Imagine a company that produces flowerpots. The variable cost of one pot is PLN 4. The price at which the pots are sold is PLN 9. The fixed cost is PLN 15,000 per month, the financial cost is PLN 1,500 per month, and the income tax rate is 19%.

Instructions:

How many pots does the company need to sell to reach an annual:

(1) operating profit of PLN 30,000?

(2) gross profit of PLN 30,000?

(3) net profit of PLN 30,000?

Solution

What we know:

Variable cost of a pot: PLN 4

Price per 1 pot: PLN 10

Annual fixed cost = 12 × PLN 15,000 = PLN 180,000

Annual financial cost = 12 × PLN 1,500 = PLN 18,000

Income tax rate = 19%

(1)

$$\text{TI in units} = \frac{Fixed\ \cos ts + Target\ income_{operating}}{Unit\ contribution\ margin} = \frac{PLN\ 180,000 + PLN\ 30,000}{(PLN\ 10\ apiece - PLN\ 4\ apiece)} = \frac{PLN\ 210,000}{PLN\ 6\ apiece} = 35,000 \text{ pcs.}$$

TI in sales value = TI volume × price = 35,000 pcs. × PLN 10/pc. = PLN 350,000

or:

Table 6.1. Contribution margin unit and ratio value

Type of data	Unit value in PLN	Ratio
Price	10	100%
Variable cost	4	40%
Contribution margin	6 (9 − 4)	60% (100% − 40%)

Source: own study.

$$\text{TI in sales value} = \frac{Fixed\ \cos ts + Target\ income_{operating}}{Contribution\ margin\ ratio} = \frac{PLN\ 180,000 + PLN\ 30,000}{60\%} = \frac{210,000}{0.6} = \text{PLN } 350,000$$

In order to achieve an operating profit, the company should sell 35,000 pots and the sales value will be PLN 350,000.

(2)

$$\text{TI volume} = \frac{Fixed\ \cos ts + Target\ income_{gross} + Financial\ costs}{Unit\ contribution\ margin} = \frac{PLN\ 180,000\ zł + PLN\ 30,000\ zł + PLN\ 18,000\ zł}{(PLN\ 10\ apiece - PLN\ 4\ apiece)} =$$

$$= \frac{PLN\ 228,000\ zł}{PLN\ 6\ apiece} = 38,000 \text{ pcs.}$$

$$\text{TI in sales value} = 38{,}000 \text{ pcs.} \times \text{PLN } 10/\text{pc.} = \text{PLN } 380{,}000$$

or:

$$\text{TI value} = \frac{PLN\ 180{,}000 + PL\ 30{,}000 + PLN\ 18{,}000}{60\%} = \frac{PLN\ 228{,}000}{0.6} = \text{PLN } 380{,}000$$

In order to achieve a gross profit of PLN 30,000, 38,000 pots must be sold and the sales value will be PLN 380,000.

(3)

$$\text{TI in units} = \frac{Fixed\ costs + \frac{Target\ income_{net}}{(1-T)} + Financial\ costs}{Unit\ contribution\ margin} = \frac{PLN\ 180{,}000 + \frac{PLN\ 30{,}000}{(1-0.19)} + PLN\ 18{,}000}{(PLN\ 10\ apiece - PLN\ 4\ apiece)} =$$

$$= \frac{PLN\ 180{,}000 + PLN\ \frac{30{,}000}{(0.81)} + PLN\ 18{,}000}{PLN\ 6\ apiece} = \frac{PLN\ 180{,}000 + PLN\ 37{,}037.04 + PLN\ 18{,}000}{PLN\ 6\ apiece} =$$

$$= \frac{PLN\ 235{,}037.04}{PLN\ 6\ apiece.} = 39{,}172.84 \text{ pcs.} \approx 39{,}173 \text{ pcs.}[28]$$

$$\text{TI in sales value} = 39{,}173 \text{ pcs.} \times \text{PLN } 10/\text{pc.} = \text{PLN } 391{,}730$$

or:

$$\text{TI value} = \frac{Fixed\ costs + T\frac{arget\ income_{net}}{(1-T)} + Financial\ costs}{Contribution\ margin\ ratio} =$$

$$= \frac{PLN\ 180{,}000 + \frac{PLN\ 30{,}000}{(1-0.19)} + PLN\ 18{,}000}{60\%} = \frac{PLN\ 180{,}000 + \frac{PLN\ 30{,}000}{(0.81)} + PLN\ 18{,}000}{0.6} = \frac{PLN\ 180{,}000 + PLN\ 37{,}037.04 + PLN\ 18{,}000}{0.6} =$$

$$= \frac{PLN\ 235{,}037.04}{0.6} = \text{PLN } 391{,}728.40$$

> The difference in the two results is due to rounded pot pieces in formula one and values to 2 decimal places in formula two.

In order to achieve a net profit of PLN 30,000, 391,730 pots must be sold and the sales value will be PLN 391,730.

Summarising the calculations made, in order to achieve a profit of PLN 30,000 at three different levels (operating, gross and net), the contribution margin must cover more and more elements of the numerator. Therefore, it should not be surprising that:

- in order to earn PLN 30,000 in operating profit, **35,000 pieces** must be sold,
- in order to achieve a gross profit of PLN 30,000, **38,000 pieces** must be sold,
- in order to achieve a net profit of PLN 30,000, **39,173 pieces** must be sold.

#issue

REAL LIFE EXAMPLE

Task 6.1

You are preparing a plan for the implementation of a new business that will deal with mediating the recycling of cell phone batteries. According to the assumptions, the company will pay PLN 2 per battery and sell it for PLN 2.10. Annual fixed costs amount to PLN 500,000, while financing costs amount to PLN 162,000.

Instructions:

(1) How many batteries should be bought and then resold for the company to earn PLN 162,000 in net profit for a full year of operations, taking into account the 19% income tax rate?

(2) If the company is exempt from paying income tax in its first year of operation, how many batteries should it buy and then resell in order to make a profit of PLN 162,000 after deducting all other costs?

(3) If the income tax exemption mentioned in item (2) is possible only under the condition that the company does not exceed PLN 8 million in sales revenue, will the company meet this condition?

Solution

(1)

$$\text{TI in units} = \frac{Fixed\ costs + \frac{Target\ income_{net}}{(1-T)} + Finacial\ costs}{Unit\ contribution\ margin} =$$

$$= \frac{PLN\ 500,000 + \frac{PLN\ 162,000}{(1-0.19)} + PLN\ 100,000}{(PLN\ 2.20\ apiece - PLN\ 2\ apiece)} = \frac{PLN\ 500,000 + \frac{PLN\ 162,000}{(0.81)} + PLN\ 100,000}{PLN\ 0.20\ apiece} =$$

$$= \frac{PLN\ 500,000 + PLN\ 200,000 + PLN\ 100,000}{PLN\ 0.20\ apiece} = \frac{PLN\ 800,000}{PLN\ 0.20\ apiece} = 4,000,000\ \text{pcs.}$$

To make a net profit of 162,000, the company must buy and resell 4 million batteries.

(2)

This time the gross profit is the same as the net profit as the company will not pay income tax, so:

$$\text{TI in units} = \frac{Fixed\ costs + Target\ income_{gross} + Financial\ costs}{Unit\ contribution\ margin} =$$

$$= \frac{PLN\ 500,000 + PLN\ 162,000 + PLN\ 100,000}{(PLN\ 2.20\ apiece - PLN\ 2\ apiece)} = \frac{PLN\ 762,000}{PLN\ 0.20\ apiece} = 3,810,000\ \text{pcs.}$$

In order for the company to make a profit of 162,000, excluding income tax, the company would have to buy and then resell 3,810,000 batteries.

(3)

TI in sales value = 3,810,000 pcs. × PLN 2.20/pc. = PLN 8,382,000

or:

Type of data	Unit value in PLN	Ratio
Price	2.20	100%
Variable cost	2	90.91%
Contribution margin	0.20 (2.20 − 2)	9.09%[32] (100% − 90.91%)

---

[32] Rounded value.

$$\text{TI in sales value} = \frac{Fixed\ costs + Target\ income_{gross} + Financial\ costs}{Contribution\ margin\ ratio} = \frac{PLN\ 500{,}000 + PLN\ 162{,}000 + PLN\ 100{,}000}{9.09\%} =$$

$$= \frac{PLN\ 762{,}000}{0.0909} = \text{PLN } 8{,}382{,}838.28$$

Both calculations (although made with varying degrees of accuracy) proved that by selling 3,810,000 batteries to earn PLN 162,000 tax-free, the company would have to record sales revenues of more than PLN 8 million. As a result, the company would not be eligible for income tax exemption.

Task 6.2

Check your knowledge – true or false test.

		True	False
1	The value of target income results from the positive difference between sales revenue and the sum of fixed and variable costs		
2	The value of target income results from the positive difference between sales revenue and fixed costs		
3	The value of target income results from the positive difference between sales revenue and variable costs		
4	In the numerator, the formula for calculating the operating target income in units has the sum of fixed costs and the expected value of operating profit		
5	In the numerator, the formula for calculating the operating target income has the sum of variable costs and the expected value of operating profit		
6	Target income in units informs about the number of products the company needs to sell to reach the target income value		
7	Target income in sales value informs about the number of products the company needs to sell to reach the target income value		
8	Target income in sales value informs about the amount of sales revenue necessary to achieve the target income		
9	The target income in units informs about the amount of sales revenue necessary to achieve the target income		
10	If the company wants to estimate the target income in units, it must include the sum of fixed costs and the assumed value of net profit in the denominator		

#answers

CLICK OR SCAN

CHAPTER 7
CHANGE IN COSTS AND PRICE

Do you know how changes in fixed cost, variable cost and price affect the break-even point or target income?

Every enterprise observes changing variable unit costs, prices or fixed costs. In this section, you will learn how the aforementioned changes will affect the break-even point and target income.

In setting both the break-even point and the target income, we have the contribution margin in the denominator and what the contribution margin is supposed to cover in the numerator. Therefore, it is only logical that as the contribution margin increases, it will be easier (faster) to reach the break-even point and target income, and vice versa (by decreasing the contribution margin, one should expect to achieve the break-even point and target income later). We can observe this phenomenon in the companies around us. Ones that sell products on a low margin need to sell a lot more of them than ones whose margin is high. Increasing the margin can be done in 3 ways:

• by reducing the variable unit cost,
• by increasing the price,
• by reducing the variable unit cost while increasing the price.

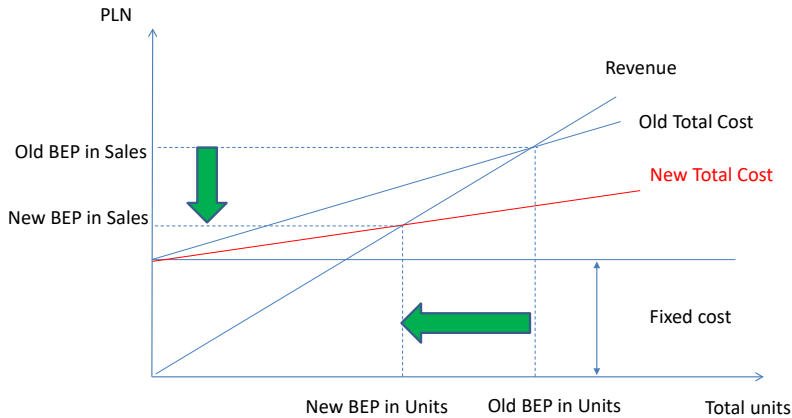## 7.1. Change in variable unit cost

#issue

REAL LIFE EXAMPLE

Source: Pixabay.

Imagine a bakery that estimated the variable cost of baking one roll at PLN 0.40. The bakery is able to reduce the unit variable cost to PLN 0.35 thanks to the energy cost subsidy it received. How will this affect its income?

The situation in which the variable unit cost has been reduced is shown in the Graph 7.1:

Graph 7.1.   Impact of lowering the unit cost on the break-even point.
Source: own study.

As can be seen in the graph above, the new lower total costs are the result of unchanged fixed costs and lower variable costs (since each additional unit of product results in a lower variable cost than the original). Due to lower variable unit costs, the new total costs have a more „flat" inclination, meaning that they grow more slowly than their original value (i.e. the old total costs). This causes the break-even point (both break-even point in units and in sales) to move closer to zero on the graph. This means that with the new (lower) total cost, the company will break even faster (i.e. by selling fewer goods). The new (i.e. lower) total cost will affect the target income in exactly the same way (i.e. it will be achievable faster than with the old (higher) total cost).

With a lower unit variable cost, the bakery will reach the target income value (as well as the break-even point) faster, that is by selling fewer rolls. Assuming that the number of rolls sold does not change, the value of income (thanks to the lower value of total costs) will increase.

Now let's consider the case of an increase in unit variable cost.

Due to an increase in the price of energy, the variable cost of baking a roll will increase to PLN 0.50. Will the company achieve the same income by selling the same number of rolls as before the energy price increase (for the same price)? If not, how many more rolls would it have to sell to achieve the same income value?

If we make the opposite change (i.e. this time the unit variable cost will be increased), the break-even point as well as the target income will be achieved later, i.e. by selling more pieces. This is shown in the Graph 7.2:
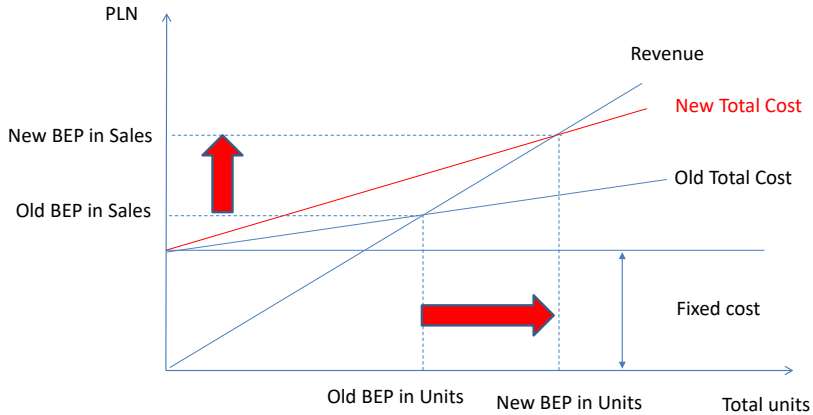
Graph 7.2. Impact of increasing unit cost on break-even.
Source: own study.

Now we know that a bakery in which the unit variable cost has increased will have to increase production and sales in order to achieve, with the price unchanged, the income it was achieving before the energy increase (and thus before the increase in the unit variable cost).

7.2. Price change

#issue

REAL LIFE EXAMPLE

Source: Pexels

The owner of the ice cream shop decided to reduce the price of a scoop of ice cream from PLN 5 to PLN 4. Is the existing number of customers enough to cover all costs?

Reducing the price will reduce the value of sales revenue and contribution margin, so the break-even point and target income will be achieved later. In this case, more products will need to be sold. This is shown in the graph below:
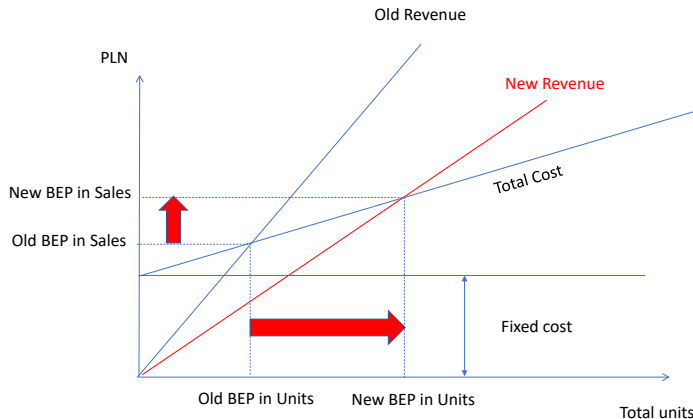
Graph 7.3. The impact of the reduction in the price of the product on the break-even point.
Source: own study.

We already know that after lowering the price of ice cream the ice cream shop will have to sell more scoops to reach its break-even point and/or target income. Now let's consider a case in which the owner decides to raise their price, for example to PLN 6 per scoop.

An increase in price will cause the opposite, that is an increase in sales revenue and contribution margin. A higher price will contribute to achieving the break-even point and target income faster, meaning that the company will be able to sell fewer units of goods. This is shown in the graph below:
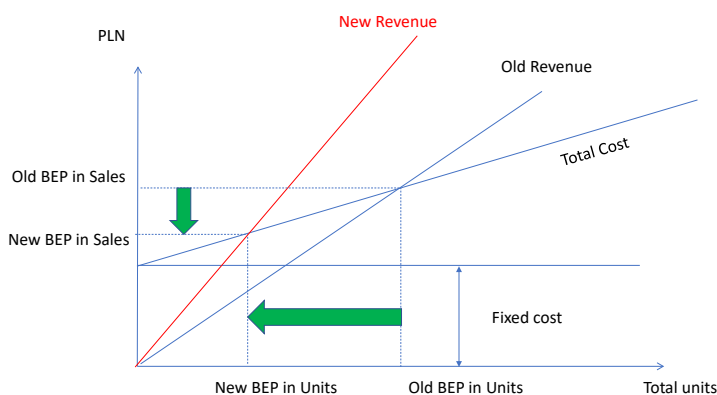
Graph 7.4. The impact of increasing the product price on the break-even point.
Source: own study.

As a result of an increase in the unit price (with the value of the unit variable cost unchanged), the owner can reach the break-even point (and/or target income) faster than with a lower price.

However, it is worth remembering that the value of the price influences customers' decisions. A lower price increases customers' interest in buying a product, while a higher price (as a rule) causes the opposite. For this reason, in addition to changing the price, it would be necessary to investigate what level of sales can be achieved at a certain price. Knowing these two values, we are able to predict their impact on the break-even point and target income. In the case of an ice cream shop that increases the price of ice cream, there is a risk that customers will go to another ice cream shop, resulting in a decrease in sales.

7.3. Change in fixed costs

#issue

REAL LIFE EXAMPLE

Source: Pexels.

As a result of the economic crisis, a seamstress decided to move her studio from a shopping centre to... her apartment. This will reduce her fixed costs associated with renting the premises by PLN 3,000 per month. Will this change affect the number of customers the seamstress must serve to break-even (assuming an unchanged unit contribution margin)?

Reducing the level of fixed costs means reducing the numerator in the break-even equation. This means that the contribution margin (which is in the denominator) will cover the lower fixed costs much faster. In the Graph 7.5, you can see that lower fixed costs also cause a lower level of total costs (because, after all, total costs are the

sum of fixed and variable costs). In this case, the break-even point and target income will be achieved more quickly, that is by selling fewer goods or services.
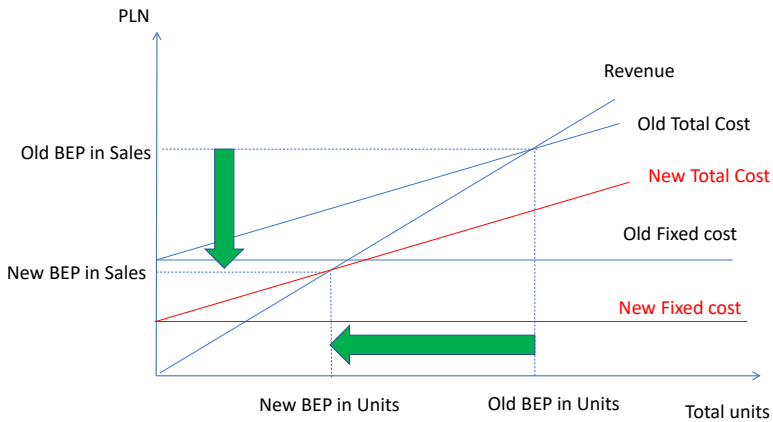
Graph 7.5.   The impact of the reduction of fixed costs on the break-even point.
Source: own study.

The seamstress' decision to reduce the level of fixed costs will lower the break-even volume and value (and target income). This means that after reducing fixed costs, the seamstress can serve fewer customers (compared to the situation before the change) to break-even. Decisions related to the reduction of fixed costs will be helpful in times of crisis, as the new, lower break-even point makes it possible to serve fewer customers, which is a fairly common situation in times of economic crisis. And what if the seamstress decided to rent a more expensive premises because, for example, a space in a very attractive but also expensive location has freed up due to the crisis?

The opposite change (i.e. an increase in fixed costs) means that more products need to be sold, as the contribution margin did not change and fixed costs increased. In this case, the break-even point and target income will be achieved later (after selling more goods). This is shown in the Graph 7.6:
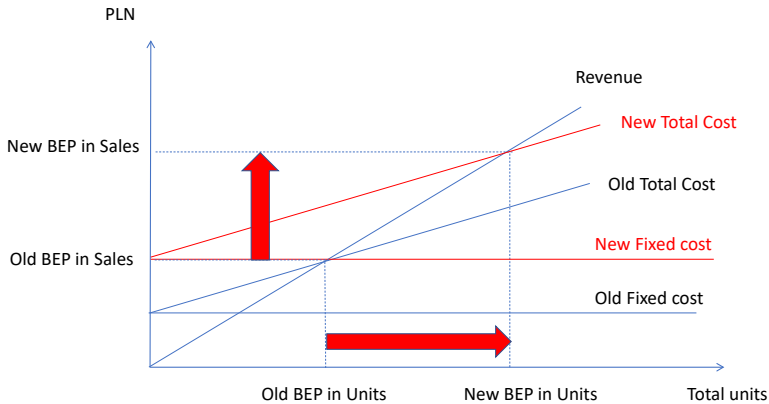
Graph 7.6. Impact of the increase in fixed costs on the break-even point.
Source: own study.

If the seamstress moves to a more expensive premises, it will increase the level of its fixed costs. In making such a decision, she should be aware that she will need to serve more customers in the new location to break-even. Such an action in the face of a crisis is very risky due to the two factors considered in this example that affect the break-even value, i.e: (1) fixed cost and (2) number of customers served – only one of them is certain – fixed cost. It seems more likely that the number of customers, in times of crisis, will not increase[33].

The impact of each cost factor on the break-even point and target income is summarised below.

Table 7.1. Impact of cost factors on the break-even point and target income.

Change in cost	Impact on: break-even point in units/sales TI in units/sales
Reduction in variable cost	Lower value
Increase in variable cost	Higher value
Reduction in fixed cost	Lower value
Increase in fixed cost	Higher value

---

[33] At this point, it is important to pay attention to the industry in which the entrepreneur operates. There are industries that do much better in a crisis than in times when there is no crisis. Within industries, there are also types of companies that handle crises differently. For example, within the automotive industry, fewer new cars are generally sold in a crisis, which means that old cars are more often being repaired. Thus, new car dealers will experience lower sales, while auto parts dealers may record higher demand for their products.

As can be seen from the above statement, an increase in any of the costs (fixed or variable unit) also increases the value at which the break-even point and target income is achieved, and vice versa (a decrease in any of the costs results in a decrease in the break-even point and target income).

A change in price has a completely different effect. This is shown in the following table:

Table 7.2. The impact of the price change on the break-even point in units and target income in units.

Price change	Impact on: Break-even point in units TI in units
Lower price	Higher value
Higher price	Lower value

As can be seen from the above statement, an increase in price results in a decrease in the value of the unit break-even point and the unit target income (i.e. it will be achieved after selling fewer goods due to a higher contribution margin), while a decrease in price increases their value. The level of the break-even point and target income in sales depends on how much the price changes. Therefore, the representation of the break-even point and target income in units is more universal.

So far, the effect of 3 separate factors (unit variable cost, fixed cost and price) on break-even point and target income values has been presented. Changing all three will be the resultant of the effects of changing each one individually. Let us check this using an example:

7.4. Impact of cumulative changes

#issue

REAL LIFE EXAMPLE

keys on hand photo – Free Image on Unsplash

Let's say we sell key chains. We buy one key chain for PLN 0.50 and sell it for PLN 1. The fixed costs are PLN 20,000 and the operating profit we plan to make is PLN 10,000. Using the formula for target income$_{operating}$, we can quickly calculate that with the above assumptions, we should sell 60,000 units to make an operating profit of PLN 10,000.

$$\text{TI in units} = \frac{PLN\ 20{,}000 + PLN\ 10{,}000}{PLN\ 1\ apiece - PLN\ 0.5\ apiece} = \frac{PLN\ 30{,}000}{PLN\ 0.5\ apiece} = 60{,}000\ pcs$$

Now suppose we have negotiated a lower price with our supplier and the variable unit cost is now PLN 0.40 apiece. The contribution margin will be higher, which should result in faster achievement of the target income. Let's check it out:

$$\text{TI in units} = \frac{PLN\ 20{,}000 + PLN\ 10{,}000}{PLN\ 1\ apiece - PLN\ 0.4\ apiece} = \frac{PLN\ 30{,}000}{PLN\ 0.6\ apiece} = 50{,}000\ pcs$$

As you can see, the operating profit of PLN 10,000 will indeed be achieved faster, as it will require the sale of 50,000 pieces (the difference is: 60,000 pcs. – 50,000 pcs. = 10,000 pcs.).

Now let's check what happens if we reduce fixed costs from PLN 20,000 to PLN 17,000.

$$\text{TI in units} = \frac{PLN\ 17{,}000 + PLN\ 10{,}000}{PL\ N\ 1\ apiece - PLN\ 0.4\ apiece} = \frac{PLN\ 27{,}000}{PLN\ 0.6\ apiece} = 45{,}000\ pcs.$$

As you can see, in this case we will also achieve the target income in units faster, selling 5,000 fewer pieces (50,000 pcs. – 45,000 pcs.).

Note that each of the subsequent changes made included the effect of the previous one. Thus, we conclude that if we made all these 3 changes at the same time,

their cumulative effect would cause us to achieve our target operating income faster by 15,000 pieces (the difference between 60,000 pieces before the changes and 45,000 pieces after all 3 changes). The opposite changes (i.e. an increase in variable unit cost, a decrease in price, and an increase in fixed costs) would have the opposite effect – they would result in achieving the target operating income by selling more pieces. Mixed changes (i.e., on the one hand, ones that reduce the number of pieces necessary to sell to make operating income, and on the other hand, ones that increase that number) will require estimating the final difference from the baseline. In this case, the key will be to calculate whether the impact of all the changes will result in the need to sell more or less goods.

#issue

REAL LIFE EXAMPLE

Task 7.1

Ms. Agata intends to open a beauty salon that will enable her to serve 3 customers at the same time. This way, she can serve 3,600 customers a year. The salon's fixed costs will amount to PLN 240,000 per year, with a variable unit cost of PLN 50. The price of the service that Ms. Agata's salon will provide is PLN 150.

Instructions:

(1) Given the above assumptions, check whether Ms. Agata is able to earn PLN 100,000 in operating profit for the full year

(2) What operating profit will Ms. Agata make if she serves 3,600 customers?

(3) Ms. Agata can take advantage of an offer from a company that will give her the necessary equipment to use for free. In return, the company will charge for the use of the equipment. However, this will not change the number of customers served per year. If Ms. Agata accepts this offer, the fixed cost will decrease to PLN 180,000 per year and the variable unit cost will increase to PLN 80 per customer service. Is the company's offer better than Ms. Agata's original plan for her business?

Solution

(1) Ms. Agata intends to earn PLN 100,000 a year. Under the original assumptions, this means she has to serve 3,400 customers:

$$\text{TI in units} = \frac{PLN\ 240,000 + PLN\ 100,000}{PLN\ 150\ apiece - PLN\ 50\ apiece} = \frac{PLN\ 340,000}{PLN\ 100\ apiece} = 3,400\ pcs$$

Ms. Agata's plan includes serving more customers (3,600) than the amount of expected income requires (3,400). Accordingly, Ms. Agata can earn PLN 100,000 in operating profit with her assumptions.

(2) To count how much Ms. Agata can earn, we can use the formula for target income:

$$\text{TI in units} = \frac{Fixed\ costs + Target\ income_{operating}}{Unit\ contribution\ margin}$$

By transforming the above formula, we obtain the following:

Target income $_{operating}$ = (TI in units × Unit contribution margin) – Fixed costs

By substituting into the above formula, we obtain the following:

Target income $_{operating}$ = [3,600 × (PLN 150 – PLN 50)] – PLN 240,000 =

= (3,600 × PLN 100) – PLN 240,000 = PLN 360,000 – PLN 240,000 = PLN 120,000

We already know that by serving 3,600 customers, Ms. Agata will earn PLN 120,000 in operating profit.

(3) Let's see how the two changes to Ms. Agata's assumptions (a decrease in fixed costs and an increase in unit variable cost) will affect the situation:

$$\text{TI in units} = \frac{PLN\ 180,000 + PLN\ 100,000}{PLN\ 150\ apiece - PLN\ 80\ apiece} = \frac{PLN\ 280,000}{PLN\ 70\ apiece} = 4,000\ pcs$$

The change in fixed costs and unit variable cost will result in a worse result than the original one, as earning PLN 100,000 in operating profit will involve serving 4,000 customers, which is not what Ms. Agata assumes. Therefore, Ms. Agata should reject the company's offer and stick to the original assumptions.

Task 7.2

Check your knowledge – true or false test.

		True	False
1	Reducing unit variable costs will result in reaching the break-even point and target income faster (i.e. it will require selling fewer pieces).		
2	Reducing unit variable costs will result in reaching the break-even point and target income more slowly (i.e. it will require selling more pieces).		
3	Increasing fixed costs will result in reaching the break-even point and target income faster (i.e. it will require selling fewer pieces).		
4	Increasing fixed costs will result in achieving the break-even point and target income more slowly (i.e. it will require selling more pieces).		
5	Reducing the price will result in reaching the break-even point in units and target income in units faster (i.e. it will require selling fewer pieces).		

6	Reducing the price will result in reaching the break-even point in units and target income in units more slowly (i.e. it will require selling more pieces).		
7	Reducing the price, unit variable cost and fixed costs will each contribute to achieving the break-even point and target income faster (i.e. it will require selling fewer pieces).		
8	Increasing the price and lowering unit variable costs and fixed costs will each contribute to achieving the break-even point and target income faster (i.e. it will require selling fewer pieces).		

#answers

CHAPTER 8
MULTIPRODUCT ANALYSIS

Is there any point in selling products without profit?

8.1. Multiple products

So far, the considerations concerned the sale of one product or one service. Such a phenomenon is rather rare in the world around us. Companies usually offer multiple services and products. This section of the handbook will show how to adapt the aforementioned solutions to a situation where we are dealing with more than one product (or service). Let's start with an example.

#issue

REAL LIFE EXAMPLE

Three products

Imagine that you run a company that produces inkjet printers and inks for that printer in special cartridges. In this particular case, there are 3 products: a printer (1), as well as black ink (2) and colour ink (3) for the said printer. You sell 1,500 printers, 6,000 black inks and 2,500 colour inks annually. The variable unit cost and price (along with the calculated unit contribution margin) are shown below:

Table 8.1. Contribution margin of three products

Type of data	Product 1	Product 2	Product 3	
Product type	Printer	Black ink	Colour ink	In total
Number of units	1,500	6,000	2,500	10,000
Variable unit cost	PLN 150	PLN 40	PLN 70	✖
Unit price	PLN 160	PLN 60	PLN 80	✖
Unit contribution margin	**PLN 10** (160−150)	**PLN 20** (60−40)	**PLN 10** (80−70)	✖

Source: own study.

As you can see, you sell 10,000 pieces of all products a year. The unit contribution margin of each of them is positive, which is a good thing. The largest contribution margin is recorded for black ink (PLN 20). The printer and colour ink have exactly the same contribution margin unit value (PLN 10). We are still missing the value of fixed costs. Some of them can be allocated to each product separately – these are so-called direct costs. Indirect costs, on the other hand, are costs that cannot be directly linked to the production of a specific product. For example, the depreciation of a machine that produces printers can be attributed to the cost of the printer, while the depreciation of an injection molding machine that produces housings for black and colour ink cartridges can no longer be so easily attributed to one product because it produces both and, on top of that, in different numbers. Let's first deal with the fixed costs attributable to each product (direct costs). Their value is as follows:

Table 8.2. Fixed costs allocated to three product

	Product 1	Product 2	Product 3	In total
Fixed costs allocated to the product (direct costs)	PLN 16,000	PLN 18,000	PLN 20,000	PLN 56,000

Source: own study.

As you can see, direct costs (that is costs that are (directly) related to the production of products and can be attributed (allocated) to a specific product) represent a different value for each product. In other words, the production of each of the 3 products is associated with a different value of the direct fixed costs incurred. Their total value is PLN 56,000. Now let's see what a simplified income statement that takes into account direct fixed costs would look like.

Table 8.3 Product margin of three products

Type of data	Product 1 (Printer)	Product 2 (Black ink)	Product 3 (Colour ink)	In total
Sales (sales revenue)	PLN 240,000 (1,500 × PLN 160)	PLN 360,000 (6,000 × PLN 60)	PLN 200,000 (2,500 × PLN 80)	PLN 800,000
minus**: variable costs**	PLN 225,000 (1,500 × PLN 150)	PLN 240,000 (6,000 × PLN 40)	PLN 175,000 (2,500 × PLN 70)	PLN 640,000
Contribution margin	PLN 15,000	PLN 120,000	PLN 25,000	PLN 160,000
minus**: direct fixed costs**	PLN 16,000	PLN 18,000	PLN 20,000	PLN 54,000
Product margin	**−PLN 1,000**	PLN 102,000	PLN 5,000	**PLN 106,000**

Source: own study.

As you can see, the margin on one of the products (this relates to printers) is negative, although the margin on all products is positive (it is PLN 106,000). Such a situation is possible when the margin earned on some products is positive and aggregates more than the negative value of the margin earned on the remaining products. If we did not analyse each product separately, we might not be aware that we are achieving a negative margin on printer sales as the aggregate margin on all products is positive. This is the advantage of approaching each product separately. Thus, let's try to explain why we have a negative margin on printer sales. To do this, we will calculate the break-even point for each product.

$$\text{Break-even point}_1 \text{ in units }_{printer} = \frac{PLN\ 16,000}{PLN\ 160\ apiece - PLN\ 150\ apiece} = \frac{PLN\ 16,000}{PLN\ 10\ apiece} = 1,600\ printers$$

$$\text{Break-even point}_1 \text{ in units }_{black\ ink} = \frac{PLN\ 18,000}{PLN\ 60 - PLN\ 40} = \frac{PLN\ 18,000}{PLN\ 20} = 900\ black\ inks$$

$$\text{Break-even point}_1 \text{ in units }_{colour\ ink} = \frac{PLN\ 20,000}{PLN\ 80 - PLN\ 70} = \frac{PLN\ 20,000}{PLN\ 10} = 2,000\ colour\ inks$$

Note that we will only reach the break-even point for printers when we sell 1,600 printers, while we only sell 1,500 at the moment. Therefore, there is a negative margin on printers. In the case of inks, the break-even point is exceeded as it is 900 pieces for black inks (and we sell 6,000 pcs.), and 2,000 pieces for colour ink (and we sell 2,500 pcs.). This is shown in the following table:

Table 8.4. Break-even point of three products

Type of data	Product 1 (Printer)	Product 2 (Black ink)	Product 3 (Colour ink)
Current sales	1,500 pcs.	6,000 pcs.	2,500 pcs.
Break-even point in units	1,600 pcs.	900 pcs.	2,000 pcs.
Difference	**−100 pcs.**	**5,100 pcs.**	**500 pcs.**

Source: own study.

The break-even values calculated above cover only direct fixed costs (i.e. those that are easily assigned to specific products). However, these are not the total fixed costs in the company. Other fixed (indirect) costs that cannot be so easily allocated to each product (e.g. administration or management costs) must also be taken into account. In our example, these costs amount to PLN 15,000. The simplified income statement, which also includes indirect fixed costs, is as follows:

Table 8.5. Operating income calculation

Type of data	Product 1 (Printer)	Product 2 (Black ink)	Product 3 (Colour ink)	In total
Sales (sales revenue)	PLN 240,000 (1,500 × PLN 160)	PLN 360,000 (6,000 × PLN 60)	PLN 200,000 (2,500 × PLN 80)	PLN 800,000
minus**: variable costs**	PLN 225,000 (1,500 × PLN 150)	PLN 240,000 (6,000 × PLN 40)	PLN 175,000 (2,500 × PLN 70)	PLN 640,000
Contribution margin	PLN 15,000	PLN 120,000	PLN 25,000	PLN 160,000
minus**: direct fixed costs**	PLN 16,000	PLN 18,000	PLN 20,000	PLN 54,000
Product margin	− PLN 1,000	PLN 102,000	PLN 5,000	**PLN 106,000**
minus: **indirect fixed costs**				PLN 15,000
Operating income				**PLN 91,000** (106,000 − 15,000)

Source: own study.

The above statement shows that the company (as a whole) makes an operating profit (which amounts to PLN 91,000). If we wanted to include indirect fixed costs in calculating the break-even point for each product, we would have to (somehow) assign this type of cost to each product. Since indirect costs are costs that cannot be directly linked to the production of a specific product, such allocation will be merely symbolic (discretionary). They can be allocated in different ways by company management, for example, a larger portion of these costs can be allocated to higher-margin products. Any such allocation results in somewhat „distorted" information on the amount of income from a given product as it is based on an assumed (rather than actual) allocation of fixed indirect cost. This is the biggest drawback of this solution, as improperly allocated fixed costs can be the cause of wrong decisions in the company. In our example, I decided to divide the said indirect costs (in the amount of PLN 15,000) into 3 equal parts, PLN 5,000 to each product. This is shown in the following table.

Table 8.6. Three products operating income calculation

Type of data	Product 1 (Printer)	Product 2 (Black ink)	Product 3 (Colour ink)	In total
Sales (sales revenue)	PLN 240,000 (1,500 × PLN 160)	PLN 360,000 (6,000 × PLN 60)	PLN 200,000 (2,500 × PLN 80)	PLN 800,000
minus**: variable costs**	PLN 225,000 (1,500 × PLN 150)	PLN 240,000 (6,000 × PLN 40)	PLN 175,000 (2,500 × PLN 70)	PLN 640,000
Contribution margin	PLN 15,000	PLN 120,000	PLN 25,000	PLN 160,000
minus**: direct fixed costs**	PLN 16,000	PLN 18,000	PLN 20,000	PLN 54,000
Product margin	−PLN 1,000	PLN 102,000	PLN 5,000	PLN 106,000
minus: **indirect fixed costs**	PLN 5,000	PLN 5,000	PLN 5,000	PLN 15,000
Operating income	**−PLN 6,000**	PLN 97,000	**PLN 0**	**PLN 91,000**

Source: own study.

In the simplified income statement above, we can see that the loss on the sale of printers has increased and that the company has stopped making money on the sale of colour inks, reaching the break-even point (PLN 0). The only product that shows a profit is black ink. It is through the sale of this product that the company makes an operating profit.

Since I have already divided the indirect fixed costs, it remains to recalculate the break-even point for each product.

$$\text{Break-even point}_2 \text{ in units }_{\text{printer}} = \frac{PLN\ 16{,}000 + PLN\ 5{,}000}{PLN\ 160 - PLN\ 150} = \frac{PLN\ 21{,}000}{PLN\ 10} = 2{,}100\ printers$$

$$\text{Break-even point}_2 \text{ in units }_{\text{black ink}} = \frac{PLN\ 18{,}000 + PLN\ 5{,}000}{PLN\ 60 - PLN\ 40} = \frac{PLN\ 23{,}000}{PLN\ 20} = 1{,}150\ black\ inks$$

$$\text{Break-even point}_2 \text{ in units }_{\text{colour ink}} = \frac{PLN\ 20{,}000 + PLN\ 5{,}000}{PLN\ 80 - PLN\ 70} = \frac{PLN\ 25{,}000}{PLN\ 10} = 2{,}500\ colour\ inks$$

Due to the increase in fixed cost in the numerator, the break-even point in units for each product has shifted and it is now necessary to sell more of each product. A comparison of the old break-even point in units (No. 1 – excluding indirect fixed costs) and the new break-even point in units (No. 2 – including indirect fixed costs) is shown below.

Table 8.7. Comparison of BEP_1 and BEP_2

Type of data	Product 1 (Printer)	Product 2 (Black ink)	Product 3 (Colour ink)
Current sales	**1,500 pcs**.	**6,000 pcs**.	**2,500 pcs.**
Break-even point$_1$ in units (excluding indirect fixed costs)	1,600 pcs.	900 pcs.	2,000 pcs.
Break-even point$_2$ in units (with indirect fixed costs)	**2,100 pcs**.	1,150 pcs.	**2,500 pcs.**

Source: own study.

As you can see, the calculation (BEP_2) for colour inks confirmed that the company reached the break-even point with this product. This means that the company (taking into account the allocation of indirect fixed costs made) does not make any money from the sale of colour inks. In turn, printer sales should increase by 600 pieces (2,100 pcs. – 1,500 pcs.) to achieve the break-even point. The company makes an operating profit on only one product (black inks).

The CVP analysis of individual products helps make decisions enabling an increase in the value of income in the company. Therefore, we could say that the easiest thing to do would be to give up the production of printers and think about what to do to make the sale of colour inks profitable. The problem is that if the company abandons the production (and sale) of printers, the company's customers will not need the inks for the printers that the company produces. Thus, the company cannot give up the production of printers. Some companies consciously choose to produce (and/or sell) goods that do not „make" a profit because they allow them to sell other products (or services), thus recording a profit on all operations (that is, the loss on the sale of some products is more than covered by the profit on the sale of other products).

- Is there any point in selling products without profit?
- Of course there is – as long as their sales allows companies to sell other products that can provide profit to the company.

#issue

REAL LIFE EXAMPLE

Task 8.1

The „Beautiful Wall" company is engaged in the production and sale of fibreglass wallpapers, glue for the said wallpapers and rubber rollers that facilitate the gluing of wallpapers. Unit prices for individual products, variable costs and direct fixed costs are shown in the table below:

Type of data	Wallpaper	Glue	Roller
Unit price	PLN 25 / roll	PLN 12 / package	PLN 10 / pc.
Unit variable cost	PLN 20 / roll	PLN 5 / package	PLN 5 / pc.
Direct fixed costs	PLN 80,000	PLN 22,400	PLN 6,000

During the year, the company plans to sell 21,900 rolls of wallpaper, 5,475 packages of glue and 1,120 rollers.

Instructions:

1. Calculate the unit contribution margin for each product

2. Is the sale of each of the 3 products profitable, considering only direct fixed costs?

3. Bearing in mind that the indirect fixed costs amount to PLN 30,000 and were allocated in the amount of PLN 15,000 to wallpaper and PLN 15,000 to glue:

   a. Calculate the company's operating profit

   b. Determine the impact of the sale of each product on operating profit

   c. Explain the possible reasons for the lack of allocation of indirect cost to rollers

4. What changes would you suggest to managers when selling rollers?

5. Calculate the new price of the roller that a. will cover the direct fixed costs, b. will also cover PLN 10,000 of indirect fixed costs if divided into 3 equal parts and assigned to each of the 3 products in the same amount.

Solution

1. The contribution margin for each product is: PLN 5 on one roll of wallpaper, PLN 7 on one package of glue and PLN 5 on one roller.

Type of data	Wallpaper	Glue	Roller
Unit price	PLN 25 / roll	PLN 12 / package	PLN 10 / pc.
Unit variable cost	PLN 20 / roll	PLN 5 / package	PLN 5 / pc.
Unit contribution margin	**PLN 5 / roll** (PLN 25 – PLN 20)	**PLN 7 / package** (PLN 12 – PLN 5)	**PLN 5 / roller** (PLN 10 – PLN 5)

2. The break-even point for individual products is:

$$\text{Break-even point}_1 \text{ in units }_{\text{wallpaper}} = \frac{PLN\ 80,000}{PLN\ 25 - PLN\ 20} = \frac{PLN\ 80,000}{PLN\ 5} = 16,000\ rolls\ of\ wallpaper$$

The planned wallpaper sales are 21,900 rolls of wallpaper. The break-even point in units will be exceeded.

$$\text{Break-even point}_1 \text{ in units }_{\text{glue}} = \frac{PLN\ 22,400}{PLN\ 12 - PLN\ 5} = \frac{PLN\ 22,400}{PLN\ 7} = 3,200\ \text{glue packages}$$

The planned sales of glue are 5,475 packages. The break-even point in units will be exceeded.

$$\text{Break-even point}_1 \text{ in units }_{\text{roller}} = \frac{PLN\ 6,000}{PLN\ 10 - PLN\ 5} = \frac{PLN\ 6,000}{PLN\ 5} = 1,200\ \text{rollers}$$

The planned sales of rollers are 1,120 pieces. The break-even point in units will not be reached. There is a shortfall of 80 rollers (1,200 – 1,120).

3a. The simplified income statement is as follows

Type of data	Wallpaper	Glue	Roller	In total
Revenues from sales	PLN 547,500 (21,900 × PLN 25)	PLN 65,700 (5,475 × PLN 12)	PLN 11,200 (1,120 × PLN 10)	PLN 624,400
Variable costs	PLN 438,000 (21,900 × PLN 20)	PLN 27,375 (5,475 × PLN 5)	PLN 5,600 (1,120 × PLN 5)	PLN 470,975
Contribution margin	PLN 109,500 (PLN 547,500 – PLN 438,000	PLN 38,325 (PLN 65,700 – PLN 27,375)	PLN 5,600 (PLN 11,200 – PLN 5,600)	PLN 153,425 (PLN 624,400 – PLN 470,975)
Direct fixed costs	PLN 80,000	PLN 22,400	PLN 6,000	PLN 108,400
Indirect fixed costs	PLN 15,000	PLN 15,000	PLN 0	PLN 30,000
Operating income	**PLN 14,500** (PLN 109,500 – PLN 80,000 – PLN 15,000	**PLN 925** (PLN 38,325 – PLN 22,400 – PLN 15,000)	**– PLN 400** (5,600 – 6,000 – PLN 0)	**PLN 15,025** (PLN 153,425 – PLN 108,400 – PLN 30,000)

As can be seen from the above income statement, the company shows an operating profit of PLN 15,025.

3b. Since the sale of rollers does not cover their direct fixed costs, the company records a loss on the sale of rollers (– PLN 400), which is covered by the profit from the sale of wallpaper and glue. The company makes the most profit from wallpaper sales (PLN 14,500). It also records a small profit on the sale of glue (PLN 925).

3c. The managers' decision to allocate indirect fixed costs to only two products (wallpaper and glue) may be due to the fact that planned sales of rollers cannot even cover direct fixed costs. For this reason, managers may not have wanted to place an additional burden on this product with discretionary cost allocation.

4. At the current price and variable unit cost, roller sales do not cover direct fixed costs. There is a shortfall in the sale of an additional 80 rollers (item 2) to cover these costs. Managers can give up selling rollers, but then they will have to send customers back to other stores for this product, avoiding a PLN 400 loss on

roller sales. This decision is quite risky (some customers may take advantage of a competitor's offer and not purchase from the „Beautiful Wall" company in the future) and involves little savings. The company could be advised to sell more rollers, although it is probably correlated with the number of wallpaper rolls sold and may not be obtainable in the first year. It could be suggested to increase the price on the rollers, for example to a level that would cover direct fixed costs.

4a. The new price that, with the sale of 1,120 rollers and a variable unit cost of PLN 5, would cover the direct fixed costs of PLN 6,000, is PLN 10.36 apiece, as:

$$\text{Break-even point}_1 \text{ in units}_{\text{roller}} = \frac{direct\ fixed\ costs}{New\ price - Unit\ variable\ cost}$$

After transforming the formula, the result is:

$$\text{New price} = \frac{Direct\ fixed\ costs}{Break-even\ point_1 in\ units_{roller}} + \text{unit variable cost} = \frac{PLN\ 6,000}{1,120\ pcs.} + \text{PLN 5/pc.} =$$

$$= \text{PLN } 10.3571/\text{pc.} \approx \text{PLN } 10.36/\text{pc.}$$

Verification:

$$\text{Break-even point}_1 \text{ in units}_{\text{roller}} = \frac{direct\ fixed\ costs}{New\ price - Unit\ variable\ cost} =$$

$$= \frac{PLN\ 6,000}{(PLN\ 10.36\ apiece - PLN\ 5\ apiece)} = \frac{PLN\ 6,000}{PLN\ 5.36\ apiece} = 1,119.40 \text{ pieces} \approx 1,120 \text{ pieces}$$

If the company raises the price of rollers to PLN 10.40 apiece, selling 1,120 units, the direct fixed cost will be covered.

4b. The new price to cover the fixed costs (direct costs of PLN 6,000 and indirect costs of PLN 10,000) at a unit variable cost of PLN 5 is

$$\text{New price} = \frac{Direct\ fixed\ costs\ +\ indirect\ fixed\ costs}{Unit\ BEP_1\ in\ units_{roller}} + \text{unit variable cost} = \frac{PLN\ 6,000 + PLN\ 10,000}{1,120\ pcs.} + \text{PLN 5/pc.} =$$

$$= \text{PLN } 19.2857/\text{pc.} \approx \text{PLN } 19.29/\text{pc.}$$

Verification:

$$\text{Break-even point}_1 \text{ in units}_{\text{roller}} = \frac{direct\ fixed\ costs}{New\ price - Unit\ variable\ cost} =$$

$$= \frac{PLN\ 6,000}{(PLN\ 10.36\ apiece - PLN\ 5\ apiece)} = \frac{PLN\ 6,000}{PLN\ 5.36\ apiece} = 1,119.40 \text{ pieces} \approx 1,120 \text{ pieces}$$

If the company raises the price of rollers to PLN 19.29 apiece, then with the sale of 1,120 pieces and a unit variable cost of PLN 5, it will be able to cover fixed costs of PLN 16,000.

Task 8.2

Check your knowledge – true or false test.

		True	False
1	Indirect costs can easily be allocated to each product		
2	Direct costs can easily be allocated to each product		
3	Assignment of indirect costs to a product affects its break-even value		

4	Assignment of direct costs to a product affects its break-even value		
5	Direct fixed costs should be divided equally for each product		
6	Allocation of fixed indirect costs to individual products is discretionary		
7	Change in the allocation of indirect fixed costs to individual products will affect their break-even value		
8	Change in the allocation of indirect fixed costs to individual products will affect the value of their contribution margin		

#answers

CLICK OR SCAN

8.2. Sales mix

Is it possible to assume for the analysis that you do not sell many products, but only one?

In part one on the CVP analysis of multiple products, an approach was presented in which each product was analysed separately. For many products, this approach becomes very time-consuming. Another possible approach is to reduce a multi-product problem to a problem in which there is only one product again. To do this, it is necessary to determine the expected sales structure (the so-called sales mix).

#definition

Sales mix, or **product mix**, should be understood as the percentage of sales of various products in total sales. In other words, it can be called the **combination of products** (**in percentage terms**) **sold by a company**.

Looking from the point of view of converting a multiple-product problem into a single-product problem, we can also say that a sales mix is a set of all products (and services) offered by a company presented as a collection. We will treat such a collection as one product. It is best to simply show an example.

#issue

REAL LIFE EXAMPLE

Defined mix – package

We will use an example from part one – that is a company selling 3 products: a printer, black ink and colour ink (for a full description of the company, see part one of the CVP analysis of multiple products – subchapter 8.1). The company sells 1,500 printers, 6,000 black inks and 2,500 colour inks. Our sales mix (product mix) is: 1,500 : 6,000 : 2,500. Now let's reduce this to the smallest possible integers:

<p align="center">15 :60 : 25 / :5</p>

<p align="center">And then: 3 : 12 : 5 – sales mix</p>

Let's now explain how to understand the sales mix (product mix) obtained. For every 3 printers sold, there are 12 black inks and 5 colour inks sold. This is the mix sales mix (product mix) in units. Thus defined, the mix is the smallest conventional unit (consisting of 3 printers, 12 black inks and 5 colour inks), which we will use in the following analysis. We can also present it in percentages.

Table 8.8. The sales mix of three products

Products	Sales mix in units	Percentage of units
Printers	3	**15%**
Black inks	12	**60%**
Colour inks	5	**25%**
In total	20	100%

Source: own study.

As you can see, the sales mix (product mix) can be presented in units (pieces) or in percentages.

Now let's take a look at the sales value structure of all 3 products (the price of the printer is PLN 160, the price of black ink is PLN 60, and the price of colour ink is PLN 80).

Table 8.9. The percentage of sales value of three products

Products	Number of pieces	Unit price	Sales value (price × number of pieces sold)	Percentage of sales value
Printer	1,500	PLN 160	**PLN 240,000**	**30%**
Black ink	6,000	PLN 60	**PLN 360,000**	**45%**
Colour ink	2,500	PLN 80	PLN 200,000	25%
In total	10,000	X	**PLN 800,000**	**100%**

Source: own study.

The above statement shows that the share of the value of printers sold in total sales is 30%, the share of black ink is 45%, and the share of colour ink is 25%.

Please note that the percentage of units (pieces) sold is (except for colour inks) different from the percentage of sales value. The differences are shown in the table below:

Table 8.10. Comparison of Percentage structure of the number of sales and Percentage structure of sales value

Products	Sales mix	Percentage structure of the number of sales	Percentage structure of sales value
Printer	3	15%	30%
Black ink	12	60%	45%
Colour ink	5	25%	25%
In total	20	100%	100%

Source: own study.

The above difference is due to the fact that in terms of percentage of sales value, we take into account not only the number of pieces of each product but also the price, which is different for each product. Therefore, it is the different price that makes the sales value in percentage terms different from the percentage of the number of units sold. By chance, the same percentages were recorded for colour inks in both cases. It is important to keep these differences in mind so that we do not make a mistake in further calculations, in which we will use the percentage of units (pieces) of products.

At this point, we can already move from a multi-product problem to a single-product problem. If there are 12 black inks and 5 colour inks sold for every 3 printers, we can assume in this case that our one product is a **package** (set) that includes 3 printers, 12 black inks and 5 colour inks. From then on, the package will be treated as one piece (unit). This is how we went from a 3-product problem to a single-product (package) problem. Now that we know what a package means in our case (3 printers, 12 black inks and 5 colour inks), the next step is to determine the unit variable cost of the package and its unit price. We will count it using the sales mix (of products).

Table 8.11. Unit contribution margin of the package

Product	Unit variable cost	Unit price	Unit contribution margin	Package sales mix	Unit contribution margin of the package
Printer	PLN 150	PLN 160	PLN 10 (PLN 160-PLN 150)	3	**PLN 30** (3 ×PLN 10)
Black ink	PLN 40	PLN 60	PLN 20 (PLN 60−PLN 40)	12	**PLN 240** (12 × PLN 20)
Colour ink	PLN 70	PLN 80	PLN 10 (PLN 80−PLN 70)	5	**PLN 50** (5× PLN 10)
Total	×	×	×	20	**PLN 320**

Source: own study.

We already know that the unit contribution margin of the package is PLN 320. Therefore, we can use the equation that determines the break-even point for the package. Fixed costs amounted to PLN 69,000 (with PLN 54,000 of direct fixed costs and PLN 15,000 of indirect fixed costs). We will calculate the break-even volume as follows:

$$\text{Break-even point for the package} = \frac{Fixed\ costs}{Unit\ contribution\ margin\ of\ the\ package} = \frac{PLN\ 69{,}000}{PLN\ 320} \ \mathbf{215.625}\ \text{packages}$$

The number of packages is not rounded to the nearest whole number to avoid errors in the calculation resulting from rounding.

We can also count the break-even point in sales using this method. To do this, we will first calculate the weighted average contribution margin ratio of the package.

Table 8.12. Weighted average contribution margin ratio of the package

Products	Sales	Share of product sales in the package[34]		Contribution margin ratio of the product		Weighted average contribution margin ratio of the package
Printer	PLN 480 (3×PLN 160)	**0.3** (480/1600)	×	**0.0625** (PLN 10/PLN 160)	=	0.018750
Black ink	PLN 720 (12×PLN 60)	**0.45** (720/1600)	×	**0.3333**...[35] (PLN 20/PLN 60)	=	0.15

---

[34] This share is the percentage of sales value impressed with a decimal instead of percentages.
[35] The value is given to 4 decimal places, although the true value has 3 in the repeating decimal. For this reason, it is recommended to make calculations in an Excel-type program so that all decimal places are taken into account.

Colour ink	PLN 400 (5×PLN 80)	**0.25** (400/1600)	×	**0.125** (PLN 10/PLN 80)	=	0.031250
In total	PLN 1,600	1				**0.2** (0.018750+0.15 +0.031250)

Source: own study.

Now we can substitute the weighted average contribution margin ratio of the package into the formula:

$$\text{BEP in sales for the package} = \frac{Fixed\ costs}{Contribution\ margin\ ratio\ of\ the\ package} = \frac{PLN\ 69,000}{0.2} = \textbf{PLN 345,000}$$

When calculating the break-even in sales using the weighted average contribution margin ratio, it is helpful to use an Excel-type program to avoid errors associated with rounding decimal numbers. Keep in mind that, alternatively, we can also count the break-even in sales in a much simpler way, that is:

$$\text{BEP in sales for package} = \text{BEP in units} \times \text{package price}$$

We already know that the break-even point in units is 215.625 packages, now let's count the package price:

$$\text{Package price} = (3\ \text{printers} \times \text{PLN 160}) + (12\ \text{black inks} \times \text{PLN 60}) + (5\ \text{colour inks} \times \text{PLN 80}) =$$
$$= \text{PLN 480} + \text{PLN 720} + \text{PLN 400} = \text{PLN 1,600}$$

$$\text{BEP in sales for package} = 215.625\ \text{packages} \times \text{PLN 1,600 / package} =$$
$$= \textbf{PLN 345,000}$$

As you can see, despite the fact that the results of the calculation were decimal values, the final break-even in sales value is the same.

Since the package is a symbolic (rather than actual) set of products, in order to avoid greater error, it will not be rounded in further calculations. We now know that we need to sell 215.625 packages to break-even (with fixed costs of PLN 69,000). Now let's convert this to pieces of each of the 3 products[36].

Table 8.13. Number of products sold needed to break-even

Number of packages needed to break-even	Sales mix	Product name	Number of products sold needed to break-even
215.625	3	Printer	(215.625 × 3) **646.875**
	12	Black ink	(215.625 × 12) **2,587.5**
	5	Colour ink	(215.625 × 5) **1,078.125**

Source: own study.

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[36]   Pieces will usually be rounded due to the impossibility of selling, for example, 0.7 printers. This will cause a small error in the final result, which should be taken into account

The sale of 215.625 packages represents the sale of 646.875 printers, 2,587.5 black inks and 1,078.125 colour inks. Selling one thousandth of a printer or ink is not possible but the lack of rounding eliminates errors in the final result. Let's check it out:

Table 8.14. Operating income calculation

Type of data	Printer	Black ink	Colour ink	In total
Sales (sales revenue)	PLN 103,500 (646.875 × 160)	PLN 155,250 (2,587.5 × 60)	PLN 86,250 (1,078.125 × 80)	PLN 345,000
minus: **variable costs**	PLN 97,031 (646.875 × 150)	PLN 103,500 (2,587.5 × 40)	PLN 75,469 (1,078.125 × 70)	PLN 276,000
Contribution margin				PLN 69,000
minus: **fixed costs**				PLN 69,000
Operating income				**PLN 0**

Source: own study.

As can be seen from the simplified income statement above, the break-even point was reached. If we rounded the number of products to whole numbers (i.e. 647 printers, 2,588 black inks and 1,078 colour inks), the operating profit would be PLN 10. It must then be remembered that the break-even point set does not indicate zero (even though it should) precisely because of the rounding error.

To summarise this part of the handbook, it can be said that the sale of several products can be treated as if they were sold as a package. A package defined in this way is considered a single product, which enables simplified calculations related to achieving the break-even point or target income from the sale of the product mix (or package). In this approach, fixed costs are not allocated to individual products, resulting in a lack of relevant information on the level of costs associated with a specific product. Moreover, the actual product mix sold may differ from the planned one, which will create further errors in the final result. It should also be remembered that any change in the price of products will result in a change in the break-even value for the adopted package and the target income value. Changing the structure of products in a package means causes the need to redefine the package (sales mix). This method gets significantly complicated when the number of products in the package increases.

#issue

REAL LIFE EXAMPLE

Task 8.3

The „White Tooth" (Biały ząbek) company produces two products. The first product is toothpaste, the second is a toothbrush. A toothbrush lasts customers longer than toothpaste. For this reason, both products are sold at a ratio of 4:1 (4 pieces of toothpaste and 1 toothbrush). The toothbrush costs PLN 18 and has a contribution margin ratio of 50%. Toothpaste sells for PLN 9 apiece and generates variable costs of PLN 3. The company's total fixed costs amount to PLN 2,100,000.

Instructions:

(1) What level of sales revenue must the company achieve to break-even

(2) If competition forces the price of toothpaste down to PLN 7.5 apiece (and the company plans to maintain a sales mix of 4 toothpastes per toothbrush), how many pieces of toothpaste must be sold to break-even?

Solution

(1) One package means the sale of 4 toothpastes and one toothbrush. Therefore:

Unit contribution margin of package = [4 toothpastes × (PLN 9 – PLN 6)] + [1 toothbrush × (PLN 18 × 50%)] = PLN 12 + PLN 9 = PLN 21/package

$$\text{Break-even in units of a package} = \frac{\text{Fixed costs}}{\text{Unit contribution margin of the package}} =$$

$$= \frac{\text{PLN 2,100,000}}{\text{PLN 21 per package}} = 100{,}000 \text{ packages}$$

Break-even in sales = 100,000 packages × [PLN 18 per toothbrush + (4 toothpastes × PLN 9)] = 100,000 × PLN 54 = PLN 5,400,000

Answer: the value of sales revenue needed to break-even is PLN 5,400,000.

(2) The new unit contribution margin of the package is:

New unit contribution margin $_{\text{package}}$ = [4 toothpastes × (PLN 7.5 – PLN 6)] + [1 toothbrush × (PLN 18 × 50%)] = 6 + 9 = PLN 15

$$\text{New break-even point in units } _{\text{package}} = = \frac{\text{PLN 2,100,000}}{\text{PLN 15 per package}} \frac{\text{PLN 2,100,000}}{\text{PLN 15 per package}} = 140{,}000 \text{ packages}$$

Answer: lowering the price of toothpaste to PLN 7.5 and maintaining the package structure (4:1) means that 140,000 packages need to be sold, that is 560,000 toothpastes (140,000 × 4 toothpastes per package)

Task 8.4

Check your knowledge – true or false test.

		True	False
1	Sales mix and product mix are synonymous terms and can be used interchangeably		
2	The expected (or current) sales structure of individual products is called the sales mix		
3	Sales mix should be understood as the percentage of total costs in relation to the value of total sales revenues		
4	Sales mix is represented as a combination of the smallest possible integers		
5	Sales mix is presented in currency (e.g. PLN)		
6	Sales mix is presented in units (pieces) or in percentage terms		
7	The percentage structure of the number of sales and the percentage structure of the value of sales always have the same values		
8	When calculating the break-even point of a package, the sum of the unit margins of all products is placed in the denominator		
9	In the case of sales mix, fixed costs are allocated to each product in a strictly defined way		
10	Changing the structure of products in a package does not entail the need to redefine the package		

#answers

CLICK OR SCAN

8.3. Other sales mix aspects

Can the average value of the contribution margin in a company that sells several thousand products be quickly calculated?

Another way to conduct a CVP analysis of multiple products is to use the value of products sold. This time we will use the aggregate data contained in the income statement.

#issue

REAL LIFE EXAMPLE

For this purpose, I will once again use the example of a company that sells printers as well as black and colour inks (the content of the task can be found in the first part of the CVP analysis of multiple products – subchapter 8.1). The simplified income statement is shown in the Table 8.15:

Table 8.15. Simplified income statement

Revenues from sales	PLN 800,000
minus: **variable costs**	PLN 640,000
minus: **direct fixed costs**	PLN 54,000
minus: **indirect fixed costs**	PLN 15,000
Operating income	**PLN 91,000**

Source: own study.

Based on the above income statement, let's now calculate the contribution margin ratio.

Table 8.16. Contribution margin calculation

Type of data	Value in PLN	Ratio
Revenues from sales	800,000	100%
Variable costs	640,000	80%
Contribution margin	160,000	**20%**

Source: own study.

The contribution margin ratio for all products sold is 20%.

We can also count this ratio in another way but it requires an analysis of each product separately, i.e.:

Table 8.17. Contribution margin of three products calculation

Printer	Unit value	Ratio
Price	PLN 160	100%
Variable cost	PLN 150	93.75%
Contribution margin	PLN 10	**6.25%**
Black ink	Unit value	Ratio
Price	PLN 60	100%
Variable cost	PLN 40	66.67%
Contribution margin	PLN 20	**33.33%**
Colour ink	Unit value	Ratio
Price	PLN 80	100%
Variable cost	PLN 70	87.5%
Contribution margin	PLN 10	**12.5%**

Source: own study.

The highest contribution margin rate is recorded for black ink (33.33%).

Now we will need the percentage share of sales value for each of the 3 products. We have already counted it in part two (subchapter 8.2). Let's recall this calculation:

Table 8.18. Percentage of sales value calculation

Products	Number of units	Unit price	Sales value (price × number of units sold)	Percentage of sales value
Printer	1,500	PLN 160	PLN 240,000	**30%**
Black ink	6,000	PLN 60	PLN 360,000	**45%**
Colour ink	2,500	PLN 80	PLN 200,000	**25%**
In total	10,000	×	PLN 800,000	**100%**

Source: own study.

To calculate the contribution margin ratio using the second method, we will use the contribution margin ratio of each product and its percentage of sales value.

Table 8.19. Average contribution margin ratio calculation

Type of data	Contribution margin ratio		Percentage of sales value	Result
Printer	6.25%	×	30%	1.875%
Black ink	33.33%	×	45%	15%
Colour ink	12.5%	×	25%	3.125%
Average contribution margin ratio				**20%**

Source: own study.

As you can see, no matter which method of counting the contribution margin ratio obtained on the sales of all 3 products (average value) you choose, the result is exactly the same, i.e. 20%. A method of counting that takes into account individual products gives more forecasting possibilities. For example, we can see how a change in sales structure will affect the average contribution margin ratio. Let's go through 3 possible cases:

(1) the percentage share of printer sales value is increasing (by 10%) at the expense of the other two products (5% decrease in the share of each)

(2) the percentage share of the sales value of black ink increases (by 10%) at the expense of the other two products (5% decrease in the share of each)

(3) the percentage share of the sales value of colour ink increases (by 10%) at the expense of the other two products (5% decrease in the share of each)

Case 1 – increase in the share of printer sales by 10%

Table 8.20. Average contribution margin ratio calculation when the share of printer sales increase by 10%

Type of data	Contribution margin ratio		Percentage of sales value	Result
Printer	6.25%	×	40%	2.5%
Black ink	33.33%	×	40%	13.0%
Colour ink	12.50%	×	20%	2.5%
Average contribution margin ratio				**18,33%**

Source: own study.

A 10% increase in the share of printer sales, which had the lowest contribution margin ratio, resulted in a 2 percentage point decrease in the value of the average contribution margin ratio on the new sales mix (drop from 20% to 18,33%).

Case 2 – increase in the share of black ink sales by 10%

Table 8.21. Average contribution margin ratio calculation when the share of black ink sales increase by 10%

Type of data	Contribution margin ratio		Percentage of sales value	
Printer	6.25%	×	25%	1.563%
Black ink	33.33%	×	55%	18.0%
Colour ink	12.5%	×	20%	2.5%
Average contribution margin ratio				22,39%

Source: own study.

A 10% increase in the share of black ink sales, which had the highest contribution margin ratio, resulted in a 2 percentage point increase in the value of the average contribution margin ratio on the new sales mix (increase from 20% to 22,39%). **Case 3** – increase in the share of colour ink sales by 10%

Table 8.22. Average contribution margin ratio calculation when the share of colour ink sales increase by 10%

Type of data	Contribution margin ratio		Percentage of sales value	
Printer	6.25%	×	25%	1.563%
Black ink	33.33%	×	40%	13%
Colour ink	12.5%	×	35%	4.38%
Average contribution margin ratio				19,27%

Source: own study.

A 10% increase in the share of sales of colour inks, whose contribution margin ratio was between the highest and lowest, resulted in a 1 percentage point decrease in the value of the average contribution margin ratio on the new sales mix (drop from 20% to 19,27%).

The above analysis allows us to conclude that **an increase in the sales of products with a high contribution margin ratio will result in an increase in the value of the average contribution margin ratio, and vice versa (i.e. an increase in the sales of products with a lower contribution margin ratio will result in a decrease in the value of the average contribution margin ratio).**

In our case, this means that if the company starts selling more black inks, the sales structure will change, thus increasing the average contribution margin ratio obtained on the new sales mix.

#note

It is worth remembering this rule.

> The increase in the sales of products with a high contribution margin ratio will increase the average contribution margin ratio of the new sales mix.

Since we know the value of the contribution margin ratio of the sales mix from the beginning of the example, we can move on to the calculation of the break-even point:

$$\text{BEP in sales} = \frac{Fixed\ costs}{Contribution\ margin\ ratio} = \frac{PLN\ 69,000}{20\%} = \frac{PLN\ 69,000}{0.2} = \text{PLN } 345,000$$

For the company to break-even, it must sell products for PLN 345,000. It is worth noting that the sales structure must be maintained. Thus, we can speak of a product package in this method, too. Counting the break-even volume will therefore require defining the package, which has already been done in part two.

To summarize the 3rd part of the multi-product break-even analysis, we can say that this time, with the help of profit and loss statement data (on the sales of all products), we are able to quickly calculate the break-even in sales value. Like the method in Part 2, fixed costs attributed to a specific product are also omitted this time. If we were to count the break-even in units, we would have to use the method from Part 1 or Part 2 of the CVP analysis for multiple products. Only by alternatively calculating the average contribution margin ratio did we gain knowledge on the (contribution margin) ratio of individual products. If we count it on the basis of the income statement, we will not find out which products have the highest contribution margin ratio. This, in turn, constitutes important information for managers who intend to increase profit in their company.

#issue

REAL LIFE EXAMPLE

Task 8.5

Romek plans to open a gas station. His offer will include diesel oil, petrol and gas. The cost and price of each fuel is imposed by the supplier. Romek's marketing research shows that he would be able to sell a PLN 16,500,000 worth of all 3 types of fuel annually with variable costs of PLN 15,675,000.

Romek received two bids for the installations necessary for the operation of the station. The first concerns the installation of petrol pumps and the equipment necessary for a station employee to operate the station, along with a staff room. The second offer is for the installation of modern unmanned petrol pumps (which offer cash and card payments). The first offer is associated with fixed costs of PLN 650,000 per year, while the second with PLN 850,000 per year.

Instructions:

1. Calculate whether Romek will break-even on both offers at the assumed level of sales?
2. Romek would like to achieve a minimum of PLN 10,000 of operating profit per month after deducting fixed costs. At what sales value is this possible? Does any of the offers enable this?

3. If sales are lower than planned by PLN 1,000,000, will the break-even point or operating profit of PLN 10,000 per month be achieved?

4. How high would the sales revenue have to be in order to make an operating profit of PLN 20,000 per month for the two offers with different fixed costs?

5. How high would the operating profit have been if Romek had managed to reduce fixed costs for the first offer to PLN 600,000 and for the second offer to PLN 780,000 per year (assuming the originally planned revenues)?

Solution

1. To count the threshold value of fixed cost, first count the following

Type of data	Value in PLN	Ratio
Revenues from sales	16,500,000	100%
Variable costs	15,675,000	95%
Contribution margin	825,000	5%

Now we can substitute these values into the formula for the break-even in sales:

$$\text{BEP}_1 \text{ in sales} = \frac{\text{PLN } 650,000}{5\%} = \frac{\text{PLN } 650,000}{0.05} = \text{PLN } 13,000,000$$

$$\text{BEP}_2 \text{ in sales} = \frac{\text{PLN } 850,000}{5\%} = \frac{\text{PLN } 850,000}{0.5} = \text{PLN } 17,000,000$$

Answer: Romek is only able to break-even by accepting the first offer (with fixed costs of PLN 650,000, the break-even point occurs when selling fuel for PLN 13,000,000 and the planned sales are PLN 16,500,000). In the case of the second offer, the planned sales will not be enough to break-even (there will be a shortfall of PLN 17,000,000 – PLN 16,500,000 = PLN 500,000). Thus, Romek should reject the second offer.

2. The second offer is not able to provide Romek with a break-even point, therefore a calculation will only be made for the first offer. Using the calculated contribution margin ratio, we can calculate the target income

$$\text{TI}_1 \text{ in sales} = \frac{Fixed\ costs + Target\ income_{operating}}{Contribution\ margin\ ration} = \frac{\text{PLN } 650,000 + (12\ x\ \text{PLN } 10,000)}{5\%} = \frac{\text{PLN } 650,000 + \text{PLN } 120,000}{0,05} = \frac{\text{PLN } 770,000}{0,05} = \text{PLN } 15,400,000$$

An operating profit of PLN 10,000 per month (PLN 120,000 per year) will be achieved with sales amounting to PLN 15,400,000. Since the planned sales are higher (PLN 16,500,000), Romek is able to earn more than he anticipated.

3. Sales lower than planned by PLN 1,000,000 means a value of PLN 15,500,000 (PLN 16,500,000 – PLN 1,000,000). In the second point, the sales value necessary to achieve the target operating income of PLN 10,000 per month was counted – it amounted to PLN 15,400,000. This is PLN 100,000 less than the assumed PLN 15,500,000 for the first offer. For this reason, with 1 million lower sales, Romek's company will not make an operating profit of PLN 10,000 per month. The break-even point in sales (calculated in point 1) was PLN 12,400,000 – thus, we can say that despite sales lower by PLN 1 million, the break-even point

will still be exceeded (the company will show an operating profit). In the case of the second offer, the break-even point was not reached even with the originally planned PLN 16,500,000 in revenue. Therefore, it will also not be achieved (let alone the target income) in the case of the second offer.

4. Let's calculate the revenue target for both offers, for which the operating profit will be PLN 20,000 per month:

$$TI_1 \text{ in sales} = \frac{Fixed\ costs + Target\ income_{operating}}{Contribution\ margin\ ration} = \frac{PLN\ 650,000 + (12\ x\ PLN\ 20,000)}{5\%} = \frac{PLN\ 650,000\ zł + PLN\ 240,000\ zł}{0,05} =$$
$$\frac{PLN\ 890,000\ zł}{0,05} = PLN\ 17,800,000$$

$$TI_2 \text{ in sales} = \frac{Fixed\ costs + Target\ income_{operating}}{Contribution\ margin\ ration} = \frac{PLN\ 850,000 + (12\ x\ PLN\ 20,000)}{5\%} = \frac{PLN\ 850,000 + PLN\ 240\ 000}{0,05} =$$
$$= \frac{PLN\ 1,090,000}{0,05} = PLN\ 21,800,000$$

5. This time, transform the formula for target income. If:

$$TI \text{ in sales} = \frac{Fixed\ costs + Target\ income_{operating}}{Contribution\ margin\ ration}$$

Then, after the transformation, we get:

(TI in sales × Contribution margin ratio) – Fixed costs = Target income $_{operating}$

All that is left to do is substitute the data for the two offers into the above formula:

Target income 1 $_{operating}$ =(PLN 16,500,000 × 0.05) – PLN 600,000 = PLN 825,000 – PLN 600,000= PLN 225,000

In the case of the first offer, the operating profit will amount to PLN 225,000 per year, or PLN 18,750 per month (PLN 225,000 / 12)

Target operating income 2 $_{operating}$ =(PLN 16,500,000 × 0.05) – PLN 780,000 = PLN 825,000 – PLN 780,000 = PLN 45,000

In the case of the second offer, the operating profit will amount to PLN 45,000 per year, or PLN 3,750 per month (PLN 45,000 / 12)

Task 8.6

Check your knowledge – true or false test.

		True	False
1	Based on the income statement, you can count the break-even volume in a company that sells multiple products		
2	The break-even point calculated on the basis of income statement data (in the case of a company selling multiple products) informs about the individual situation of each product separately		
3	On the basis of income statement data, it is possible to count only the break-even value obtained on all products sold by the company (without a breakdown by product)		

#answers

CHAPTER 9
MARGIN OF SAFETY

Did you know that safety also exists in corporate finances?

Source: Bank Phrom on Unsplash

Marcin intends to purchase a machine that will allow him to provide printing services. He did a preliminary survey of his customers and calculated that he was able to not only cover the monthly costs of his business but also achieve his planned operating profit. Thrilled, Marcin bragged about his calculations to a friend. The friend asked him about the margin of safety in the planned business, and he didn't mean OHS regulations at all. Below you will find out what Marcin's friend meant and why it is so important.

#definition

> Another important term that comes up when analysing CVP is **the margin of safety.** We define it as the **excess value of (planned or current) sales over the value of sales at which the company reaches the break-even point**.

In other words, it is the distance from the level of sales at which the company makes a profit to the value of sales at which the company will break-even. The greater this distance, the greater the security of a given company with regard to recording a loss in the event of a drop in sales levels. Therefore, the margin of safety will tell managers by how much sales can decrease before the company starts making a loss. A graphical representation of the margin of safety is shown in the Graph 9.1:
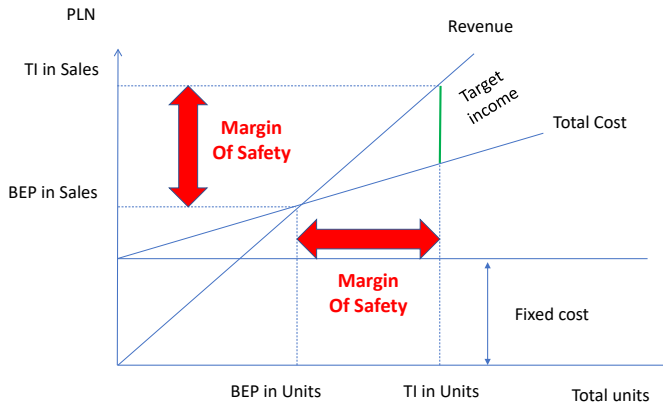
Graph 9.1. The margin of safety
Source: own study.

A larger margin of safety means more security for the business in the face of a (very often unplanned) drop in sales. A low margin of safety means that the security of a particular business is no longer that great as it is much less resilient to a decline in sales, such as lower sales than planned.

If the margin of safety for Marcin's plans is not large, the risk of starting a printing business is considerable as Marcin may have over-optimistically estimated the number of customers or the price of the service. His friend wanted to warn him of this risk.

The margin of safety is most often expressed in Polish zloty (or another currency) or as a ratio. The formula to calculate the margin of safety in Polish zloty is as follows:

The margin of safety in PLN	=	Current (or planned) value of sales revenue in PLN	−	Sales value in PLN for the break-even point

A decrease in the margin of safety expressed in PLN can result from two or three factors: (1) a lower number of goods or services sold, (2) a lower unit price (even with an unchanged number of goods or services sold), both factors (1 and 2) mentioned above occurring simultaneously.

#issue

REAL LIFE EXAMPLE

Safety scenarios

Marcin should include all 3 scenarios in his calculations mentioned above and see how they will affect the projected operating profit.

In the case of a company selling a single product (or in the case of treating several products as a single product – i.e. a so-called package), the margin of safety can be

expressed in units (or packages). There are two formulas for the margin of safety in units:

(1)

| The margin of safety in units | = | Current (or planned) sales volume in units | − | Sales volume in units for the break-even point |

(2)

$$\text{The margin of safety in units} = \frac{The\ margin\ of\ safety\ in\ PLN}{Unit\ price}$$

Let's say that Marcin assumed monthly sales for 20 customers, each with 1,000 advertising folders, that is a total of 20,000 folders (20 × 1,000 pcs. = 20,000 pcs.). The break-even point calculated by Marcin will be reached with the sale of 18,000 pcs. The margin of safety in pieces will be as follows:

| The margin of safety in units | = | 20,000 pcs. | − | 18,000 pcs. | = | 2,000 pcs. |

Marcin's planned business can avoid a loss if the drop in sales does not exceed 2,000 folders. If the sales made are lower than planned by exactly 2,000 pcs. (meaning the sale of 18,000 pcs, as 20,000 pcs. − 2,000 pcs. = 18,000 pcs.), Marcin's company will reach the break-even point, so it will not make a profit but it will not record a loss either. Sales lower by more than 2,000 folders means recording a loss on operations. Marcin now has to revise his plan to see if selling 2,000 fewer pcs., compared to the planned 20,000 pcs., is actually possible.

The second way to calculate the margin of safety in pieces will first require calculating its value in PLN. Assuming that the price of one folder is PLN 4 and the volume break-even point is 18,000 pcs., the margin of safety in PLN would be calculated as follows:

| The margin of safety in PLN | = | Current (or planned) value of sales revenue in PLN | − | Sales value in PLN for the break-even point |

that is

| The margin of safety in PLN | = | (PLN 4 × 20,000 pcs.) | − | (PLN 4 × 18,000 pcs.) |

| The margin of safety in PLN | = | PLN 80,000 | − | PLN 72,000 |

| The margin of safety in PLN | = | PLN 8,000 |

Now that we know the value of the margin of safety in PLN, we can calculate its value in pieces. The calculation is as follows:

$$\text{The margin of safety in units} = \frac{The\ margin\ of\ safety\ in\ PLN}{Unit\ price} = \frac{PLN\ 8,000}{PLN\ 4} = 2,000 \text{ pcs.}$$

We got the same margin of safety result (of 2,000 pcs.) with both methods of its calculation.

Now let's turn to the margin of safety ratio, which can be expressed as a decimal fraction or as a percentage.

The margin of safety ratio will be determined using the following formula:

$$\text{The margin of safety ratio} = \frac{The\ margin\ of\ safety\ in\ PLN}{Current\ (or\ planned)\ value\ of\ sales\ revenue\ in\ PLN}$$

If we wanted to calculate the ratio as a percentage, we would have to multiply the above formula by 100% to look like this:

$$\text{The margin of safety ratio}_{[\%]} = \frac{The\ margin\ of\ safety\ in\ PLN}{Current\ (or\ planned)\ value\ of\ sales\ revenue\ in\ PLN} \times 100\%$$

An increasing value calculated using the above formulas indicates an increase in the margin of safety. Regardless of which formula you use, the interpretation is always the same: the higher the value of the margin of safety, the lower the risk of recording a loss (i.e. reaching or even exceeding the break-even point).

Table 9.1. Relationship between the margin of safety and Risk of returning to the break--even point or making a loss

↑ The margin of safety	↓ Risk of returning to the break-even point or making a loss
↓ The margin of safety	↑ Risk of returning to the break-even point or making a loss

Source: own study.

Now let's calculate the margin of safety ratio for Marcin's planned business.

#**formula**

$$\text{The margin of safety ratio} = \frac{The\ margin\ of\ safety\ in\ PLN}{Current\ (or\ planned)\ value\ of\ sales\ revenue\ in\ PLN} = \frac{PLN\ 8,000}{(20,000\ pcs\ x\ PLN\ 4)} = \frac{PLN\ 8,000}{PLN\ 80,000} = 0{,}1$$

$$\text{The margin of safety ratio}_{[\%]} = \frac{The\ margin\ of\ safety\ in\ PLN}{Current\ (or\ planned)\ value\ of\ sales\ revenue\ in\ PLN} = \frac{PLN\ 8,000}{(20,000\ pcs\ x\ PLN\ 4)} \times 100\% =$$
$$= \frac{PLN\ 8,000}{PLN\ 80,000} \times 100\% = 10\%$$

For the printing company Marcin plans to open, the margin of safety ratio is 10% (or 0.1). This means that sales revenue can fall by 10% for Marcin's company to stop making a profit (if sales revenue falls exactly by 10%, Marcin's company to stop making a profit (if sales revenue falls exactly by 10%, Marcins company will break-even). Let's check it against our earlier calculations:

20 000 pcs. × PLN 4 – [(20 000 pcs. × PLN 4) × 10%) = PLN 80 000 – PLN 8 000 = PLN 72 000

We received a break-even value, in line with earlier assumptions.

As mentioned earlier, lower sales revenue can result not only from fewer customers but also from lower prices.

Now, let's calculate by how much Marcin can reduce the price per folder to break-even with the sale of 20,000 pcs. This time, we will use the formula for the break-even volume, which we will transform leaving the unit price on one side of the equation[37] and assuming that we sell 20,000 folders, the unit variable cost of each folder is PLN 1.5, and the fixed costs are PLN 45,000. The calculation will be as follows:

$$\text{Planned sales}_{[\text{pcs.}]} = \frac{Fixed\ costs}{new\ unit\ price - unit\ variable\ cost}$$

$$\text{Planned sales}_{[\text{pcs.}]} \times (\text{new unit price} - \text{unit variable cost}) = \text{Fixed costs}$$

$$\text{new unit price} - \text{unit variable cost} = \frac{Fixed\ costs}{Planned\ sales\ [pcs.]}$$

$$\text{new unit price} = \frac{PLN\ 45,000}{20,000\ pcs.} + \text{PLN 1.5/pc.} = \text{PLN 2.25/pc.} + \text{PLN 1.5/pc.} = \text{PLN 3.75/pc.}$$

Assuming the sale of 20,000 advertising folders, with a unit variable cost of PLN 1.5 and fixed costs of PLN 45,000, the price of a folder can drop to PLN 3.75. At this price, Marcin's company will break even. The new price represents 93.75% of the originally planned price, as:

$$\text{PLN 4} - 100\%$$

$$\text{PLN 3.75} - x$$

$$\text{X} = \frac{PLN\ 3.75\ x\ 100\%}{PLN\ 4} = 93.75\%$$

This means that Marcin can reduce the price of the folder by no more than 6.25% (100%–93.75%). If Marcin lowers the price of a folder by exactly 6.25%, his company will not make a profit and will merely achieve a break-even point. If Marcin reduces the price of a folder by more than 6.25%, the sales revenue will fall to a level that cannot cover all costs, resulting in an operating loss.

In summary, Marcin already knows that the margin of safety of his planned company will be 2,000 pieces or PLN 8,000. Both values impy the possibility of a 10 % decrease in sales revenue (a larger decrease in sales revenue will mean an operating loss). Marcin also knows that he can reduce the price per folder by a maximum of 6.25%. Now he must revise his assumptions again taking into account the aforementioned values.

#issue

What if your business has a margin of safety value that is at an alarmingly low level? You need to increase sales and/or reduce costs. If you do this, your company's margin of safety will increase.

↑ sales and/or ↓ costs =↑ margin of safety

Safety level

Let's test this with another example.

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[37]   In an analogous way, the formula can be transformed to estimate the limit value of fixed cost or unit variable cost

Source: Pexels

Imagine a local museum that sells 1,500 tickets a year at PLN 4 apiece.

Sales revenue = 1,500 tickets x PLN 4/ticket = PLN 6,000

The break-even point is reached at 900 tickets sold.

Break-even value = 900 tickets x PLN 4/ticket = PLN 3,600

In this case, the margin of safety is 600 tickets and PLN 2,400 because:

Table 9.2. The margin of safety in units and in PLN

Type of data	Number of tickets	Value in PLN
Sales revenue	1,500	6,000
minus: **Break-even value**	900	3,600
= **Margin of safety**	**600**	**2,400**

Source: own study.

#formula

We can also count the value of the margin of safety in pieces from the second formula:

$$\text{The margin of safety in units} = \frac{The\ margin\ of\ safety\ in\ PLN}{Unit\ price} = \frac{PLN\ 2{,}400}{PLN\ 4} = \textbf{600 tickets}$$

The margin of safety ratios, in turn, are:

$$\text{The margin of safety ratio} = \frac{The\ margin\ of\ safety\ in\ PLN}{Current\ (planned)\ sales\ revenue\ in\ PLN} = \frac{PLN\ 2{,}400}{PLN\ 6{,}000} \frac{PLN\ 2{,}400}{PLN\ 4} = \textbf{0.4}$$

and

$$\text{The margin of safety ratio}_{[\%]} = \frac{The\ margin\ of\ safety\ in\ PLN}{Current\ (planned)\ sales\ revenue\ in\ PLN} \times 100\% = \frac{PLN\ 2{,}400}{PLN\ 6{,}000} \frac{PLN\ 2{,}400}{PLN\ 6{,}000} \times 100\% =$$
$$= 0.4 \times 100\% = \textbf{40\%}$$

Let's summarise the safety margin of our local museum:

Table 9.3. Four types of margin of safety

Sales value of 1,500 tickets	PLN 6,000
Break-even value at 900 tickets sold	PLN 3,600
Margin of safety in PLN	**PLN 2,400**
Margin of safety in pieces	**600**
Margin of safety ratio	**0.4**
Margin of safety ratio in%	**40%**

Source: own study.

Let us now interpret the results obtained. In the case of the museum in question, sales could drop by PLN 2,400, by 600 tickets, or by 40% before the museum starts making a loss. The aforementioned PLN 2,400 and 600 tickets represent the distance to the break-even point. This distance is also 40% of sales, take a look:

– for the value of sales in PLN:

$$PLN\ 6,000 - 100\%$$

$$PLN\ 2,400 - x$$

$$X = \frac{PLN\ 2,400\ x\ 100\%}{PLN\ 6,000} = 40\%$$

– and for the number of tickets sold:

$$1,500\ pcs. - 100\%$$

$$600\ pcs. - x$$

$$X = \frac{600\ pcs.\ x\ 100\ \%}{1,500\ pcs.} = 40\%$$

An analogous situation will arise when we represent the value of the ratio in fractions instead of percentages:

– for the value of sales in PLN:

$$PLN\ 6,000 - 1$$

$$PLN\ 2,400 - x$$

$$X = \frac{PLN\ 2,400\ x\ 1}{PLN\ 6,000} = 0.4$$

– and for the number of tickets sold:

$$1,500\ pcs. - 1$$

$$600\ pcs. - x$$

$$X = \frac{600\ pcs.\ x\ 1}{1,500\ pcs.} = 0.4$$

We already know that the museum can afford to sell fewer than 1,500 tickets a year and still make an operating profit. The margin of safety indicates by how many tickets can the sales decrease so as not to generate a loss. From this point of view, „safety" in the name of the margin means protection against loss.

Now let's look at a completely different use of the margin of safety. Let's assume that we want to open our own business and we are just in the planning stage. This time, we will use the margin of safety to forecast operating profit. Just substitute the data into the formula below:

Operating income = Margin of safety in PLN × Contribution margin ratio

How does it work?

The margin of safety represents the value of sales above the break-even point. This means that fixed costs have already been fully covered. That is, the contribution margin increases the value of operating profit. Sounds complicated? Take a look at the following example:

We know that the ticket price at our local museum is PLN 4. Let's assume that the variable unit cost of a ticket is PLN 3. We also know that the museum reaches the break-even point after selling 900 tickets. Therefore, using unit or aggregate values, we can count the contribution margin ratio:

Table 9.4. Three types of contribution margin calculation

Type of data	Aggregate value in PLN	Unit value	Ratio in %
Sales for 900 tickets	PLN 3,600 (900 × PLN 4)	PLN 4	100%
Variable cost for 900 tickets	PLN 2,700 (900 × PLN 3)	PLN 3	75%
Contribution margin	900 (3600 − 2700)	PLN 1	**25%**

Source: own study.

We already know that the contribution margin ratio for our museum is 25%. We also know that we made the calculations for the break-even value. This means that the aggregate value of the contribution margin fully covers fixed costs. In other words, it is equal to fixed costs. That is to say, our museum's fixed costs amount to PLN 900. Let's check it out:

Table 9.5. Calculation of operating income on a sale of 900 tickets

Sales revenue (900 × PLN 4)	PLN 3,600
Variable costs (900 × PLN 3)	PLN 2,700
Contribution margin	PLN 900
Fixed costs	PLN 900
Operating income	PLN 0

Source: own study.

With fixed costs of PLN 900 and the sale of 900 tickets with a unit price of PLN 4 and a variable unit cost of PLN 3, the company is breaking even. The value of fixed cost is useful for checking the formula for projected operating profit. Let's use the values previously calculated for 1,500 tickets and substitute them into the formula:

$$\text{Operating income} = \text{Margin of safety in PLN} \times \text{Contribution margin ratio} =$$
$$= \text{PLN } 2,400 \times 25\% = \textbf{PLN 600}$$

Our projections show that by selling 1,500 tickets the museum will make a profit of PLN 600. Let's check it out:

Table 9.6. Calculation of operating income on a sale of 1,500 tickets

Sales revenue (1,500 × PLN 4)	PLN 6,000
Variable costs (1,500 × PLN 3)	PLN 4,500
Contribution margin	PLN 1,500
Fixed costs	PLN 900
Operating income	**PLN 600**

Source: own study.

As you can see, the operating profit is exactly what we projected using the formula with the margin of safety.

The margin of safety changes in exactly the same way that the break-even point changes, i.e. its increase can be achieved by increasing sales or lowering the break-even point (which, in turn, can be done by reducing variable unit cost and/or increasing price).

#**issue**

REAL LIFE EXAMPLE

Task 9.1

Marcel plans to open his own business. He received a proposal to work with three suppliers. Each imposes a cost and unit price. The offers mentioned are presented below:

Type of data	Offer 1	Offer 2	Offer 3
Unit price	PLN 100	PLN 80	PLN 40
Variable unit cost	PLN 80	PLN 60	PLN 20

Each offer is associated with different fixed costs. The amount for offer 1 is PLN 1.5 million per year; for offer 2 it is PLN 1.75 million; and for offer 3 it is PLN 1.6 million per year.

Marcel conducted marketing research that shows he would be able to sell 100,000 products a year, no matter which company he partners with.

Instructions:

1. Count the unit contribution margin and contribution margin ratio of all 3 offers. Which one is the most attractive from Marcel's perspective?

2. Marcel learned that the sale of the products contained in each of the 3 offers presented is highly sensitive to the economic situation and that in unforeseen situations sales can fall by up to 22%. Which of the offers enables the maintenance of income when sales drop by 22% (compare the margin of safety ratio)

3. What would the operating result be for all 3 offers if revenues fall by 22% compared to what was originally planned.

4. What operating profit can Marcel make if he sold 90,000 products per year – compare the projected operating profit of each offer using the contribution margin ratio.

Solution

Contribution margin calculation:

Type of offer	Offer 1		Offer 2		Offer 3	
Type of offer	Unit value in PLN	Value in%	Unit value in PLN	Value in%	Unit value in PLN	Value in%
Price	PLN 100	100%	PLN 80	100%	PLN 40	100%
Variable cost	PLN 80	80%	PLN 60	75%	PLN 20	50%
Contribution margin	**PLN 20** (100−80)	**20%**	**PLN 20** (80−60)	**25%**	**PLN 20** (40−20)	**50%**

The unit contribution margin is the same (PLN 20) in each of the 3 offers. The contribution margin ratio for offer 1 is 20%, for offer 2 – 25%, and for offer 3 – 50%. The highest value of the contribution margin ratio is recorded for offer 3 (50%). Therefore, Marcel's preference should be offer 3.

1. The formula for the margin of safety ratio is as follows:

$$\text{The margin of safety ratio }_{[\%]} = \frac{The\ margin\ of\ safety\ in\ PLN}{Current\ (planned)\ sales\ revenue\ in\ PLN} \times 100\%$$

To be able to apply the above formula, we must first calculate the planned value of sales revenue and the value of the margin of safety in PLN.

Type of data	Offer 1	Offer 2	Offer 3
Planned value of sales revenue	**PLN 10,000,000** (100,000 × PLN 100)	**PLN 8,000,000** (100,000 × PLN 80)	**PLN 4,000,000** (100,000 × PLN 40)
Fixed cost	PLN 1,500,000	PLN 1,750,000	PLN 1,600,000

Unit contribution margin[38]	20%	25%	50%
BEP value	PLN 7,500,000 (1,500,000/20%)	PLN 7,000,000 (1,750,000/25%)	PLN 3,200,000 (1,600,000/50%)
Margin of safety in PLN	**PLN 2,500,000** (10,000,000 – 7,500,000)	**PLN 1,000,000** (PLN 8,000,000 – PLN 7,000,000)	**PLN 800,000** (PLN 4,000,000 – PLN 3,200,000)

Now we can substitute the data into the formula:

$$\text{Margin of safety ratio }_{\text{offer 1 [\%]}} = \frac{PLN\ 2,500,000}{PLN\ 10,000,000} \times 100\% = 25\%$$

$$\text{Margin of safety ratio }_{\text{offer 2 [\%]}} = \frac{PLN\ 1,000,000}{PLN\ 8,000,000} \times 100\% = 12.5\%$$

$$\text{Margin of safety ratio }_{\text{offer 3 [\%]}} = \frac{PLN\ 800,000}{PLN\ 4,000,000} \times 100\% = 20\%$$

Only offer 1 enables the achievement of an operating profit in the event of a 22% drop in sales, as the margin of safety ratio amounts to 25% (which is greater than 22%)

2. Check the impact of a 22% decrease in sales (calculations will be made for 100%– 22%=78% of sales value)

Type of data	Offer 1	Offer 2	Offer 3
78% of the planned value of sales revenues	PLN 7,800,000 (10,000,000 × 78%)	PLN 6,240,000 (8,000,000 × 78%)	PLN 3,120,000 (4,000,000 × 78%)
78% of fixed costs	PLN 6,240,000 (8,000,000 × 78%)	PLN 4,680,000 (6,000,000 × 78%)	PLN 1,560,000 (2,000,000 × 78%)
Contribution margin	PLN 1,560,000 (7,800,000 – 6,240,000)	PLN 1,560,000 (6,240,000 – 4,680,000)	PLN 1,560,000 (3,120,000 – 1,560,000)
Fixed cost	PLN 1,500,000	PLN 1,750,000	PLN 1,600,000
Operating income/ loss	**PLN 60,000** (1,560,000 – 1,500,000)	**– PLN 190,000** (1,560,000 – 1,750,000)	**– PLN 40,000** (1,560,000 – 1,600,000)

In the event of a 22% drop in revenue (compared to what was originally planned), Marcel will record an operating profit of PLN 60,000 if he chooses offer 1. In the case of the other two offers, Marcel would incur an operating loss in the amounts of: PLN 190,000 in the case of offer 1 and PLN 40,000 in the case of offer 2.

3. The margin of safety calculations for 90,000 pieces sold:

	Offer 1	Offer 2	Offer 3
Revenues from sales	PLN 9,000,000 (90,000 × PLN 100)	PLN 7,200,000 (90,000 × PLN 80)	PLN 3,600,000 (90,000 × PLN 40)

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38   The value calculated in point 1.

BEP value	PLN 7,500,000 (1,500,000/20%)	PLN 7,000,000 (1,750,000/25%)	PLN 3,200,000 (1,600,000/50%)
Margin of safety in PLN	**PLN 1,500,000** (9,000,000 – 7,500,000)	**PLN 200,000** (PLN 7,200,000 – PLN 7,000,000)	**PLN 400,000** (PLN 3,600,000 – PLN 3,200,000)

Operating income = Margin of safety in PLN × Contribution margin ratio =

Type of data	Offer 1	Offer 2	Offer 3
Operating income	**PLN 300,000** (1,500,000 × 20%)	**PLN 50,000** (200,000 × 25%)	**PLN 200,000** (400,000 × 50%)

With the sale of 90,000 products, operating profit will be highest for offer 1 (PLN 300,000), followed by offer 3 (PLN 200,000), and lowest for offer 2 (PLN 50,000).

Verification:

Type of data	Offer 1	Offer 2	Offer 3
Revenues from sales	**PLN 9,000,000** (90,000 × PLN 100)	**PLN 7,200,000** (90,000 × PLN 80)	**PLN 3,600,000** (90,000 × PLN 40)
Variable costs	**PLN 7,200,000** (90,000 × PLN 80)	**PLN 5,400,000** (90,000 × PLN 60)	**PLN 1,800,000** (90,000 × PLN 20)
Contribution margin	**PLN 1,800,000** (9,000,000 – 7,200,000)	**PLN 1,800,000** (7,200,000 – 5,400,000)	**PLN 1,800,000** (3,600,000 – 1,800,000)
Fixed cost	PLN 1,500,000	PLN 1,750,000	PLN 1,600,000
Operating income/ loss	**PLN 300,000** (1,800,000 – 1,500,000)	**PLN 50,000** (1,800,000 – 1,750,000)	**PLN 200,000** (1,800,000 – 1,600,000)

Task 9.2

Check your knowledge – true or false test.

		True	False
1	The margin of safety is synonymous with OHS regulations		
2	The margin of safety is the difference between the level of (current or planned) sales and the level of total costs in the company		
3	A smaller margin of safety means that the company is more resilient to a drop in sales that will result in a loss		
4	The margin of safety can be expressed in currency (e.g. PLN) or in pieces		
5	The margin of safety in units is the ratio of the value of margin of safety in PLN to the unit contribution margin		
6	The margin of safety ratio is expressed as a percentage or decimal fraction		

#answers

CHAPTER 10

APPLYING THE THEORY OF CONSTRAINTS

Why could this be a bad idea to increase sales of products with the highest contribution margin?

If you think that what has been written so far with respect to the CVP analysis is enough to manage the level of profit in a company, this part of the handbook may surprise you. This time, the problem of the above-mentioned analysis will be described from the point of view of the theory of constraints (TOC[39]). As the name suggests, the theory presents the issue of management from the perspective of various types of constraints known as bottlenecks. Bottlenecks can be, for example, insufficient manpower responsible for production, packaging of products or provision of services, limited productivity of machines, excessive delivery times, and inefficient work of the sales department (which could sell many more products or services).

#definition

> In other words, **a situation in which the demand for products is greater than the capacity to produce it, or deliver it to the customer, will be a bottleneck for a company.**

The *Source* of many bottlenecks is time, which for any company, regardless of its experience, size or location, means a 24-hour day, a seven-day week, then a month, a quarter, and a year. For this reason, a new indicator must be taken into account - the unit contribution margin per bottleneck.

$$\text{Unit contribution margin per bottleneck} = \frac{\text{Unit contribution margin}}{\text{Bottleneck}}$$

Does this change anything in the CVP analysis? It can change everything. To better understand why this is so important, let's look at an example.

The company „Modern Floors" uses a machine to produce 2 types of products made from modern wear-resistant fibres: single-colour carpets – **product 1 and** multi-colour carpets – **product 2.** The price, variable unit cost and contribution margin of each product is shown in the table below:

Table 10.1. Unit contribution margin calculation

Type of data	**Product** 1 Single-colour carpets	**Product 2** Multi-colour carpets
Unit price per 1 m^2	PLN 10	PLN 15
Unit variable cost	PLN 4	PLN 5
Unit contribution margin	**PLN 6** (PLN 10 – PLN 4)	**PLN 10** (PLN 15 – PLN 5)

Source: own study.

As you can see, the unit contribution margin is highest for product 2, so (in theory) this product should be preferred in production (and sales) to increase the company's

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[39] Theory of Constraints (TOC)

profit. Product 1 has a lower unit contribution margin and, thus, its production should (in theory) be reduced in favour of product 2.

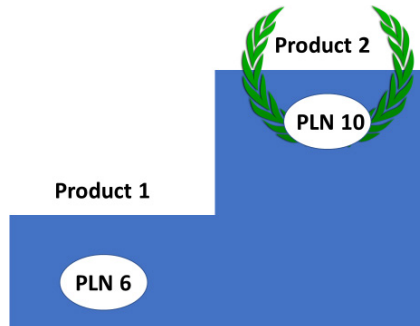Ranking of products in terms of unit contribution margin

Figure 10.1. Ranking of products in terms of unit contribution margin
Source: own study.

In the case of the company in question, the bottleneck is, on the one hand, one machine and, on the other, its operating hours (it can work no more than 24 hours a day). Therefore, the company must choose one type of product over the other, as simultaneous production is impossible. Now let's look at the production time for each of the products, which will be taken as a bottleneck for the purposes of our calculations.

Table 10.2. Number of hours required to produce 1 m² (bottleneck)

Type of data	Product 1 Single-colour carpets	Product 2 Multi-colour carpets
Number of hours required to produce 1 m² (bottleneck)	1 h	10 h

Source: own study.

Let's now calculate the unit contribution margin per bottleneck, which is the time required to produce 1 m². Since the machine needs only 1 hour to produce 1 m² of product 1 and as much as 10 hours to produce 1 m² of product 2, we will use a shorter time span to compare the two times. In this case, it will be 1 hour. The new unit will be the unit contribution margin per hour.

Table 10.3. Unit contribution margin per bottleneck (hour) calculation

Type of data	Product 1 Single-colour carpets	Product 2 Multi-colour carpets
Unit contribution margin	PLN 6	PLN 10
Number of hours required to produce 1 m² (bottleneck)	1 h	10 h
Unit contribution margin per bottleneck (hour)	**PLN 6/h** (PLN 6 / 1h)	**PLN 1/h** (PLN 10 / 10 h)

Source: own study.

Note that the situation is very different now. Product 1 is characterised by the highest unit margin per bottleneck, i.e. machine hour, and product 2 – the lowest.

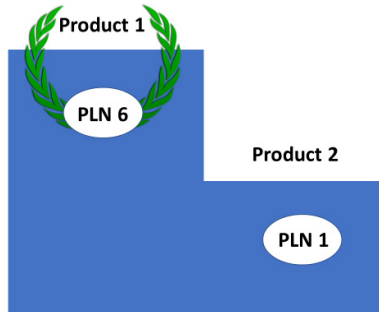Ranking of products in terms of unit contribution margin per machine hour

Figure 10.2. Ranking of products in terms of unit contribution margin per machine hour
        Source: own study.

The company has only one machine that can produce only one product at a time and, therefore, it must make maximum use of each hour of work. Taking into consideration unit margin per bottleneck, i.e. machine hour, there are 2 extreme cases where:

• we will only produce product 1 at the expense of product 2;
• we will only produce product 2 at the expense of product 1.

Let's check this, taking one week as an example. A week has 7 days and each day has 24 hours. During one week, the machine operates for 168 hours (7×24 hours) without any break. The number of carpets that can be produced and the contribution margin generated due to their sale are calculated below. For each product, calculations were made on the assumption that the machine produces only that product for 168 hours.

Table 10.4. Contribution margin on metres produced calculation

Type of data	Product 1 Single-colour carpets	Product 2 Multi-colour carpets
Unit contribution margin per bottleneck	PLN 6/h (PLN 6 / 1h)	PLN 1/h (PLN 10 / 10 h)
Number of hours required to produce 1 m² (bottleneck)	1 h	10 h
Number of metres produced during 168 hours	**168 m²** (168 h / 1 h)	**16.8 m²** (168 h / 10 h)
Contribution margin on metres produced	**PLN 1,008** (168 × PLN 6)	**PLN 16.80** (16.8 × PLN 1)

Source: own study.

As you can see, the theory of constraints has helped us avoid a mistake in which product 2 would be the preferred one (due to the highest value of the unit contribution

margin). If we decided not to produce the single-colour carpet (product 1) and to produce only the multi-colour carpet (product 2) for a whole week, the contribution margin would be PLN 16.80. Whereas, if we spent this time producing the one-colour carpet (product 1, which has a lower unit contribution margin), the contribution margin would be PLN 1,008. Does this mean that the company should stop producing product 2? Not necessarily. It could raise the price of product 2 in such a way that it does not matter which product is produced at a given time. The idea is that regardless of the product that the machine produces for one hour, the unit margin per hour worked will be the same. We will calculate the new unit contribution margin for product 2 based on the higher unit contribution margin per hour that is typical of product 1. Thanks to the application of the new unit contribution margin for product 2, its unit contribution margin per hour will be the same as for product 1.

Table 10.5. New contribution margin calculation

Type of data	Product 1 Single-colour carpets	Product 3 Multi-colour carpets
Unit contribution margin	PLN 6	PLN 10
Number of hours required to produce 1 m² (bottleneck)	1 h	10 h
New contribution margin	×	**PLN 60** (PLN 6 × 10 h)

Source: own study.

Based on the new unit contribution margin of product 2, we can calculate its new price in the following way:

Table 10.6. New price per m² calculation

Type of data	Product 1 Single-colour carpets	Product 2 Multi-colour carpets
New contribution margin	×	PLN 60
Unit variable cost	×	PLN 5
New price per m² (new contribution margin + unit variable cost)	×	**PLN 65** (PLN 60 + PLN 5)

Source: own study.

If we increased the price of product 2 to PLN 65, it would not matter which product we produce, as the unit contribution margin per hour would be the same for both products (1 and 2). Let's check it out:

Table 10.7. Unit contribution margin per bottleneck comparison

Type of data	Product 1 Single-colour carpets	Product 2 Multi-colour carpets
Old price per m²	**PLN 10**	×
New price per m²	×	**PLN 65**
Unit variable cost	PLN 4	PLN 5
Unit contribution margin	PLN 6 (PLN 10 – PLN 4)	PLN 60 (PLN 65 – PLN 5)
Number of hours required to produce 1 m² (bottleneck)	1 h	10 h
Unit contribution margin per bottleneck (hour)	**PLN 6/h** (PLN 6 / 1h)	**PLN 6/h** (PLN 60 / 10 h)

Source: own study.

After the price has changed, it will not matter which product is made by the machine. Every hour that the machine spends producing will generate PLN 6 of unit contribution margin regardless of whether product 1 or product 2 is produced. When the unit contribution margin of product 2 is increased, given that both products are produced and sold, the company's profit will also increase.

Task 10.1

Marta's company produces tablecloths, curtains, and net curtains. The variable unit cost and price of all three products is shown in the table below:

Type of data	Tablecloth	Net curtains	Curtains
Unit variable cost	PLN 20 / pc.	PLN 55 / pc.	PLN 78 / pc.
Unit price	PLN 30 / pc.	PLN 70 / pc.	PLN 90 / pc.

Instructions:

(1) Calculate the unit contribution margin for each product.

(2) Prepare a ranking of unit contribution margins from the highest to the lowest value.

(3) Taking into account the time required to make each of the three products (specified in the table below) and the fact that they are produced using a single machine (which is the company's bottleneck), calculate the contribution margin per machine hour.

	Tablecloth	Net curtains	Curtains
Required number of hours to manufacture the product	0.25	0.5	0.5

(4) Prepare a ranking of unit contribution margins per machine hour from the highest to the lowest value.

(5) How would the price of the two products have to change so that their unit contribution margin per machine hour equals the highest value of unit contribution margin per machine hour?

Solution

(1) The unit contribution margin of each product is:

Type of data	Tablecloth	Net curtains	Curtains
Unit variable cost	PLN 20 / pc.	PLN 55 / pc.	PLN 78 / pc.
Unit price	PLN 30 / pc.	PLN 70 / pc.	PLN 90 / pc.
Unit contribution margin	**PLN 10 / pc.** (30−20)	**PLN 15 / pc.** (70−55)	**PLN 12 / pc.** (90−78)

(2) The ranking of unit contribution margins is as follows:

1st place	Net curtains (PLN 15 / pc.)
2nd place	Curtains (PLN 12 / pc.)
3rd place	Tablecloth (PLN 10 / pc.)

(3) The unit contribution margin per machine hour is:

Type of data	Tablecloth	Net curtains	Curtains
Unit contribution margin	PLN 10 / pc.	PLN 15 / pc.	PLN 12 / pc.
Required number of hours to manufacture the product	0.25	0.5	0.5
Unit contribution margin per machine hour	**PLN 40/h**	**PLN 30/h**	**PLN 24/h**

(4) The ranking of unit contribution margins per machine hour is as follows:

1st place	Tablecloth (PLN 40 / pc.)
2nd place	Net curtains (PLN 30 / pc.)
3rd place	Curtains (PLN 24/ pc.)

(5) As the tablecloth has the highest value of the unit contribution margin per machine hour, the price of the other two products, i.e. curtains and net curtains, should be changed as follows:

- firstly, calculate the new value of the unit contribution margin of the curtains and the net curtains, bearing in mind that the highest value is PLN 40 per

hour (for the tablecloth) and the time required to produce both products is (0.5 hours);

Type of data	Net curtains	Curtains
Required number of hours to manufacture the product	0.5 h	0.5 h
New unit contribution margin	PLN 20 (PLN 40/h × 0.5 h)	PLN 20 (PLN 40/h × 0.5 h)

- now that we know the new value of the unit contribution margin of both products, we can determine their new price.

Type of data	Net curtains	Curtains
New unit contribution margin	PLN 20 / pc.	PLN 20 / pc.
Unit variable cost	PLN 55 / pc.	PLN 78 / pc.
New unit price	PLN 75 / pc. (20+55)	PLN 98 / pc. (20+78)

The new price for the net curtains is PLN 75 per piece and for the curtains is PLN 98 per piece.

Verification:

Type of data	Tablecloth	Net curtains	Curtains
(New) unit price	PLN 30 / pc.	PLN 75 / pc.	PLN 98 / pc.
Unit variable cost	PLN 20 / pc.	PLN 55 / pc.	PLN 78 / pc.
(New) unit contribution margin	PLN 10 / pc. (30-20)	PLN 20 / pc. (75-55)	PLN 20 / pc. (98-78)
Required number of hours to manufacture the product	0.25	0.5	0.5
Unit contribution margin per machine hour	**PLN 40/h** (10/0.25)	**PLN 40/h** (20/0.5)	**PLN 40/h** (20/0.5)

Task 10.2

Check your knowledge – true or false test.

		True	False
1	The theory of constraints uses the so-called „bottlenecks" in the company.		
2	The number of product packages may be a bottleneck.		
3	Time is not usually the source of „bottlenecks".		

4	A situation in which the demand for products is greater than the capacity to produce them is identified as the so-called „bottleneck".		
5	From the point of view of the company's final profit, the unit contribution margin is more important than margin per bottleneck.		
6	Increasing the sales of products with the highest unit contribution margin will result in a higher profit compared to increasing the sales of products with the highest unit contribution margin per „bottleneck".		

#answers

CLICK OR SCAN

Summary

After reading the second part of this handbook, you should be able to answer the following questions:

- what are the types of costs?
- what is contribution margin?
- what is break-even point?
- what is target income?
- how to use CVP analysis?
- what is margin of safety?
- how to use the theory of constraints in CVP analysis?

Reminder

Every company has different types of costs. Regardless of whether it is a manufacturing, merchandiser or service enterprise, costs can be grouped into two main categories: fixed and variable. Most of the costs can be attributed to one of these two cost categories. However, there may be costs that have characteristics of both categories, i.e. they are partly fixed and partly variable. A significant simplification in their analysis is possible thanks to the high-low method. Depending on the adopted cost structure, their total value will be different when the scale of the company's operations changes (Chapter 2). Choosing the best cost structure means planning them adequately to the expected situation. Cost planning is one of the basic conditions for taking control of the company's finances.

The division of costs into fixed and variable ones allows you to check whether, with a specific sales volume and assumed price, it is possible to achieve two key stages of each enterprise:

1) covering all costs with revenues and
2) achieving the planned profit (Profit – Target income).

Measuring the degree to which costs are covered by revenues is possible thanks to the CVP analysis (Chapters 3–6). Every company should plan its financial situation first. This will allow you to avoid many unpleasant situations, e.g. when the planned sale exceeds the company's production capacity.

The level of costs incurred depends on a number of different factors. A significant part of these factors depends on the company. For example, the technology used, the company's location, or cooperation with other companies on the basis of outsourcing will determine the value and structure of costs. The level of costs incurred will affect the possible gross margin. Remember that any change in costs, price or volume of sales makes it necessary to re-analyse – that is, to re-plan the company's financial situation (Chapter 7).

The CVP analysis is based on a company that sells only one product. However, it can also be applied to companies that sell many products. Depending on how many products the company sells and how accurate the data it needs, it has several methods to plan the break-even point and target income. It should be remembered that the products sold can have a very different impact on the company's profit. The sale of some of them will increase the profit, while others will decrease it. Fortunately, the company has the ability to identify unprofitable or low-profit products (Chapter 8). Once you know which products are lowering the profit in your company, you can consider whether you still want to sell them under the same conditions as before.

The effects of implementing the financial plan may be more or less different from the expected results. For this reason, it is worth thinking about the safety of the company's operation. The margin of safety will show you what changes in the scale of operations your company is ready for (Chapter 9). If you prepare your company for larger deviations from the planned values, you will be better prepared for unforeseen situations.

Different gross margins generated by different products create problems. In general, a company prefers to sell high-margin products, but very often cannot give up offering low-margin products. The theory of constraints allows to solve this problem by adjusting product prices to the desired gross margin value. Moreover, this theory will take into account the company's constraints that reduce its profit (Chapter 10).

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