

Marlena Ciechan-Kujawa,¹ Michał Buszko,² Karolina Taranowska³

Nicolaus Copernicus University in Toruń

1 e-mail: marlenac@umk.pl

2 e-mail: mibus@umk.pl

3 e-mail: karolina.taranowska@gmail.com

Sensitivity Analysis in Business Risk Assessment in Practice of Polish Companies

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Abstract. Sensitivity analysis is used to help companies obtain the information necessary to assess the level of risk of their operations. The aim of the article is to present the results of research carried out by the authors within the scope of assessment of sensitivity in the sample of more than 50 Polish companies. The paper presents the relationships between key factors affecting competitiveness in the industry, their impact on the financial results and the type of profit sensitivity analysis used in companies. The research indicates the high usefulness of the basic tools of profit sensitivity analysis in the assessment of business risk, in particular the analysis of break-even point and the operational safety margin. In addition, the average usefulness is attributed to complementary methods such as leverages, limit values and profit multipliers.

Introduction

Risk is a fundamental element of any type of business and it determines its success or failure. The impact of risk in the activities of companies, financial institutions or other entities results from the need to make decisions that are in principle oriented towards the future and for which it is impossible to foresee all the conditions of their implementation. In general, the longer horizon of the decisions taken, the greater risk associated with them. Current or short-term decisions are usually related to minimal risk. Risk can be defined in

many ways, but in economic sciences usually means the possibility of achieving a result other than expected with a certain probability. Achieving financial output different from those initially planned may be a result of the impact of factors coming from closer or more distant business environment, may be a result of improper implementation of internal processes or be derived from bad relations with stakeholders. Deviations from the planned results may influence the company either in positive or negative way. In the latter case, they will lead to the loss of the value of the company, and thus to reduce the wealth of the owners. The impact of risk may in extreme cases cause insolvency of the company, and thus pass the risk to stakeholders. To reduce the level and impact of risk, each company should have a developed system of managing different types of risk, consisting of specific tools, methods and procedures. One of the more frequently used methods of risk analysis in business is the analysis of the sensitivity of financial results, including the analysis of profit sensitivity.

The aim of the research was to determine universality of the application of the profit sensitivity analysis, its usefulness in business risk assessment and identification of the relationship between key factors affecting competitiveness in the industry, their impact on the financial result and the scope of profit sensitivity analysis methods used in companies.

For the purposes of this study, the authors adopted a hypothesis that the profit sensitivity analysis is useful in the practical assessment of business risk.

The contribution of this paper is presentation of the empirical evidence of attitudes of companies towards managing the risk and using sensibility analysis as a tool of the risk management.

1. Methods and research sample

To meet the goals of the paper the authors performed studies of literature as well as prepared survey research based on a questionnaire. The survey was conducted using the CAWI technique and assumed probability sampling from the population of Polish companies. The research was carried out from 19/04/2017 to 12/05/2017. The questionnaire was sent electronically to companies to which contact (e-mail address) was obtained from <http://www.baza-firm.com.pl>, a company search engine on the Internet. It was addressed to the owners, board members, employees of accounting departments, financial departments and controlling departments. Totally 66 completed questionnaires were sent back. Among them 12 were rejected due to errors that appeared when respondents filled the questionnaire, hence just 54 were taken for further analysis.

The questionnaire was aimed at empirical determining whether the profit sensitivity analysis tools are useful in assessing the risk of business operations in Polish companies. It consisted of 15 questions divided into two parts. The first one concerned the characteristics of the business activity carried out by the companies to which the questionnaire was addressed. The second part was related to the analysis of the profit sensitivity, in which

respondents specified the tools used by the company in such an analysis and evaluated their usefulness in the risk assessment of operations.

The questionnaire contained closed questions (with the exception of the question regarding the position of the person filling in the questionnaire) which were linked with a set of answers to choose from, covering all the possibilities related to the issue considered in the paper. Both single-choice and multiple-choice questions were used (with explanation indicating the possibility of giving more than one answer). A question-scale was also used to determine the usefulness of sensitivity analysis in risk assessment. Some of the questions, apart from the answers listed, got a free space for giving own answers if the presented proposals did not meet the respondents' criteria.

Among the 54 respondents there were mostly chief accountants, followed by the owners, accountants and controllers. The group surveyed represented organizations of various sizes. Over a half of them conducted production activities. The vast majority operated on the domestic market and had conducted activities for over 10 years. Due to the long period of operation, it was assumed that these entities had experience in business risk management.

2. Literature review

The risk in business operations and its assessment is an issue very commonly presented in the literature. In terms of rational management, the risk should be understood as a natural and widespread phenomenon whose sources can occur both inside and outside the company. It affects the business due to the permanent necessity of taking decisions the effects of which may be different than expected (Nowak, 2010, p. 11). External sources of risk are factors independent of the company that result from the macroeconomic and competitive environment, however some institutions with a large economic potential or political power may influence the chosen environment factors (Redziak, 2015, pp. 45–48). Internal factors of risk are specific for the company or industry itself and may result from the business model of the entity, its organization, tangible or intangible resources, products and market potential, as well as internal relations, information flow, organizational culture or corporate governance (Borkowski, 2008, p. 45; Ciechan-Kujawa, 2017, p. 11).

Risk generates certain opportunities but on the other hand it may bring negative results that destroy the value of the company. In practice, the latter aspect is more often stressed (Brustbauer 2016, p. 71) as it may determine the failure of the whole business. Due to the risk influence, the business results as a rule differ from those expected and have an impact on the level of profit, cash flows, market share, business value and goodwill. Although the latter factor defines the ultimate company's performance (McShane, Nair, Rustambekov, 2011, p. 653; Kuziak, 2011, p. 19) some others are more often emphasized, such as expected net profit and cash flows, which can be determined on a basis of the financial statements. As the risk is characterized by variability, it requires not only identification but also formal analysis and proper management. The effectiveness of the

implemented risk management instruments and methods depends on five factors affecting business, i.e. environmental uncertainty, industry competition, firm size, firm complexity, and board of directors' supervising (Gordon, Loeb, Tseng, 2009, p. 322).

It should be emphasized that the risk is a form of variability that can be measured in opposite to uncertainty which implies a situation where the future output is not known and not measurable (Knight, 1921, p. 23). Risk represents a set of possible outcomes, as well as the probability of their occurrence (Karmańska, 2008, p. 30), which can be determined by one of the three methods: a priori, statistically or estimation. Thus, the essence of risk is the probability of obtaining the given result determined on the basis of methods based on objective knowledge, which excludes uncertainty. Risk is then limited to situations where the decision maker may attach mathematical probability to any random events that can occur (Toma, Chitita, Sarpe, 2012, p. 978).

One of the methods of identifying external and internal factors affecting the financial, operational and investment risks is the sensitivity analysis. This analysis is used to forecast and control processes particularly exposed to risk and to establish priorities in limiting risk's impact.

Sensitivity is a feature of a company determined by measuring the influence of changes of given factors onto changes of financial results. The influence is measured by using the flexibility of the dependent variable in relation to chosen factors (Mielcarek, 2006, p. 12). It can be examined using statistical, mathematical or graphic methods. The analyses based on four selected criteria: application, computational intensity, ease and clarity in the representation of sensitivity were presented, for example, by Frey and Patil (2002). One of the most vital types of sensitivity analyses is the one related to profits, which examines the level of impact of such factors as: volume, price of sales, variable and fixed costs on the level of profitability of operations (Sojak, 2015, p. 228). By establishing absolute and relative financial ratios, it enables the assessment of: break-even point, profit sensitivity to change of critical factors determining profit, margin of operating safety, operating leverage, financial and total leverage as well as profit multipliers.

The literature on the subject indicates that the preparation of the sensitivity analysis is particularly complicated in case of activities diversified in terms of assortments and market segments (Umpfenbach, Dalkiran, Chinnam, Murat, 2018, p. 4). Mielcarek (2006), Ćwiąkała-Małys and Nowak (2009) and Żwirbla (2014) attempted to elaborate some solutions in this field. While Ćwiąkała-Małys and Nowak (2009, pp. 155–168) presented a generalized analysis of the operational profit flexibility, using the classic operating profit model, Żwirbla (2014, p. 108) proposed the matrix approach of shaping profit parameters, differentiating the point of view of the seller and buyer and taking into account the existence of negotiated prices.

The sensitivity analysis is most often used in assessment of risk of investment projects. In the literature one may find primarily the case studies presenting the use of this tool (Chen, 2002; Michalski, Skudlik, 2016; Śładkiewicz, 2016; Qin, Ma, Bai, 2011, Zarzecki, 2014). However, there is still lack of research presenting studies conducted on a larger

group of enterprises, which would characterize not only the method, but also a wider context related to its use for taking decisions, in particular proving its usefulness in the assessment of business risk. Such issue was the main motivation to prepare this paper.

3. Results and discussion

The survey research allowed to obtain opinions of the professionals working for 54 companies in the field of sensitivity analysis as the instrument of risk management. Detailed characteristics of the respondents (companies) are presented in table 1.

Table 1. Characteristics of the surveyed companies

Specification	Number of companies	Specification	Number of companies
Total	54	Type of capital	
Size		Polish capital / more than 50%	45
Micro	12	Foreign capital / more than 50%	8
Small	15	Range of operations	
Medium	17	Local	9
Large	10	National	30
Type		International	15
Production	28	Years of operation	
Services	11	Under 5 years	7
Trade	15	5-10 years	16
		Over 10 years	31

Source: own work based on the survey research.

The vast majority of the investigated units (approximately 75%) indicated that they use methods of profit sensitivity analysis in their business practice (tab. 2). This is the most common approach among the production companies. It should be noticed that a use of the analysis is increasing with a change of a size group of companies and a range of their operations, as well as along with the time of their functioning on the market.

In the group of entities that do not use the profit sensitivity analysis one can find mainly micro and small companies. Eight of them indicated the lack of need as the cause of not using the analysis. Other entities underlined that such analysis would be useful, however they do not have adequate competences (people, knowledge, other resources) to carry it out. The latter issue was raised in particular by units operating longer on the market and conducting rather production activities than the servicing ones. Trade companies do not identify the need to use such tools. One can also conclude that, in most cases, the limitation in the use of the presented management accounting methods is the lack of identification of variable and fixed costs of the operations. As many as 11 of the 14 companies

in the group do not examine or analyse costs but take into account their change as a result of fluctuations in business activities.

Table 2. Use of profit sensitivity analysis methods by the surveyed entities

Specification	Size				Type			Range of operation			Years of operation			Total
	Micro	Small	Medium	Large	Production	Services	Trade	Local	National	International	Below 5 years	5-10 years	Above 10 years	
Yes	4	9	17	10	24	6	10	2	23	15	2	10	28	40
No	8	6	0	0	4	5	5	7	7	0	5	6	3	14

Source: own work based on the survey research.

In almost half of the cases, the profit sensitivity calculation is made by the chief accountant, and in every fourth unit this task is done by the controller (table 3). If the measurement of profit sensitivity is carried out in the micro and small companies, regardless of the character of their business, it is carried out primarily by the owner. The obtained results show that along with a development of the company, i.e. an increase in its size, range of operations and the time of running the business – this task is transferred to the specialized financial departments. Nonetheless, it usually remains at the discretion of managing staff and is not passed to be conducted by other employees than the ones employed at the accounting departments.

Table 3. Organization of the process of measuring the profit sensitivity

The professionals responsible for the analysis		Frequency of calculations	
Position	Quantity of indications	Frequency	Quantity of indications
Owner	7	Once a month	7
Controller	11	Once a quarter	7
Chief accountant	18	Every six months	4
Accounting employee	3	Once a year	11
Others	1	Irregularly	11

Source: own work based on the survey research.

Apart from investigating the people responsible for conducting sensitivity analysis in the surveyed companies, the authors asked about the frequency of such activities (table 3). The respondents most commonly pointed irregular or annual use (about 2/5 of the examined companies). Just 4 entities used it semi-annually and 1/3 of the sample used

sensitivity analysis quarterly or monthly. More often sensitivity analysis was performed by larger production companies, operating longer on the market (above 10 years).

As sensitivity analysis can be used for the identification and monitoring of the most significant external and internal factors affecting the activity of the company and to reduce financial, operating and investment risks, the authors examined factors essential for competitiveness in the industries represented by investigated entities. The authors tried to find whether the companies monitor these factors by examining their impact on the financial results and how they manage the risk. Proper risk management is vital for both survival as well as development of company and involves observing the actions of competitors and anticipating their reactions. Competitiveness can be evaluated from the perspective of factors that create it and results that are deriving from it. In this first approach, it should be pointed out that competitiveness is influenced, *inter alia*, by the ability to react quickly to changes in the environment, to use efficiently resources and by rational decision-making processes. On the other hand, the results of competition reflect, for example, market share or financial results of the company against the background of the leaders.

In the group of the analysed companies three major revenue-cost factors – sales prices, sales volume and prices of raw materials (table 4) – were indicated as relevant. As many as 49 out of the 54 surveyed companies indicated that the price is a key element of the competition on their markets. The price was listed as the most important criterion by companies of different sizes, mainly of production type (28) and trading (10 out of the 11 surveyed), with long market history and functioning in the national market. In the second place there was a sales' volume indicated primarily by trading companies (14 out of the 15 surveyed) and operating in the international markets (14/15). The significance of the prices of raw materials and materials has been clearly noted as the key factor by the representatives of the production companies (25 out of the 28 examined), representing rather larger entities. The minority of entities identified remunerations of employees and the price of energy as factors affecting competitiveness in the industry. The responders rarely pointed out the importance of other costs, such as, for example, foreign services, charges and taxes. The choice of factors considered as significantly important was usually conditioned by the type of the business. As expected, the awareness of the impact of specific factors on a business activity rises with the increase of the size of the company, the time of running the business and the range of its operations. In addition, in units that carry out production activity, at least a few key factors are noticed more often than in others (tab. 4).

Table 4. Revenue-cost factors affecting competitiveness in the industry

Specification	Size				Type			Range of operation			Years of operation		
	Micro	Small	Medium	Large	Production	Services	Trade	Local	National	International	Below 5 years	5–10 years	Above 10 years
Sales price	11	13	15	10	27	10	12	6	29	14	6	15	28
Sales volume	8	9	14	9	19	7	14	8	18	14	5	12	23
Price of materials	5	9	10	8	25	4	3	3	21	8	3	9	20
Price of energy	0	2	5	8	10	3	2	1	6	8	0	6	9
Remunerations	2	2	7	9	10	4	6	2	11	7	0	6	14
Foreign services	0	0	4	7	8	1	2	0	5	6	0	3	8
Others	1	0	5	3	5	1	3	1	4	4	0	3	6

Source: own work based on the survey research.

Awareness of the key revenue-cost factors in the industry should induce units to continuously monitor these factors and to carry out the analysis of the degree of their impact on the financial result. Therefore, it should be possible to identify logical connections between risk areas indicated by the company and a degree of their impact on the company operations. There should be used analytical tools for their monitoring. The data presented in the Table 5 show, however, that only some companies can observe mechanisms for such an approach. The analysis was subject to the functioning of the described cause-effect approach in the case of three risks the most often identified in the surveyed group. Research show that approximately 65–75% of respondents analysed the impact of identified risk factors on the financial result, but only a few used dedicated tools. Only $\frac{1}{4}$ of companies, which underlined the importance of sales prices as a key factor of competition in the industry, analysed the sensitivity of profit on price change using e.g. price multiplier or price limit. In case of 32 companies, which pointed the significant importance for the material consumption costs, only four monitor the level of these costs by using multipliers or indicators of sensitivity. The most entities monitor the sales volume indicators relevant to the market share or expanding the scope of operations. About a half of the surveyed companies which indicated that the market competitive position in the industry is affected by the scale of the operations, set the break-even point, and $\frac{1}{3}$ of the companies monitor the safety margin of operation. Therefore, it can be determined that three indicated key factors of competitiveness are the most commonly analysed from the point of view of their impact on financial results (table 5), but the number of companies that examine them is definitively smaller, and those that use dedicated tools for this purpose, is even more limited.

Table 5. Application of dedicated sensitivity analysis methods in the assessment of key operational risks

Specification	Key factors of competitiveness	Impact on the company's financial result	Quantity of companies using dedicated tools of profit sensitivity analysis	Types of applied methods of sensitivity analysis	Number of companies using a specific tool
Sales price	49	38	13	Price limit value	11
				Sales price multiplier	6
Sales volume	40	30	21	Quantitative break-even point	21
				Quantitative margin of safety	13
				Sales volume multiplier	2
Price of materials	32	20	4	Variable costs limit value	2
				Variable costs multiplier	3

Source: own work based on the survey research.

The research carried out by the authors has also been used to determine the usefulness of the used tools of profit sensitivity analysis in the assessment of business risk. The assessment was made only by companies which declared that they use identified tools. For this purpose, we used five-point Likert scale, where 5 meant very high usefulness, and 1 – lack of usefulness. The results of the analysis, the average of all responses as well as dominant indications, are presented in the table 6.

Research show that the most commonly used tool of profit sensitivity analysis is the break-even point, with indications of its common quantitative dimension (more than 66% of the cases). A lower number of users characterizes a safety margin (about 40% indications). In the group of large and medium-sized companies additionally the level of operating and financial leverage was examined. Definitely the least commonly used element of the sensitivity analysis were multipliers (table 6). The most comprehensive scope of the analysis can be observed in the production companies with a range of national and international operations and that have been on the market for above 10 years. Micro and small companies, regardless of the type of the business, indicated using commonly the main tools of profit sensitivity analysis (break-even point and margin of safety). Large and medium-sized companies expand the analysis of the limit values and leverages.

Table 6. The methods of profit sensitivity analysis and their usefulness in risk management

Specification	Quantity of entities using the method	Assessment of usefulness	
		Average	Dominant
Quantity break-even point	36	4.22	5
Value break-even point	28		
Quantity margin of safety	23	4	5
Value margin of safety	11		
Price limit value	15	3.67	4
Variable costs limit value	9	3.22	3
Fixed costs limit value	9	3.33	4
Operating leverage	18	3.67	4
Financial leverage	17	3.82	4
Total leverage	13	3.69	4
Sales volume multiplier	6	3.67	4
Sales price multiplier	8	3.63	3
Variable costs multiplier	6	3.5	4
Fixed costs multiplier	6	3.5	4

Source: own work based on the survey research.

The majority of companies that use the profit sensitivity analysis assessed its usefulness in business risk assessment as large (dominant 4). However, it should be noted that the average values for the whole surveyed group were not as high (3.5–4.22 in the five-point Likert scale). Only two indicators – break-even point and operating safety margin – received average above 4 and dominant level 5. The obtained results allow to notice that with the increase in the company size, the range of the operations and the number of years of operations of the company, higher evaluation of the usefulness of the sensitivity analysis in risk assessment can be observed. The highest usefulness of this method in the research group was declared by the representatives of the production companies, the lowest one by service companies.

Conclusions

The complexity of the risks associated with running a business makes it necessary to improve the quantitative tools related to this issue. Tools of profit sensitivity analysis allow for an early response to anticipated threats from both interior and environment of the company. Companies point to the high usefulness of the basic tools for the analysis of profit sensitivity in the business risk assessment (break-even point, operational safety margin). The use of leverage, limit values and profit multipliers was less popular. The study shows that in many cases the application of the profit sensitivity analysis is not a consequence of the conscious implementation and application of the risk monitoring mechanism. Only in some companies one may find connections between the type of identified risk, the

assessment of the probability and a degree of the impact on the company's performance as well as the implementation of dedicated tools for measuring and monitoring of the level of risk.

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ANALIZA WRAŻLIWOŚCI W OCENIE RYZYKA BIZNESOWEGO W PRAKTYCE POLSKICH PRZEDSIĘBIORSTW

Słowa kluczowe: analiza wrażliwości, ocena ryzyka, konkurencyjność, rachunkowość zarządcza

Streszczenie. Analiza wrażliwości pomaga przedsiębiorstwom uzyskać informacje niezbędne do oceny poziomu ryzyka ich działalności. Celem artykułu jest przedstawienie wyników badań przeprowadzonych przez autorów w zakresie oceny wrażliwości w próbie ponad 50 polskich firm. W artykule przedstawiono związki pomiędzy kluczowymi czynnikami wpływającymi na konkurencyjność w branży, ich wpływem na wyniki finansowe oraz rodzajem analizy wrażliwości zysku wykorzystywanej w przedsiębiorstwach. Badania wskazują na wysoką przydatność podstawowych narzędzi analizy wrażliwości na zysk w ocenie ryzyka biznesowego, w szczególności analizy progu rentowności i marginesu bezpieczeństwa operacyjnego. Ponadto średnią użyteczność przypisuje się metodom złożonym, takim jak dźwignie, wartości graniczne i mnożniki zysków.

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