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## CONTENTS

### *SURVEY AND RESEARCH STUDIES*

<b>ECONOMIC ASSESSMENT OF THE CONSTRUCTION OF THE NUCLEAR ENERGY WASTE REPOSITORY</b>	<b>5</b>
<i>Katarína ČULKOVÁ – Roland WEISS</i>	

<b>QUALITY OF LIFE AS AN INDICATOR OF REGIONAL COMPETITIVENESS</b>	<b>16</b>
<i>Zuzana HRABOVSKÁ</i>	

<b>E-COMMERCE: A PROSPEROUS FORM OF TRADING IN SLOVAKIA</b>	<b>25</b>
<i>Mária JANOŠKOVÁ</i>	

<b>WASTE MANAGEMENT OF VRANOV NAD TOPLŤOU</b>	<b>42</b>
<i>Pavol KALUHA</i>	

<b>METHODOLOGY OF CREATION OF INDEXES IN THE FIELD OF THE BUSINESS ENVIRONMENT</b>	<b>48</b>
<i>Janka KOPČÁKOVÁ – Erik WEISS</i>	

<b>RETAIL TRANSFORMATION AND ITS ROLE IN THE POST-CRISIS RECOVERY OF THE ECONOMY: EXPERIENCE OF SLOVAKIA AND UKRAINE</b>	<b>59</b>
<i>Vanda LIESKOVSKÁ – Iryna RESHETNIKOVA</i>	

<b>APPLICATION OF PREDICTIVE MODELS FOR EVALUATING THE FINANCIAL HEALTH OF SELECTED COMPANIES</b>	<b>69</b>
<i>Lukáš VAVLIČ</i>	



# ECONOMIC ASSESSMENT OF THE CONSTRUCTION OF THE NUCLEAR ENERGY WASTE REPOSITORY

## EKONOMICKÉ POSÚDENIE VÝSTAVBY ÚLOŽISKA ODPADU JADROVEJ ENERGETIKY

*Katarína ČULKOVÁ – Roland WEISS*

### **Abstract**

The nuclear energy waste management presents nowadays an important social and economic topic. The goal of the presented paper is to evaluate economy of the construction of the nuclear energy waste repository. The economic evaluation of the repository concept is done through is average cost method for assessment of investment to the nuclear waste repository, considering life cycle of the repository and nuclear fuel cycle. The calculation includes current volumes of nuclear energy waste, excluding new volumes of waste produced. The results of the paper can be used for other types of energy project evaluation, together with assessment of the impacts on the environment, human and economic development.

**Key words:** waste management, economic efficiency of waste treatment, nuclear energy, nuclear waste storage.

### **Abstrakt**

Nakladanie s odpadom z jadrovej energie predstavuje v súčasnosti dôležitú spoločenskú a ekonomickú tému. Cieľom predkladaného príspevku je zhodnotiť hospodárnosť výstavby úložiska jadrového odpadu. Ekonomické zhodnotenie výstavby úložiska je vypočítané metódou priemerných nákladov investícií do úložiska jadrového odpadu s ohľadom na životný cyklus úložiska a cyklus jadrového paliva. Výpočet zahŕňa súčasné objemy odpadu z jadrovej energie bez uvažovania s novými objemami vyprodukovaného odpadu. Výsledky príspevku je možné použiť pre hodnotenie podobných typov energetických projektov spolu s hodnotením vplyvov na životné prostredie, spoločnosť a ekonomický rozvoj.

**Kľúčové slová:** odpadové hospodárstvo, ekonomická efektívnosť spracovania odpadov, jadrová energetika, skladovanie jadrového odpadu.

### **Introduction**

The management of nuclear energy waste as well as other radioactive waste is an important social topic, defining the technical and economic solution for the implementation of the final storage of nuclear energy waste. Highly radioactive or heat-emitting waste will gain relevance. The concept of the implementation of final storage facilities for nuclear energy waste, highly radioactive or heat-emitting waste, assumes the use of new, so far unused technologies for the creation of the mine work. It demands to be without the use of additional materials for the stabilization of the mine work, precisely with regard to their service life from the point of view of long-term demanding stress in the duration of half time the breakdown of nuclear energy waste, highly radioactive or heat-emitting waste. It demands to be further from the point of view of achieving the technical and

economic construction parameters enabling the realization of such a work (Lucas, 1979).

The solution of the concept of the implementation of the final storage of nuclear energy waste, highly radioactive or heat-emitting waste requires sufficient knowledge of the current state. It is required especially in the areas of valid legislative and international legal obligations, knowledge of the current state of the research already carried out and the state of the art in this field in the world (IAEA, 2005). The area is dealt by scientific institutions such as Sandia National Laboratories (Sandia National Laboratories, 2023), and U.S. Department of Energy's National Nuclear Security Administration (National Nuclear Security Administration, 2000). The other organizations are Nuclear Waste Management Organization (The Nuclear Waste Management Organization, 2018), Blue Ribbon Commission on America's Nuclear Future, Radioactive waste storage and disposal facilities in south Australia (Cook et al., 2016), and Deep geological nuclear waste disposal (Conca and Kirchner, 2012).

The management of nuclear energy waste as well as other radioactive waste is covered from a legislative point of view in COUNCIL DIRECTIVE 2011/70/EURATOM of July 19, 2011, which establishes a Community framework for the responsible and safe management of spent fuel and radioactive waste. Research in this area is a globally open and very topical issue at several world research workplaces and scientific institutions. It is mostly covered by official state bodies dealing with long-term and strategic options for the permanent storage of nuclear waste within the entire EU, but also in the world. The solution to this task lies in the global solution for the permanent storage of nuclear waste. Research of creating a concept for the implementation of final storage facilities for nuclear energy waste, highly radioactive or heat-emitting waste is currently being carried out in individual states according to the proposed method and place of waste storage. Presented is influenced by U.S. Department of Energy, 2013; U.S. Department of Energy, 2015; International Atomic Energy Agency, 2005; Cook and Kirchner, 2016; Nuclear Waste Management Organization, 2016; Sandia National laboratories, 2023; and Nuclear Waste Management Organization, 2018.

In the EU in 2010, 143 nuclear reactors were in operation in fourteen member countries, which annually produce about 7,000 m<sup>3</sup> of highly radioactive waste (RAW), while the majority of this waste is stored in temporary repositories. Deep repositories are now considered the most suitable and safest method of RW disposal. On a global scale, several studies are being carried, which, under specific geological conditions, can be assumed to have the required properties for the safe storage of nuclear waste (Nuclear Waste Management Organization, 2015), however mostly in the area of nuclear waste repositories from the view of legislation, technological and geopolitical aspects. In connection with mentioned the goal of the contribution is to evaluate costs for the construction of the nuclear

energy waste repository, as well as to make illustration for costs of storing 80,000 tons of radioactive waste.

## **1 Literature review**

The available studies for nuclear waste repositories are from several authors, for example, Jenkins and Taebi (2019) investigate the viability of Energy Justice as a framework to assist the governance of multinational risk of nuclear waste repositories. The study focuses on how to govern the risk of nuclear waste in a multinational fashion, and questions the extent to which this approach could offer a useful account to help understand the justice issues multinational repositories give rise to, calling for greater attention to issues of energy justice. Study of Chien (2014) gives attention to policy making, allocated differently and thus producing variety of policy reactions in post-crisis governance across nations and urging researchers to go beyond treating crisis as focusing event in policy change and look into the macro-political conditions that promote or undermine the driving energy behind policy change dynamics. Drottz-Sioberg (2010) made an empirical study of radiation leakage from canisters in the repository), asking of risk estimations in relation to the repository. The results showed rather restricted time horizons among the respondents. Risk estimations relating to nuclear wastes were not extremely high. Greco and Yamamoto (2019) considered geographical political economy literature, finding insufficient in accounting for particular outcomes plus regional economic conditions, however only for the plant closure. Cho and Yoon (2015) estimated the induced effect of hosting a new nuclear power plant (NPP) on the local economy separately for the construction and operation phases. Generally, higher economic-induced effects were achieved from operational activities rather than from construction-related ones, although itemized differences might exist (see also King and Yang, 1981). According to Woo (2012), the economic factor is still a critical matter for the commercial trade between two countries, which depend on the energy demand and uranium price.

Combined heat and power (CHP) reactors can support the EU low-carbon society goals while providing stability in production and cost (Carlsson et al., 2012). However, little is known about the market potential or economic competitiveness of these reactors in future European cogeneration markets. The study showed that reactor capital costs and the costs of capital had the largest influence on competitiveness (Facella, 2006). To achieve a cost-effective investment, based on the economic analysis model of Life Cycle Management (LCM) for the Systems, Structures and Components (SSCs) at nuclear power plants is established. In this sense, Yang et al. (2015) applied various economic data input, the preventive maintenance costs, corrective maintenance costs, loss production costs. Net present value of total benefit and total investment of all LCM alternatives are output, and ultimately the net present value index to determine the advantages and disadvantages of various alternatives and identify the best alternative (see also Wang et al., 2015). Efficient and sustainable methods

of clean fuel and energy production are needed in all countries of the world in the face of depleting oil reserves and the need to reduce carbon dioxide emissions. Avsec et al. (2012) showed how hydrogen technologies could be implemented with renewable technologies and nuclear technology, when finding nuclear technology produce very cheap electricity and could produce cheap energy like heat and vapor.

## 2 Methodology

When creating a concept for the implementation of final storage facilities for nuclear energy waste, highly radioactive or heat-emitting waste, it is inevitable to address the economic aspect of the difficulty of building a storage facility, as it is an essential part of the decision-making process of assessment. The very complexity of the preparation and construction of the repository within the scope of the planned life cycle requires all information, including the economic part, for the presentation and comprehensive assessment of the repository concept (Hardin et al., 2012).

The most proper method for the economic evaluation of the repository concept is cost method for evaluation of investment to the nuclear waste repository. We used mainly method of average costs. The method is proper in time of investment project preparation, when there are possibilities to select other technical or technological solution, however those are comparable variants.

The costs are calculated as:

$$\text{Annual Cost} = \text{Depreciation} + i \cdot \text{Investment} + \text{Operation Cost}$$

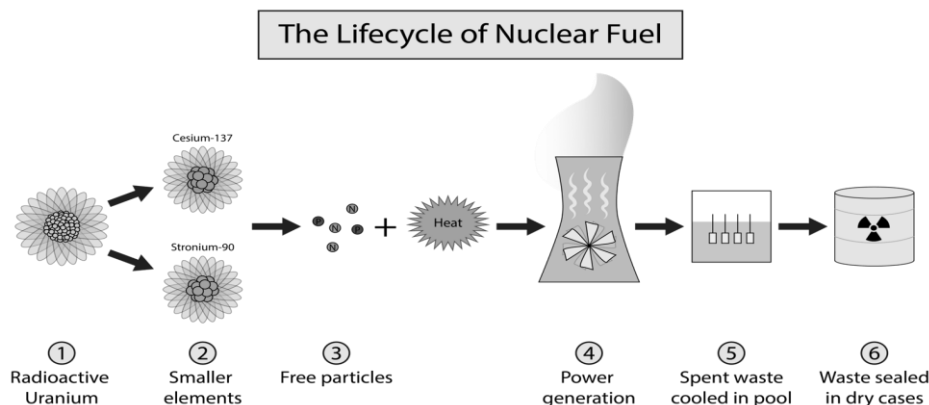
The cost method can be used also according to the concept of discounted costs, as follows.

$$\text{Discounted Costs of investment project} = \text{Investment} + \text{Discounted Annual Operation Costs without depreciation}$$

The decision criteria in both cases are cost minimizing.

During the research, we considered the life cycle of the repository and nuclear fuel cycle according to Taylor et al., (2022). The life cycle of a repository includes phases such as site monitoring and selection, site characterization, design and granting of permits and licenses, construction itself, waste disposal and closure of the repository (Nuclear Waste Management Organization, 2009), (Conca and Kirchner, 2012), (Technology cluster for efficient utilization of land resources., 2017).

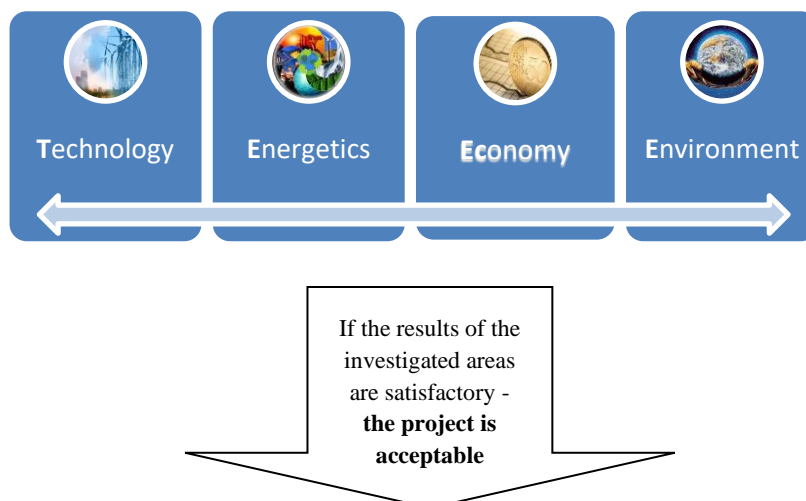




**Figure 1. The life cycle of a nuclear waste repository**

Source: Jennewein, 2018

Depending on the chosen concept of storing nuclear energy waste, highly radioactive or heat-emitting waste, the duration of the life cycle of the repository also differs significantly. The resulting economic calculation therefore necessarily requires recalculated costs using inflation estimates and an estimate of the expected amount of costs during the life cycle of the repository.



**Figure 2. Model of the project**

Source: own processing (Cehlár et al., 2011)

### 3 Results

The estimated costs for the construction of final nuclear waste repositories are at the level shown in Table 1, the construction of nuclear energy waste repositories represents an ecological debt that must be solved in the next decades (Nuclear Waste Management Organization, 2015), (Technology cluster for the effective use of earth's resources, 2017).

The costs listed in Table 1 include the costs associated with:

- the construction of the mine,
- operation and actual storage of nuclear energy waste,
- highly radioactive or heat-emitting waste,

- closure of the repository itself,
- a simple inclusion of inflation at the rate of 2% per year
- calculated growth of costs during the planned life cycle 60 – 70 years.

The calculation includes only current volumes of nuclear energy waste, highly radioactive or heat-emitting waste. It does not include the costs of storing new volumes of waste produced during the implementation of the life cycle of the planned repositories. It is due to expectations of scientific, technical and technological progress during the planned life cycle of such a repository (60 – 70 years). The other factors are the possible "inaccurate" definition of new volumes of nuclear energy waste, highly radioactive or heat-emitting waste produced during the implementation of the life cycle of the planned repositories (Technological Cluster for the Effective Use of Earth Resources, 2017).

**Table 1 Estimated costs for the construction of the nuclear energy waste repository**

Nuclear power by country in 2022								
Country	Number of operated reactors	Capacity Net-total (Mwe)	Generated electricity (GWh)	Domestic generation (%) of share	Operating reactors (Pcs)	Reactors under construction (Pcs)	Average power per reactor (Mwe/reactor)	Cost for nuclear waste storage system based on German forecast (Mld.Eur)
Argentina	3	1,627	5,258	4	3	1	542	4
Armenia	1	375	2,266	30.7	1	0	375	1
Belgium	7	5,927	32,094	47.5	7	0	847	15
Brazil	2	1,884	14,463	2.9	2	1	942	5
Bulgaria	2	1,926	15,014	31.8	2	0	963	5
Canada	19	13,500	98,588	16.8	19	0	711	34
Czech Republic	6	3,904	28,637	35.8	6	0	651	10
Finland	4	2,752	22,646	34.6	4	1	688	7
France	58	63,130	418,001	76.9	58	1	1,088	157
Germany	9	12,074	91,784	15.8	9	0	1,342	30
Hungary	4	1,889	14,778	53.6	4	0	472	5
China	29	34,140	123,808	2.4	26	23	928	60
India	21	5,780	37,835	3.7	21	6	275	14
Iran	1	915	3,724	1.5	1	0	915	2
Japan	48	42,388	0	0	43	3	986	105
Mexico	2	1,330	9,312	5.6	2	0	665	3
Netherlands	1	482	3,874	4	1	0	482	1
Pakistan	3	690	4,578	4.3	3	2	230	2
Romania	2	1,300	10,754	18.5	2	0	650	3
Russia	34	24,654	169,065	18.6	34	9	725	61
Slovakia	4	1,814	14,420	56.8	4	2	454	5
Slovenia	1	688	6,061	37.2	1	0	688	2
South Africa	2	1,860	14,763	6.2	2	0	930	5
South Korea	24	20,717	149,199	30.4	24	4	863	51
Spain	7	7,121	54,860	20.4	7	0	1,017	18
Sweden	10	9,470	62,270	41.5	10	0	947	24
Switzerland	5	3,333	26,468	37.9	5	0	667	8
Turkey	0	0	0	0	0	2	-	0
Ukraine	15	13,107	83,123	49.4	15	0	824	33
UA Emirates	0	0	0	0	0	4	-	0
United Kingdom	16	9,373	57,918	17.2	16	0	586	23
United States	100	99,244	798,616	19.5	99	5	1,002	247
<b>World Total</b>	<b>439</b>	<b>376,821</b>	<b>2,410</b>	<b>10.9</b>	<b>437</b>	<b>64</b>	<b>23,294</b>	<b>950</b>

Source: Ritchie et al., 2022

Many cost estimates have been made for the creation of permanent repositories for the disposal of nuclear waste in different types of rock in different countries. A major influence on the costs of a nuclear repository is based on the project period, which is such a repository at the level of 60 to 70 years, including temporary storage of spent nuclear fuel and permanent deep geological storage. The process of dealing with nuclear waste is lengthy and involves more than just disposal itself. In general, for such a repository, in any type of rock, it includes steps such as site monitoring and selection (3 to 4 years), site characterization (3 to 9 years), design and licensing (5 to 7 years), construction (6 up to 8 years), waste disposal (35 to 40 years) and closure (9 to 12 years). These years represent the total life cycle of the project during which the costs are constantly changing.

The United States has approximately 80,000 tons of spent nuclear fuel (SNF) and highly radioactive nuclear waste (HLW), although the forms of each are quite different. HLW is in various liquid, sludge and solid forms in various containers, such as 90 million gallons stored in large tanks.

Table 2 estimates the cost of nuclear waste storage and, when calculated with simple inflation of 2% and calculating the growth of costs over the life cycle, these costs rise to about \$192 billion in volcanic tuff rock, \$67 billion in salt masses, and \$179 billion in crystalline rocks. All data are relevant with the current level of technology (Conca and Kirchner, 2012).

**Table 2 Costs of storing 80,000 tons of radioactive waste in MUSD in time (for SNF and HLW waste)**

<b>Description</b>	<b>Volcanic tuff</b>	<b>Salt massifs</b>	<b>Crystalline rocks</b>
Development, suggestion and characteristics	9,488	800	11,006
Surface and underground equipment	24,053	7,187	27,901
Waste packages and barriers / shields	19,164	1,250	8,700
Confirmations, approval, certification	3,273	926	3,797
Regulation, infrastructure, report, support	4,687	2,030	5,436
Integration of QA/QC, NRC program, etc.	6,821	3,708	7,912
Transport	9,434	7,000	6,500
Institutional costs and financial support	6,604	6,604	6,604
<b>Total</b>	<b>83,528</b>	<b>29,505</b>	<b>77,857</b>

*Source: own processing*

Table 3 calculates costs for storing 80,000 tons of radioactive waste in MSD in time, calculated costs with using of simple inflation 2% / year with assumed higher profitability in period of operation 17-52 years.

**Table 3 Costs estimation for storing 80,000 tons of radioactive waste**

Costs estimation			
Description	Volcanic tuff	Salt massifs	Crystalline rocks
	192,105	67,861	179,069
Estimated costs for the temporary storing	13,500	13,500	13,500
Cumulative costs on complex storing	205,605	81,361	192,569

Source: own processing

## Discussion and Conclusion

During the research, we considered economic point of view. However, economic evaluation of construction of nuclear repository have to be done together with consideration of technical and technological assumptions (Goraczko et al., 2020). Together with economic assessment there is necessary to follow up also national and international recommendations, requirements and regulations (Lytsy and Yia-Mella, 2013). In addition, municipalities' representatives have to be involved into the process of nuclear waste repository locality (Ocelik et al., 2017) with aim to minimize general mistrust against political elites and state institutions.

Moreover, during the construction of such facility, the possibility of using effectively the prescriptions requested for the realization of the final site has to be investigated (Martinelli, 2015). The nuclear fuel and other radioactive waste is a topic to be studied also due to its huge social impacts (Dvorakova et al., 2015). According to Newman (2021) financial impact of the Department of Energy's inability to take possession of spent fuel from commercial nuclear power companies can be involved to the assessment as well. Also, Bonano et al. (2018) stated storage of nuclear waste influences current practice for commercial spent nuclear fuel management.

All mentioned factors could be involved to the processes of the waste disposal to demonstrate the reliability of nuclear waste disposal with minimal expected impacts on the environment, human and economic development, so-called triple bottom line (Ojovan and Steinmetz, 2022).

The contribution is based on the principle of sustainable energy and economy. With its multidisciplinary approach it contributes to the possible realization of the required connection of research with applied practice, through the help of increasing the contribution of development to overall economic growth, as the desired effect of mutual research and development cooperation between "academic land", research and development entities, universities and the business environment (Elokhin, 1994). The results of the contribution point to the costs of implementing final storage facilities for nuclear energy waste, highly radioactive or heat-emitting waste due to the implementation of technologies for the creation of a storage facility. The results of the contribution can also be used for other types of mining activities with a high degree of geometric and average variability of the

work, with a high degree of directional variability while simultaneously achieving a new level of operational stability of the mine work. Possible applications are further in the field of energy for the construction of geothermal power plants, in the field of underground construction for transport infrastructure, industrial and civil amenities (Xue et al., 2022), underground industrial agricultural production and other industrial and civil applications.

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# QUALITY OF LIFE AS AN INDICATOR OF REGIONAL COMPETITIVENESS

## KVALITA ŽIVOTA AKO INDIKÁTOR KONKURENCIESCHOPNOSTI REGIÓNOV

*Zuzana HRABOVSKÁ*

### **Abstract**

The quality of life is one of the areas for assessing the competitiveness of regions and can be evaluated using objective as well as subjective indicators. The aim of the presented paper is to propose the possibilities of an objective assessment of the quality of life in the NUTS3 regions of the Slovak Republic using secondary data available from the databases of the Statistical Office of the Slovak Republic in the period 2014-2020. regions did not change in the monitored period. However, a positive convergence of less developed regions (Regions of Prešov, Žilina, Trnava and Nitra) to the level of quality of life in the Bratislava region was identified.

**Key words:** quality of life, regional competitiveness, NUTS 3, the Slovak Republic

### **Abstrakt**

Kvalita života je jednou z oblastí posudzovania konkurencieschopnosti regiónov a možno ju hodnotiť pomocou objektívnych ako aj subjektívnych ukazovateľov. Cieľom predkladaného príspevku je navrhnúť možnosti objektívneho hodnotenia kvality života v regiónoch NUTS3 Slovenskej republiky s využitím sekundárnych údajov dostupných z databáz Štatistického úradu Slovenskej republiky v období rokov 2014 – 2020. Z realizovanej analýzy vyplynulo, že najpriaznivejšími podmienky pre kvalitný život disponuje Bratislavský kraj a poradie ostatných regiónov sa v sledovanom období nezmenilo. Identifikovaná však bola pozitívna konvergencia menej rozvinutých regiónov (Prešovský, Žilinský, Trnavský, Nitriansky kraj) k úrovni kvality života v Bratislavskom kraji.

**Kľúčové slová:** kvalita života, regionálna konkurencieschopnosť, NUTS 3, Slovenská republika

### **Introduction**

Economic development and continuous efforts aimed at increasing well-being and quality of life represent one of the main strategic goals in most countries and regions. Recently, regions have again been rediscovered as an important source of competitive advantage in the current globalized world, in which the competitiveness of regions is considered one of the most important determinants of economic development. The gradual increase in competitiveness leads to the fulfilment of regional policy goals, as well as to the growth of well-being, quality of life and to long-term economic development. In this context, the growth of the competitiveness of the regions is considered one of the basic sources of mobilization of available production factors of the regions and has a significant impact on the development of the regions.



The aim of the presented paper is to outline a possible way of quantifying changes in the quality of life as an important aspect of regional competitiveness in the conditions of NUTS 3 regions in the Slovak Republic in the period 2014-2020.

## **1 Regional competitiveness as a determinant of regional development**

Competitiveness is a multidimensional characteristic of the quality of the socioeconomic region space, which determines the efficiency of the use of regional resources and, in addition to obvious changes in the quantitative output of the regions (measured by GDP per capita), is manifested in the improvement of the quality of life in the region.

In the professional literature, we come across different approaches to defining regional competitiveness. Often, the competitiveness of regions is perceived as a specific combination of intentional factors (Krueger et al. 2018) or it is a set of factors that have the potential to ensure a high standard of living and quality of life in the region according to national and global standards (Prokop and Stejskal 2015). The quality of life aspect is also emphasized by Žitek and Klímová (2015), who define regional competitiveness as a multidimensional characteristic of the quality of the socioeconomic space, which determines the productivity of the use of territorial resources and is reflected in a higher quality of life in the region.

Regional competitiveness is defined by the European Commission as "the ability to generate relatively high incomes, employment and quality of life in conditions of external competition with the overall sustainability of resources with the aim of sustainable growth in the living standards of regions (countries) with a low unemployment rate" (European Commission, 1999). Regional competitiveness is thus determined by the region's ability to provide favorable conditions for life to its residents, which is linked to its ability to attract not only new residents but also investors to its territory.

The level of productivity determines the level of prosperity that can be obtained through the economic activities of the country. Productivity determines the level of sustainable development that a given economy can achieve. It means that the more competitive an economy is, the higher level of income it can produce for its population. (Gonos, Ivanková and Čulková 2019)

Currently, more and more emphasis is at the gradual increase in the importance of regions and their responsibility for creating conditions for growth and maintaining economic and social competitiveness not only in the national but also in the international context. One of the reasons why it is necessary to focus on the local level to identify factors of competitiveness is the persistent regional disparities.

Measuring regional competitiveness is important for comparing the competitive position of the regional economy, industry or companies in national economies as well as in a global context. Based on the differences in content when

defining regional competitiveness, in the available literature one can encounter a number of approaches to measuring competitiveness. In principle, however, it can be stated that most methods of assessing regional competitiveness are based on the construction of a system of indicators, from the development of which the competitiveness of the respective region is identified.

Despite the fact that, on a theoretical level, the competitiveness factors of regions are inter-regionally comparable, it is not possible to use unadjusted models developed for the assessment of national competitiveness to assess regional competitiveness. The reason is mainly the lack of statistical data at the regional level, as well as specific factors of the regions' competitiveness. (Judrupa, 2021). The Regional Competitiveness Index, which is published annually by the World Economic Forum, is often used to quantify and then compare the competitiveness of countries.

The global competitiveness index (especially due to its comprehensible construction) forms the basis for the development of regional competitiveness indices also in the local conditions of the Slovak Republic. An example is the study (Širá, Kiseľáková, Šofranková, 2017), which constructs the regional competitiveness index of the Slovak Republic based on the global competitiveness index. The index of regional competitiveness in the regions of the Slovak Republic, based on the methodology of the European Commission, was also applied in a study by the authors Jašková and Havierniková (2016), who noted the heterogeneous development of regional competitiveness.

For the purposes of quantifying the very broadly defined economic and social level of regions, the method of economic n-angles is suitable. It is sufficiently simple to apply and its conclusions are clear for a wide professional and lay public. The method of economic n-angles is based on the construction of the so-called magic (or macroeconomic) quadrangle, which is used to assess the economic level of individual national economies. In graphic terms, when using this method, a polar chart is used, in which the values of the relevant quantities are recorded, while the resulting figure - an n-angle - is created by connecting the obtained points.

Martinčík (2008) quantified the competitiveness of regions in the Czech Republic through a system of 18 indicators, which are divided into the area of macroeconomic performance (MA), the area of growth potential (RP) and quality of life (KV). The original model contains seven indicators in each area, while three of them belong to two areas at the same time and create a kind of transition bridges between the main analyzed areas.

Due to several similarities in economic and social development in the Czech Republic and the Slovak Republic, as well as due to the similarity of the system of indicators reported by the Czech Statistical Office and the Statistical Office of the Slovak Republic, this method appears to be suitable for a quick evaluation of the competitiveness of the regions of the Slovak Republic.

## 2 Quality of life quantification as part of the measurement of regional competitiveness

Based on the model of Martinčík (2008), we can assess the area of the quality of life of the regions based on the values of the selected indicators (Table 1). The data source for the analysis was the DATAcube database of the Slovak Statistical Office. The data of self-governing regions in the Slovak Republic (NUTS3) for the period 2013-2020 were analyzed. In the analysis, indicators were used in relative terms (i.e. in terms of per capita), which enables comparison not only over time, but also between the analyzed regions (possibly also between regions in a wider international context) each other.

**Table 1 Indicators of the quality of life of self-governing regions**

sústava ukazovateľov podľa Martinčíka (2008)		upravené ukazovatele pre podmienky SR	Zdroj: Štatistický úrad SR, DATAcube
average incapacity for work due to illness	<b>KV1</b>	average duration of 1 case of incapacity for work due to illness total in days per capita**	zd3002rr
environmental pollution	<b>KV2</b>	amount of evaluated municipal waste in kg per capita *,**	zp3002rr
number of committed crimes per capita	<b>KV3</b>	number of committed crimes per capita**	sk3003rr
number of cultural facilities per capita	<b>KV4</b>	number of galleries, museums, theaters, permanent cinemas and facilities for leisure and hobby activities per inhabitant*	ku5005rr
number of doctors per capita	<b>KV5</b>	number of separate general practitioner clinics for adults, for children, dentists, gynecologists and specialists per capita*	zd3004rr
number of registered automobiles per capita	<b>KV6</b>	number of registered automobiles per capita	do3003rr
finished flats per capita	<b>KV7</b>	finished flats per capita	st3004rr

Source: own processing

Notes:

\* modified indicator

\*\* inverted values of the indicator were used in the model due to the inversely proportional relationship of changes in the value of the indicator to the level/dynamics of competitiveness

The indicators of the level and dynamics of the quality of life in the regions of the Slovak Republic were calculated from the indicators of the n-angle so that the values of the individual indicators were expressed as a share of the so-called base value. In the case of the evaluation of the level of quality of life, the basic value was the value of the indicators for the entire Slovak Republic. In the case of indicators of dynamics, the base value was the value of the individual assessed indicators (18-gon) in 2013. The overall level and dynamics of the quality of life as part of the regional competitiveness indicator were subsequently calculated as the arithmetic mean of the values of the indicators recalculated in relation to the base value for the individual indicators included in areas of quality of life assessment.

### 3 Quality of life in self-governing regions in the Slovak Republic

#### 3.1 Quality of life level

When evaluating the level of quality of life, the identical ranking of regions was found as in the overall index of the level of competitiveness (Výrostová, Hrabovská, Douša, 2023). It can therefore be concluded that the quality of life corresponds to the overall competitiveness of the regions, and the prerequisites for further favorable economic and social development are created in the regions and there is no deepening of undesirable regional differences (Table 2).

**Table 2 The level of quality of life in self-governing regions of the Slovak Republic in 2014-2020**

	2013	2014	rank ing 2014	2015	2016	rank ong 2016	2017	2018	rank ing 2018	2019	2020	rank ing 2020	2014/ 2020
Slovak Republic	100,0	100,0		100,0	100,0		100,0	100,0		100,0	100,0		
Region of Bratislava	159,2	159,2	1.	165,4	155,7	1.	154,7	144,4	1.	134,8	143,4	1.	
Region of Trnava	103,9	106,2	2.	105,2	109,1	2.	108,2	110,9	2.	115,0	113,2	2.	
Region of Žilina	95,0	99,2	3.	96,2	98,0	3.	99,1	100,1	3.	100,6	101,2	3.	
Region of Košice	99,1	95,5	4.	95,9	91,7	4.	93,0	90,9	4.	91,4	91,3	4.	
Region of Banská Bystrica	89,1	90,4	5.	91,3	92,8	5.	91,3	93,2	5.	94,8	92,7	5.	
Region of Trnava	88,9	89,5	6.	86,4	88,4	6.	85,0	87,4	6.	88,0	86,9	6.	
Region of Prešov	91,5	87,9	7.	86,4	89,0	7.	87,8	90,6	7.	91,1	89,4	7.	
Region of Nitra	80,2	80,1	8.	80,4	81,9	8.	85,7	87,0	8.	88,4	85,7	8.	

*Zdroj: own processing accordin to Statistical Office of the Slovak Republic, database DATAcube*

In the monitored period of 2014 – 2020, there were no changes in the ranking of self-governing regions when evaluating the level of quality of life compared to the average values of the quality of life in the Slovak Republic. The highest quality of life was achieved in the Region of Bratislava (in 2020, the values of the quality of life dynamics index were 43% higher than the SR average). The lowest level of quality of life was found in the Region of Nitra, where the values of the quality of life index in 2020 were only at the level of 85% of the average values for the entire Slovak Republic.

#### 3.2 Dynamics of quality of life

The situation in the area of quality of life is evaluated by a group of indicators, which assess the effects of the environment, the health status of the population and other cultural and social aspects of life in the regions. The dynamics of the quality of life in the self-governing regions shows changes compared to the values of the quality of life index in 2013. The situation is favorably evaluated when there is an increase in the values of the quality of life index in 2020 compared to 2013. At the same time, we can state that a higher increase in the index indicator

dynamics of the quality of life indicates higher dynamics of the quality of life of the self-governing region.

In 2020, the situation in the Region of Prešov was evaluated most favorably (a qualitative increase of up to 81.8% was recorded here compared to 2013).

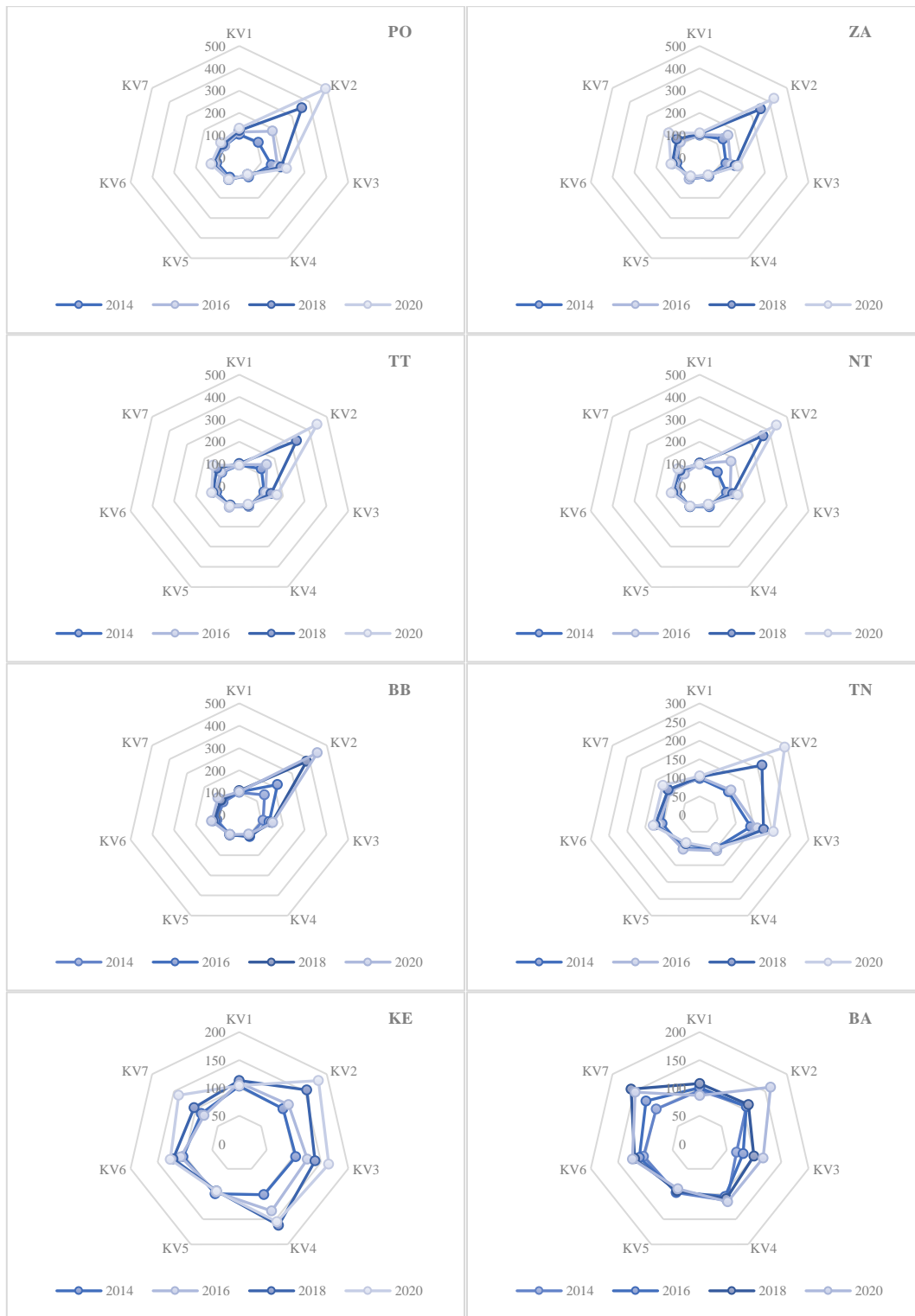
Paradoxically, the dynamics of the quality of life in the Region of Bratislava is rated worst, which compared to the base year, has the lowest values of all self-governing regions, as well as in comparison with the values of the index at the level of the Slovak Republic. This situation does not mean a decline in the quality of life in the Region of Bratislava (this region achieved the best values of the quality of life level in the evaluated period, Table 3). The rate of growth of the quality of life in the Bratislava region is lower than in the other self-governing regions, from which we conclude that there is a convergence of regions in the area of quality of life and in the future, we can expect a faster convergence of the quality of life of the self-governing regions to the most advanced Region of Bratislava.

**Table 3 Dynamics of the quality of life in self-governing regions of the Slovak Republic in 2014-2020**

	2013	2014	pora- die 2014	2015	2016	pora- die 2016	2017	2018	pora- die 2018	2019	2020	pora- die 2020	2014/ 2020
Slovak Republic	100	103,5		107,7	111,9		118,9	130,0		132,9	144,3		
Region of Prešov	100	106,2	4.	112,7	125,1	2.	129,5	154,9	1.	161,5	181,8	1.	↑↑↑
Region of Žilina	100	110,7	1.	109,8	118,7	3.	132,4	151,1	3.	157,8	171,1	2.	↓
Region of Trnava	100	105,3	5.	108,3	113,2	5.-6.	120,3	144,8	5.	154,2	168,3	3.	↑↑
Region of Nitra	100	104,4	6.	110,2	117,1	4.	132,8	149,7	4.	158,6	165,1	4.	↑↑
Region of Banská Bystrica	100	107,4	2.	113,3	125,9	1.	134,4	152,7	2.	157,4	163,6	5.	↓↓↓
Region of Trenčín	100	107,3	3.	107,9	113,2	5.-6.	115,1	130,0	6.	136,9	148,0	6.	↓↓↓
Region of Košice	100	99,8	7.	104,8	109,3	7.	121,6	126,8	7.	127,4	138,0	7.	
Region of Bratislava	100	97,6	8.	102,3	103,1	8.	111,0	114,1	8.	111,7	120,3	8.	

*Zdroj: own processing accordin to Statistical Office of the Slovak Republic, database DATAcube*

Positive changes in the quality of life in the Regions of Prešov, Žilina, Trnava, Nitra and Banskobystrica were mainly contributed by the favorable development of the values of the KV2 indicator (volume of municipal waste produced), while no significant changes in the KV2 indicator were recorded in the Regions of Košice and Bratislava as well as the reduction in the number of of crimes per inhabitant (KV3) (Figure 1).



**Figure 1 Changes in indicators of the quality of life in self-governing regions of the Slovak Republic in 2014 - 2020**

*Source: vlastné spracovanie*

## Conclusion

When examining the quality of life in relation to changes in regional competitiveness, we used selected objective indicators that were available in publicly accessible databases of secondary data. However, the quality of life is theoretically defined very broadly and there is no universally accepted definition. This variety of opinions on the quality of life is also reflected in the approaches to its evaluation. It is therefore particularly necessary to emphasize that the interpretation of changes in the quality of life in the regions depends on the choice of evaluated indicators. In addition, the subjective perception of the quality of life through the individual satisfaction of citizens should not be forgotten. In the presented paper, we focused on the assessment of the quality of life in self-governing regions in the Slovak Republic, while we found that in the observed period of 2014 - 2020, there were no changes in the order of NUTS3 regions in the achieved level of competitiveness. When evaluating the dynamics of competitiveness (i.e. when comparing the values of the quality of life index in the regions with the average values in the Slovak Republic), we note that interregional differences are diminishing and the level of quality of life in the regions of the Slovak Republic is approaching the level of quality of life achieved in the Region of Bratislava.

In order to achieve a more comprehensive picture of the quality of life in the regions, it is advisable to expand the model with other indicators in the field of education, healthcare, social care, living conditions, etc. as well as the residents' opinions on the subjective perception of the quality of life.

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# E-COMMERCE: A PROSPEROUS FORM OF TRADING IN SLOVAKIA

## E-COMMERCE: PROSPERUJÚCA FORMA OBCHODOVANIA NA SLOVENSKU

*Mária JANOŠKOVÁ*

### **Abstract**

In recent years, e-commerce is one of the most common ways of shopping in the countries of the developed world. In the era of digital revolution and rapid technological changes, e-commerce has become an attractive way of buying and selling goods and services. It is an increasingly important tool for traders, who want to expand their business, but also for customers who use e-commerce as a more convenient and easier way of shopping. This trend is also visible in Slovakia, where e-commerce continues to expand and has an ever-increasing impact on the retail market and the economy. According to research findings, it is among the most popular ways of shopping. The paper deals with the development of e-commerce in Slovakia in the period from 2013 to 2022. After analyzing the macro and micro-environment of the industry, it points to the influence of individual factors, as well as the opportunities and threats resulting from the findings of the research.

**Keywords:** e-commerce, customers, macro environment, microenvironment, PEST analysis, Slovakia.

### **Abstrakt**

Elektronický obchod je v posledných rokoch jedným z najbežnejších spôsobov nakupovania v krajinách vyspelého sveta. V ére digitálnej revolúcie a rýchlych technologických zmien sa elektronický obchod stal atraktívnym spôsobom nákupu a predaja tovaru a služieb. Je čoraz dôležitejším nástrojom pre obchodníkov, ktorí chcú rozšíriť svoje podnikanie, ale aj pre zákazníkov, ktorí využívajú elektronický obchod ako pohodlnejší a jednoduchší spôsob nakupovania. Tento trend je viditeľný aj na Slovensku, kde e-commerce neustále expanduje a má stále väčší vplyv na maloobchodný trh a ekonomiku. Podľa zistení výskumu patrí medzi najobľúbenejšie spôsoby nakupovania. Príspevok sa zaoberá vývojom e-commerce na Slovensku v období rokov 2013 až 2022. Po analýze makro a mikroprostredia odvetvia poukazuje na vplyv jednotlivých faktorov, ako aj príležitosti a hrozby vyplývajúce z výsledky výskumu.

**Kľúčové slová:** e-commerce, makroprostredie, mikroprostredie, PEST analýza, Slovensko

### **Introduction**

The internet is the technology that influenced humanity the most at the turn of the millennium. This phenomenon has become an integral part of our life when many people cannot imagine existence without the internet. It simplifies our daily life when obtaining information, entertainment, and communication. It is also still a more significant part of the economy of developed countries.

The development of electronic commerce was mainly caused by technological innovations. In the early 1970s, the first applications were presented by innovations in the electronic transfer of funds from one organization to another. Only some companies and financial institutions used these. Consequently, electronic data interchange was introduced for the electronic transfer of documents, which extended electronic transfers from financial transactions to other types of transactions (Tokase & Mujmule, 2021).

Electronic business / e-commerce is a way of doing business, in which products or services are sold using computer networks, such as the internet. It uses technologies such as mobile commerce, electronic funds transfers, supply chain management, the internet marketing, online transaction processing, electronic data interchange, inventory management systems, and automated data collection systems. It usually uses the World Wide Web at least in one phase of the transaction life cycle, but it can also use other technologies, such as e-mail, etc. (Kütz, 2016).

Information technology is changing the way of doing business in the market. E-commerce implements technology for the automation of business transactions and workflows from the point of view of business processes. It is also a way to reduce the cost of services and at the same time increase the efficiency of products and speed up the service delivery process (Jain et al., 2021).

E-commerce makes it easier for people to conduct business transactions on the internet, without personal contact. Shafiyah et al. (2013) list seven advantages that make e-commerce unique and preferred, namely: omnipresence, global reach, universal standards, richness, interactivity, information density, and personalization/customization and adaptation.

According to Kütz (2016), businesses have several options that can be used individually or in combination. They include:

- Creation of web side for online purchase,
- Involvement on online marketplaces,
- Business between organizations,
- Collection of demographic data (the internet, social media),
- Exchange of data between organizations,
- E-mail marketing,
- Pre-sale of new products and services, etc.

E-commerce using as a way of transactions performing, connecting with the business, becomes still more and more popular. It becomes priority for the number of organizations and consumers.

## 1 Key events in the e-commerce development

In e-commerce history there were recorded several key events that played important role during its forming. Short review is given in Figure 1:

Year	Description of e-commerce development
1969	John R. Goltz and Jerry Wilkins had established first e-commerce organization by dial-up link, called CompuServe.
1979	Michael Aldrich established electronic purchase by link to the system for the transactions processing through telephone link to the television receiver.
1982	Permanent development of technologies in the electronic led to the launching of the first platform of electronic business by Boston Computer Exchange company.
1992	First online bookstore, launched by Charles M. Stack under the title „Book Stacks Unlimited“.
1994	Marc Andreessen and Jim Clark created Netscape Navigator as a tool for web browsing.
1995	Jeff Bezos launched Amazon as web page for electronic business for books sale. In the same year also Pierre Omidyar launched AuctionWeb, presently known as eBay.
1998	Max Levhin, Peter Thiel, Like Nosek and Ken Howery established PayPal as payment system for electronic business and as a tool for money transfer.
1999	Online market with financial means, exceeding 25 million dollars, presented by Alibaba Online.
2000	Google Adwords presented the waay how e-commerce companies could advertise through Google use.
2005	Amazon introduced membership at Amazon Prime. Etsy enabled craftsmen and small traders to sale goods online.
2009	Jack Dorsey and Jim McKelvey created Square. In the same year Eddie Machaalani and Mitchell Harper based internet business BigCommerce.
2011	Google Wallet enabled digital way of payment. Facebook began to provide for owners of business web pages' advertisement possibilities through the stories. Stripe company had been launched for payment processing.
2014	Apple company presented service Apple Pay as a tool for mobile payments and digital wallet, enabling users to pay for the products or operation at the Apple equipment.
2017	Partner of electronic business BigCommerce launched purchase on Instagram (Tokase & Mujmule, 2021).
2020	COVID-19 pandemic helped the rapid development of electronic business (BigCommerce, 2022).

**Figure 1 Key events in the e-commerce development**

*Source: own processing*

The introduction of the possibility to shop on the internet around 1990 meant a new way of doing business for entrepreneurs. Since then, e-commerce has seen incredible growth and transformation, resulting in huge benefits for clients and organizations worldwide (Bezhovski, 2016).

The e-shop is a website with the possibility of selling goods and services, enriched with other functions, such as a shopping cart, order, discount coupons, cash, and others. The use of an online store has many advantages, which is why it is popular even among beginning entrepreneurs.

CMS (Content Management System) is used to manage the content of the e-shop. It represents a safe and reliable editorial system, easy to use. Shopping through the e-shop enables customers to make a comfortable and quick purchase

from any place and device, while they can compare prices, delivery time of goods from several sellers, etc.

Rapid technological progress and the growth of the internet penetration have enabled the creation of a large number of new online stores and an increase in existing sales. Mobile e-commerce made it possible to shop via smartphones and tablets, which increases convenience and accessibility for customers.

## 2 E-commerce models

The successful functioning of e-commerce allows companies to generate several models that are gradually developed in relation to the products and services, provided to interested parties. They also include sources of income, as well as potential customer base. We present the following six basic models:

1. **Business-to-Business (B2B)** is an e-commerce model, in which goods or services are exchanged between organizations. It is usually a situation where one organization provides goods or services online to others, not to the target group.
2. **Business-to-Consumer (B2C)** refers to the distribution of goods and services from business to customers. It is one of the original forms of e-commerce; its volume has tremendously grown in the last two decades (Meghani, 2022).
3. **Consumer-to-Business (C2B)** is the opposite of the B2C model, which means that in this case customers offer goods and services to entrepreneurs. There are two categories of C2B e-commerce owners:
  - Independent representatives offer products or services on a website created for this purpose. This approach helps to communicate directly with customers and negotiate deals.
  - Freelancers are service providers and product sellers on the independent sites (Meghani, 2022).
4. **Consumer-to-Consumer (C2C)** means that a customer sells goods to other customers usually through a website, third party or independent online platform, created for this purpose. In general, all peer-to-peer transactions of goods and services are carried out online and fall under the C2C e-commerce business model. It requires a high level of trust between customers.
5. **Business-to-Government (B2G)** means that a business sells its product or service to the government through a website.
6. **Customers-to-Government (C2G)** presents an electronic commerce between customers and the government. It helps individuals request data or submit comments regarding public services directly to government institutions. This category includes e.g. electricity bills, health insurance fees/payments and taxes. It is a simple way for customers to communicate with the government immediately (Taher, 2021).

### 3 Methodology

The object of our research is the Slovak B2C market, where organizations offer their products and services directly to customers. We focused on the structure of the market, trends, customer preferences and competitive environment. We used qualitative and quantitative methods, online survey, and statistical data analysis.

We conducted a primary analysis of the current state of the macro-environment and microenvironment of the e-commerce to obtain up-to-date information, considering the rapidly changing elements. We obtained information and data from secondary sources, published studies, reports and statistics on e-commerce, namely from Eurostat, Heureka, APEK, GeoPost, WorldBank, etc.

### 4 Results: Analysis of e-commerce macro environment in Slovakia

E-commerce in Slovakia is influenced by macro environmental factors; therefore, we used a PEST analysis to evaluate them. We focused on selected political, legislative, economic, socio-cultural and technological factors that are most important for e-commerce.

- **Political-legislative environment:** Slovakia is a stable democracy and has good international relations, which is reflected in its membership in EU, NATO, and OECD. The country recorded increased trade and investment, but at the same time, it faces challenges related to EU membership, such as compliance with standards and regulations. The government's stability suffered a little in the last election period, but it continues to support comprehensive and sustainable economic development (AllianzTrade, 2023). Political-legislative factors affecting e-commerce, primarily including the government's approach to ICT support and the adoption of e-commerce legislation. The EU documents that the member states, including the Slovak Republic, implement at the national level have a significant influence on the mentioned factors. In Slovakia, there are several legal regulations, regulating e-commerce and providing protection to consumers. The rapid development of digital services and new technologies has a significant impact on the field of e-commerce. Communication, shopping and obtaining information have become part of the daily routine and are constantly evolving. The European Digital Agenda for 2020-2030 seeks to ensure a secure digital environment, and similar conditions for digital markets with major platforms and the improvement of European digital sovereignty.
- **Economic environment:** conditions for the development of e-commerce are influenced by many macroeconomic factors. These include the country's economic level, economic growth, and the ability of businesses to innovate. From February 2022, the economic performance of Slovakia is affected by the adverse consequences of the Russian invasion of Ukraine. Disruption of supply chains and the banning of some categories in foreign trade have slowed down

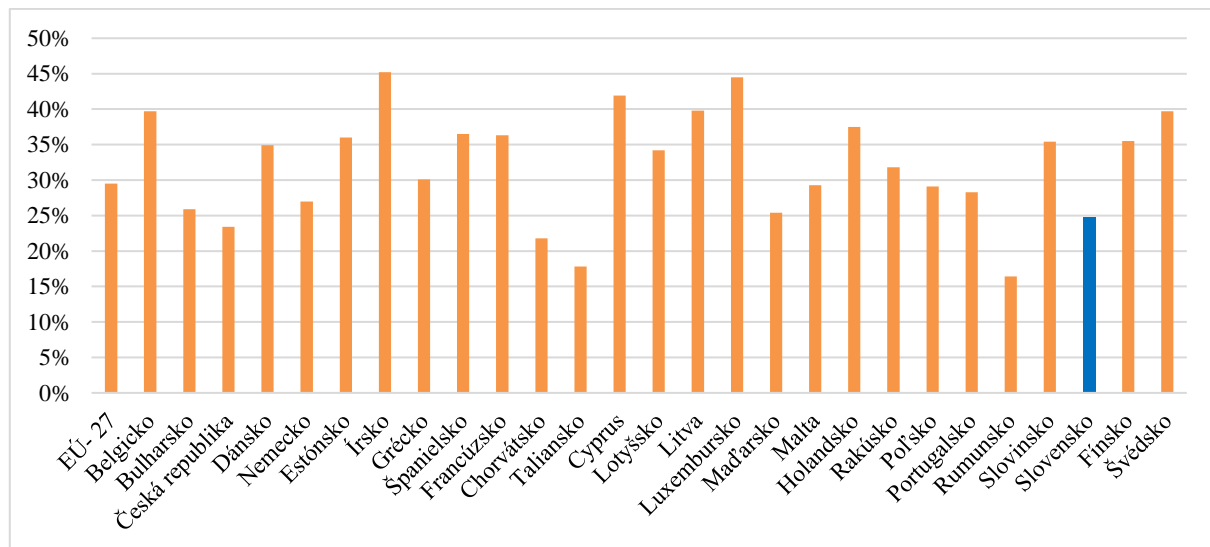
the industry's performance. Energy dependence on Russia increases the prices of oil, electricity and gas and it creates significant pressure to inflation (Erste Group, 2022).

**Table 1 Chosen macroeconomic indicators in Slovakia**

Indicator	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
GDP per inhabitant (%)	0,5	2,6	5,1	1,8	2,8	3,9	2,4	-3,5	3,4	0,6
Average inflation (%)	1,5	-0,1	-0,3	-0,5	1,4	2,5	2,8	2,0	2,8	12,1
Measure of unemployment (%)	14,1	13,1	11,5	9,6	8,1	6,5	5,7	6,7	6,8	6,1

Source: own processing according to (Eurostat, 2023)

- Socio-cultural environment:** including the aspects that are difficult to measure. For e-commerce, the key factor is the level of education, the attitude of the population towards new information and communication technologies, the use of the internet, the ability to communicate in a foreign language, etc. The level of population education in Slovakia has been increasing in recent years. According to Eurostat data (2023), the rate of the highest education attainment in Slovakia was in 2022 – 24,7 %, which means below the EU average (29,5%) (see Figure 2).

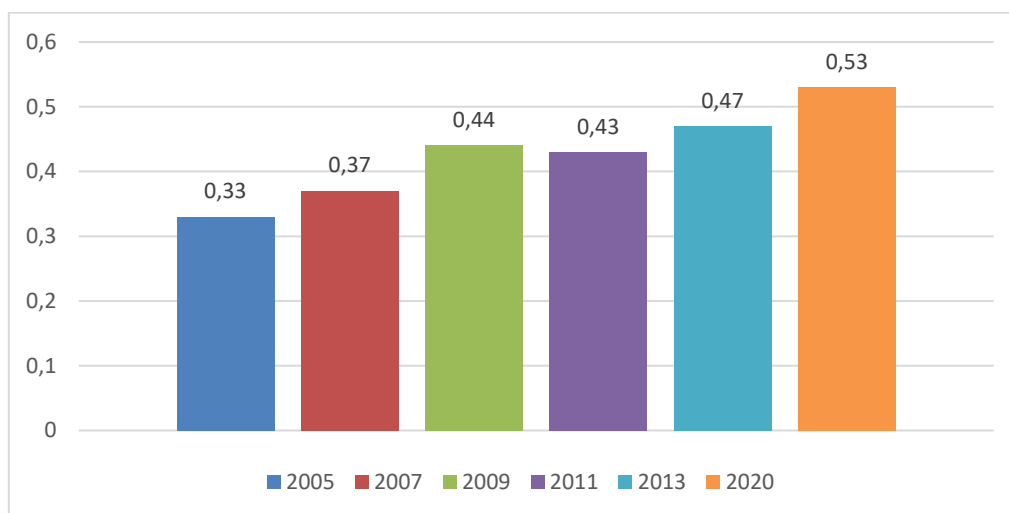


**Figure 2 Measure of the highest achieved education in Slovakia and EU (%)**

Source: own processing according to (Eurostat, 2023)

Knowledge of a foreign language is a highly valued skill not only in Slovakia, but also worldwide. Since global economy and business relationships cross national borders, it is essential to be able to communicate in multiple languages. According to the English Proficiency Index (EFI) world ranking, Slovakia in 2022 placed in 23<sup>rd</sup> place among 111 countries in the world in measuring the level of knowledge of the English language. In Europe, Slovakia

is in 13th place (35 countries). The Institute for Public Issues (IPI) presented the results of the long-term analytical and monitored project “Digital Literacy in Slovakia.” The project from 2005 mapped one of the key prerequisites for a successful transition to an information society and a knowledge-based economy, namely the readiness of population groups to use modern information and communication technologies (ICT). In 2020, the level of digital literacy improved in Slovakia, expressing the ability to work with modern information technologies. The index, which measures 29 digital skills, reached a value of 0.53 points, which means the population over 14 years of age scored 53 points out of 100 for their skills (see Figure 3).



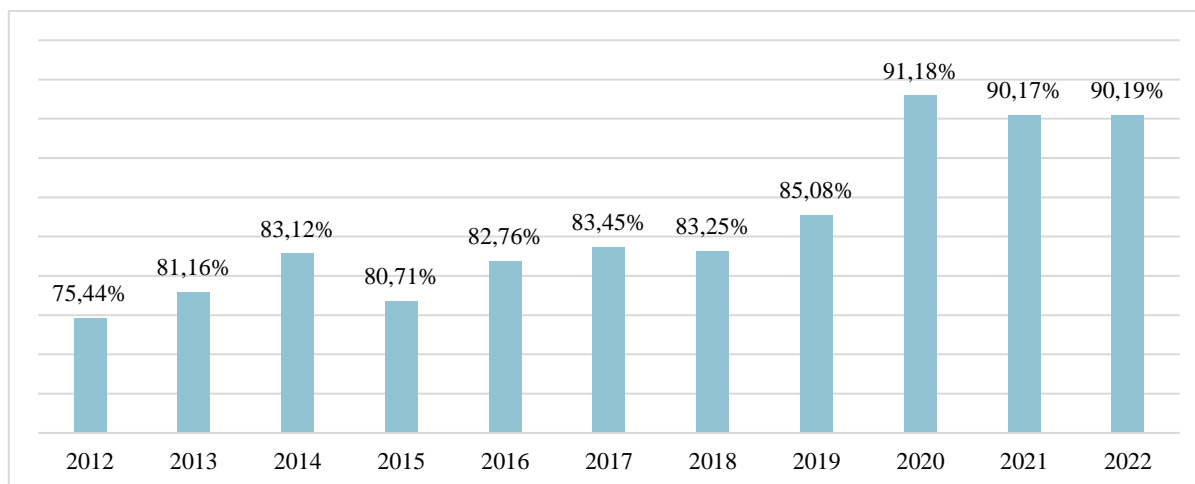
**Figure 3 Level of digital literacy of Slovakian population (Index in points)**

*Source: own processing according to (Velšic, 2020)*

Compared to the measurement in 2005, there was recorded a most significant improvement in the field of electronic communication (social networks, chat, video chat, mail, SMS/MMS, discussion groups, forums, etc.), in work with information and electronic services, the internet banking and e-shopping - from the original 33 points to 53 points out of 100 (see Figure 3). Overall, there was an increase in the level of digital skills (work with forms and questionnaires, searching for information, etc.). Hardware control skills (connecting to the internet, work with the scanner, computer, touch devices, smartphones, tablets, etc.) have also improved. However, adaptation to ICT varies according to social groups and environments. The older people are, the lower their education, social status and economic activity, the less likely they are to be willing and able to adapt to new technologies. In addition, regional differences are no longer as important as in the past. Groups with high resistance to adaptation mainly include the population over 65, with low education, pensioners, the unemployed and low-income households (Velšic, 2020).

- **Technological environment:** the internet presents an inseparable part of e-commerce. Without this tool, e-commerce could not exist. The internet began its use in Slovakia from the beginning 90s. The use of the internet in Slovakia

is developing and since 2020, its use increased significantly, compared to 2012 up to 15% (see Figure 4). Currently, more than 90% of the population uses the internet, which is very positive for e-commerce. In 2020, the impact of the COVID-19 pandemic was also reflected in the use of the internet (more than 91% of the population).



**Figure 4 The internet use in Slovakia (%)**

*Source: own processing according to (Eurostat, 2023)*

In e-commerce, information and communication technologies (ICT) have a great importance. A key requirement for the successful introduction and use of e-commerce is the existence of functional telecommunication networks, enabling a high-quality connection to the internet with sufficient data transmission speed. In March 2021, the Slovak government approved a national extension plan to ensure that every household (urban or rural) has access to the internet connection with a minimum speed 100 Mbps (European Commission, 2023). Broadband internet is already widely available in Slovakia, smartphones and tablets are popular, becoming a common way to access the internet. The rapid ICT development brings many opportunities for e-commerce, e.g. new forms of marketing, digital products or services. On the other hand, for organizations that do not know how to respond adequately to new technologies, ICT represents a permanent risk.

## **5 Results: Analysis of e-commerce microenvironment in Slovakia**

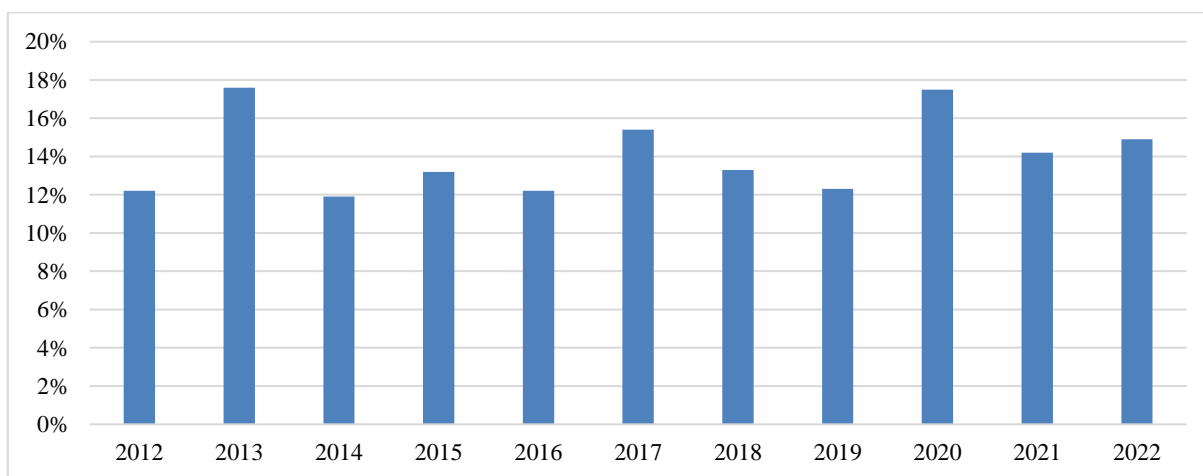
When analyzing the microenvironment, we identified factors, influencing the object of research. This procedure enabled to identify the key aspects, influencing the functioning and performance of the investigated object in its microenvironment. We used STEP analysis method for the evaluation of the macro environment, including the examination of the factors from the social, technological, economic, and political environment, affecting e-commerce in Slovakia (Antošová, 2012). By this way, we gained an overview of the wider context, and we identified the key factors that influence it.



Presently, there is no business sector, completely avoiding digital transformation. The rapid development of the internet and technology has resulted in the boom of e-commerce, which has become part of everyday life. In this context, more and more attention is to the microenvironment of electronic commerce in Slovakia.

The success of organizations operating in e-commerce in Slovakia is influenced by many factors. It includes competitors, suppliers, customer behavior, logistics, distribution, innovation, and related marketing activities. With the increasing number of online shopping customers, it is important to research and analyze the microenvironment of e-commerce so that businesses can adapt and be successful in the market.

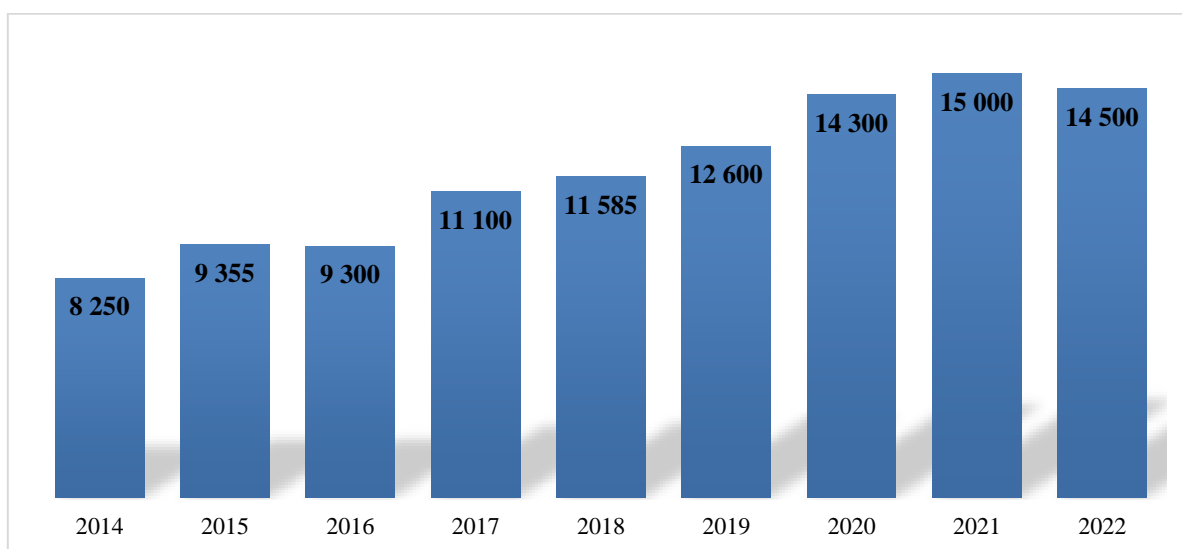
- **Market size:** E-commerce allows businesses to access new markets and customers around the world. In order for businesses to be able to trade effectively through the internet, they must orientate themselves in a foreign-language environment, make and receive payments in foreign currency, ensure cross-border delivery of goods and manage potential problems related to international trade and legislation. If these prerequisites are met, B2C e-commerce is practically unlimited. The Slovak Republic is one of the growing regions in Central Europe in the field of e-commerce. As the digital infrastructure and logistics network improves, the country's growth potential is evident. The graph in Figure 5 expresses the percentage of companies, receiving at least 1% of their orders through the internet. When comparing the development of e-commerce in the years 2012-2022, we find that while in 2012, 12.1% of organizations did business online, in 2020, it was up to 17.7%, and in 2021-2022, there was a slight decrease. It is important to realize that the drop to 14.9% in 2022 is not significant and e-commerce still represents considerable potential for businesses that decide to invest in this area. This proves that online sales and ordering of goods and services is a significant trend in Slovakia.



**Figure 5** Number of companies in Slovakia, accepting minimally 1% online orders

Source: own processing (Eurostat, 2023)

- Entry into the e-commerce market and the number of e-shops:** low entry barriers characterize B2C e-commerce in Slovakia. An e-shop can be set up by an entrepreneur who meets the basic criteria for establishing a business company and, in addition, procures an electronic platform for operating an e-shop. There are several providers of various services for e-commerce, such as payment gateways, carriers, marketing agencies, etc., which facilitate the operation of the e-shop. Even so, gaining and maintaining a stable position in a competitive environment requires careful planning and a good strategy. From 2012, the e-commerce market grew up to 82% (year 2021) thanks to the rapid development of digital technologies and the increase in demand for online purchases. In addition to the number of e-shops in Slovakia, their character is also changing. Their website becomes more than just a place to buy; customers can also get information, reviews and advice. They become attractive to customers. As the e-commerce market grows, so do competition. Annually, 500-700 new online sales are created in Slovakia, the quality and professionalism of which are increasing (see Figure 6). The dynamics is also proven by the fact that up to a quarter of the online stores that exist today, were founded during the pandemic. Entering the e-commerce market is relatively easy; an e-shop can be set up with minimal costs, without the need to own a physical operation. Many traditional “stone” stores have decided to establish their own e-shop in order to maintain their sales and compete with other sellers.

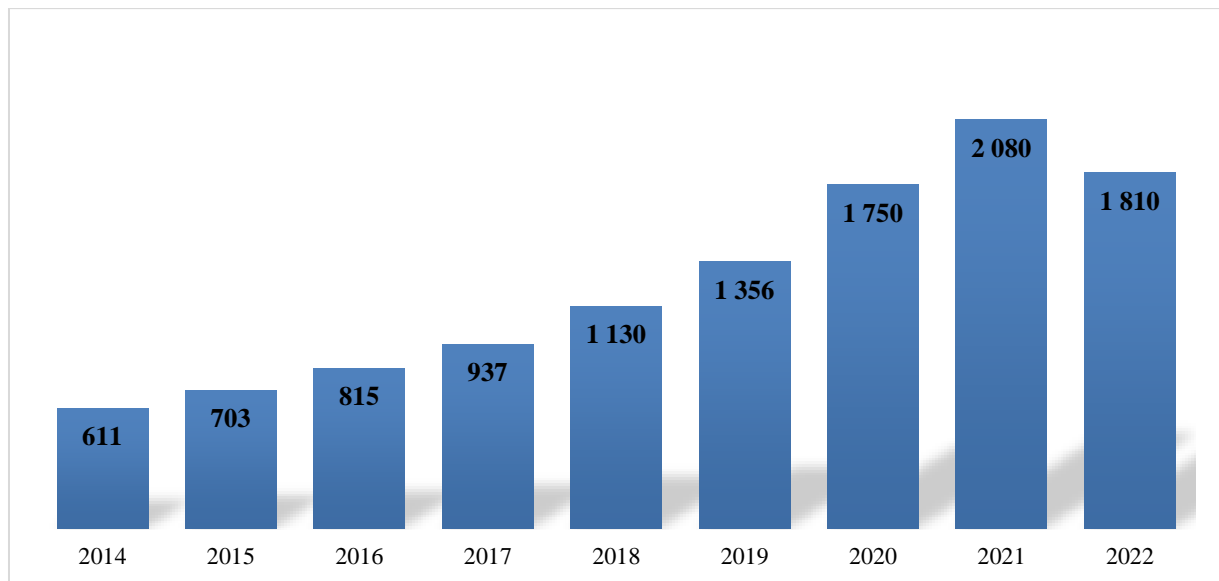


**Figure 6 Number of e-shops in Slovakia in 2014-2022**

*Source: own processing according to (Heureka group, 2022)*

- Development of e-commerce sales:** The Covid-19 pandemic had a significant impact on sales in e-commerce in Slovakia. Because of the closure of “stone” stores and restrictions on free movement, many customers have turned to online shopping. According to the Heureka portal, in 2020 turnover in Slovakia recorded € 1.75 billion, i.e., an increase of 29% compared to 2019. The number of online stores also increased significantly by 13.5% (see Figure 7), and

customers had more choices. After years of growth, in 2022, there was decrease in sales by 13%.



**Figure 7 E-commerce turnover in Slovakian market (in mil. €)**

*Source: own processing according to (heureka.group, 2022)*

- **Competition in e-commerce:** Due to the ease, with which customers can obtain goods and services from all over the world through the internet, there is a high competition in e-commerce. Competition in e-commerce also offers advantages to customers. Lower prices and higher quality of goods and services are the result of increased competition. In order to compete in this market, e-shops often have to provide better prices, faster deliveries and a higher level of customer service. E-commerce customers also have the ability to compare products and prices from different sellers in real time, which greatly benefits their purchasing decisions. In order to be competitive and to retain their customers, online sellers must constantly improve their product offering, prices and other services.

According to the size of e-shops sales in Slovakia in 2020, the e-shop Alza.sk, which originally started with the sale of electronics and appliances, later added games, books, toys, sports equipment, drugstores, and other goods, placed in the 1st place. Mall.sk was in 2nd place was, offering similar goods. 3<sup>rd</sup> place belongs to iTesco.sk, which mainly sells food and household goods. Forbes Slovakia magazine published a list of the most famous e-shops operating on the Slovak market, based on data from financial statements, taking into account sales and profit, as well as the ratio of online sales on the total sales (Forbes, 2022).

	<b>Company</b>	<b>Orientation</b>
1.	Andrea Shop	Electronics/ various
2.	Dedoles	Fashion
3.	Eyerim	Fashion
4.	Factcool	Fashion
5.	GymBeam	Sports nutrition
6.	Kondela	Furniture
7.	Martinus	Books
8.	MobilOnline	Electronics
9.	MTBiker	Sports equipment
10.	Nay	Electronic

**Figure 8 Top e-commerce in Slovakian market in 2022**

*Source: own processing according to (Forbes, 2022)*

The mentioned e-shops are the most important e-commerce players in Slovakia. They have a similar importance, contributing to the development of the e-commerce ecosystem. They have their own focus and assortment, trying to reach different customer groups with different preferences and needs. Customers decide which of them best suits their purchasing requirements and preferences.

- **Customers:** In recent years, the Slovak online market has achieved a solid place on the map of European e-commerce. Slovakia is a smaller Central European country, but in this area, it also competes with large European countries (Černý et al., 2022). Slovak customers use online stores more and more often every year. Almost 77% of Slovaks did in 2022 at least one online purchase (Table 2). Compared to the average of the European Union, we are among the nations where online shopping is progressing. In the last 10 years, the level has increased by almost 30%, above the average of consumers in the EU. This is related not only to the expansion of the internet availability and the growth of e-commerce, but also to the growing trust in electronic payment methods.

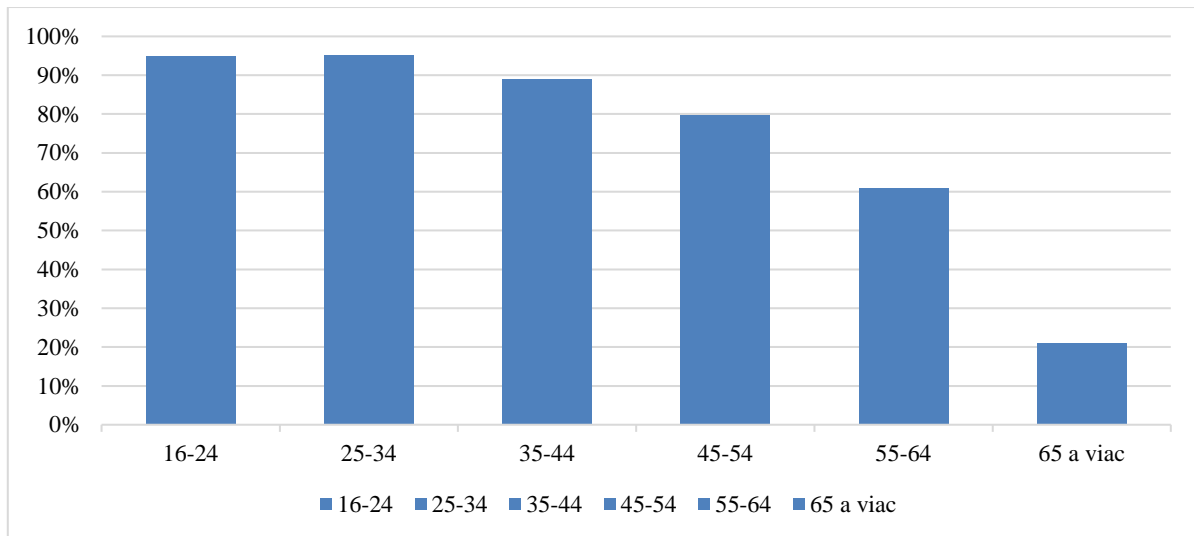
**Table 2 Online purchase in 2012-2022 (in %)**

	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>
<b>Slovakia</b>	47,21	50,24	52,95	55,12	57,46	59,52	63,21	62,45	75,32	76,72
<b>EU</b>	44,48	48,12	49,63	56,34	58,53	59,00	60,18	64,74	67,11	68,02

*Source: own processing according to (Eurostat, 2023)*

Online shopping has been preferred by more and more people of all ages in Slovakia in recent years. This trend is associated with various benefits, including the convenience of shopping from home, a diverse selection of products, fast delivery, increased digitization and technological advances. Younger generations mostly use online shopping and perceive it as a natural part of their lives (up to 95%). Middle-aged people are quickly discovering the

benefits of online shopping and using it to buy items they cannot get in “stone” stores (about 80%). Older generations, who were initially reluctant to shop online, are gradually discovering its benefits (20%) (see Figure 9).



**Figure 9** Age categories of consumers in Slovakia, shopping online

*Source: own processing according to (Eurostat, 2022)*

The most frequently used device for online shopping is a smartphone (68%), their big advantage is that they are portable and allow shopping anytime and anywhere. Less used devices are laptops (43%), computers (34%) and tablets (19%). They are popular for the middle generation, suitable for browsing products, reading reviews, and knowing the products.

Electronic commerce gained the most number of new customers during the Covid-19 pandemic, who in 2020-2021 shopped online due to the limited opportunities to shop in “stone” stores. This trend was manifested mainly in the area of food, drugstore and hygiene needs, and lately also in other categories. Slovaks currently buy the most clothes (69%), shoes (54%), perfumery/drugstore (54%), medicines/health (37%), books (35%), food/drinks (32%), electronics (23%) and sporting goods (22%). In recent years, e-commerce in Slovakia has increased awareness of environmental issues and interest in environmentally friendly solutions. As online retailers realize that their business has an impact on the environment, they strive to reduce their ecological footprint. In Slovakia, 63% of customers prefer to buy ecological products and services, and 48% are willing to pay extra for them (Mergado, 2020).

- **Partners:** The development of e-commerce is strongly influenced by marketing companies, carriers, and financial institutions. Currently, there are many entities offering marketing, consulting, technical and other services for B2C e-commerce (e.g. Heureka, Mergado, Shoptet, etc.). In addition to its own transport, the online store can use various carriers, including Slovak Post, DHL, DPD, GLS, 123Kuriér, etc. The partners of online traders are also the extensive network of Packeta, ParcelShop and parcel machines. It is important that the e-shop provide customers with different shipping options so that each customer can choose. When choosing a shipping method, customers consider delivery speed, price, and availability. Due to the lack of delivery options, customers often abandon the shopping cart before finally ordering the goods. Online sellers in Slovakia can use banks and non-bank companies for insurance and payment processing, including PayPal, GP Webpay, GoPay, 24Pay, Besteron and Trustpay. The most widespread are payment options via the internet banking, which include TatraPay from Tatra banka, Sporopay from Slovenská sporiteľňa, ePlatby from VÚB (EcommerceBridge, 2019). According to the survey, the most used payment method online in Slovakia are Visa/Mastercard payment cards (58%), online bank transfer (31%), digital wallet (26%) and other payment applications (10%). Despite increasing digitization and the internet penetration in society, and thanks to the growing demand for fast and secure payment solutions, consumers also very often use cash on delivery (52%).

## **6 Opportunities and threats for Slovakian e-commerce**

After a thorough analysis of the macro and microenvironment, we evaluated the opportunities and threats for Slovak e-commerce. The classification of factors shows the prevalence of opportunities over threats, which can be potentially favorable for B2C e-commerce in the future. Among the opportunities are the growth of the e-commerce market, the increasing availability of the internet, the growing confidence of consumers in online shopping, also thanks to the increased number of mobile devices. The threats include increasing competition, increasingly demanding customers, and the deteriorating macroeconomic situation of Slovakia, which negatively affects the purchasing power of Slovaks.

Criteria	(+) Opportunities	(-) Threats
Political and legislative factors	<ul style="list-style-type: none"> <li>• Support of digitalization development</li> <li>• Customer protection</li> <li>• Cooperation with EU</li> </ul>	<ul style="list-style-type: none"> <li>• Possible changes in legislation that can negatively influence e-commerce</li> </ul>
Economic factors	<ul style="list-style-type: none"> <li>• Stable business environment</li> <li>• EU support</li> </ul>	<ul style="list-style-type: none"> <li>• Negative macroeconomic conditions</li> </ul>
Social and cultural factors	<ul style="list-style-type: none"> <li>- high measure of ICT use, mainly mobile equipment</li> <li>- good availability and high measure of the internet use</li> </ul>	<ul style="list-style-type: none"> <li>- older population and other groups with low measure of digital literacy</li> </ul>
Technological factors	<ul style="list-style-type: none"> <li>- increasing of the high speed internet coverage in Slovakia</li> </ul>	<ul style="list-style-type: none"> <li>- shortage of the internet infrastructure in some Slovakian regions</li> </ul>
Competitiveness, possibility of market entrance	<ul style="list-style-type: none"> <li>- increasing and developing market</li> <li>- almost none barriers for market entrance</li> </ul>	<ul style="list-style-type: none"> <li>- new B2C businessmen</li> <li>- pressure to prices and margin decreasing in competition environment</li> </ul>
Partners	<ul style="list-style-type: none"> <li>- number of transport possibilities</li> <li>- number of payment ways possibilities</li> </ul>	<ul style="list-style-type: none"> <li>- customer mistrust of payment / transport way</li> </ul>
Customers	<ul style="list-style-type: none"> <li>- increasing interest on online purchase</li> <li>- increasing trust of customers</li> </ul>	<ul style="list-style-type: none"> <li>- demanding customer</li> <li>- decreasing level of customer's purchasing power</li> </ul>

**Figure 10 Opportunities and threats for Slovakian e-commerce**

*Source: own processing*

## Conclusion

Nowadays, e-commerce presents an integral part of modern business. It uses the internet technologies and allows customers to conveniently shop from any location using a computer, tablet or smartphone. Due to the mentioned, e-commerce has become a very popular tool, rapidly developing. The research results presented above indicate that e-commerce in the form of B2C in Slovakia can be evaluated positively.

Shopping behavior in Slovakia is influenced by demographic factors, namely age, gender, occupation and economic situation, education and other factors. Slovak customers appreciate quality, looking for a reasonable price and giving emphasis on brands and the origin of products. They are often loyal to certain brands and merchants, whom they consider trustworthy, and in terms of opportunities to use of modern ICT, they prefer online shopping. If there has been an increase in online shopping in recent years, it is also due to increased trust in electronic commerce, good availability of the internet and mobile devices. Slovaks are often motivated to buy online by special offers and promotions, but

the key element remains quality and trust in the seller. It is important for them to be able to compare prices at several sellers online and in “stone” stores.

E-commerce is increasingly influencing the Slovak retail market and the overall economy of the country. Due to the rapid development of technology and changes in customer preferences, e-commerce should be growing even more significantly in the future. Challenges and opportunities for business will vary, depending on country specifics and changing consumer needs. Therefore, it is important to constantly monitor the market and adapt to new trends and technologies. Our interest is to focus ongoing research on the comparison of the e-commerce market in Slovakia and other V4 or EU countries.

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# WASTE MANAGEMENT OF VRANOV NAD TOPLĽOU

## ODPADOVÉ HOSPODÁRSTVO MESTA VRANOV NAD TOPLĽOU

*Pavol KALUHA*

### **Abstract**

The paper is focused on the evaluation of the waste management situation in the town of Vranov nad Topľou. The aim is to comment on the importance of indicators related to municipal waste management, such as the amount of municipal waste produced, the recycling rate of municipal waste and the amount of waste disposed in landfills in order to achieve the objectives of the Waste Prevention Programme of the Slovak Republic, the Waste Management Programme of the Slovak Republic and the Sustainable Development Goals of the key document of the United Nations AGENDA 2030 and to propose measures that would contribute to improving waste management, intensifying material and energy recovery and also reducing the amount of landfilled waste. This will lead to an increase in the environmental and economic efficiency of the municipality.

**Keywords:** waste, waste management, sustainable development

### **Abstrakt**

Príspevok je zameraný na zhodnotenie stavu odpadového hospodárstva mesta Vranov nad Topľou. Cieľom je vyjadriť sa k dôležitosti indikátorov týkajúcich sa odpadového hospodárstva samospráv, ako napríklad k množstvu vyprodukovaného komunálneho odpadu, miere recyklácie komunálneho odpadu a množstvu uloženého odpadu na skládky v snahe dosiahnuť ciele Programu predchádzania vzniku odpadov Slovenskej republiky, Programu odpadového hospodárstva Slovenskej republiky a ciele udržateľného rozvoja kľúčového dokumentu Organizácie spojených národov AGENDY 2030 a navrhnúť opatrenia, ktoré by prispeli k zlepšeniu nakladania s odpadom, intenzifikácii materiálového i energetického zhodnotenia a takisto zníženiu množstva uloženého odpadu na skládky. Tento krok povedie k zvýšeniu environmentálnej a ekonomickej efektívnosti samosprávy.

**Kľúčové slová:** odpad, odpadové hospodárstvo, udržateľný rozvoj

### **Introduction**

Waste management in cities and municipalities is a key aspect of sustainable development. The population of countries is constantly growing and with increasing urbanisation, the volume of waste is increasing, presenting new challenges to municipalities. Today, however, waste should not only be seen as a problem, but also as an opportunity to improve our quality of life and protect the environment.

### **1 Waste and sustainability**

In the literature we encounter different definitions of waste. Waste Act no. 79/2015 Z. z., § 2, section 1 defines waste as a movable thing or substance which the holder disposes of, wants to dispose of or is obliged to dispose of in accordance with this Act or special regulations. (Waste Act no. 79/2015 Z. z. about waste).

In his publication, Pitchel identified waste as a solid material that has no economically added value (Pitchel 2014).

„Sustainability is defined by meeting our needs to complete a certain task or activity in an efficient and productive manner that benefits the implementer and does not negatively affect the environment around us, in an approach that allows us to better utilize resources in three key areas, they are: economy, environment, and society.

1. Economic impact, is represented in the financial benefits of adopting different plans in the operations involved at achieving a certain task.
2. Environmental impact, involves the effect outputted from the activities we perform, this comes in the form of emissions, non-natural or non-native products outputted to the planet's ecosystem.
3. Societal impact, targets the effect of our activities on humans' quality of life. this involves their access to resources, employment and as well as the presence of a healthy ecosystem for them to live in. “ (Mubaslat, 2021)

„Sustainability is deeply rooted within waste management as some consider it to be the basis on which it is built on. governing this relation is the concept of the 3rs of waste management and what will further be introduced as part of the environmental pyramid.

Three Rs of sustainability are reduce, reuse and recycle, and they can be utilized across our waste management operations by follow three key recommendations, which are:

1. Waste Reduction, is most preferable to us as it provides the best sustainable outcome of the 3 R's of waste management.
2. Waste Reuse, whenever we find an inevitable source of waste, we look at opportunities to reuse, either for the same purpose or for another. this provides us with moderate sustainable payback.
3. Waste Recycling, is the least preferable as it provides the least sustainable returns. (Mubaslat, 2021)

## **1.1 Municipal waste**

Waste Act no. 79/2015 Z. z. defines municipal waste as "mixed waste and separately collected waste from households, including paper and cardboard, glass, metals, plastics, biological waste, wood, textiles, packaging, waste electrical and electronic equipment, used batteries and accumulators and bulky waste, including mattresses and furniture, mixed waste and separately collected waste from other sources if such waste is similar in nature and composition to household waste." (§ 80 Waste Act no. 79/2015 Z. z.).

The waste produced must be collected and treated appropriately, which is still a problem in many developed countries, leading to potential risks such as groundwater or air contamination (Ahmed, Dijk 2023).

The increasing amount of municipal solid waste generated in many parts of the world has become a significant environmental challenge. (Hassan et al., 2023)

Elimination of the level of environmental pollution caused by municipal waste can be achieved mainly in two ways, namely through the development of more advanced and economically viable zero-waste technologies or through organised waste collection, which is linked to more environmentally friendly recovery and recycling (Stričík, Čonková, Bačová, 2019).

## 1.2 Waste Management Hierarchy



**Figure 1 Waste Management Hierarchy**

*Source: own processing*

The waste management hierarchy consists of 5 activities, which are ranked from the most appropriate waste management options to the least appropriate.

1. Waste prevention is the first priority (Ogunwumi, Salami 2023).
2. If this is not possible, the product generated should be prepared for reuse through various treatments. In this step, the product may not become waste but rebirth occurs.
3. Recycling, in which the production source is recovered and an input material is created to carry out the next production process.
4. Waste recovery, during which waste is positively used (e.g. for energy).
5. Waste disposal: the worst management option in the waste hierarchy (e.g. incineration without energy recovery).

The waste management hierarchy points to the most environmentally friendly steps to be taken before waste is landfilled. (EPA 2020). This is also why it is an environmentally unacceptable activity that is considered extremely harmful to the environment and therefore not usually listed in the hierarchy. There are many negative impacts associated with landfilling, such as the release of methane gas or the contamination of groundwater with leachate. (Wenga, 2023).

## 2 Waste Management of Vranov nad Topľou

This section focuses on the analysis of the state of waste management in the city of Vranov nad Topľou and the comparison of individual indicators for the years 2017-2021.

The indicators used in research are:

- estimated amount of waste generated per year,
- the minimum expected amount of waste to be separated from the total volume of municipal solid waste,
- the maximum amount of waste landfilled out the total waste generated per year,
- revitalization and construction of container stands.

(Actual data for 2022 and 2023 have not yet been published by the city and therefore we work only with projected values in these years).

**Table 1 Waste management of Vranov nad Topľou**

<b>indicator</b>	<b>estimated amount of waste generated per year (tonnes)</b>						
<b>year</b>	2017	2018	2019	2020	2021	2022	2023
<b>planned value</b>	7000 t	7000 t	7000 t	7000 t	7000 t	7000 t	7000 t
<b>real value</b>	7064 t	7402 t	7512 t	7000 t	6108 t		
<b>indicator</b>	<b>the minimum expected amount of waste to be separated from the total volume of MSW</b>						
<b>year</b>	2017	2018	2019	2020	2021	2022	2023
<b>planned value</b>	15.0%	15.0%	38.0%	40.0%	42.0%	45.0%	45.0%
<b>real value</b>	10.0%	44.0%	35.0%	40.0%	44.4%		
<b>indicator</b>	<b>the maximum amount of waste landfilled out the total waste generated per year</b>						
<b>year</b>	2017	2018	2019	2020	2021	2022	2023
<b>planned value</b>	85.0%	85.0%	62.0%	60.0%	58.0%	55.0%	55.0%
<b>real value</b>	90.0%	56.0%	65.0%	60.0%	55.6%		
<b>indicator</b>	<b>revitalisation and construction of container stands</b>						
<b>year</b>	2017	2018	2019	2020	2021	2022	2023
<b>planned value</b>	2	1	1	1	0	0	0
<b>real value</b>	1	0	0	0	3		

Source: Záverečný účet mesta Vranov nad Topľou, 2022

In Table 1 we can see 4 waste management indicators.

The first indicator is the estimated amount of waste generated per year. In all the years studied, the city planned with 7000 tons of waste generated.

In 2017, the citizens of the city generated 7064 tons of waste. In 2021 6108 tons, a difference of 956 tons.

The second indicator relates to the rate of waste separation. We can say that since 2020 the city has been able to meet its own targets and in 2021 the city exceeded this target by 4.4%.

The third indicator refers to the rate of landfilled waste. This indicator is expected to be as low as possible. As with the previous indicator, the own targets have been achieved from 2020 onwards (as indicator 2 and 3 are linked).

The fourth indicator is revitalisation and construction of container stands. The City of Vranov nad Topľou has only managed to meet its target in 2021 of the surveyed years, when it did not plan any revitalisation or construction of container stands, but 3 were built.

## Conclusion

Despite the fact that Vranov nad Topľou has managed to meet its own targets since 2020, the city is still failing to meet these targets from a global perspective (whether national, European or global targets). As regards waste recycling rates, the European Union target (on which the targets of the individual programmes of the Slovak Republic are based) is to achieve a recycling rate of at least 50 % for household waste and 55 % for municipal waste by 2025. The city of Vranov nad Topľou was still 6.6% below this value in 2021.

According to the Directive of the European Parliament, the landfill rate is to be below 10% by 2035. The latest available landfill rate (2021) in our research is 55.6%, which is 45.6% above the threshold.

In order to achieve these objectives, we propose the following measures to the town of Vranov nad Topľou:

- introduction of quantitative waste collection - this will result in a higher sorting rate of municipal waste,
- reformulation of the city's waste objectives
- introduction of SMART systems - SMART systems will help to keep more transparent records of waste, which will help to find the causes of failures in achieving waste targets and over the years will also save the city money allocated to waste management due to automation of processes,
- tightening the supervision of black dumps.

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# METHODOLOGY OF CREATION OF INDEXES IN THE FIELD OF THE BUSINESS ENVIRONMENT

## METODOLÓGIA TVORBY INDEXOV V OBLASTI PODNIKATEĽSKÉHO PROSTREDIA

*Janka KOPČÁKOVÁ – Erik WEISS*

### **Abstract**

We have many indices on a global scale. However, if we focus more closely on the business environment, there is an index that is specific to this area. The Business Environment Index (BEI) expresses satisfaction, or dissatisfaction of individual entrepreneurs with the quality of the business environment in which they operate and carry out their business activities. Every amendment, decree or legislative change can have a negative impact on the quality of the business environment. The Corruption Perception Index (CPI) is an integral part of the Business Environment Index (BEI). Within the Corruption Perception Index, the Slovak Republic improved its rating by 4 points in 2021 and advanced its rating from 48 points (2020) to 52 points (2021). Forecasts for 2022 speak of equally bad results of the BEI resulting from the fact that this indicator achieved very bad results already in 2021 and the dissatisfaction of entrepreneurs continued to grow significantly. However, the reality is that both of these indexes have recently been criticized by several foreign authors. The aim of the contribution was to point out the high values of individual indexes of different countries of the world, despite the criticism of the aforementioned indexes by foreign authors. The reason was the fact that even though countries achieve different values of the input sources of the indices and the economy in individual countries is different, the same conditions apply to the input sources of individual indices in all countries of the world, which causes the difference in the values of these indices.

**Key words:** Business Environment Index, Corruption Perceptions Index

### **Abstrakt**

V celosvetovom meradle sa nám vyskytuje mnoho indexov. Avšak, ak sa bližšie zameriame práve na podnikateľské prostredie, vystupuje tu index, ktorý je pre túto oblasť špecifický. Index podnikateľského prostredia vyjadruje spokojnosť, resp. nespokojnosť jednotlivých podnikateľov s kvalitou podnikateľského prostredia, v ktorom pôsobia a vykonávajú svoju podnikateľskú činnosť. Každá novelizácia, vyhláška, či legislatívna zmena môže mať negatívny dopad na kvalitu podnikateľského prostredia. Neodmysliteľnou súčasťou Indexu podnikateľského prostredia je aj Index vnímania korupcie. V rámci Indexu vnímania korupcie sa Slovenská republika v roku 2021 zlepšila v hodnotení o 4 body a postúpila svoje hodnotenie zo 48 bodov (2020) na 52 bodov (2021). Prognózy za rok 2022 hovoria o rovnako zlých výsledkoch IPP vyplývajúcich zo skutočnosti, že tento ukazovateľ dosahoval veľmi zlé výsledky už v roku 2021 a naďalej výrazne rástla nespokojnosť podnikateľov. Skutočnosťou však je, že oba tieto indexy v poslednej dobe zasahuje kritika viacerých zahraničných autorov. Cieľom príspevku bolo poukázať na výšku hodnôt jednotlivých indexov rôznych krajín sveta, aj napriek kritike spomínaných indexov od zahraničných autorov. Dôvodom bol fakt, že aj keď krajiny dosahujú rôzne hodnoty vstupných zdrojov indexov a ekonomika v jednotlivých krajinách je rôzna, pre vstupné zdroje jednotlivých indexov platia rovnaké podmienky vo všetkých krajinách sveta, čo zapríčiňuje rozdielnosť hodnôt týchto indexov.

**Kľúčové slová:** Index podnikateľského prostredia, Index vnímania korupcie



## **Introduction**

The Business Environment Index (BEI) monitors satisfaction, or dissatisfaction of entrepreneurs with the quality of the business environment. The uniqueness of the quality of the business environment in the Slovak Republic reached its highest values in 2006. Currently, the Business Environment Index (BEI) in the Slovak Republic reaches its lowest values. One of the reasons for the low value of the Business Environment Index (BEI) may be the COVID-19 pandemic and the individual decrees and restrictions that the government of the Slovak Republic had to issue. In connection with the COVID-19 pandemic, a state of emergency was also introduced by the government of the Slovak Republic. The state of emergency was defined by the period of threat or the period of impact of the consequences of an extraordinary event on life, health or property, which is declared according to the Act on Civil Protection. This is understood as a threat to public health II. degree (in the event of a communicable disease, suspicion of it, suspicion of death, communicable disease). In connection with the extraordinary situation, in the periods 16.03. 2020 – 14.06.2020, 01.10.2020 – 14.05.2021 and 25.11.2021 – 22.02.2022 declared state of emergency. A state of emergency is declared on the condition that there has been or is an immediate threat of a threat to the life and health of persons, including in connection with the emergence of a pandemic, threat to the environment, property values, industrial, traffic or other operational accidents. The last declaration of a state of emergency before the COVID-19 pandemic was during World War II. Since the situation in connection with the COVID-19 pandemic was serious, it was necessary to close a number of establishments in order to reduce the infection rate of the population. The closing of individual establishments could have caused a negative impact on the Business Environment Index (BEI).

Another important index that is used on a global scale is the Corruption Perception Index (CPI). Currently, several foreign authors are criticizing the Corruption Perceptions Index (CPI) because the individual data sources that enter the results of this index show causal relationships among themselves. The fact is that corruption is not perceived homogeneously in different countries of the world. Countries with a developed economy show a lower level of corruption than countries with a developing economy. In such countries, corruption reaches higher values. Another criticism of the authors towards the CPI is the fact that there are synergistic effects between the individual input sources that directly enter the index, which causes national policy makers to decide on several sources entering the CPI. Thus, the authors recommend national policy makers to focus not only on one data source, but a set of sources with the same balanced aggregation.

Despite the fact that the negative values of the BEI were probably caused by the COVID-19 pandemic and the negative criticism of the CPI by several authors, we pointed out these indices in more detail in the post. The individual indices are measured all over the world, and for that reason it is necessary to draw attention to the fact that it is an BEI, the negative values of which could have been caused by the COVID-19 pandemic. Due to the fact that it was a global pandemic, the Business Environment Index (BEI) could be negative in other countries of the world as well. At the same time, the CPI receives negative reviews from several foreign authors, but the criteria for evaluating this index are the same in all countries of the world.

## **1 Business Environment Index (BEI)**

The term business environment refers to local economic conditions that support or, on the contrary, slow down the creation and development of businesses. The quality of the business environment is measured using indices that have a different construction, use different types of data and variables.

The index has three rating categories:

- The first category consists of 12 items and its main task is to monitor the development of the legislative and regulatory environment in Slovakia.
- The second category consists of 11 items and its main task is to summarize the effects of other external macroeconomic factors on businesses.
- The third category of the index consists of 10 items and shows the contribution of the companies themselves to the development of the business environment.

Each of the 33 items has its own weight within the Business Environment Index (BEI). The index represents the weighted arithmetic mean of changes in individual items.

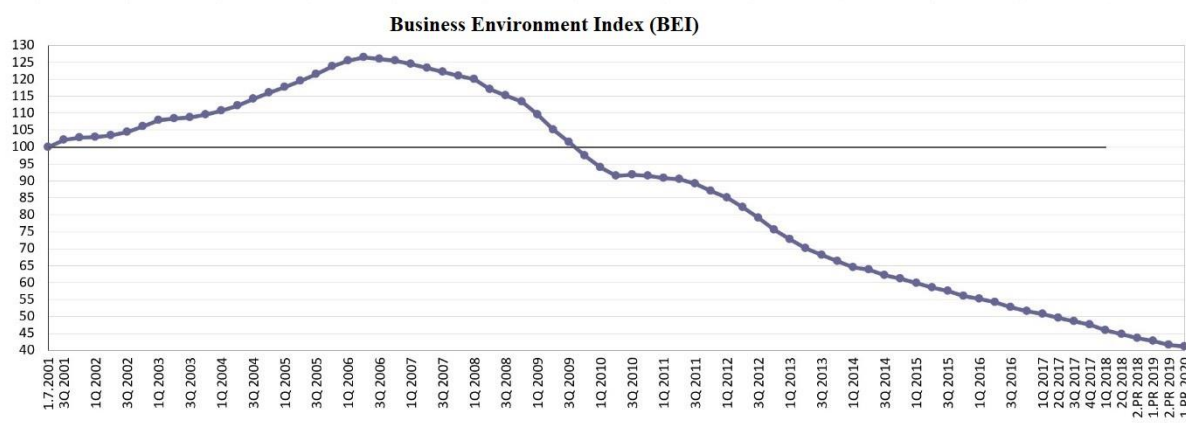
When monitoring the index of measuring the quality of the business environment, they are specified in more detail:

- Easy of Doing Business – an index created by the World Bank, with a higher score indicating a better, simpler and more transparent regulatory environment for business entities and protection of property rights. The index is composed of 10 sub-indexes.
- Index of economic freedom - evaluates the economies of the world according to the level of economic freedom, namely the basic right of every person to control his work and property. The index is composed of four basic sub-indices (rule of law, limited state, efficiency of regulation, market openness).

- Global Competitiveness Index – reflects the fact that competitiveness is determined by many factors. The index is divided into three sub-indexes (basic assumptions, increasing efficiency, innovation and sophistication), but at the same time each sub-index consists of other sub-indexes.
- Corruption Perception Index - it quantifies the level of public sector corruption. This indicator can be seen as one of the important determinants.

## 2 Measurement of the Business Environment Index (BEI) in the Slovak Republic

The Business Environment Index (BEI) is a constant and regular monitoring and evaluation of the quality of the business environment in the Slovak Republic. The following Figure 1 shows us the Business Environment Index (BEI) over a period of about 20 years.

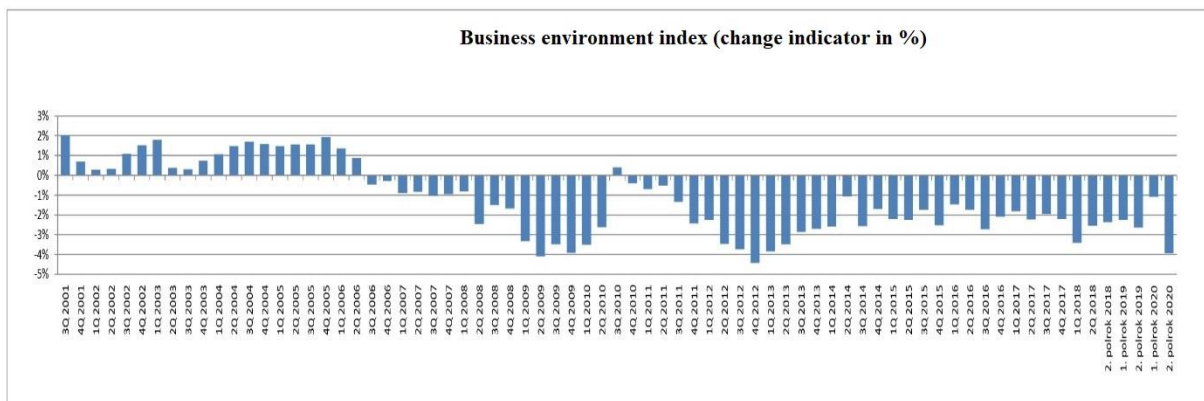


**Figure 1 Business environment index in the Slovak Republic**

Source: <https://www.alianciapas.sk/2021>

It is clear from Figure 1 that the Business Environment Index (BEI) in the Slovak Republic reached its highest value in 2006, more precisely in the 1st quarter. The value of the Business Environment Index (BEI) began to decline gradually. Relative stagnation was recorded between 2010 and 2011, where the Business Environment Index (BEI) subsequently fell further. If the year 2020 were to be monitored separately, it is obvious that in the second half of the year, entrepreneurs had a negative view of the quality of the business environment. According to analysts, the reason for the increase in the dissatisfaction of businessmen with the quality of the business environment may be the COVID-19 pandemic. The negative rating of the Business Environment Index (BEI) decreased from -1.08 % in the first and second quarters of 2020 to -3.93 % in the third and fourth quarters of 2020. Entrepreneurs' dissatisfaction with the quality of the business environment thus decreased by 2.85 % during 2020. Overall, this is the worst perception of the quality of the business environment since 2012.

Figure 2 shows us the percentage change in the Business Environment index (BEI).



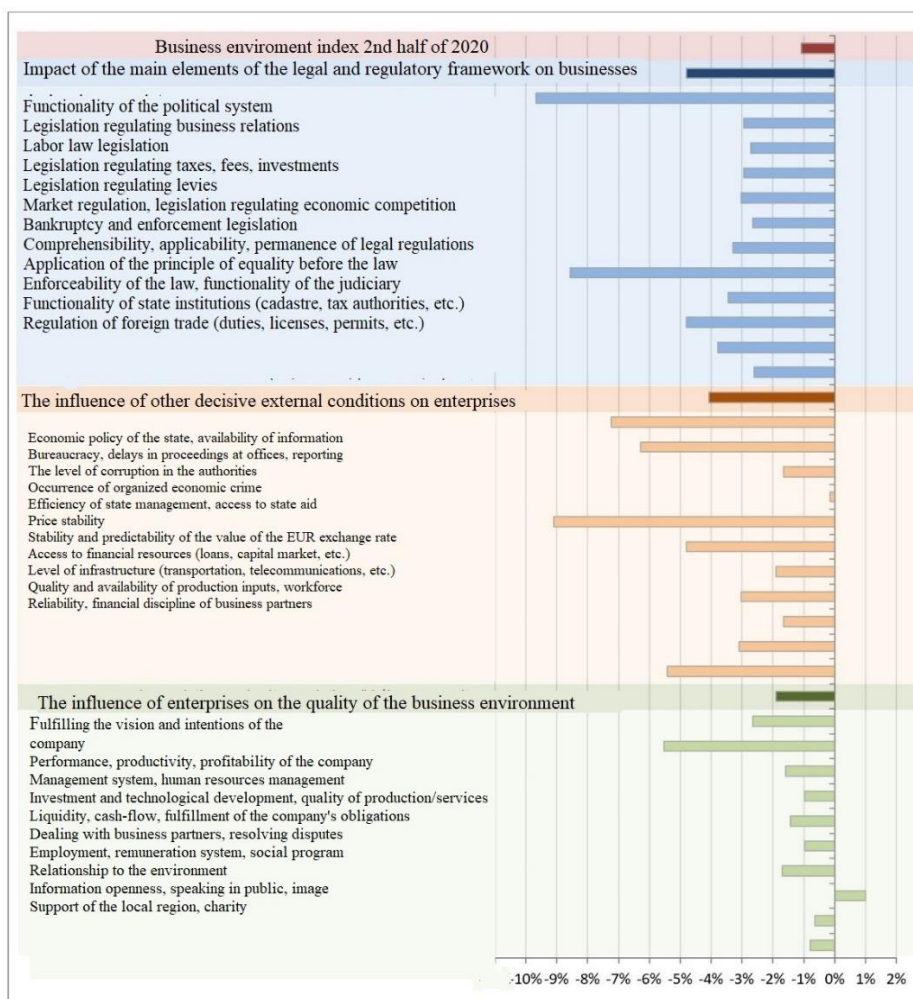
**Figure 2 Percentage change BEI**

Source: <https://www.alianciapas.sk/2021>

According to market research and analysts, entrepreneurs considered the biggest barriers to doing business in the 2nd half of 2020 to be:

- functionality of the political system in the state (-9.68 %),
- efficiency of state management, access to state aid (-9.10 %),
- comprehensibility, applicability, permanence of legal regulations (-8.56 %),
- economic policy of the state, availability of information (-7.23 %),
- bureaucracy, delays in proceedings at offices (-6.28 %).

Individual changes are also shown in the following figure 3.



**Figure 3 Evaluation of the business environment**

Source: <https://www.alianciapas.sk/2021>

It is obvious that entrepreneurs within the Business Environment Index (BEI) in the second half of 2020 positively evaluated only the relationship to the environment, and that by exactly 1 %.

If a category of the most negative regulations of the government of the Slovak Republic were to be created, entrepreneurs would include the top 3 government proposals:

- Act amending Act No. 663/2007 Coll. on the minimum wage as amended and amending Act no. 311/2001 Coll. Labor Code as amended,
- Act on the 13th pension and on the amendment of certain laws,
- Act amending Act No. 468/2019 Coll. on the state budget for 2020

The Business Environment Index can be said to be the result of the methodology applied by the Business Alliance of Slovakia. Individual changes are monitored and recorded quarterly in the business environment in Slovakia.

### 3 Index measuring the quality of the business environment on a global scale

The following table 1 shows us a comparison of the index at the world index level. We chose the Slovak Republic and the Czech Republic as the compared countries. The aim was to show the results of the neighboring countries, which formed one state until 31.12.1992.

**Table 1 Comparison Indexes measuring the quality of the business environment**

2019	Overall ranking		
Indexes	SK	CZ	World leaders
<b>Easy of Doing Business</b>	75	76	New Zealand, Singapore, Hong Kong, Denmark, Korea
Business start-ups	118	134	
Building permits	146	157	
Connection to the electrical network	54	11	
Real estate registration	8	32	
Access to credit	48	48	
Investor protection	88	61	
Paying taxes	55	53	
Cross-border trade	1	1	
Enforceability of contracts and agreements	46	103	
Solving insolvency	46	16	
<b>Index of economic freedom</b>	65	74	Hong Kong, Singapore, New Zealand, Sweden
<b>Global Competitiveness Index</b>	67	71	Singapore, USA, Hong Kong
<b>Corruption Perceptions Index</b>	50	56	Denmark, New Zealand, Finland, Singapore

Source: Own processing

From the above-mentioned table 1, it is clear that the Czech Republic achieves higher values in individual indexes. However, the fact is that the Slovak Republic achieves higher values in the partial results of the Easy of Doing Business Index. These are mainly sub-indexes such as:

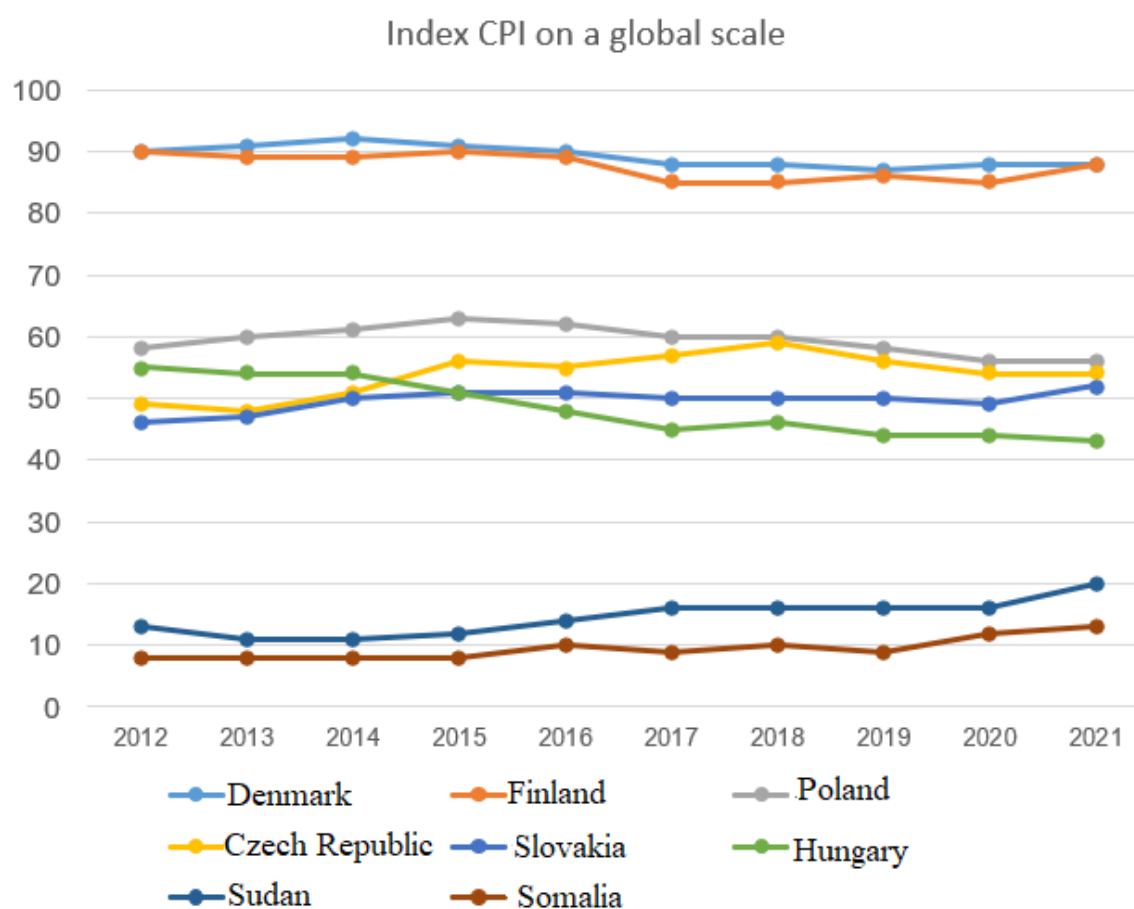
- connection to the electrical network,
- investor protection,
- paying taxes,
- solving insolvency.

Table 1 also includes the individual world countries that achieve the best values in individual indexes.

## 4 Corruption Perceptions Index (CPI)

One of the indexes that belongs to the world index for measuring the quality of the business environment is the Corruption Perception Index (CPI). Nowadays, this index is looked at more and more often.

The Corruption Perceptions Index (CPI) expresses the level of corruption in the public sector in 180 countries around the world. The index is compiled from the results of 13 different expert and business surveys. The Corruption Perceptions Index (CPI) was introduced in 1995 by the international non-governmental organization Transparency International to measure, evaluate and internationally compare the level of corruption. The following Figure 4 shows the Corruption Perception Index (CPI) in individual countries around the world during the period 2012-2021.



**Figure 4 Comparison CPI**

*Source: Own processing according to <https://www.transparency.org/en/cpi/2021>*

The following curves in Figure 4 point to the fact that the higher the CPI value, the lower the corruption of the given country, while the lower the CPI value, the higher the corruption of the given country. It is clear from Figure 4 that the CPI did not change significantly during 2012-2021, only slightly. It is also clear that countries with highly developed economies, such as the Nordic countries of Denmark and Finland, achieve high values of the CPI, which shows that

corruption in these countries is low. At the same time, countries such as Sudan and Somalia achieve low values of the CPI below 20, which implies that there is high corruption in these countries. The V4 countries were placed at the interface of CPI values in the interval 40-65.

For the year 2021, the Slovak Republic ranks 3rd in the CPI among the V4 countries, with a value of 52. Among the V4 countries, the Slovak Republic has lower corruption than Hungary (43), while achieving higher corruption than the Czech Republic (54) and Poland (56).

## Conclusion

In the first part, the paper presents the theoretical basis of the Business Environment Index (BEI). Another part of the contribution is a reference to the Business Environment Index (BEI) in Slovakia over 20 years. At the same time, he compares the Slovak Republic with the neighboring Czech Republic, with which they formed one state until 1992. The individual values are similar to each other, while the Slovak Republic achieves higher values than the Czech Republic in the sub-indexes of connection to the electricity grid, investor protection, tax payment and insolvency resolution.

As an integral part of the comparison of world indices, the Corruption Perception Index (CPI) was also compared in the article. In 2021, the values of the index of the Slovak Republic together with the V4 countries ranged from 43 to 54, which proved the middle limit of the interval. Countries, whose economies are among developing countries achieved low values of the index, which means a high level of corruption. At the same time, countries such as Denmark and Finland maintained the Corruption Perceptions Index at 88, which indicates lower corruption than in less developed countries.

Czech writer and painter Jozef Čapek said: "Money is the driving, productive force of corruption." For that reason, individual countries should not only look at their interests and money in the state budget, but should pay particular attention to the well-being of people, which would also reduce the corruption of the given countries. Let's believe that every country will enter the new year with this idea in order to reduce its Corruption Perception Index every year.

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# RETAIL TRANSFORMATION AND ITS ROLE IN THE POST-CRISIS RECOVERY OF THE ECONOMY: EXPERIENCE OF SLOVAKIA AND UKRAINE

## MALOOBCHODNÁ TRANSFORMÁCIA A JEJ ÚLOHA PRI POKRÍZOVOM OBNOVENÍ EKONOMIKY: SKÚSENOSTI SLOVENSKA A UKRAJINY

*Vanda LIESKOVSKÁ – Iryna RESHETNIKOVA*

### Abstract

The article examines changes in the behavior of Ukrainian consumers during the crisis caused by the pandemic and the war, as well as related new trends in retail trade. The purpose of the article is to summarize the theoretical aspects of consumer behavior during the crisis and the experience of retail development and transformation in Slovakia and Ukraine. The analysis was carried out on the basis of secondary sources of information and analytical data of the state statistics of Ukraine and Slovakia. Retail remains the country's main anti-crisis industry, which, despite difficult times, satisfies consumer needs and demonstrates economic growth. Optimizing the assortment, logistics processes, the use of multi-channel marketing technologies and quick response to changes in consumer requests help to keep up.

**Keywords:** consumer behavior, economic crisis, transformation of retail, economic recovery, multichannel marketing

### Abstrakt

Článok skúma zmeny v správaní ukrajinských spotrebiteľov počas krízy spôsobenej pandémiou a vojnou, ako aj súvisiace nové trendy v maloobchode. Účelom článku je zhrnúť teoretické aspekty spotrebiteľského správania počas krízy a skúsenosti z rozvoja a transformácie maloobchodu na Slovensku a Ukrajine. Analýza bola vykonaná na základe sekundárnych zdrojov informácií a analytických údajov štátnej štatistiky Ukrajiny a Slovenska. Maloobchod zostáva hlavným protikrízovým odvetvím krajiny, ktoré napriek ťažkým časom uspokojuje potreby spotrebiteľov a vykazuje ekonomický rast. Udržať krok pomáha optimalizácia sortimentu, logistické procesy, využívanie multikanálových marketingových technológií a rýchla reakcia na zmeny v požiadavkách spotrebiteľov.

**Kľúčové slová:** spotrebiteľské správanie, hospodárska kríza, transformácia maloobchodu, oživenie ekonomiky, multikanálový marketing

### Introduction

As soon as society recovered from the economic crisis caused by the Covid-19 pandemic, it found itself in a new one - provoked by the Russian military invasion of Ukraine. These events became a real test for both the population and retail. Consumers changed their purchasing behavior due to stress and lack of understanding of the situation. Stores were closed during the pandemic due to restrictive measures in countries, and the war caused damage to retail chains in Ukraine due to the loss of stores as a result of hostilities and the seizure of territories. At the same time, crisis conditions in both cases led to the transformation

of retail store formats and consumer service technologies. E-commerce and food delivery services have been activated. The purpose of the article is to generalize the theoretical aspects of consumer behavior during the crisis and the experience of development and transformation of retail in Slovakia and Ukraine in recent years.

## **1 Purchase behavior of consumers in crisis situations.**

Theoretical issues of changing consumer behavior patterns in difficult, crisis situations are considered in the works of scientists (Sławomir Smyczek, Ewa Kieźel 2011, Bezvukh, S. V. 2016, Chlipała, P., Żbikowska A. 2022, Reshetnikova, I. 2023, who note that economic, social, political and other crises change consumer behavior. In particular, Polish scientists (Sławomir Smyczek, Ewa Kieźel 2011, p.20) consider the crisis as an important determinant of consumer behavior that affects the macro level - creates a set of factors and phenomena in various sectors of the macro environment that affects the ability of households and individuals to satisfy its needs and desires, and on a micro scale - determines the level of household prosperity. Chlipała, P. and Żbikowska A. devoted a separate monograph to the problems of consumer behavior in the context of the Covid-19 pandemic, which examined changes in consumer behavior during the pandemic and identified possible future consumption trends after the end of the pandemic. The authors conclude that the pandemic will create momentum for pro-social and sustainable consumption. Summarizing theoretical studies on this topic, scientists express the opinion that the crisis is definitely a stress for consumers and the country's economy, but at the same time, it is also an opportunity, because it forces you to relieve the current order. During a crisis, qualitative changes usually occur in society. The consequences of the crisis are so widespread and significant that it is not possible to talk about a return to the usual consumer behavior, although we do not yet know the future consequences of the changes taking place. That is why consumers give up education, culture, limit the scope of consumption - they buy goods and use the same services as before the crisis period, but reduce the frequency of purchases or the number of goods purchased, looking for replacements for expensive service.

Therefore, during the crisis, consumers are not sure about the further development of the scenario of events and strive to maintain their usual standard of living, or try to minimize costs by looking for alternative, cheaper offers, expanding professional activities, looking for additional sources of income. This conclusion regarding the behavior of consumers during the crisis is confirmed by the results of the study "The War Goes to Consumer" by the KANTAR company, conducted in May-August 2022: 68% of Ukrainian consumers were forced to abandon many life plans. At that time, 53% of Ukrainians resorted to savings and consumer restrictions, and they did it deliberately, not because they did not have enough money, but because they were not sure of the future and considered unnecessary spending unnecessary. During the war, Ukrainians save the most on entertainment,

recreation (61%) and sports (56%). In the minority - savings on food products and utility services. Only 14% save on them. ( Kantar research, 2022).

At the same time, as the experience of the pandemic and the situation provoked by the war showed, the crisis affects to a greater degree the consumption of goods and services of the middle price category, while it almost does not affect those categories of goods in which a stable group of buyers has formed: premium goods, natural and organic products.

## **2 State of retail on the eve of the COVID-19 pandemic.**

Retail trade is one of the branches of the national economy that has been actively transformed over the past two decades in both Slovakia and Ukraine, despite global and domestic crises. Perhaps the biggest crisis that the retail industry of these countries had to go through was connected with the transition from a directive-driven to a market economy. But the countries passed this stage in different ways, so there are certain differences in the evolution of retail in Slovakia and Ukraine. They are related to various economic, cultural and geopolitical factors affecting the activities of retail enterprises.

Slovakia earlier started the process of transition from a directive to a market economy and carried out the process of small privatization more transparently. In the early 1990 s, 2,200 retail operating units were transferred from the public to the private sector as part of restitution. Small self-service stores and traditional counters or mixed grocery stores have become the predominant retail format. While in Ukraine, at the first stages of building its own internal market, spontaneous trade in street markets dominated. And although the retail market of Ukraine is more attractive for foreign investors than the market of Slovakia in terms of its volume, foreign chains began to dominate the Slovak market much earlier. The shopping areas purchased by foreign chains were located in the center of cities, had a permanent customer base and an excellent credit history. However, already at the end of the 90s, there is a change of owners. Thus, in 1996, the K-mart company left the Slovak market, and its stores were absorbed by the British company Tesco. The beginning of the 2000s is associated with the process of economic concentration in retail trade. During this period, the top 10 retail chains were dominated by Slovak ones. But after the country joined the European Union, active economic expansion of foreign networks began. International companies began to gradually strengthen their positions. Considering the volume of turnover, they could afford low prices and significant price discounts, which was attractive to the Slovak consumer. In 2005, there were already seven international companies operating in Slovakia in the TOP-10 retail companies (Lieskovská, (2003) Lieskovská, Dzuričková 2013).

At that time, Western retail did not rush to Ukraine due to its geopolitical uncertainty, and this gave Ukrainian retail chains a chance to strengthen their position on the market. The leading role was played by traditional farmers' markets and small shops in the "around the house" format. In the early 2000 s, there were attempts to enter Russian trade networks in the eastern and southern parts of

Ukraine, but they did not last long on the market due to a change in political elites. The chain of stores of the Austrian retailer "Billa" opened in Ukraine only in 2000, and the company "Metro" entered the market in 2003, but they did not pose a significant competition to Ukrainian operators in the retail market. Unlike Slovakia, where the evolution of retail took place gradually, without revolutionary upheavals, Ukrainian society was accompanied by periodic revolutionary upheavals (2004 and 2014). Each time they caused a rapid devaluation of the national currency and inflation, which affected the purchasing power of the population. Such instability and unpredictability scared off foreign network owners. Since 2016, the company "Billa" began to close its stores in certain regions of Ukraine, and in 2020 it finally left the Ukrainian market, selling its assets to the Lithuanian company "NOVUS". In recent years, the mentioned company has demonstrated a high rate of expansion of its presence despite the retail problems associated with the pandemic and the war. From 2007 to the present, the French company "Auchan" continues to work in Ukraine, despite fierce competition from Ukrainian networks. And in 2021, the German company "Lidl" announced its intention to enter the Ukrainian market. Although the Ukrainian FMCG market on the eve of the war was one of the most attractive for foreign investors, the leading role was played by Ukrainian companies that offered products from Ukrainian manufacturers.

In retail, both in Slovakia and Ukraine, globalization processes brought a high level of integration of business firms and a large number of operational units with a single management center. Mergers, creation of cooperatives and concentration of companies into large corporations have become typical. Foreign investments, new forms of sales through catalog stores, e-commerce, and delivery services began to be actively promoted.

### **3 Changes in the conditions of the crisis caused by the pandemic and the war.**

The crisis, which was caused by the outbreak of the Covid-19 pandemic, was accompanied by the closure of shops due to hygiene measures. In this period, from the point of view of consumer behavior, at the beginning of the pandemic, there was an increased influence of social networks on consumers and panicked moods, which manifested themselves through hyped and excessive purchases of products of daily demand.

Internet sales with home delivery have expanded to an assortment of food products and ready meals. In retail, there were problems in supply chains, there was not enough labor. Most retail chains have started to open their own grocery and food delivery services. Nevertheless, it should be noted that retail quickly adapted to functioning in the conditions of restrictions associated with the pandemic. During this period, new technologies for cashless payments were actively spread thanks to barcodes, radio frequency identification, electronic sales processing, order automation and the introduction of intelligent technologies. Internet trade reached a new quantitative and qualitative level. They were mastered even by

consumers of a terrible age. And if at the beginning of the pandemic there was a drop in the pace of retail trade, then at the beginning of 2022, retail enterprises renewed their turnover and demonstrated the growth rates that were on the eve of the pandemic. Other companies continued their expansion on the Slovak market. As evidenced by the data in the table. 1 parent company Schwarz Gruppe manages the chains "Lidl" and "Kaufland" as of 2022 occupies a dominant position.

Creditworthiness and bankruptcy models are used to determine the financial health of a company and to correctly predict future developments. Prediction models are also key for strategic management and risk elimination. The models are based on historical data, any anomalies in which may signal a potential risk of bankruptcy or financial instability. Using creditworthiness and bankruptcy models, it is possible to specify what the company's weaknesses are and not only identify potential threats, but also define potential solutions that can lead to improvements in the company's financial health. In this paper, we applied the creditworthiness model - the Rabbit Quick Test and the bankruptcy model - the Altman model.

**Table 1 TOP-12 retail chains on the Slovak market (2022)**

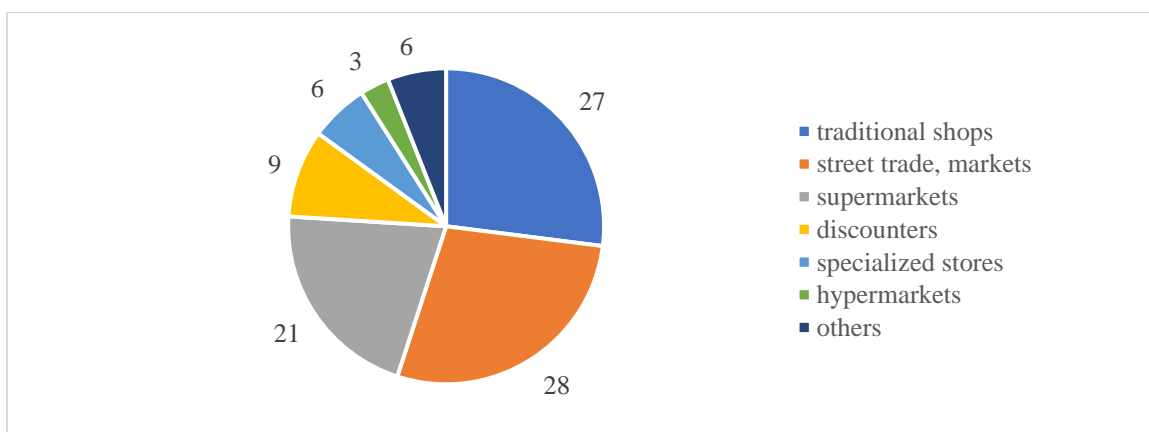
	Name	Turnover in millions of eu without VAT	Growth rates compared to the previous year,%	Number of shops
1	LIDL SR	1653,5	109,5	155
2	TESCO STORES	1490,5	107,0	154
3	KAUFLAND SR	1379,5	106,9	72
4	GGT (VO)	759,4	108,4	1
5	BILLA SR	713,6	103,1	158
6	METRO C&C	417,1	95,1	6
7	NAY	374,1	118,4	57
8	LABAŠ	305,4	107,8	781
9	DM DROGERIA	263,1	113,9	159
10	MERKURY M	201,0	102,4	30
11	TERNO	189,3	107,1	127
12	OBI Slovakia	173,9	118,1	16

*Source: developed by the authors based on the resource (www.tovarapredaj.sk)*

Also interesting is the gradual expansion of Slovak companies into the networks that entered the TOP 12 trading companies (GGT, NAY, LABAŠ, DM pharmacy). On the other hand, Tesco, which has been at the top of the list of TOP shopping companies for the longest time, does not give up. It plans to continue to

expand its presence in the coming months and is looking for new premises between 400 and 2,000 square meters, mainly in cities and large villages, as well as plots of land of 2,000 square meters in villages with a smaller population.

Regarding Ukraine, it should be noted that for two years in a row - 2020 and 2021 - despite the pandemic and quarantine, trade was among the top five most profitable sectors of the Ukrainian economy. Everything changed with the beginning of the war. The Association of Retailers of Ukraine and the Ukrainian Council of Shopping Centers estimated that the reduction in turnover in the first months of the war amounted to 75% of the pre-war level. As of June 2022, almost three months after the start of the war, the 10 largest players in the industry closed about 300 of their supermarkets, but kept more than three thousand outlets open (Birovash, 2022). In addition to the direct loss of industry assets as a result of hostilities, one must consider the reduction in consumption, as a large part of potential buyers went abroad, and those who remained began to save. The structure of sales by retail store formats is shown in Fig. 1. As can be seen from the figure, traditional shops (near the house) and markets remain the most popular among Ukrainians. This is explained by their accessibility, mobility and distribution throughout the country, while chain supermarkets and discounters are concentrated in large cities.

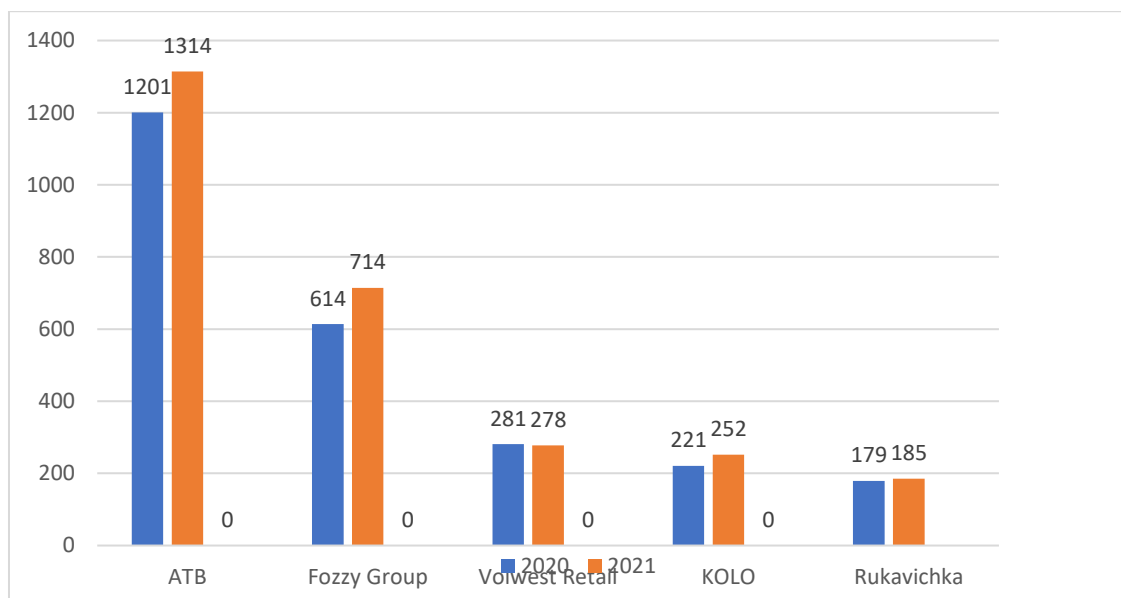


**Figure 1 The structure of sales of FMCG products by retail formats in 2022, %**

*Source: GfK consumer panel (2022)*

Retail chains in Ukraine control a smaller share of the market than is observed in Slovakia, and in terms of the number of stores, the leading Ukrainian chains are the ATB campaign and Foozy Group ("Silpo" and "Fora" supermarkets). The total number of stores of the largest chains is shown in Fig. 2.





**Figure 2 The total number of stores of leading food retailers in 2020-2021**

*Source: GfK consumer panel (2022)*

Before the start of the full-scale war, more than 1,300 discounters of the "ATB" chain worked in various parts of Ukraine, and this figure grew by 100-120 stores every year. As of the end of October 2023, there are 1,200 supermarkets in 305 settlements in Ukraine. And this is an absolute record in the domestic retail industry (Forbes UA, October 2023).

Retail responds to the crisis and changes in consumer attitudes by optimizing the trade assortment and improving customer service processes. One of the popular ways to optimize the product offering is private labels (own trademarks - Red), which allow chains to reduce prices and attract more consumers. In particular, due to loyalty and trust in ATB, more than a third of the assortment is own brands, and their share is growing.

### **Post-crisis transformation of retail.**

The crises of recent years have become serious challenges for retail and caused a number of transformations in the industry. The leading retail chains undertook optimization of their own costs and increased the number of their own brands on the shelves; opened their own delivery services; workers who lost their regular jobs were trained to become online consultants; and in Ukraine, during the cash boom, retail outlets became a kind of ATMs with their own cash registers. The pandemic has caused a spike in e-commerce usage due to restrictions on store withdrawals. In Ukraine, this trend of active use of online trade has persisted even after the end of the pandemic, because curfews are in effect during martial law, and long-term disruptions in energy supply make cash registers and cashless payments impossible. Retail chains create their own online stores.

If you briefly formulate the possible trends of retail transformation in the post-crisis period, then they look like this:

- attention to the social responsibility of retail;
- growing demand for organic/natural/ecological products;
- growing demand for local products;
- growth in the number of products in the Private Label trade range;
- struggle for the consumer by improving the quality of service, creating a special atmosphere.
- supermarkets are increasingly becoming not only an "anchor" in a shopping center, but an independent shopping center - with a rest area, its own bakery, coffee shop, and a corner for consumption of freshly bought ready meals.
- personalization of the offer of discounts and coupons based on the use of mobile applications and "data base".
- using artificial intelligence technologies and communications with clients
- development of online trade technologies and product delivery services
- hypermarkets are giving way to supermarkets, since the latter are located in more attractive places, and consumers are increasingly buying clothes, shoes and household appliances, books via the Internet
- supermarket chains are entering the market of shops "around the house", supplementing their portfolio of brands with small-area stores in the format of discounters. Such as "Carrefour - City", "Carrefour - Express". So far, this trend is visible in France on the examples of the companies Carrefour and Auchan.

## **Conclusion**

Thus, the conducted research allows us to conclude that the economic crises provoked by the Covid-19 pandemic and the war in Ukraine differ from classic economic crises due to their suddenness and unpredictability of their end times. They change models of consumer behaviour and complicate the operating conditions of retail enterprises. At the same time, crises become a catalyst for the introduction of innovations in retail, which in turn contributes to the recovery of the country's economy. Both consumers and retail eventually get used to the conditions of the crisis and over time restore their shopping experience or acquire a new one. Retail is the first to recover from the crisis by satisfying the constant demand of its customers in products and services of daily consumption.

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# APPLICATION OF PREDICTIVE MODELS FOR EVALUATING THE FINANCIAL HEALTH OF SELECTED COMPANIES

## APLIKÁCIA PREDIKČNÝCH MODELOV NA VYHODNOTENIE FINANČNÉHO ZDRAVIA VYBRANÝCH SPOLOČNOSTÍ

*Lukáš VAVLIČ*

### **Abstract**

The article examines the application of predictive models for evaluating the financial health of selected companies. By utilizing well-established models such as the Králiček's Quick test and Altman model, the study conducts a comprehensive assessment of selected companies, providing a comprehensive overview of their financial situation. The analysis delves into key indicators, ratios, and parameters of these models. The article aims to compare results and contribute to a deeper understanding of methodologies for assessing the financial health of companies and their practical implications for decision making.

**Keywords:** predictive models, financial health assessment

### **Abstrakt**

Príspevok preskúma aplikáciu prediktívnych modelov na hodnotenie finančného zdravia vybraných spoločností. Použitím dobre etablovaných modelov ako Králičkov rýchly test a Altmanov model, štúdia vykonáva komplexné hodnotenie vybraných spoločností, poskytujúc komplexný pohľad na ich finančnú situáciu. Analýza preniká do kľúčových indikátorov, pomerov a parametrov týchto modelov. Cieľom príspevku je porovnávať výsledky a prispieť k hlbšiemu pochopeniu metodológií hodnotenia finančného zdravia spoločností a ich praktických dôsledkov pre rozhodovanie.

**Kľúčové slová:** predikčné modely, hodnotenie finančného zdravia

### **Introduction**

Creditworthiness and bankruptcy models are used to determine the financial health of a company and to correctly predict future developments. Prediction models are also key for strategic management and risk elimination. The models are based on historical data, any anomalies in which may signal a potential risk of bankruptcy or financial instability. Using creditworthiness and bankruptcy models, it is possible to specify what the company's weaknesses are and not only identify potential threats, but also define potential solutions that can lead to improvements in the company's financial health. In this paper, we applied the creditworthiness model - the Rabbit Quick Test and the bankruptcy model - the Altman model.

### **1 Predictive multivariate models**

Predictive multivariate models consist of a number of ratio indicators and their weights, which are determined on the basis of mathematical-statistical methods - through discriminant analysis, with the discriminant representing the discriminant

value. In multidimensional models, the larger the number of indicators, the larger the n-dimensional space they jointly create. This is why multidimensional models are suitable for making more accurate predictions. (Kočišová, Kubala, 2012)

### 1.1 Králíček's Quick Test

The Králíček's Quick Test is used to quickly assess a company's creditworthiness. This prediction model is most commonly used in Europe to characterise a company's financial stability and performance. The model consists of 4 indicators and a simple scoring method. According to the results of the ratio indicators, a value is assigned to each according to a rating scale. (Zalai et al., 2007)

Ratio indicators of the Králíček's Quick Test:

- Equity ratio (R1) = total equity/assets
- Debt repayment period in years (R2) = (foreign funds-cash-bank accounts)/operating cash flow
- Cash Flow to Performance Ratio (R3) = EBIT/Assets
- Return on total capital (R4) = Operating Cash Flow/performance

**Table 1 Rating scale for the indicators of the Králíček's Quick Test**

Indicator	Rating Scale - scoring method				
	Very Good	Good	Medium	Bad	At Risk of Insolvency
	(1)	(2)	(3)	(4)	(5)
Equity Ratio (R <sub>1</sub> )	> 30%	> 20%	> 10%	< 10%	negative
Debt Repayment Period in Years (R <sub>2</sub> )	< 3 years	< 5 years	< 12 years	> 12 years	> 30 years
Cash Flow to Performance Ratio (R <sub>3</sub> )	> 10%	> 8%	> 5%	< 5%	negative
Return on Total Capital (R <sub>4</sub> )	> 15%	> 12%	> 8%	< 8%	negative

Source: Author's processing according to ZALAI, K., 2007, *Finančno-ekonomická analýza podniku*.

The individual score values are added to the ratio and the overall results of the Králíček's Quick Test are interpreted according to the following criteria:

- index > 3 - it is a creditworthy company,
- 1 < index ≤ 3 - grey area or area of indistinct results, but bankruptcy is possible,
- index ≤ 1 - the company faces critical threats in its financial management. (Baran, 2008)

For the selected 3 companies operating in the same sector, Alfa, Beta, Gama, we evaluated financial, earnings and overall stability over a 3-year period. Alfa faced potential critical threats in the 3 years under review due to its relatively high equity to total assets ratio. Beta faced a similar situation, but in 2022 financial stability improved significantly, which supported the increase in foreign capital. Gama is in the grey area in terms of financial stability assessment, although it is not

facing bankruptcy the improvement in the situation in general would be achieved by increasing foreign capital and using its potential to expand business activities.

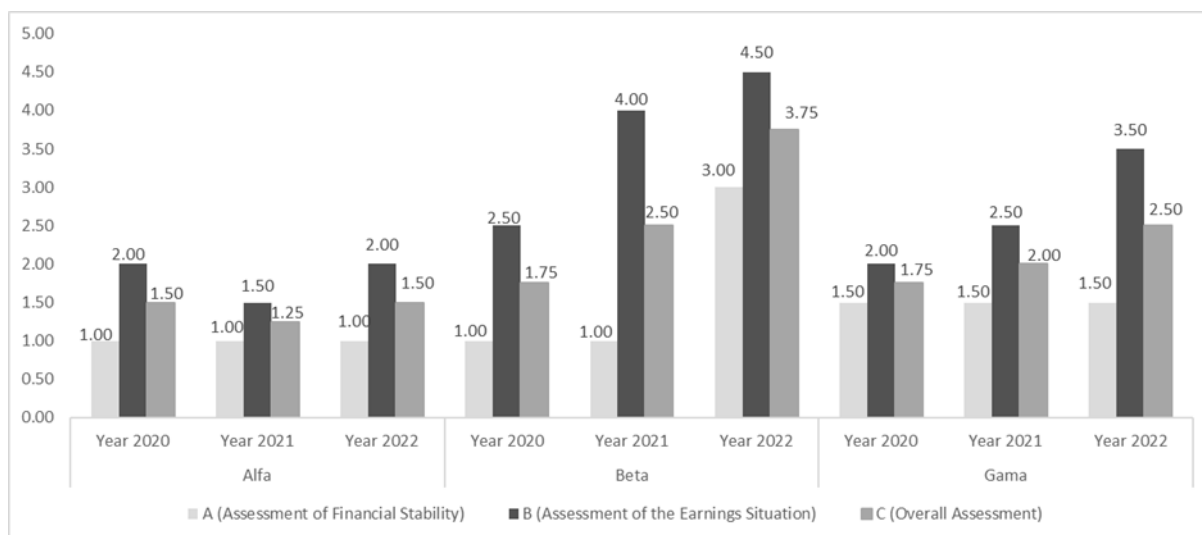
According to Králiček's quick test, earnings stability is mainly influenced by total revenues and operating cash flow. Both Alfa and Gama reached a relatively low value, with the exception of 2023, when the earnings situation has improved to the point where we can say that this is a creditworthy company. Beta also performed well from a revenue perspective and despite negative operating cash flow had a significantly high total company revenue. The upward trend in revenues is key to the improving earnings situation. Positive increase in this ratio can be influenced by, for example, the introduction of new technologies in production, the expansion of production internationally and others.

**Table 2 Králiček's Quick Test applied to selected companies over a 3-year period**

	Alfa			Beta			Gama		
	Year 2020	Year 2021	Year 2022	Year 2020	Year 2021	Year 2022	Year 2020	Year 2021	Year 2022
<b>Králiček's Quick Test</b>									
<b>A (Assessment of Financial Stability)</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>3.00</b>	<b>1.50</b>	<b>1.50</b>	<b>1.50</b>
<b>B (Assessment of the Earnings Situation)</b>	<b>2.00</b>	<b>1.50</b>	<b>2.00</b>	<b>2.50</b>	<b>4.00</b>	<b>4.50</b>	<b>2.00</b>	<b>2.50</b>	<b>3.50</b>
<b>C (Overall Assessment)</b>	<b>1.50</b>	<b>1.25</b>	<b>1.50</b>	<b>1.75</b>	<b>2.50</b>	<b>3.75</b>	<b>1.75</b>	<b>2.00</b>	<b>2.50</b>
<b>R1 (Equity Ratio)</b>	63.93%	66.93%	67.05%	53.67%	42.23%	33.62%	49.22%	45.80%	44.22%
	Score 1	Score 1	Score 1	Score 1	Score 1	Score 1	Score 1	Score 1	Score 1
<b>R2 (Debt Repayment Period in Years)</b>	1.776	1.437	2.129	0.493	2.332	-5.327	4.813	3.452	5.289
	Score 1	Score 1	Score 1	Score 1	Score 1	Score 5	Score 2	Score 2	Score 2
<b>R3 (Cash Flow to Performance Ratio)</b>	12.87%	11.24%	14.93%	8.92%	1.91%	3.56%	5.43%	3.84%	3.62%
	Score 1	Score 1	Score 1	Score 2	Score 4	Score 4	Score 3	Score 4	Score 4
<b>R4 (Return on Total Capital)</b>	11.79%	12.18%	9.12%	9.59%	4.25%	-2.82%	16.52%	19.97%	10.12%
	Score 3	Score 2	Score 3	Score 3	Score 4	Score 5	Score 1	Score 1	Score 3

*Source: own processing*

In the overall assessment, 2023 was a better year for all 3 companies, but Beta significantly outperformed, indicating that it is a company with good financial health. From a revenue perspective, the companies under review performed relatively well, but expansion into other markets or the contribution of new products to the market could be beneficial for both companies. Although Alfa and Gama are in a grey area overall, i.e. they are not at risk of bankruptcy, it would be important to expand external financing to achieve financial stability.



**Figure 1 Comparison of the results of the Králíček's Quick Test for selected companies**

*Source: own processing*

## 1.2 Altman's model

The Altman model is based on data available in financial statements, whereas the original model compared information between solvent and insolvent companies and evaluated critical values of ratios. After a partial evaluation of the ratios, an Altman Z-score is calculated for which the following critical values are set:

- $Z > 2.99$  - the financial situation of the company is predicted to be good,
- $1.81 < Z < 2.99$  - grey area or area of indeterminate results, but bankruptcy is possible,
- $Z < 1.81$  - financial situation is critical, bankruptcy is very likely. (Kabat, 2011)

The original model was defined in 1968 and was intended for publicly traded joint stock companies and has undergone several modifications to make it applicable to other market participants.

On the selected 3 companies operating in the same sector, we evaluated the individual indicators over a period of 3 years and applied a modified version of Altman's model from 1983, which is also suitable for companies that are not traded on a regulated market. (Zalai, 2010)

Calculation of Altman's Z-score for the modified 1983 model:

$$Z = 0,717 * x_1 + 0,847 * x_2 + 3,107 * x_3 + 0,420 * x_4 + 0,998 * x_5 \text{ (Zalai, 2010)}$$

where:

- $x_1$  = working capital/assets
- $x_2$  = retained earnings / assets
- $x_3$  = EBIT (earnings before interest and tax) / assets
- $x_4$  = market value of equity / book value of total liabilities
- $x_5$  = sales / assets



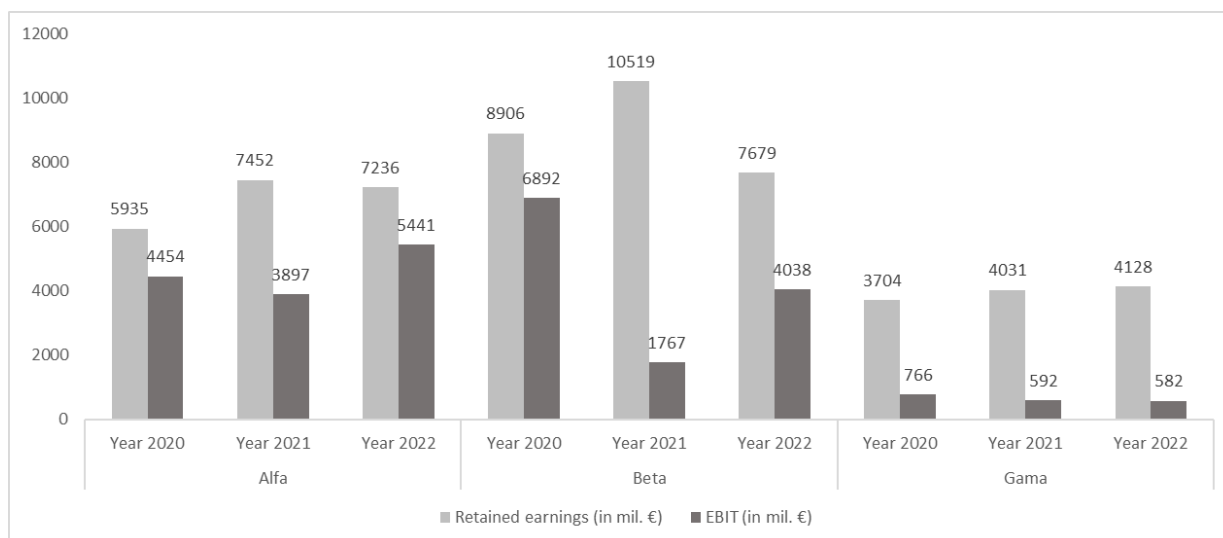
Based on Altman's Z-score and analysis of individual ratios, none of the companies under review are creditworthy from a financial health perspective. Alfa, Beta are in the grey zone, they are not at risk of bankruptcy or bad financial situation, but some measures are necessary to improve. For all companies we have observed a year-on-year increase

	Alfa			Beta			Gama		
	Year 2020	Year 2021	Year 2022	Year 2020	Year 2021	Year 2022	Year 2020	Year 2021	Year 2022
Altman's model (1983)	2.604	2.607	2.796	2.331	1.938	1.865	1.375	1.268	1.421
x1	0.122	0.090	0.172	0.113	0.471	0.633	0.022	-0.023	-0.010
x2	0.171	0.215	0.199	0.115	0.114	0.068	0.263	0.262	0.257
x3	0.129	0.112	0.149	0.089	0.019	0.036	0.054	0.038	0.036
x4	1.773	2.024	2.035	2.578	1.759	1.458	0.970	0.845	0.793
x5	1.230	1.163	1.188	0.794	0.707	0.632	0.563	0.590	0.767

**Table 3 Altman's model applied to selected companies over a 3-year period**

*Source: Authors processing.*

For all companies we observed a year-on-year increase in revenues, however, for EBIT we observed an alternating trend of up and down for Alfa, Beta and Gama only had a downward trend in EBIT. The amount of retained earnings in case of Beta, Gama was relatively high. The amount of net working capital reflects that part of the current assets are covered by long-term funds, except for Gama, where a significant part of the current assets exceeded the current assets. In this case, the company incurred unfunded debt. Such a situation poses a significant risk to the company as the golden rule of financing is not respected and the company may be at risk of going bankrupt. This risk could be avoided, for example, the use of external sources of finance can be beneficial to the company and also help to increase company profits.



**Figure 2 Comparison of retained earnings and EBIT for selected companies**

Source: Authors processing.

## Conclusion

The findings from the analyses point to the versatility and effectiveness of predictive models and their importance in strategic and financial decision making of the company. The aforementioned predictive models - namely the creditworthiness model (Králiček's Quick Test) and the bankruptcy model (Altman's model and Altman's Z-score) - also serve as a tool for identifying potential risks and also for identifying a company's strengths. Predictive models are applicable to companies operating in the same industry as well as in other industries. Companies located in critical zones have the opportunity to eliminate the risk of bankruptcy by increasing not only sales but especially profits. Such an upward trend can occur by implementing new technologies or, for example, by expanding the product range or expanding into new markets. Rethinking the structure of funding sources is also a significant tool that can lead to an improvement in a company's financial health.

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