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ECONOMICS OF DEVELOPMENT Volume 23, No. 4

Editorial Board

ЗМІСТ / CONTENTS

О. Таранова, Г. Рисалієва, М. Ражапбаєва
Вплив доходів населення на розвиток малого та середнього бізнесу:
міжнародно-порівняльний аналіз 8
E. Taranova, G. Rysalieva, M. Razhapbaeva
Influence of household income on the development of small and medium-sized businesses:
An international comparative analysis 8

В. Іванченков, В. Вовк, О. Єрмоленко, Г. Прусова, О. Ревенко
Інноваційні чинники забезпечення стратегічних змін у галузях національної економіки 20
V. Ivanchenkov, V. Vovk, O. Yermolenko, G. Prusova, O. Revenko
Innovative factors ensuring strategic changes in sectors of the national economy 20

Г. Кот, М. Вільчинська, Д. Салабура, А. Дабек, А. Валеня
Конкурентна позиція країн-членів Європейського Союзу
за рівнем соціально-економічного розвитку відповідно до Індексу людського розвитку 38
H. Kot, M. Wilczynska, D. Salabura, A. Dabek, A. Walenia
Competitive position of the European Union member states with regard
to socio-economic development according to the Human Development Index 38

Л. Спицька
Психологія споживання та ефективність маркетингових кампаній:
Вплив психологічних факторів на споживчі вподобання та купівлю 48
L. Spytska
Consumer psychology and the effectiveness of marketing campaigns:
The influence of psychological factors on consumer preferences and purchases 48

А. Линдюк, І. Гаврилюк, Ю. Томашевський, Р. Хірівський, М. Когут
Вплив штучного інтелекту на маркетингові комунікації: нові можливості та виклики для бізнесу 60
A. Lyndyuk, I. Havrylyuk, Yu. Tomashevskii, R. Khirivskyi, M. Kohut
The impact of artificial intelligence on marketing communications: New business opportunities and challenges 60

О. Семененко, С. Годзь, Р. Дужий, І. Ступницький, В. Коверга
Механізми забезпечення енергетичної безпеки в системі міжнародних відносин
з урахуванням економічних санкцій та політичних конфліктів 72
O. Semenenko, S. Hodz, R. Duzhyi, I. Stupnytskyi, V. Koverga
Mechanisms for ensuring energy security in the system
of international relations considering economic sanctions and political conflicts 72

К. Абдуллаєв, П. Гасанов, А. Алієва, Н. Алієва, А. Мустафаєв
Ненафтовий сектор економіки Азербайджанської Республіки:
перспективи та напрямки розвитку в рамках сучасної економічної політики 82
K. Abdullayev, P. Hasanov, A. Aliyeva, N. Aliyeva, A. Mustafayev
The non-oil sector of the Republic of Azerbaijan's economy:
Prospects and directions for development within the framework of contemporary economic policy 82

Б. Р. Рекшепі, Л. Нуредіні, М. К. Садіку, Е. Хаджрізі
Економічна ефективність інвестицій в інновації в економіці, заснованій на знаннях 95
B.R. Rexhepi, L. Nuredini, M.K. Sadiku, E. Hajrizi
Economic efficiency of investment in innovation in a knowledge-based economy 95

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Influence of household income on the development of small and medium-sized businesses: An international comparative analysis

Abstract. This study was aimed at analysing the impact of household incomes on the development of small and medium-sized businesses (SMEs) on the example of Kyrgyzstan and developing recommendations for the implementation of international experience in the country. The research methodology included the collection and analysis of statistical data to estimate the average monthly nominal wage using the arithmetic mean. The method of economic and statistical analysis was used to compare wages in Kyrgyzstan with similar indicators in other countries using Wilcoxon t-test, and to analyse the economic performance of SMEs for the period 2017-2023. The study found that a high level of household income contributes to an increase in consumer demand and stimulates the development of SMEs through increased sales and investment. However, low household incomes have a negative impact on purchasing power and, consequently, on the sustainability and profitability of businesses. It has been found that household incomes play a decisive role in shaping the demand for goods and services, which directly affects the activity and growth of SMEs in the country. The wage level in Kyrgyzstan was found to be extremely low and significantly different from the average wage level in other countries. The study also identified the main challenges that hinder the successful development of SMEs in Kyrgyzstan, including a complex bureaucratic environment, insufficient financial support, high poverty levels, and a lack of investor protection. As a result, a set of recommendations was developed to improve the conditions for SME development in Kyrgyzstan. The implementation of these recommendations will create favourable conditions for the growth and development of SMEs in Kyrgyzstan, contributing to the country's economic sustainability and social development

Keywords: level of wages; economic growth; state support; level of corruption; bureaucratic obstacles

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INTRODUCTION

Household incomes play a key role in the development of small and medium-sized businesses (SMEs) in various countries of the world. In Europe, SMEs account for 99% of all companies and provide jobs to more than 85 million citizens out of a total working-age population of 200 million people. In 2022, there were about 24.3 million SMEs operating in the EU (European Commission, 2024). The high level of income of the population contributes to an increase in purchasing power, which, in turn, stimulates demand for goods and services provided by SMEs. For example, in high-income countries such as Germany (as of early 2024, about EUR 3,984 per month), SMEs make up the bulk of the economy, providing jobs (Ranked: Countries…, 2024). On the other hand, in low-income countries such as India and Nigeria, SMEs face more serious challenges. In such countries, there is often a low purchasing power of the population, which limits the opportunities for SMEs to grow and develop. According to the World Bank, in India, despite the significant potential for SME development, many enterprises face difficulties due to low-income levels and limited access to financial resources. In such circumstances, SMEs are forced to look for innovative approaches to attract customers and increase their competitiveness in the market (Ausat *et al*., 2023; Chit *et al*., 2023).

The topic of the impact of household incomes on the development of SMEs in Kyrgyzstan is extremely relevant in light of the current economic challenges and opportunities of the country, since the level of income of the population directly affects demand and consumer activity, determining the demand for goods and services provided by SMEs. Low-income levels in certain regions of the country, such as Southern and Western Kyrgyzstan, create challenges for small businesses, complicating access to finance and limiting the potential for growth and innovation (Sakkaraeva & Kumashev, 2024). On the other hand, regions with higher income levels, such as the capital Bishkek and the northern regions of the country, have more favourable conditions for the development of SMEs. The high purchasing power of the population there contributes to increased demand for products and services, stimulating the development of local entrepreneurship. Awareness of these income differences and their impact on the business environment of Kyrgyzstan is necessary to formulate targeted economic policies aimed at supporting the sustainable development of SMEs in all regions of the country.

This topic has attracted the attention of many researchers who have devoted their work to the investigation of various aspects of SMEs. L. Al-Haddad *et al*. (2019) revealed that SMEs play a key role in generating jobs and stimulating economic growth. This fact confirmed the importance of the SME sector as a driving force for creating new jobs and increasing the overall level of income in society. The study by A. Arjang *et al*. (2024) highlighted the importance of business innovations for SMEs and their impact on improving the quality of life. The development of innovative strategies has contributed not only to economic growth, but also to the improvement of social indicators, including income levels and access to services. Among the strategies to support SMEs, special attention was paid to financing and financial inclusion. G. Chandrarin *et al*. (2018) confirmed that improved financial inclusion and access to finance significantly contributed to reducing poverty and unemployment through the development of SMEs. Review of the papers by J.M. Nkwabi & L.B. Mboya (2019) and V.O. Okolo *et al*. (2023) supplemented the understanding of the impact of income on the development of SMEs and its contribution to economic growth indicators in various regions of the world. C.R. Kulueva & A.A. Satybaldyeva (2022) analysed aspects of regulation and support of SMEs in the socio-economic development of Kyrgyzstan, and also revealed the protective role of Kyrgyz regulatory documents to solve existing problems of entrepreneurship development in the southern region. The study by U.K. Muidinov & U.A. Teshebaeva (2022) shows some socio-economic features of entrepreneurship in Kyrgyzstan, considering the specifics of the transition period.

Consequently, the research conducted in the field of SMEs not only revealed their key role in the economies of various countries, but also proposed specific support strategies aimed at promoting their sustainable growth, social inclusion, and innovative development. Thus, recent studies indicate a variety of areas of influence of household incomes on the development of SMEs in various regions of the world. Despite the significant amount of research in this area, identifying the features of the impact of household incomes on the development of SMEs in Kyrgyzstan remains an urgent task that requires further analysis and research. The purpose of the study was to identify the specific features of the impact of household income on the development of SMEs on the example of Kyrgyzstan. In order to achieve the goal, the following tasks were identified: to assess the impact of the incomes of the Kyrgyz population on the development of SMEs and to compare them with the incomes of other countries of the world; to identify the problems of SME development in Kyrgyzstan that hinder its successful development; to develop a number of recommendations to solve the identified problems regarding the development of SMEs in Kyrgyzstan.

MATERIALS AND METHODS

The study on the impact of household incomes on the development of SMEs in Kyrgyzstan was conducted using a comprehensive analysis of statistical data and an international comparative approach. Statistical data were collected on the average monthly nominal wages of employees of enterprises and organisations in various sectors of the Kyrgyz economy. The information was obtained from the report of the National Statistical Committee of the Kyrgyz Republic (2024). Data for 2022-2023 were used for the analysis. To calculate the average salary in the country, the standard arithmetic mean method was used, which allowed establishing a general trend in income levels in Kyrgyzstan during the selected period.

The average salary in Kyrgyzstan was compared with similar indicators in other countries of the world, such as the Netherlands, Ireland, Greenland, Canada, Denmark, Norway, Iceland, the USA, Luxembourg, Switzerland (Ranked: Countries…, 2024). These countries were chosen due to the fact that their citizens have the highest salaries. The Wilcoxon t-test was used to determine statistically significant differences between income levels. This nonparametric test compared data ranks and identified

statistically significant differences between groups of countries. This approach identified key trends in the income level of the Kyrgyz population and also compared them with international experience. Next, data were collected on the number and main economic indicators of the activities of SMEs in Kyrgyzstan for the period from 2017 to 2023 (National Statistical Committee..., 2024). For the analysis, data were used on the share of SMEs in the total volume of entrepreneurial activity, their contribution to the country's economy and the dynamics of this contribution during the study period. This study also identified the problems of SME development in Kyrgyzstan. To do this, the main obstacles faced by SMEs in the country were analysed. The main sources of data were official reports on the state of the business environment, international ratings, and analysis of statistical indicators and international comparisons (Economy rankings, 2020; Entry points for digital..., 2021; Trends in the development..., 2024).

The final stage of the study included the development of specific recommendations and strategies to support the development of SMEs in Kyrgyzstan. The main task of this stage was to adapt and apply the experience of successful countries that have achieved significant results in stimulating the development of SMEs through effective government policies and support programmes. To this end, an extensive analysis of international experience and best practices from other countries was carried out, including the study of government programmes, financial support mechanisms, tax incentives, administrative reforms, and measures to improve the business environment. The key aspects that can be adapted and implemented in the conditions of Kyrgyzstan to increase the competitiveness and sustainability of SMEs were highlighted. The study used the experience of several countries such as Singapore, Brazil, Mexico, Switzerland, Estonia, and Canada to develop recommendations and strategies for the development of SMEs in Kyrgyzstan. These countries were chosen because of their successful experience in developing and implementing effective government policies and support programmes. The use of best practices in poverty alleviation, education promotion, microcredit, digitalisation and government support can create a favourable economic environment and contribute to the country's economic growth.

RESULTS

Assessment of the impact of income of the Kyrgyz population on the development of SMEs and comparison with other countries of the world

In Kyrgyzstan, the impact of household income on the development of SMEs is especially significant, given its economic structure and the level of socio-economic development. A high level of income contributes to an increase in consumer demand, which is important for the development of SMEs, since a significant part of their activities is based on this segment. Low income, on the contrary, limits the purchasing power of the population, which makes it difficult to sell goods and services, reducing the profitability and sustainability of enterprises themselves. Thus, the growth of household incomes not only stimulates consumer demand in the market, but also provides entrepreneurs with more opportunities to invest in expanding and modernising their businesses, contributing to their sustainable development. Table 1 shows the average monthly nominal wages of employees of enterprises and organisations by type of economic activity in Kyrgyzstan for 2022 and 2023 in USD.

Table 1. Average monthly nominal wages of employees of enterprises and organisations by type of economic activity in Kyrgyzstan

Type	Value, USD		As a percentage of the corresponding period of the previous year	
	2022	2023	2022	2023
Agriculture, forestry, and fishing	137.17	283.3	106.4	206.5
Extraction of mineral resources	537.53	564.41	133.5	105
Manufacturing industries	467.96	546.12	187.4	116.7
Provision (supply) of electricity, gas, steam	377.22	463.81	111.5	123
Water supply, cleaning, waste treatment and recycling	207.23	264.96	102.7	127.9
Construction	247.52	299.04	117.3	120.8
Wholesale and retail trade, repair of cars, motorcycles	260.46	327.37	104.2	125.7
Transportation and cargo storage	327.24	409.07	114	125
Activities of hotels and restaurants	238.7	310.52	125.6	130.1
Information and communication	474.89	636.06	113.7	133.9
Financial intermediation and insurance	493.07	602.98	114.9	122.3
Real estate transactions	206.65	274.97	114.8	133.1
Professional, scientific, and technical activities	311.04	639.65	117.5	127.4
Administrative and support activities	213.61	320.3	106.4	149.9
Public administration and defence; Compulsory social security	298.44	523.36	113.5	175.4
Education	174.61	284.93	106.2	163.2
Public health and social services	171.07	242.34	134.9	141.7
Art, entertainment, and recreation	132.91	261.77	117.9	197
Other service activities	206.77	212.12	107.1	102.6
Total average salary	292.37	354.36		117.5

Source: compiled by the authors based on National Statistical Committee of the Kyrgyz Republic (2024)

Thus, for the period 2022-2023, the average salary increased by 17.5%. In agriculture, forestry, and fisheries, there was a significant increase in wages by 106.4% in 2022 and by 206.5% in 2023, which is primarily due to investments in agriculture, contributing to increased agricultural productivity. The mining sector, on the contrary, showed a 5% decrease in wages in 2023, which is due to global changes in resource prices or to internal economic factors such as a decrease in production or changes in industry regulation. Manufacturing industries showed moderate wage growth of 16.8%, due to the introduction of new technologies and improved production processes. The significant wage growth of 175.4% in the public administration and defence sector in 2023 reflects an increase in government spending on social security and defence, and the implementation of structural reforms in management and defence. It is important to note that the salary level in Kyrgyzstan is significantly lower than in many other countries, as shown in Figure 1.

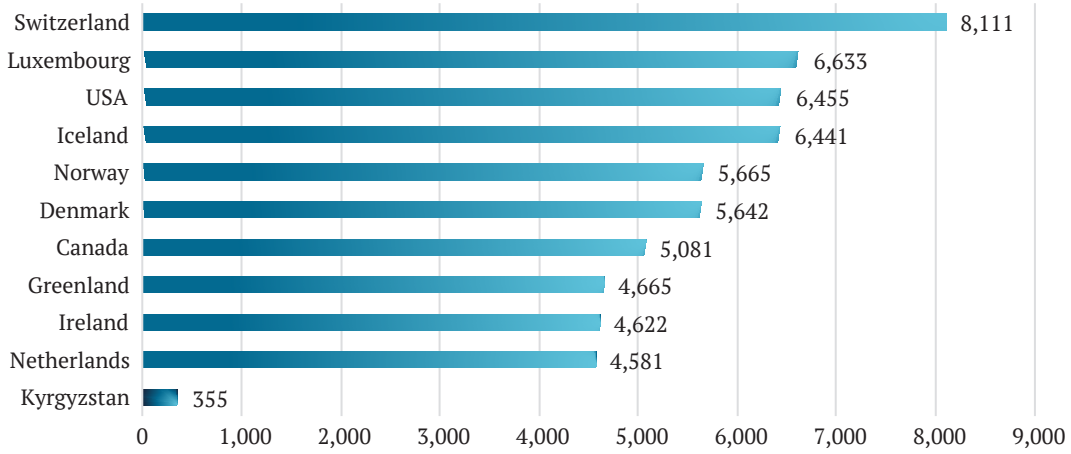

Figure 1. Comparison of the average wage of Kyrgyzstan with the countries with the highest wage levels as of the end of 2023, USD

Source: compiled by the authors based on Frequently asked questions about small business (2023), Ranked: Countries with the highest and lowest average salaries (2024)

Thus, in comparison with the above-mentioned countries, the salary level in Kyrgyzstan is significantly lower. For example, the average salary in Switzerland is the highest of the listed countries and amounts to USD 8,111. While in Kyrgyzstan, the average salary is USD 355. This means that the average salary in Switzerland is about 23 times higher than in Kyrgyzstan. This significant gap reflects the low income and economic challenges faced by Kyrgyz residents, including access to housing, medical care, and other social services. Given the significantly low-income level of the population in Kyrgyzstan, starting own business seems to be an extremely difficult task. Low incomes create significant barriers for potential entrepreneurs, including limited access to capital, insufficient purchasing power of the population and limited market opportunities. These factors complicate not only the launch of new enterprises, but also their sustainable functioning, affecting economic activity and the development of the country as a whole. Figure 2 below shows the dynamics of the development of SMEs in Kyrgyzstan.

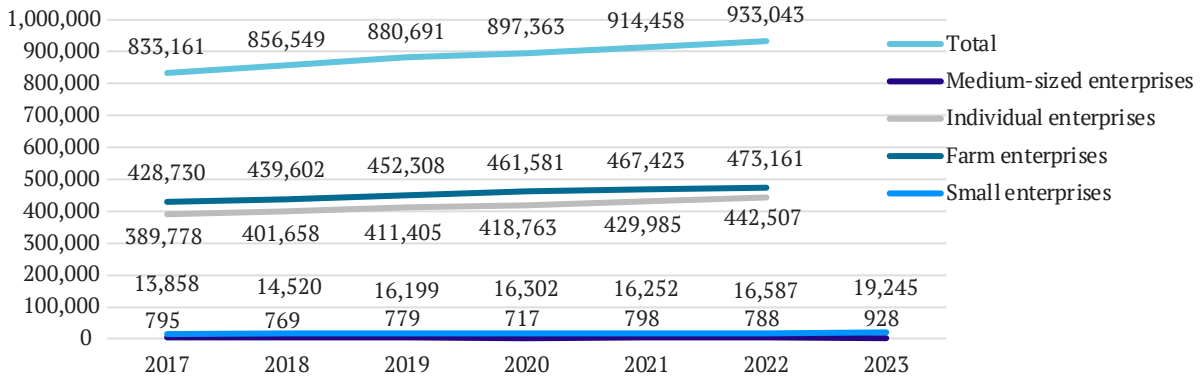

Figure 2. Dynamics of development of SMEs in Kyrgyzstan, units

Source: compiled by the authors based on the National Statistical Committee of the Kyrgyz Republic (2024)

The analysis of the presented data showed that the sector of SMEs in Kyrgyzstan is developing extremely slowly. In the period from 2017 to 2022, there was a slight increase in the number of small enterprises from 13.9 thousand units to 19.2 thousand units, which indicates an extremely slow growth dynamic. Nevertheless, the overall pace of

SME development remains extremely low, no more than 7% over the entire period, which indicates the existing structural barriers and economic constraints that hinder the more dynamic development of this sector in the country. This is confirmed by the main economic indicators of the activities of SMEs, which are presented in Table 2.

Table 2. Main economic indicators of the activities of SMEs, as a percentage of the total volume of the republic

	2017	2018	2019	2020	2021	2022
Revenue (gross income) from the sale of products (goods, works, services)	29	29.5	31.8	27.4	32.1	33.3
Volume of industrial production	21.4	22.1	21.2	17.8	20.8	22.1
Volume of contract works performed using in-house resources	77.1	88.7	93.4	96.1	89.6	90.8
Volume of agricultural production	63.1	62.5	62.6	62.5	61.3	62.7
Wholesale and retail trade; Repair of cars and motorcycles	82.6	79	81.6	80.8	83.9	80.6
Scope of services provided by hotels and restaurants	96.7	97	95.9	98.6	90.8	94.3
Transportation and cargo storage	60.9	60.5	61	65.7	60.3	66.2
Scope of postal and courier services	15.7	14.4	18.1	18.3	34.1	45.1
Export	34.7	39.3	35.4	24.9	27.3	66.9
Import	64.4	64.2	65.5	54.4	56.7	65.8

Source: compiled by the authors based on the National Statistical Committee of the Kyrgyz Republic (2024)

Analysing the main economic indicators of the activities of SMEs in Kyrgyzstan for the period 2017-2022, it can be noted that revenue from the sale of products (goods, works, services) showed a slight increase from 29% in 2017 to 33.3% in 2022, which indicates an extremely slow increase in the economic activity of SMEs. The volume of industrial output produced by SMEs remained relatively low and ranged between 17.8% and 22.1%, indicating insufficient industrialisation of SMEs. The volume of contract work performed on its own is consistently high and reached 90.8% in 2022, which underlines the importance of SMEs in the construction sector. Consequently, it can be concluded that the development of SMEs remains slow in some key sectors, such as industrial production.

Thus, income plays a key role in the development of SMEs in Kyrgyzstan, significantly affecting their ability to develop and sustainability. This analysis showed that SMEs in Kyrgyzstan are developing at extremely low rates, which is also conditioned by extremely low incomes of the country's population. It is important to understand that low-income limits purchasing power, which, in turn, reduces demand for SME products and services. In conditions of insufficient demand, enterprises cannot generate sufficient revenue to reinvest in business development and expansion. In addition, low incomes of the population lead to limited access to financial resources, which further exacerbates the problems faced by SMEs.

Identification of problems of SME development in Kyrgyzstan

It is necessary to agree with the President of the Kyrgyz Republic Sadyr Zhaparov, who identified several main factors that negatively affect the development of SMEs in the country (Sadyr Zhaparov: We..., 2021). One of the significant problems is the presence of family clans that usurp power and control key economic and political resources in the country. Such concentration of power in the hands of a narrow group of people creates conditions for unequal competition and hinders the free development of entrepreneurship. Family clans often put personal interests above public ones, which undermines trust in state institutions and economic processes.

Corruption is another serious problem for the development of SMEs in Kyrgyzstan. Corrupt practices permeate various levels of government and create additional barriers for entrepreneurs. In this context, it should be noted that as of 2023, Kyrgyzstan was ranked 141st out of 180 countries in the Corruption Perception Index, which is the leading global indicator of the level of corruption in the public sector. In 2023, the country received 26 points, which is one point less than in 2022 (Transparency International. Kyrgyzstan, n.d.). Such a low rating indicates serious problems with corruption, which negatively affect the business climate and hinder the development of SMEs in Kyrgyzstan.

Outflow of young people outside the republic for employment purposes: economic instability and limited employment opportunities within the country lead to a significant outflow of young people abroad. Young and qualified personnel leaving the country deprive the economy of the necessary human capital, which makes it difficult to develop innovative projects and increase labour productivity in SMEs. In 2022, the National Statistical Committee of the Kyrgyz Republic (2024) conducted a population census, including questions about migration. According to the census results, 16% of the total population of Kyrgyzstan, or 1 million 94.5 thousand people, were temporarily absent from their permanent place of residence. Of this number, 876,883 people (80% of the absent population) migrated outside the country, and 271,631 people migrated inside Kyrgyzstan. The Global Data Institute (2023) report noted that among the reasons for migration from Kyrgyzstan, respondents indicated the following: the desire to improve their financial situation and earn more money (36.9%), the desire to find a job and build a career (15.9%). Such high rates are demonstrated by the unwillingness and inability to open and develop SMEs in their country.

The majority of citizens have a high level of poverty and low income. Low-income levels hinder the accumulation of capital required to invest in business development and innovation. The proof of this is the low ratings in the Poverty Headcount Ratio (the level of poverty in terms of population). Poverty Headcount Ratio is a rating developed by the World Bank to assess the proportion of the population living below the national or international poverty line

(Poverty & equity brief…, 2023). The indicator is expressed as a percentage and reflects the percentage of people in a country or region whose income (or consumption) is below the established poverty level. International poverty lines such as USD 1.9, USD 3.2 and USD 5.5 per day at purchasing power parity are used for global comparisons. Kyrgyzstan received a rating of 33.3 in 2021, which indicates an extremely low financial condition of the country's population. Pressure on entrepreneurs from public authorities manifests itself in the form of bureaucratic obstacles, excessive regulation, and unreasonable inspections. Bureaucratic obstacles are manifested in complex and complicated procedures for business registration, obtaining licenses and permits. These processes often require a long time and numerous approvals, which significantly slows down the start-up and operation of enterprises. For example, it may take from several weeks to several months to obtain a standard business license, which creates uncertainty and additional costs for entrepreneurs.

Over-regulation is also a serious problem. The regulatory framework in the field of business is often unnecessarily complex and ambiguous, which makes it difficult for entrepreneurs to understand their rights and obligations and forces them to involve additional legal consultants, increasing operating costs. Unjustified inspections by government agencies further aggravate the situation. Frequent and unexpected inspections can be carried out without a clear reason and in violation of procedures, which distracts entrepreneurs from their main activities and creates additional financial and time costs (Kyfyak *et al*., 2024). For example, small businesses may be subject to several inspections per month, which practically paralyses their activities. These factors together create an unfavourable business environment, reduce the confidence of entrepreneurs in government agencies and hinder the development of SMEs. Uncertainty and high risks of interaction with government agencies limit opportunities to attract investment and expand business, which ultimately slows down the country's economic growth (Ivanov *et al*., 2021).

The insecurity of the interests of entrepreneurs, there are no guarantees for investors. The insecurity of entrepreneurs' interests and the lack of guarantees for investors in Kyrgyzstan create significant barriers to business development and capital raising. Entrepreneurs often face insufficient protection of their rights, which leads to additional risks and uncertainty. Table 3 shows the Ease of Doing Business ranking, which considers various aspects of the business environment, such as ease of business registration, obtaining construction permits, access to loans, investor protection, taxation, and resolution of insolvency issues (Economy rankings, 2020). This rating helps to assess how comfortable and safe it is to do business in a particular country, which is an important indicator for entrepreneurs and investors when making decisions about investments and business expansion.

Table 3. Sub-indexes of Ease of Doing Business rankings of Kyrgyzstan and the top five countries in the ranking

	Result of Kyrgyzstan (80th place in the ranking)	Result of New Zealand (1st place in the ranking)	Result of Singapore (2nd place in the ranking)	Result of Hong Kong (3rd place in the ranking)	Result of Denmark (4th place in the ranking)	Result of the Republic of Korea (5th place in the ranking)
Registration of enterprises	42	1	4	5	45	33
Obtaining building permits	90	7	5	1	4	12
Connection to the power supply system	143	48	19	3	21	2
Registration of property	7	2	21	51	11	40
Obtaining loans	15	1	37	37	48	67
Protection of minority investors	128	3	3	7	28	25
Taxation	117	9	7	2	8	21
International trade	89	63	47	29	1	36
Contract enforcement	134	23	1	31	14	2
Resolution of insolvency	78	36	27	45	6	11

Source: compiled by the authors based on the Economy rankings (2020)

In this rating, it is worth paying attention to the huge gap between the leading countries regarding investor protection. Kyrgyzstan received 128 points, extremely high scores that demonstrate the lack of investor protection in the country. Also in this rating, it is worth paying attention to the "taxation" sub-index, which also received a large number of points, which indicates an imperfect taxation system that greatly hinders the development of SMEs in the country. Complex and frequently changing tax rules create an additional burden on entrepreneurs, increasing

their operating costs and requiring additional resources to maintain accounting records and comply with tax obligations. This is especially difficult for small businesses, which do not always have sufficient financial and administrative capabilities to effectively manage tax issues, which ultimately reduces their competitiveness and hinders growth (Kalchenko *et al.*, 2018). Contract enforcement is also at an extremely low level (134 points), which indicates weak legal protection for entrepreneurs and investors. An ineffective judicial system and lengthy dispute resolution procedures make it difficult for entrepreneurs and investors to protect their rights and interests. For example, when violating the terms of a contract, businessmen often face long court proceedings that can drag on for years, which leads to significant financial losses and a decrease in confidence in the legal system. The low level of contract execution also deters potential investors, as they are not confident in the possibility of a quick and fair dispute resolution. This creates additional risks and uncertainty for doing business, which limits SMEs' access to necessary financial resources and hinders their development.

According to the National Bank of the Kyrgyz Republic, interest rates on loans for small businesses range from 18% to 24% per annum (Trends in the development..., 2024). High interest rates on loans cannot be affordable for everyone to start their own business. It is important to note that such high rates are due to the low solvency of borrowers and the high level of financial risks. By the end of 2023, the total loan portfolio of the Kyrgyz banking sector reached KGS 275.7 billion (USD 3.31 billion). This volume includes loans aimed at various sectors of the economy, including agriculture, trade, construction, and industry. Loans for agriculture, for example, increased by 8.1%, reaching KGS 45.6 billion (USD 0.55 billion). In 2023, the total volume of loans issued to SMEs amounted to only 12% of the total loan portfolio of the banking system, which demonstrates the limited access of SMEs to financial resources (Trends in the development..., 2024). In addition, entrepreneurs face serious difficulties in purchasing modern equipment, due to the constant increase in prices for imported goods due to fluctuations in the USD against the KGS. Rising electricity and gasoline prices further complicate business operations, as these factors directly affect the cost of products and services provided by SMEs.

Thus, the problems of SME development in Kyrgyzstan include bureaucratic obstacles, excessive regulation, unreasonable inspections, insufficient protection of entrepreneurs' rights, lack of guarantees for investors, and weak legal protection and low level of contract execution. These factors create an unfavourable business environment, reduce the confidence of entrepreneurs and investors in government institutions, increase operating costs and hinder the attraction of necessary financial resources, which ultimately slows down the country's economic growth and the development of SMEs.

Recommendations for solving identified problems of SME development in Kyrgyzstan

In this context, the proposed recommendations are aimed at eliminating the above-mentioned problems and creating a favourable business environment that will contribute to the growth of entrepreneurial activity, attract investment, and increase the competitiveness of the Kyrgyz economy. Improving the literacy and education of the population is a fundamental strategy to stimulate economic development and strengthen the SME sector in Kyrgyzstan. Improving educational standards and expanding access to quality education from an early age lays the foundation for the development of competent and qualified personnel capable of further contributing to the development of the national economy. Increasing the level of education of the population will increase the chances of the population to get well-paid jobs, which will increase their purchasing power and stimulate demand for products and services provided by SMEs. Special attention should be paid to the development of additional education and professional retraining programmes that will help the adult population adapt to changing economic conditions and labour market requirements. Public and private initiatives to support start-ups and entrepreneurship among young people through business incubators, accelerators and specialised courses will also contribute to the growth of SMEs.

Reducing the drain of the young population abroad. At the state level, a number of strategies used by other countries can be applied to solve the problem of the leakage of young personnel abroad. To do this, it is important to develop and implement a policy aimed at improving working conditions and remuneration for young professionals. For example, Sweden offers high living standards and social protection, which makes it attractive to young professionals despite higher taxes (Tynaliev *et al.*, 2024). It is also important to strengthen investments in education and scientific and technical research to create a strong intellectual base and offer promising career opportunities to young people. Canada is an example of a country that actively invests in research and education, creating attractive conditions for young professionals. To retain young professionals, it is also important to focus on creating incentives to work in nationally significant industries and sectors of the economy. For example, China uses incentive and subsidy programmes to attract talented young people to key industries such as information technology and innovation.

To combat poverty, various countries have applied a variety of strategies that can be successfully implemented in Kyrgyzstan. For example, Brazil has implemented the Bolsa Família in Brazil (2019) programme, which provides cash transfers to poor families subject to certain social obligations, such as school attendance and regular medical check-ups. This model of conditional cash transfers has had a significant impact on reducing inequality and hunger, significantly reducing the number of people living in poverty and bridging the historical urban-rural divide in Brazil. Another successful example is the Conditional Cash Transfers programme in Mexico, which provided subsidies to families with children on the condition that children attend school and receive regular medical check-ups (Stampini & Tornarolli, 2012). This initiative has contributed to improving children's educational performance and health, which has contributed to reducing poverty in the long term. For Kyrgyzstan, the implementation of such programmes can have a significant positive impact on the fight against poverty. It is important to adapt such ideas to the specific conditions of the country, considering social and economic characteristics. The introduction of such programmes can

stimulate access to education and health care, which is especially important for improving human capital and reducing social inequalities in Kyrgyzstan.

The problem of insecurity of the interests of entrepreneurs and the lack of guarantees for investors can be solved by implementing world experience, which is successfully applied in other countries. Reference can be made to the experience of Singapore, which has demonstrated a successful model of protecting the rights of investors and entrepreneurs through a strict legal and regulatory framework. The main functions for the protection of investors' rights are performed by a special agency for the protection of investors' rights – the Monetary Authority of Singapore (MAS). MAS monitors the activities of financial institutions, requires disclosure of information to ensure transparency, develops measures to protect the rights of investors, sets standards for independent assessment and audit, and promotes financial literacy among the population. Thus, MAS implements a comprehensive approach to protecting investors and maintaining financial stability in Singapore.

Increasing the level of digitalisation in the country is also able to improve the development of SMEs in the country. Although Kyrgyzstan has defined a digital transformation policy in several key strategic documents, including the National Development Strategy for the period from 2018 to 2040, the Government Programme for 2018-2022 and the National Digital Transformation Programme "Digital Kyrgyzstan-2019-2023", the level of digitalisation remains extremely low (Entry points for digital…, 2021). The main problems include insufficient digital literacy and the lack of a clearly defined investment plan for the development of digital human capital. Despite the active development of the IT sector, the main obstacle to its expansion is the lack of qualified IT specialists and the outflow of talented Kyrgyz developers abroad to foreign employers.

In this context, the practice of Estonia is interesting, which has demonstrated successful experience in the field of digitalisation of public services, which has significantly increased the level of trust on the part of entrepreneurs and investors. The key measures contributing to this success are the introduction of electronic residency, which allows foreign entrepreneurs to conduct business in the country remotely, the creation of online platforms for registering and doing business, and the introduction of digital signatures and documents that simplify and accelerate legal processes. Germany also provides various forms of protection for investors, including insurance and legal guarantees. Important measures include the introduction of state guarantees for investors in case of political or economic risks, the creation of export credit and investment insurance agencies, and the provision of legal support and advice to foreign investors.

The key areas of support for SMEs can also be identified as financial support from the state, the provision of tax benefits, interest-free loans, and free rental premises. It is extremely important for the state to pay special attention to the development of regions, since it is there that the regulation of conditions for the accessibility and development of individual entrepreneurship is required. It is also important to create consulting companies that will inform entrepreneurs about legitimate actions that contribute to the favourable development of entrepreneurial activity in the country.

DISCUSSION

The role of SMEs in the economic development of Kyrgyzstan remains key, as in many countries of the world, since these enterprises not only create jobs and stimulate economic growth, but also contribute to social stability and innovative development (Asgary *et al.*, 2020; Dahliah *et al.*, 2023). However, appropriate support strategies are required for the effective development of SMEs, considering the specifics of the national economy and the international experience of successful countries (Diabate *et al.*, 2019). In this context, household incomes play an important role in the dynamics of the development of SMEs, since a high level of income contributes to an increase in consumer demand, which stimulates the production and sale of goods and services of SMEs. On the contrary, low incomes limit purchasing power, which can negatively affect the profitability and sustainability of these enterprises. In addition, high incomes contribute to an increase in the volume of investments that SMEs can direct to development, business expansion, and innovation (Ausat & Suherlan, 2021).

This study was aimed at a comprehensive assessment of the impact of income of the Kyrgyz population on the development of SMEs in Kyrgyzstan. During the analysis, the key factors determining the success of SMEs in conditions of economic instability and social changes were identified. As it was found, the incomes of the population affect the ability of entrepreneurs to invest in improving the skills of their employees and improving working conditions, which, in turn, increases the productivity and competitiveness of enterprises. The study noted that government support aimed at increasing income levels and reducing poverty can significantly improve the conditions for the development of SMEs. Such measures include the provision of tax incentives, subsidies, access to loans and training programmes for entrepreneurs. Together, all these factors create a favourable environment for sustainable growth and prosperity of SMEs in Kyrgyzstan. This conclusion is confirmed in the study by J.M. Nkwabi & L.B. Mboya (2019), which explored the factors hindering the growth of SMEs in Tanzania, such as financial constraints, lack of capital, technological challenges, and complex government regulation. In addition, the study identified several significant challenges that significantly impede the development of SMEs in the country. One of the key problems is the high level of corruption, covering various levels of government. Corrupt practices create additional barriers for entrepreneurs, increasing transaction costs and worsening the business climate. B.I. Gumel & B. Bin Bardai (2023) also focused on this issue, emphasising the dual role of government as a source of obstacles to the development of SMEs, and as a catalyst for their development.

Another significant problem is the complex and often unpredictable bureaucratic environment. Business registration procedures, obtaining licenses and permits require significant time and financial costs, which slows down the development of entrepreneurship (Gutium *et al.*, 2023). Excessive regulation and frequent unjustified inspections also increase uncertainty and create additional barriers to business. This was also confirmed by B.I. Gumel & B. Bin Bardai (2023), who identified twenty-five factors influencing the development of SMEs in emerging economies. The

researchers emphasised that the difficulties associated with bureaucratic processes significantly limit access to financing and investments necessary for sustainable SME growth. J. Juergensen *et al*. (2020) also highlighted this problem, which significantly affects the development of SMEs. They noted that a complex bureaucratic environment not only increases the cost of doing business, but also creates significant obstacles to attracting investment and developing new projects. The researchers argue the need to simplify administrative procedures and increase their transparency as key steps to ensure a more favourable environment for SMEs. In addition, insufficient protection of the rights of investors and entrepreneurs, a weak legal system, and a low level of contract execution limit investment opportunities and create additional risks for business. In this context, the authors of this study agree with A.M. Jussupova & G.U. Khajiyeva (2022), who, using the example of the development of SMEs in Kazakhstan, also argued that the lack of investor protection could lead to distrust on their part and limit access to capital necessary for the sustainable development of SMEs.

According to L. Al-Haddad *et al*. (2019), weak investor protection can create barriers to raising capital, since investors, fearing losses, will be less inclined to invest in SMEs, which will negatively affect their ability to expand and develop. The study also revealed that a low level of education and a high level of poverty create additional obstacles to the development of SMEs, limiting access to skilled labour and reducing the purchasing power of the population, which in turn hinders economic growth and sustainability of these enterprises. A. Arjang *et al*. (2024) argued that the lack of adequate infrastructure and limited market access also complicate the activities of SMEs. The lack of financial literacy among entrepreneurs and the lack of government support exacerbates the current situation. An important part of this study was the development of recommendations for solving the identified problems. The implementation of successful international experience to stimulate the development of SMEs in Kyrgyzstan, presented in the study, was a key strategy in the context of their important role in the economy, creating jobs and stimulating innovation. To improve the protection of the interests of entrepreneurs and investors, Kyrgyzstan was invited to implement successful international experience. For example, Singapore is an example of a country with an effective investor protection model supported by a strict legal and regulatory framework implemented through MAS – the agency monitors the activities of financial institutions, ensures transparency and investor protection, which contributes to maintaining financial stability. It was also recommended to pay attention to Estonia's experience in digitalising public services, which should increase the level of confidence of entrepreneurs. The study noted that the introduction of e-residency and digital technologies to simplify business processes can be useful for improving the business environment in Kyrgyzstan.

Thus, the paper focuses on the importance of legal protection of entrepreneurs and investors, which is an important area for attracting investments and ensuring the sustainable development of SMEs. The lack of adequate protection of rights can create significant risks and limit business development, therefore, the study emphasises the need to improve the legal environment as one of the priority areas of policy. The advantage of this study lies in its systematic approach to analysis and recommendations. The study considers not only economic aspects, but also social and institutional factors affecting the development of SMEs. This distinguishes this research from other approaches, as it strives for a comprehensive understanding of the problems and offers integrated solutions that contribute to the sustainable and long-term development of the Kyrgyz economy.

CONCLUSIONS

The results of the study showed that the income of the population of Kyrgyzstan has a significant impact on the development of SMEs. A high level of income contributes to an increase in consumer demand, which, in turn, stimulates the development of SMEs, providing enterprises with the opportunity for growth and modernisation. At the same time, low income limits the purchasing power of the population, which makes it difficult to sell goods and services, reducing the profitability and sustainability of enterprises. Thus, increasing household incomes plays a key role in stimulating consumer demand and provides entrepreneurs with more opportunities to invest in the development of their businesses, which contributes to their sustainable growth. The analysis of the data also showed that the salary level in Kyrgyzstan is significantly lower than in other countries, which limits opportunities for the development of SMEs.

The problems of SME development in Kyrgyzstan are multidimensional and include the presence of family clans, high levels of corruption, economic instability, youth outflow, low incomes for most citizens, bureaucratic obstacles, excessive regulation, unreasonable inspections, insufficient protection of the rights of entrepreneurs, lack of guarantees for investors, and weak legal protection and low level of contract execution. These factors create an unfavourable business environment, reduce the confidence of entrepreneurs and investors in government institutions, increase operating costs and hinder the attraction of necessary financial resources, which ultimately slows down the country's economic growth and the development of SMEs. Further, recommendations were proposed to address the identified problems of SME development in Kyrgyzstan. Attention was paid to improving the educational system, which includes updating curricula, introducing world practices, and developing professional retraining. These measures are aimed at the development of qualified personnel who will contribute to the economic growth of the country. In addition, strategies have been proposed to prevent the diversion of young people abroad, such as improving working conditions and creating career opportunities in nationally important industries.

Measures to combat poverty were also considered, using successful examples from other countries, such as conditional cash transfer programmes. To protect the rights of entrepreneurs and investors, it is proposed to adopt the experience of Singapore and Germany in the field of legal protection and financial guarantees. An important component of the recommendations is to increase the level of digitalisation, with an emphasis on improving digital literacy and creating favourable conditions for IT professionals. These measures are aimed at creating a favourable business

environment conducive to the growth of entrepreneurial activity, attracting investment and improving the competitiveness of the Kyrgyz economy. Thus, the role of SMEs in the economic development of Kyrgyzstan remains key, but for their effective growth, appropriate support strategies are needed that consider the specifics of the national economy and international experience. Further research may include a more detailed international comparative analysis of the impact of household incomes on the development of SMEs, taking into account the specific socio-economic conditions of each country. This will help to identify the most effective strategies for increasing household incomes and their impact on the development of entrepreneurship in various regions of the world.

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CONFLICT OF INTEREST

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Вплив доходів населення на розвиток малого та середнього бізнесу: міжнародно-порівняльний аналіз

Анотація. Це дослідження було спрямоване на аналіз впливу доходів населення на розвиток малого та середнього бізнесу (МСБ) на прикладі Киргизстану та розробку рекомендацій для імплементації міжнародного досвіду в країні. Методологія дослідження включала збір та аналіз статистичних даних для оцінки середньомісячної номінальної заробітної плати зі застосуванням середнього арифметичного. Метод економіко-статистичного аналізу було застосовано для порівняння заробітних плат у Киргизстані з аналогічними показниками інших країн із використанням Т-критерію Вілкоксона, а також для аналізу економічних показників діяльності суб'єктів МСБ за період 2017-2023 років. У дослідженні було виявлено, що високий рівень доходів населення сприяє збільшенню споживчого попиту і стимулює розвиток МСБ через підвищення обсягів продажів та інвестицій. Однак низький рівень доходів населення чинить негативний вплив на купівельну спроможність і, отже, на стійкість і рентабельність підприємств. З'ясовано, що доходи населення відіграють визначальну роль у формуванні попиту на товари та послуги, що безпосередньо впливає на активність і зростання МСБ у країні. Було виявлено, що рівень заробітної плати в Киргизстані є вкрай низький і суттєво відрізняється від середнього рівня заробітних плат в інших країнах світу. У дослідженні також було ідентифіковано основні проблеми, які гальмують успішний розвиток МСБ у Киргизстані, включаючи складне бюрократичне середовище, недостатню фінансову підтримку, високий рівень бідності населення та відсутність захищеності інвесторів. У результаті дослідження було розроблено набір рекомендацій для поліпшення умов розвитку МСБ у Киргизстані. Впровадження цих рекомендацій дасть змогу створити сприятливі умови для зростання та розвитку МСБ у Киргизстані, сприяючи зміцненню економічної стійкості та соціального розвитку країни

Ключові слова: рівень заробітної плати; економічне зростання; державна підтримка; рівень корупції; бюрократичні перешкоди

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Innovative factors ensuring strategic changes in sectors of the national economy

Abstract. As an essential component of strategic changes at the national economic level, the process of transformations in industries plays a vital role in creating a favourable environment for attracting investments, developing new technologies, and improving the population's quality of life. This article aimed to determine the features of the formed industry structure of the national economy through an assessment of factors that influence the provision of strategic changes in the sectors of the national economy to determine the direction of strengthening the innovation component of industry transformations. The economic aspects of strategic changes at the national economy level are identified and analysed, considering the features of the country's innovation, investment, and environmental policies, the

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productivity of innovations themselves, and the involvement of businesses in the innovation process. An analysis of the level of development of innovation factors that influence the provision of strategic changes in the sectors of the national economy of the studied countries is presented. The assessment of factors influencing the provision of strategic changes in the branches of the national economy (16 factors) was carried out using the construction of an economic and mathematical model. The results obtained showed a direct dependence of strategic changes in national economies on innovation factors. The exception were the factors of state environmental policy and education financing. In the economy of Ukraine, a decrease in the activity of innovation factors was revealed, except for the production potential of business. Focusing on this system of factors will contribute to a comprehensive understanding of modern requirements and management capabilities for ensuring strategic changes in sectors of the national economy through mechanisms of innovative development

Keywords: socio-economic development; sustainable development; types of economic activity; industry structure; transformation; factor influence; technological progress

INTRODUCTION

The process of sectoral transformations as a component of strategic changes at the level of the national economy relates to several key aspects. These include the transition to a more efficient and innovative production model, the development of competitive industries, as well as adaptation to changes in global market conditions. Sectoral transformations play an important role in creating a favourable environment for attracting investment, developing new technologies, and raising the standard of living of the population. Such changes contribute to the reorientation of the economy to a more sustainable and balanced way of development, which is reflected in the general economic growth and social progress of the country. This approach allows to consider strategic changes in the sectors of the national economy as a key element for stimulating innovation, growth, and creating sustainable economic development in the country. The feature of the modern industry environment is that its practices are constantly being researched and reformed in the context of technologies that change these practices because of technical and informational achievements considering the principles of sustainable development. Society, enterprises, and individuals face a system of challenges that are not so easy to overcome.

The value of existing research on ensuring strategic changes in the sectors of national economies can be assessed from different positions. R. Guo *et al*. (2020) found the impact of company size on the ability to transfer knowledge and implement sustainable innovations in business practice. The authors proposed strengthening inter-organisational management as the main motivational factor for stimulating innovative shifts. The researchers focused on small and medium-sized companies' tangible and intangible assets. Small and medium-sized enterprises also became research subjects in innovation implementation in the work of A. Afshar Jahanshahi *et al*. (2020). However, the scientists did not find the impact of business size on companies' innovative activity level. According to the research results, the authors called corporate culture and the level of its development at the enterprise the main drivers of the implementation of green innovations. The main incentive for companies to implement green innovations and processes was identified as a customer-centric corporate culture and market eco-trends.

Increased investment in technological progress and ICT also contributes to economic progress. The availability of finance and economic growth are interdependent, as they create favourable conditions for investment and financing in the market while reducing financial costs and expanding financial services. Many organisations consider green innovation an essential component of their strategy to reduce the negative impact of traditional growth models. F. Han *et al*. (2024) identified public policies and government initiatives as essential components for accelerating green innovation transformations. For example, the Chinese government has already included green innovation in its constitution in 2018, creating a basis for developing a green technology bank to support the implementation of green technologies. Innovation and progress in the field of technology are key growth factors aimed at increasing the dynamics of national economies and reducing the negative impact on the environment. A fundamental problem for modern society, which has become the foundation of green transformation plans in many countries, is the need to reduce CO_2 emissions. Investigating this problem and directions for its possible solution, S. Ding *et al*. (2023; 2024) developed a forecast model for estimating CO_2 emissions, which combines an inventive cumulative generating extinction operator, a data smoothing index, and particle swarm optimisation on carbon emissions. The information accumulated using this model informs decarbonisation plans for Chinese provinces.

Researchers are of broad interest in factors that mediate the potential for innovative changes in business entities and economies. Strategic aspects of the impact of innovations on the expected changes in the socio-economic development of national economies also appear to be unstudied and challenging to assess. Relevance is also added by the dynamism of factors that determine the possibilities of innovative development of the economy. One of the conditions determining the need for further scientific research on the level of innovative development of the economy of Ukraine is the presence of a military conflict. War on the country's territory complicates and slows down the processes of innovative transformations in the national economy. A military conflict causes a significant lag in the Ukrainian economy from the level of development of the EU countries and the world. In this regard, constant monitoring and benchmarking of Ukraine's innovative development level in the context of other countries is necessary to assess the degree of the gap and find possible options for its reduction in the future. These aspects determined the feasibility of conducting this scientific research. The

purpose of the article was to determine the features of the formed sectoral structure of the national economy through the assessment of factors affecting the provision of strategic changes in the sectors of the national economy and to determine directions for strengthening the innovative component of sectoral transformations.

MATERIALS AND METHODS

To determine the optimal number of factors, the following criteria were used in the study: cumulative percentage – those factors are selected as determinants that ultimately cover approximately three-quarters of the original information (the cumulative percentage should be more than 75%); Kaiser's criterion, according to which only factors with an eigenvalue of more than one were selected. According to R.B. Cattell (1966) eigenvalue graph, the number of factors should be left up to the "breaking point". This is the point at which the eigenvalue line becomes aligned (levelled). If the number of factors is large and the increase in explanatory variance is too small, then the approximate number of factors can be taken at the level of the first or second breaking level of the graph. To assess the factors influencing the provision of strategic changes in the sectors of the national economy in different countries, a system of indicators has been developed that considers the following requirements: the significance of indicators and their groups for state management of sustainable development based on the innovative component. Based on the results of the analysis of the current state of socio-economic aspects of ensuring strategic changes in the sectors of the national economy in the countries of the world (in particular, in Ukraine), it was established that its development is influenced by the results of the activities of the sectors themselves, their age, quality, professional structure, and conditions, which have developed in the external environment and leave an imprint on the organisation of relations with other participants (partners, actual and potential consumers of business products). The comparability of indicators included in the economic-mathematical model is already ensured in the procedure of the factor analysis itself, which allows the use of data expressed in different units of measurement. The internal calculation mechanism eliminates such incomparability through the procedure of their standardisation.

Thus, because of modelling, enough factors are formed to describe the dynamics of the entire array of primary information in dimensionless (relative) units. This approach allowed to compare them with each other and build dynamic series while using a significantly smaller array of information for further calculations and conclusions. With the possibility of regulating indicators and forecasting the level of changes in factors that can act as indicators of development, based on which it is appropriate to justify measures to improve the system of ensuring strategic changes in the sectors of the national economy in the global (cluster) structure in general and the national economy of an individual country in particular. With the ability to forecast not only the components themselves, defined as influencing factors, but also based on their totality, it is possible to calculate the integral indicator of development and its forecast model if necessary. Considering the above, Table 1 presents the system of indicators that served as initial data for factor modelling and their notation in the model.

Table 1. The composition of the initial indicators regarding the assessment of the provision of strategic changes in the sectors of the national economy

Indicator	Legend in the model
Population, thousand persons	X1
Gross national income (GNI) per capita, USD	X2
Urban population, % of total population	X3
Export of agricultural products, million USD	X4
Human freedom index	X5
Employment rate, %	X6
Social progress index	X7
Digital competitiveness ranking	X8
Value added of services, % of GDP	X9
Value added of production, % of GDP	X10
Human development index	X11
Global innovation index (GII)	X12
Aquaculture production, metric tons	X13
Terrestrial protected areas, % of total land area	X14
Government expenditure on education, total, % of government spending	X15
Life expectancy at birth, years	X16

Source: created by the authors

The indicators were selected based on the analysis of literary sources devoted to the analysed issues (Zatonatska & Voznenko, 2019; Commission Staff Working Document No. 52021SC0352, 2021; Key enabling technologies policy, 2022; Kunytska-Iliash & Berezivskyi, 2023; Problems and prospects..., 2023) and taking into account the specifics of the socio-economic and organisational and cultural environment, the importance of the selected socio-economic phenomenon for the fulfilment of the tasks set before it, and the purpose of the study. The availability of information and the complexity of additional calculations were also considered. A number of the indicators employed

in the analysis are not available for the subsequent years. Thus, summarising information on all selected statistical indicators for 2021 led to a reduction of the sample to 62 countries of the world. To better select the factors and increase the factor load of the components of them, the normalised Varimax rotation method is used in the work, which allowed to maximise the variance between the factors and provides the possibility of its simpler interpretation in the case of multidimensionality of the initial data. They were formed using official sources of statistical information (Expenditure..., 2020; Agricultural products, 2021; Terrestrial..., 2021; Aquaculture..., 2022; Human development index, 2022; Services..., 2022; GNI per capita..., 2023; Vásquez *et al.*, 2023; Manufacturing..., 2023; Social progress..., 2023; The World Factbook, 2023; Unemployment..., 2023; Urban population..., 2023; World Intellectual Property Organization, 2023; World digital..., 2024; World Health Organization, 2024). The selected indicators were checked for the correlations, based on the results of which correlated indicators (X7, X11, X12) were excluded from the model. Therefore, the basis of the analysis was the observations for the specified period on the following variables: X1, X2, X3, X4, X5, X6, X8, X9, X10, X13, X14, X15, X16.

RESULTS

Processes of structural transformations call for the establishment of a certain type of relationship between enterprises and the authorities, between clusters of enterprises, between countries, etc. The reason why it is so important to consider the influence of the external environment when analysing strategic changes in the sectors of the national economy is based on their concept. This opinion is so widespread that when defining the concept of strategic changes in the sectors of the national economy, attention is focused on the process of transformations that take place in specific sectors of the economy of the countries in order to increase their efficiency, competitiveness, and impact on general economic development (Zatonatska & Voznenko, 2019; Kunytska-Iliash & Berezivskyi, 2023). This process may include the following aspects: structural changes (transition from traditional to new sectors of the economy, changes in production, consumption and distribution of resources); innovations and technological progress (development of new technologies, their integration into production and implementation of innovative methods and processes); development of human resources (investment in training and improving the qualifications of the workforce to meet the requirements of new sectors of the economy); regulatory policy (implementation of new rules and policies to promote the development of specific industries, types of activities or reform existing rules to stimulate economic growth and investment); international competition (promoting the development and competitiveness of export-oriented industries); strategic partnerships and investments (formation of integrated business structures with companies that have technological or financial resources for the joint development of new sectors of the economy.

From an economic point of view, the processes and results of structural transformations of the economy depend on the face of such challenges as high inflation and interest rates, geopolitical conflict, and the market consequences of the COVID-19 pandemic, which is evidence of the power of innovation. As per the latest data by the World Intellectual Property Organization (2023), global investment in research and development (R&D) saw a substantial increase, reaching 5.2% in 2021 compared to 2020. This growth rate is almost on par with the 6% growth rate observed in 2019, pre-pandemic. Notably, business spending on R&D surged by 7% in 2021, marking the highest growth rate since 2014. Key players in the innovation market also showed a significant increase in R&D spending in 2021: China (9.8%), the United States of America (5.6%), Japan (3.6%), Germany (2.7%), and the Republic of Korea (7.1%). Even excluding the significant contribution of the United States and China, global R&D in 2021 experienced growth of 2.7%. The growth rate of business R&D is also positive, at 4.1% in 2021 compared to a decrease of 1.7% in 2020. According to the report from the World Intellectual Property Organization (2023), Ukraine entered the group "Productivity above the expected level of development". The level of innovation productivity of national economies varied depending on the income level across country groups (Table 2; Fig. 1).

Table 2. Innovation performance at different income levels (performance above expectation for level of development)

High-income group	GII (Score)	Upper middle-income group	GII (Score)	Lower middle-income group	GII (Score)	Low-income group	GII (Score)
Switzerland	67.6	China	55.3	India	38.1	Rwanda	20.6
Sweden	64.2	Thailand	37.1	Viet Nam	36.0	Madagascar	19.1
United States	63.5	Brazil	33.6	**Ukraine**	32.8	Burundi	12.5
United Kingdom	62.4	North Macedonia	33.0	Philippines	32.2		
Finland	61.2	South Africa	30.4	Indonesia	30.3		
Netherlands (Kingdom of the)	60.4	Republic of Moldova	30.3	Mongolia	28.8		
Germany	58.8	Jordan	28.2	Morocco	28.4		
Denmark	58.7	Jamaica	27.1	Tunisia	26.9		
Republic of Korea	58.6			Uzbekistan	26.2		

Table 2. Continued

High-income group	GII (Score)	Upper middle-income group	GII (Score)	Lower middle-income group	GII (Score)	Low-income group	GII (Score)
France	56.0			Pakistan	23.3		
Japan	54.6			Senegal	22.5		
Israel	54.3						
Canada	53.8						
Estonia	53.4						

Source: created by the authors based on World Intellectual Property Organization (2023)

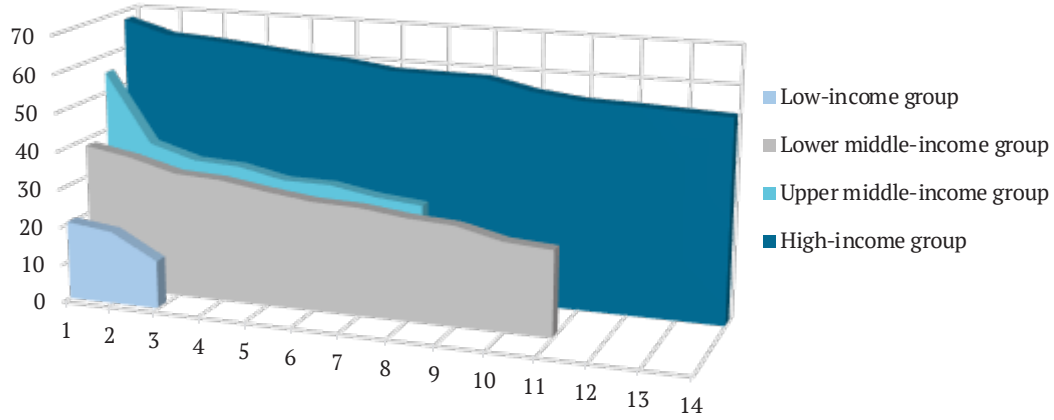

Figure 1. Distribution of countries with high innovation productivity according to the GII depending on the level of income

Source: created by the authors based on World Intellectual Property Organization (2023)

As can be seen from the given distribution, most of this group of innovative productivity is represented by high-income and lower-middle-income countries (more than 69%). The economic interpretation can be as follows: when incomes are significant, a surplus of funds can be directed to innovative development, and innovations are considered a source of subsequent income. Suppose the income is below the average level. In that case, more than one's funds are needed to develop innovations, investors are needed, and innovative products are perceived as ways to improve or optimise processes and costs. Such features determine high innovative productivity, considering a particular country's innovative investment and environmental policy. Thus, all processes in the field of enterprise activity are interconnected and mutually conditioned, both by the internal and external environment. Regarding innovation efficiency, technological progress is the main driver for improving innovation performance (Lin *et al.*, 2019). In addition, strategic economic initiatives can achieve significant achievements in industry by collaborating with enterprises, academic institutions, and research organisations to create a unified innovation sector, which is critical to the sustainable development and strategic transformation of national economic sectors (Ding *et al.*, 2024). According to compliance with the criteria for explaining the variation of indicators and load values, Table 3 shows the values of the contribution of factors to the total variability of their aggregate. As the data shows, the selected factors are significant: their eigenvalues are > 1. Furthermore, the first factor makes the largest significant contribution, explaining 32.051% of the variability, and together, the four factors explain 75.623% of the total variance of the indicators. This shows that the factor analysis carried out based on the given data made it possible to present the original variables at the level of 75.623% commonality, which reflect the provision of strategic changes in the sectors of the national economy of the represented countries in 2021, with four independent variables (Table 4).

Table 3. Contribution of factors to the total variance

Factor	Eigennumber	Total variance, %	Cumulative variance, %
F1	4.167	32.051	32.051
F2	2.275	17.499	49.550
F3	1.634	13.566	63.116
F4	1.059	12.507	75.623

Source: created by the authors

Table 4. Data for factor analysis by country

Salary No.	Country	Population, thousand persons	GNI per capita, USD	Urban population, % of total population	Export of agricultural products, million USD	Human freedom index	Employment rate, %	Social progress index	Rating of the digital collective enterprise, score	Services, value added, % of GDP	Manufacturing, value added, % of GDP	Human development index	GII	Aquaculture production, metric tons	Terrestrial protected areas, % of total land area	Government expenditure on education, total, % of government spending	Life expectancy at birth, years
		X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16
1	Argentina	45,195.8	20,925	92.229	42.673	7.38	53.8	78.64	43.64	52.5	15	0.842	29.80	3,687	8.48	12.28	75.4
2	Australia	25,499.9	49,238	86.362	46.716	8.84	61.9	87.83	78.68	65.7	6	0.951	48.30	126,206.3	20.36	13.13	84.5
3	Austria	9,006.4	53,619	58.995	21.313	8.67	57.3	88.05	80.88	62.4	17	0.916	50.90	4,920.39	29.28	8.85	81.6
4	Belgium	11,589.6	52,293	98.117	57.802	8.61	51.1	87.22	75.26	68.8	12	0.937	49.20	223	15.49	11.32	81.9
5	Botswana	2,351.6	16,198	71.56	136	7.9	46.1	65.89	33	63.6	6	0.693	24.68	163	29.14	21.46	61.1
6	Brazil	212,559.4	14,370	87.317	111.086	7.22	51.7	71.26	51.48	59.4	10	0.754	34.20	650,356.3	30.31	12.28	72.8
7	Bulgaria	6,948.4	23,079	76.025	7.348	8.08	53	76.81	50.78	62.3	10	0.795	42.40	15,173.62	41.04	10.56	71.8
8	Canada	37,742.2	46,808	81.653	87.299	8.85	61	88.17	87.31	69.6	10	0.936	53.10	191,449	11.91	11.05	82.7
9	Chile	19,116.2	24,563	87.817	23.976	8.44	51.9	80.78	61.8	36.8	9	0.855	35.10	1,443,520	20.89	19.36	78.9
10	China	1,439,323.8	17,504	62.512	88.526	5.57	64.7	65.74	84.43	53.3	27	0.768	54.80	72,805,297	15.62	10.85	78.2
11	Colombia	50,882.9	14,384	81.74	9.433	7.01	56.9	69.83	45.45	58	12	0.752	31.70	192,521	16.91	15.68	72.8
12	Croatia	4,105.3	30,132	57.878	4.325	8.16	48.3	82.32	49.75	60.4	11	0.858	37.30	26,830.7	38.36	10.72	77.6
13	Cyprus	1,207.4	38,188	66.856	555	8.42	58.9	83.18	59.37	73.2	6	0.896	46.70	7,862.3	38.59	12.74	81.2
14	Czech Republic	10,708.9	38,745	74.214	13.780	8.61	58.6	85.19	65.22	58.8	21	0.889	49.00	20,991	22.16	10.88	77.7
15	Denmark	5,792.2	60,365	88.24	25.053	8.98	59.5	90.54	95.16	66.7	12	0.948	57.30	40,594.2	16.97	11.89	81.4
16	Estonia	1,326.5	38,048	69.415	3.202	8.91	59.7	86.16	75.42	62.5	13	0.890	49.90	849.45	21.33	14.25	77.1
17	Finland	5,540.7	49,452	85.596	9.045	8.85	55.7	90.46	90.13	59.8	9	0.940	58.40	14,399.4	13.33	10.23	82.0
18	France	65,273.5	45,937	81.242	86.216	8.34	51.1	86.07	75.66	70.3	24	0.903	55.00	198,885.7	27.98	8.88	82.5
19	Germany	83,783.9	54,534	77.544	104.151	8.73	59.6	88.72	79.33	62.9	19	0.942	57.30	32,649	37.45	8.85	80.6
20	Greece	10,423.1	29,002	80.038	10.189	7.86	45.6	82.44	55.62	68.2	9	0.887	36.30	143,925.6	35.22	7.11	80.1
21	Hong Kong, China	7,182.7	62,607	100	9.487	8.41	56.3	65.74	96.58	89.6	1	0.952	53.70	3,908.87	41.88	12.82	85.5
22	Hungary	9,660.4	32,789	72.245	12.584	7.73	56.4	78.21	55.23	57	17	0.846	42.70	17,846.74	22.60	10.36	74.5
23	Iceland	341.2	55,782	93.944	2.781	8.77	64.6	89.54	77.61	64.6	9	0.959	51.80	53,136	20.30	15.61	82.7
24	India	1,380,004.4	6,590	35.393	50.490	6.39	43.9	60.19	55.13	47.5	14	0.633	36.40	9,408,300	7.52	14.65	67.2
25	Indonesia	273,523.6	11,466	57.29	65.099	7.1	64.7	66.67	50.15	42.8	19	0.705	27.10	14,606,534	12.17	16.07	67.6
26	Ireland	4,937.8	76,169	63.912	17.373	8.9	58.5	87.69	79.16	55.4	35	0.945	50.70	42,099	14.44	12.02	82.0
27	Israel	8,655.5	41,524	92.674	2.546	7.66	59.8	83.17	79.58	72.4	10	0.919	53.40	14,875	24.49	18.43	82.3
28	Italy	60,461.8	42,840	71.346	63.664	8.49	44.3	85.23	61.77	65.2	15	0.895	45.70	145,861.9	21.49	7.44	82.9
29	Japan	126,476.5	42,274	91.867	14.117	8.73	60	88.19	73.01	69.5	20	0.925	54.50	963,679.6	29.75	7.43	84.8
30	Jordan	10,203.1	9,924	91.626	1.361	6.91	31.4	67.32	52.52	61.1	17	0.720	28.30	2,145	4.47	9.68	74.3
31	Kazakhstan	18,776.7	23,943	57.821	3.935	6.77	65.7	71.21	66.07	53.9	14	0.811	28.60	5,438.4	10.03	24.08	69.4
32	Korea, Republic	25,778.8	44,501	81.414	15.905	8.39	79.6	86.47	89.72	57	25	0.925	59.30	2,427,677	16.97	12.83	83.7
33	Latvia	1,886.9	32,803	68.421	6.491	8.67	55.9	82.46	63.86	63.7	12	0.863	40.00	901.4	18.19	12.65	73.6
34	Lithuania	2,722.3	37,931	68.249	8.037	8.68	57.3	83.71	70.34	60.7	16	0.875	39.90	5,137.71	17.05	12.74	73.7

Table 4. Continued

Salary No.	Country	Population, thousand persons	GNI per capita, USD	Urban population, % of total population	Export of agricultural products, million USD	Human freedom index	Employment rate, %	Social progress index	Rating of the digital collective enterprise, score	Services, value added, % of GDP	Manufacturing, value added, % of GDP	Human development index	GII	Aquaculture production, metric tons	Terrestrial protected areas, % of total land area	Government expenditure on education, total, % of government spending	Life expectancy at birth, years
		X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16
36	Malaysia	32,365.9	26,658	77.696	36.577	7.17	62	74.08	73.29	51.6	23	0.803	41.90	416,978.4	13.33	20.46	74.9
37	Mexico	128,932.8	17,896	81.016	46.712	6.92	56.7	70.84	48.74	59.2	18	0.758	34.50	246,913.7	14.49	16.19	70.2
38	Mongolia	3,278.3	10,588	68.785	504	8	55.8	67.21	40.69	39.6	7	0.739	34.20	0.00	19.79	9.99	71.0
39	Netherlands	17,134.9	55,979	92.572	129.038	8.78	64.2	88.97	93.31	69.4	11	0.941	58.60	40,590	22.48	11.02	81.7
40	New Zealand	4,822.2	44,057	86.789	54.541	9.01	66.9	87.26	77.13	65.6	10	0.937	47.50	116,839	33.39	14.29	82.5
41	Norway	5,421.2	64,660	83.323	16.004	8.75	63.3	90.74	91.3	52.5	5	0.961	50.40	1,665,112	29.92	10.27	83.2
42	Peru	32,971.9	12,246	78.5	12.720	7.93	71.7	70.7	47.23	49.2	13	0.762	31.20	150,817.6	22.27	16.71	72.4
43	Philippines	109,581.1	8,920	47.684	7.616	6.83	56.2	67.46	47.16	61	18	0.699	35.30	2,272,528	15.87	16.72	69.3
44	Poland	37,846.6	33,034	60.075	47.064	7.96	55	80.17	60.94	56.9	17	0.876	39.90	44,787	39.54	11.17	76.5
45	Portugal	10,196.8	33,155	66.849	11.513	8.69	54.7	84.75	65.18	64.7	12	0.866	44.20	19,516.48	22.91	9.71	81.0
46	Qatar	2,881.1	87,134	99.278	57	6.16	87.5	66.47	70.48	44.8	9	0.855	31.50	113.9	15.78	9.32	79.3
47	Romania	19,237.7	30,027	54.329	12.434	8.33	50.4	76.89	51.97	58.2	16	0.821	35.60	11,714	24.52	8.14	74.2
48	Russian Federation	144,386.8	27,166	74.934	43.804	6.23	58.3	71.99	60.27	52.9	14	0.822	36.60	319,342	11.45	8.94	69.4
49	Saudi Arabia	34,813.9	46,112	84.508	4.844	5.12	57	63.89	64.35	46.7	13	0.875	31.80	114,489.7	4.76	19.26	76.9
50	Singapore	5,850.3	90,919	100	16.058	7.98	66.3	83.76	95.14	69.4	21	0.939	57.80	5,243.56	5.55	13.06	82.8
51	Slovak Republic	5,459.6	30,690	53.82	5.223	8.21	56.6	81.29	54.2	59.1	20	0.848	40.20	2,304	37.59	9.35	74.9
52	Slovenia	2,078.9	39,746	55.427	4.139	8.37	55.5	84.19	64.97	57.7	20	0.918	44.10	1,685.9	40.36	11.50	80.7
53	South Africa	59,308.7	12,948	37.323	14.257	7.3	35.9	69.95	43.64	63	12	0.713	32.70	10,525.32	8.69	18.49	62.3
54	Spain	46,754.8	38,354	81.056	74.156	8.56	49.3	85.35	68.21	67.4	12	0.905	45.40	279,910	28.12	9.16	83.0
55	Sweden	10,099.3	54,489	88.238	21.187	8.83	59.7	89.42	95.19	64.8	13	0.947	63.10	15,253	14.52	13.49	83.0
56	Switzerland	8,654.6	66,933	73.996	11.301	9.11	64.1	90.26	94.94	71.9	18	0.962	65.50	2,364	12.13	14.55	84.0
57	Thailand	69,799.9	17,030	52.163	47.389	6.89	65.1	69.8	63.16	56.7	27	0.800	37.20	989,898	18.55	11.88	78.7
58	Türkiye	84,339.1	31,033	76.569	25.953	5.79	44	66.59	52.84	52.8	22	0.838	38.30	471,686	6.95	8.81	76.0
59	Ukraine	43,733.8	13,256	69.757	27.593	6.86	50.8	74.17	50.07	51.8	10	0.773	35.60	16,881.8	12.96	14.25	71.6
60	United Arab Emirates	9,890.4	62,574	87.299	15.746	6.06	74.8	70.7	90.52	51.6	10	0.911	43.00	2,662.94	19.35	14.76	78.7
61	United Kingdom	67,886.0	45,225	84.152	31.330	8.75	60.2	86.13	85.83	71.5	9	0.929	59.80	230,279.5	28.74	11.23	80.7
62	United States of America	331,002.7	64,765	82.873	201.572	8.73	58.2	84.65	100	77.6	11	0.921	61.30	448,614.6	13.02	12.65	77.2

Source: created by the authors based on Expenditure on tertiary education (% of government expenditure on education) (2020), Agricultural products (2021), Terrestrial protected areas (% of total land area) (2021), Aquaculture production (metric tons) (2022), Human development index (2022), Services, value added (% of GDP) (2022), GNI per capita, Atlas method (current US$) (2023), I. Vásquez *et al.* (2023), Manufacturing, value added (% of GDP) (2023), Social progress index rankings (2023), The World Factbook (2023), Unemployment (%) (2023), Urban population (% of total population) (2023), World Intellectual Property Organization (2023), World digital competitiveness ranking (2024), World Health Organization (2024)

Then, it is necessary to check the expediency of leaving four factors by the method of constructing a graph of eigenvalues ("stone scree") proposed by R.B. Cattell (1966) and N. Cliff (1987). Considering the above methodical recommendations regarding this criterion, from Figure 2, it could be maintained that the break occurs on component 4, and already from component 5, coordination and visual alignment of the graph begin.

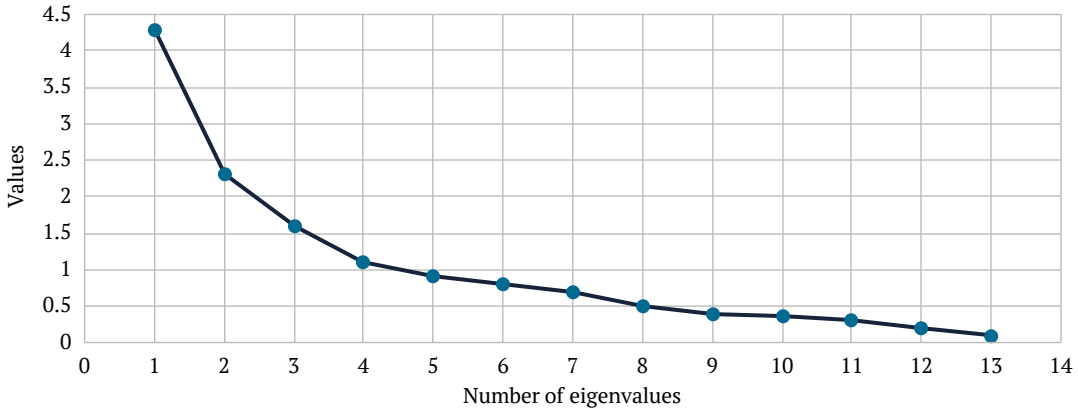

Figure 2. Graph of eigenvalues of factors

Source: made by the authors

Theoretically, it would be possible to leave three or four factors. Considering that three factors explain only a little more than 63% of the variance and four factors – more than 75% of the variance – makes sense to leave exactly four factors in the model. In the article, for the economic interpretation of the obtained factors, it is advisable to consider the values of their coefficients of scales (factor loadings), which are given in Table 5.

Table 5. Values of the factor loadings of the components

Indicator	Factor			
	F1	F2	F3	F4
X1	–0.189	**–0.867**	–0.194	–0.169
X2	**0.849**	0.120	0.276	0.034
X3	0.663	0.106	0.019	0.429
X4	0.134	–0.678	0.152	0.137
X5	0.298	0.237	0.698	0.144
X6	**0.712**	0.055	–0.309	–0.161
X8	**0.878**	–0.229	0.205	0.057
X9	0.297	–0.098	0.629	0.399
X10	0.021	–0.154	–0.092	**0.859**
X13	–0.022	**–0.791**	–0.180	–0.277
X14	–0.070	0.138	**0.700**	0.146
X15	–0.084	0.111	**–0.701**	0.361
X16	**0.766**	0.009	0.492	–0.076

Source: created by the authors

Since the factor loadings on the relevant indicator are the correlation coefficient between them, the components of the factors are determined by the loadings, the values of which exceed 0.7. Analysis of the data given in Table 5 allows to draw the following conclusions. To the first factor (F1) with loadings of 0.849, 0.712, 0.878, and 0.766, respectively, included indicators: GNI per capita (X2), employment rate (X6), digital competitiveness rating (X8), and life expectancy at birth (X16). The grouping of the specified indicators into one factor can have the following economic interpretation. The indicator GNI per capita (X2) entered the model with a positive indicator loading, so its increase will lead to improvement of the conditions for ensuring strategic changes in the sectors of the national economy. The meaning of this form of dependence can be explained as follows. If the indicator of the GNI per capita increases, it can lead to the following improvements in the conditions for ensuring strategic changes in the sectors of the national economy: an increase in investments, since a high GNI per capita can stimulate the inflow of investments in order to ensure the effective modernisation of economic sectors; the development of infrastructure because the increase in the income of the population promotes investments in the improvement of infrastructure, which will have the effect of supporting the development of sectors of the national economy; the growth of consumer demand, which will grow due to the greater solvency of the population, and demand, as it is known, is the root cause of the manufacturer's choice of a type of activity, the development of economic sectors, a change of their importance in the national economy, etc.

An increase in the competitiveness of manufacturers and the national economy in the international arena will be the result of an increase in financial resources available for the implementation of strategic projects in various sectors of the economy. This can help to implement the latest technologies, increase productivity, and improve the quality of products and services. A high level of GNI can make the country more attractive to foreign investors, which in turn stimulates the development of both existing and new sectors of the economy. Therefore, from the point of view of ensuring innovative development and strategic changes in the sectors of the national economy for any country, the amount of GNI per capita becomes an indicator of development and a source of funding for such development.

The level of employment (X6) was also included in the model with a positive value of the indicator loading, so its increase should have a favourable effect on the implementation of strategic changes in the sectors of the national economy. Indeed, the unemployed do not belong to the personnel of any economic entity and cannot participate in the formation or support of certain industry transformations, strengthening of innovative solutions, development of production implementations, etc. They can replenish the ranks of "stowaways", that is, be consumers of the products of the relevant industry. The growth of unemployment is a manifestation of non-acceptance of the ongoing reforms, a decrease in tax discipline, which collectively leads to budget losses and the inability to ensure the creation of public wellbeing. Therefore, in this case, the legalisation of labour relations and employment in general acts objectively as a factor of structural changes and reduces the shortage of personnel resources of operating enterprises.

The rating of digital competitiveness (X8) because of modelling also turned out to be a stimulant; the more it grows in the national economy, the more positive its impact on innovation capacity becomes. In part, the reasons for such interdependence coincide with the previous indicator. Because digital transformations of enterprises make it easier to enter foreign and domestic markets, especially under the conditions of mastering e-commerce. Digital technologies are widely used in marketing activities as a factor for improving the customer experience; they are effective in communication with consumers or potential customers, as well as for establishing internal relations (planners; automated databases of customers and suppliers; systems for monitoring and evaluating the performance of personnel, individual divisions, profit and cost centres, the enterprise, etc.).

The indicator of life expectancy at birth (X16) has a positive indicator loading in the model, so its increase will have a favourable effect on the processes of formation and development of strategic changes in the sectors of the national economy. It turns out that the constant increase of this indicator will have a positive effect on the conditions for ensuring strategic changes in the sectors of the national economy. It should be outlined that this dependence must be understood correctly: after reaching the retirement age, employment is generally limited, and when certain aspects of the innovative development of a specific enterprise (or clusters of enterprises) change, especially with high staff turnover, people who work in a team for a long time do resist such changes. The dynamics of this indicator may cause ambiguous effects and may have certain features in each industry. In general, the combination of these indicators for any country reflects the potential income from labour, the growing burden on the budget due to pension payments, and the actual increased life expectancy of the population. It is logical to observe such shifts in the improvement of living conditions, which is embedded in the concept of sustainable development.

Thus, the combination of the above indicators as part of the F1 reflects the importance and transparency of the state policy of socio-economic development to create favourable conditions for living and doing business. These indicators are related to the level of economic development of the country. GNI per capita indicates a country's economic well-being, employment rate indicates the availability of jobs for the population, digital competitiveness indicates a country's technological progress, and life expectancy is an indicator of the level of health care and general well-being of the population. Indirectly, they reflect the possibilities of innovative development and the reactions of businesses and citizens to the actions of the state. The structure of the F1 makes it possible to interpret a new aggregated variable – the well-being of the population and the digital development of business – which have a significant impact on the processes of policy formation and ensuring strategic changes in the sectors of the national economy. The second factor (F2) contains two indicators: population size (X1 – loading –0.867) and volume of aquaculture products (X13 – loading –0.791). Moreover, both indicators are in the model with a negative load, which can be explained as follows.

When the population grows, the innovative development of sectors of the national economy decreases due to the limited provision of their strategic changes. Especially if there is a declining dynamic of the economically active population. Such interdependence can be explained if the fact of a change in the number of people in the country is perceived as a consequence of the appearance of at least one of the reasons, the occurrence of which creates the need to state the severance of a person's relations with the corresponding country: one's own desire to migrate, violation of discipline (deportation), a valid reason caused by the impossibility to live and work further in this country (transfer of a husband or wife to work in another country; moving to a new place of residence; impossibility of living in this area, confirmed by a medical opinion; leaving the country for security reasons, death of an individual, etc.). Given the conditions of 2022-2024 in Ukraine, many people have lost contact with the country due to security issues; mortality and disability have also increased. For countries in which hostilities are not taking place, it makes sense to separately consider the state of the environment and indicators of birth/death rates and population growth due to migration reasons. The migration component of the population change process is also a rather ambiguous factor, which is explained by the complexity and multifaceted consequences of migration in the economic and social plan. Migration could be due to a protracted crisis or a threat to national values, but now it has acquired new features because some of those who went abroad will return, some have decided, and some will not. Therefore, the effects of migration can be both positive and negative for innovative development.

With an increase in the volume of aquaculture products (X13), the process of ensuring strategic changes in the sectors of the national economy, according to the logic of the model, should deteriorate. According to the Law of Ukraine No. 5293-VI (2012), aquaculture (fish farming) is represented by the agricultural activity of artificial breeding, maintenance and cultivation of aquaculture facilities in fully or partially controlled conditions for obtaining agricultural products (aquaculture products) and their sale, feed production, reproduction of biological resources, conducting selection and breeding work, introduction, resettlement, acclimatisation and reacclimatisation of hydrobionts, replenishment of aquatic biological resources, preservation of their biodiversity, as well as provision of recreational services. In the context of compliance with the principles of sustainable development, a reasonable reduction in the production of such products and less interference with the natural environment is considered logical. In practice, if with an increase in the volume of aquaculture products, the process of ensuring strategic changes in the sectors of the national economy deteriorates, there may be several reasons. One possible reason is insufficient infrastructure or resources to effectively distribute and supply this increased output. There may be non-systemic management problems or a lack of necessary strategic plans to take advantage of the new opportunities that arise with the growth of aquaculture volumes. Without proper attention to these aspects, the situation in this industry and related industries of the national economy may worsen.

The combination of both indicators (population and volume of aquaculture products) in the model has the following economic effect. Both indicators reflect the economic potential of regions in the country: a high volume of aquaculture products indicates the development of the agricultural sector and its profitability, and a large population can indicate the presence of a wide consumer market. The possibility of the development of the aquaculture sector in the region, because the increase in population can contribute to the demand for aquaculture products, which, in turn, can cause an increase in its volumes. Population and aquaculture production can mutually influence each other: a developed aquaculture sector can create new jobs and support economic growth in regions (country), which in turn can lead to population growth through labour migration.

However, thinking about why the combination of these indicators creates one disincentive factor may be based on the inexpediency of focusing on this sector in the long term, because the steady dependence of the economy on the aquaculture sector can lead to instability and risk for the national economy for several reasons. Any problems or crisis situations in this area can lead to serious obstacles to economic growth. For example, fish diseases or changes in climatic conditions can lead to significant reductions in production and profits in the aquaculture industry. One-sided specialisation in aquaculture can lead to job losses and reduced employment if the industry experiences crisis situations. This can cause social problems and economic instability both in individual regions and in the country. Therefore, to ensure stable economic development, it is important to develop a diversified economy, avoid excessive dependence on one industry, and consider the risks associated with such dependence. The given structure of the F2 makes it possible to interpret a new aggregated variable – the intensity of the development of the consumer base and innovative strategies for preserving biodiversity, which have a significant impact on the processes of organisation and ensuring strategic changes in the sectors of the national economy.

As for the third factor (F3), it includes two indicators: state terrestrial nature conservation areas (X14 with a weighting factor of 0.700) and state spending on education (X15 with a weighable factor of −0.701), which allows it to be interpreted as the state policy of nature use and education financing. The first indicator is included in the factor model with a positive indicator loading, i.e., an increase in the share of nature conservation areas (as a percentage of the total area) causes a strengthening of the provision of strategic changes in the sectors of the national economy. For example, the economy of Ukraine is characterised by a high specific weight of resource-intensive and energy-intensive technologies, the introduction and expansion of which was carried out in the most cost-effective way – without sufficient construction of appropriate treatment facilities. This was possible in the absence of effectively functioning legal, administrative, and economic mechanisms of nature management and without taking into account the requirements of environmental protection. And for any country, a purely resource-based approach remains relevant: the more nature conservation areas, the less land resources can be used by enterprises, which, of course, reduces the prospects for expanding both agricultural land and industrial zones. The transition of enterprises to the principles of the circular economy can be an innovative factor in solving such issues.

Moreover, it should be noted that increasing the share of public spending on education in modern conditions is not an absolute priority for most countries. School education is clearly supported, but further development of the educational component of human capital becomes under the control of the education seekers themselves and enterprises that are interested in the corresponding development. In this way, the sectoral profiling of education, which is relevant to the needs of the national economy, is ensured. Therefore, a negative indicator loading can be perceived as a fact that the reduction of the share of expenses in the total amount of public spending on education as an opportunity to redirect funding to the innovative development of industries. Thus, the combination of such indicators, which reflect the shares of state terrestrial nature conservation areas and state spending on education in a certain country, into one factor in modern conditions looks quite logical. The fourth factor (F4) contains one indicator: the added value of production in GDP (X10 – loading 0.859), which allows it to be interpreted as the production potential of business in the country. The indicator in the model is present with a positive load, so an increase in the added value of the production sphere causes a strengthening of the provision of strategic changes in the sectors of the national economy. From an economic point of view, such interdependence is manifested for the following reasons.

Stimulation of investments: this effect is explained by the fact that investments in modern technologies and R&D can support strategic changes aimed at increasing

competitiveness and stability of the economy. Development of innovations and high-tech industries: as practice shows, an increase in added value can be reflected accordingly in the development of innovative technologies and production methods. The same applies to high-tech sectors of the economy, which are of strategic importance for the competitiveness of a certain country in the global market environment. In turn, innovation becomes a driver of strategic change, allowing industries to adapt to new challenges and market conditions. The increase in labour productivity is due to the introduction of new technologies, personnel training, and optimisation of production processes. As a result, it can stimulate production growth and create new opportunities for further strategic changes. The creation of new investment markets because of increased added value can create new opportunities for investment in other sectors of the economy, which, in turn, can support strategic changes and the development of various related and supporting industries. Therefore, increasing the added value of the production sphere, as a rule, plays a key role in ensuring strategic changes in the sectors of the national economy, contributing to their sustainable development and competitiveness. Thus, the given composition of significant indicators of four factors, obtained because of the conducted factor analysis based on statistical data of 62 countries, allows to draw the following general conclusions.

Thus, conditions for the formation and level of ensuring strategic changes in the sectors of the national economy based on innovations for the analysed period are determined by the following factors: population well-being and digital business development (F1); intensity of development of the consumer base and innovative strategies for preserving biodiversity (F2); state policy of nature use and financing of education (F3); production potential of business in the country (F4). Most factor loadings on indicators are positive (X2, X6, X8, X10, X14, X16), which indicates the existence of a high directly proportional orientation of the action of the identified components to ensure strategic changes in the sectors of the national economy. Such indicators are stimulants for strategic industry changes based on innovation, as their growth will have a positive effect on such a result in the end. And the received indicators with a negative loading (X1, X13, and X15) are destimulants regarding such provision; that is, when they increase, the state of the phenomenon under study will worsen.

The innovative components (factors) of ensuring strategic changes in the sectors of the national economy in the analysed countries for 2021 are multidirectional and have different intensity, as it is shown in Figure 3-6, and they are displayed by the values of the factors by country, respectively. The results of the analysis of the actual values of the factor "well-being of the population and digital business development" (F1) in terms of the studied countries showed (Fig. 3) that Singapore, Qatar, Korea, the United Arab Emirates, Switzerland, and the Netherlands have the largest positive values, and Denmark, given the complexity of the factor exclusively from stimulants, is evidence of a high standard of living and digitalisation of business as an innovative factor of ensuring strategic changes in the sectors of the national economy.

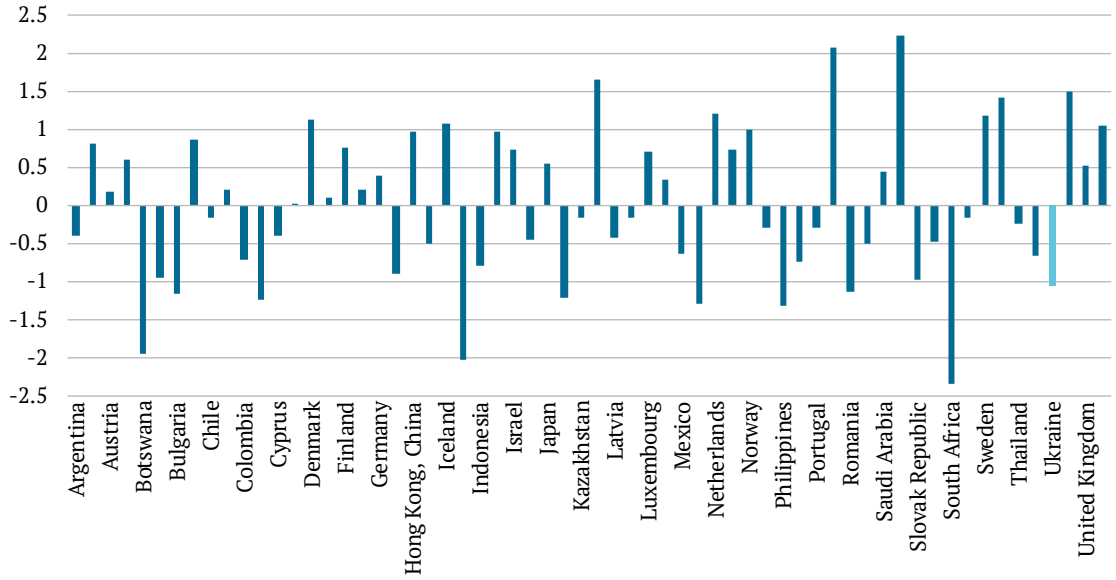

Figure 3. Actual values of the factor "population well-being and digital business development" (F1) by country
Source: created by the authors

Ukraine is positioned in the lower (negative) part of the diagram with a value of −1.05, which indicates significant risks. Issues of employment, income of the population, and the decrease in life expectancy, especially for men, remain problematic. Under martial law, these risks are further exacerbated by mortality, high business costs, uncertainty, and migration. The only steadily improving aspect remains the rapid digitisation of business. The review of the actual values of the factor "intensity of consumer base development and innovative biodiversity preservation strategies" (F2) in the section of the given countries proves the best indicators in China, India, Brazil, and the Netherlands (Fig. 4).

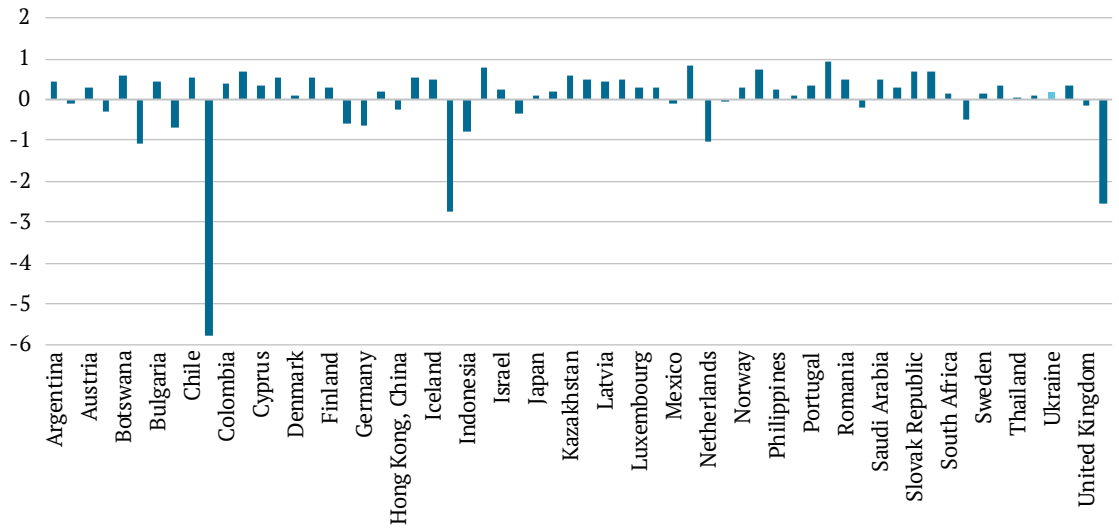

Figure 4. Actual values of the factor "intensity of consumer base development and innovative biodiversity preservation strategies" (F2) by country
Source: created by the authors

Since both components of the factor are destimulants, the positive value of F2 (0.19) should be regarded as a negative trend for the time being, although the value is small in magnitude. It should be outlined that due to security issues, there is currently population instability both within the country as a whole and by region. For the development of agricultural activities related to the production of aquaculture products, there are also issues due to pollution and damage to artificial reservoirs due to military actions. Figure 5 shows a significant number of countries have a positive development of the factor with sufficiently high values.

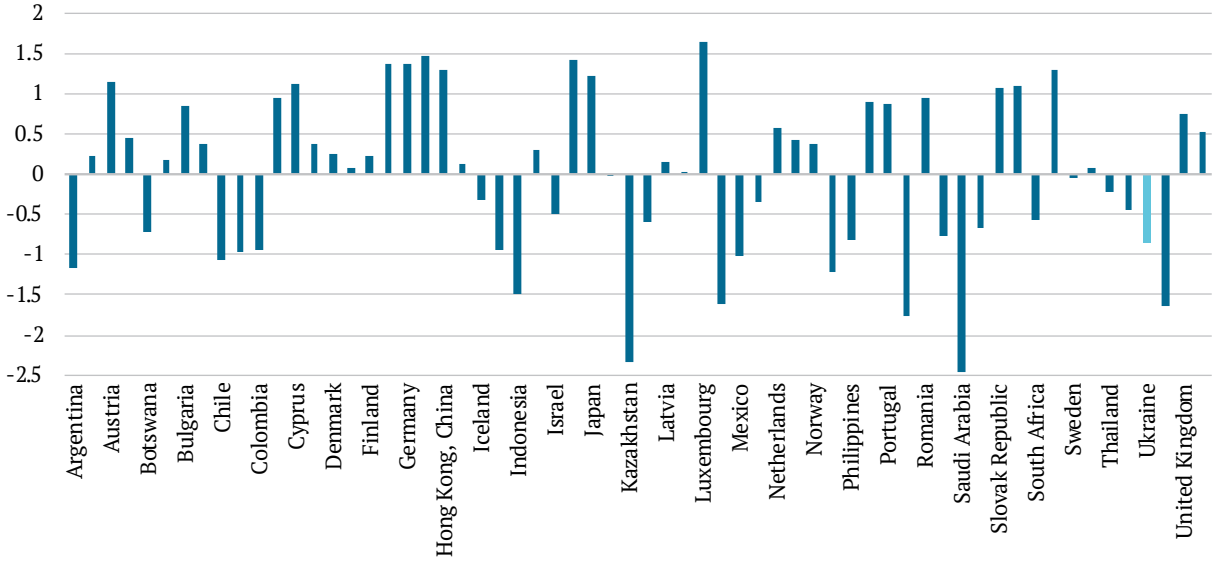

Figure 5. Actual values of the factor "state policy of nature use and financing of education" (F3) by country
Source: created by the authors

The leaders were Luxembourg, Italy, Greece, France, Germany, Spain, and Japan. Saudi Arabia, Kazakhstan, Qatar, Malaysia, the United Arab Emirates, Peru, and Argentina have the worst results. Ukraine has an average value of the factor (−0.85). If analysing the indicators included in F3, Greece, Italy, and Japan have the lowest indicator of public spending on education (from 7 to 8%), while the development of F3 in these countries is high. Botswana, Chile, Malaysia, and Israel have the highest indicator of public spending on education (from 18 to 21%). In Ukraine, over the past 8-10 years, this indicator has ranged from 13 to 14.5%. As for the share of state land conservation areas, which is the basic factor F3 as a stimulant, it should be outlined that it has a large spread. Thus, Luxembourg, Bulgaria, Hong Kong, Poland, Great Britain, Cyprus, Croatia, Slovenia, and New Zealand have the largest shares (from 51 to 33%), and this fact significantly affected the positive value of the F3 factor. Ukraine has an average negative level

of F3 by module. It is worth emphasising the need to focus public policy on innovations capable of reducing pollution, economical and repeated use of resources, calling business to social responsibility, and paying attention to environmental issues. These aspects should be taken into account when determining the directions of strategic changes in industries and issues of their resource provision.

The analysis of the actual values of the factor "production potential of business in the country" (F4) by country is also interesting from a scientific point of view, which, according to the results of modelling, is a stimulant. Figure 6 shows that Hong Kong, Botswana, the United States of America, Brazil, Israel, and Luxembourg have the highest values. Ireland, Thailand, China, Korea, Slovakia, and Slovenia have the lowest level of the factor (F4) due to the low added value of production. Ukraine has a positive value of this factor (0.53). The basis of Ukrainian exports has been raw agro-industry and metals for a long time. Agriculture and processing industry make a significant contribution.

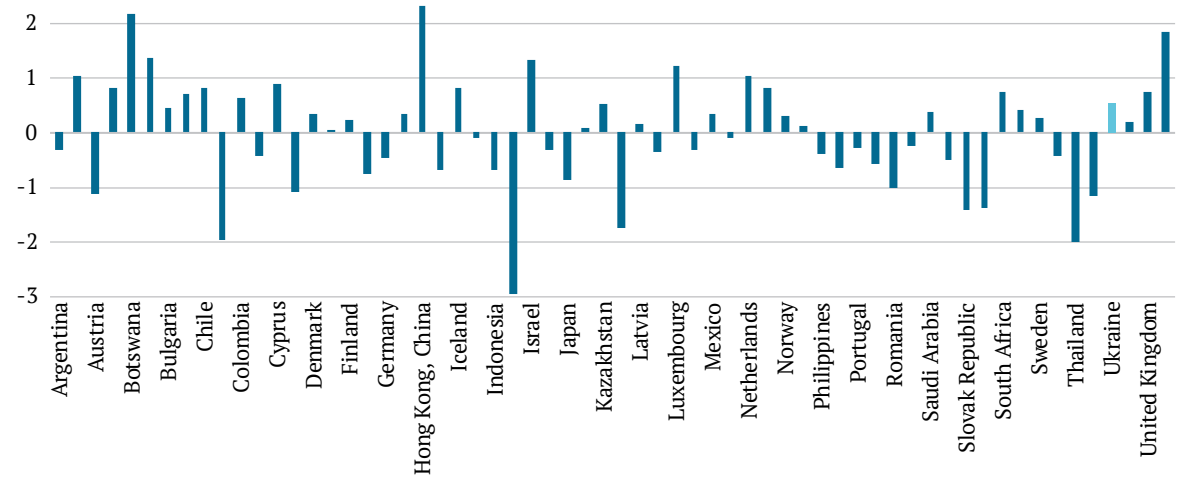

Figure 6. Actual values of the factor "production potential of business in the country" (F4) by country
Source: created by the authors

As practice shows, a limited part of goods exported by Ukraine in modern conditions has a high level of added value (Export evolution..., 2023). The significant part remains focused on raw materials. This has a negative impact on the country's potential profit, as high value added is a key element of competitiveness and sustainable economic growth. Graphically, the dynamics of innovative factors influencing the provision of strategic changes in the sectors of the national economy for Ukraine is shown in Figure 7.

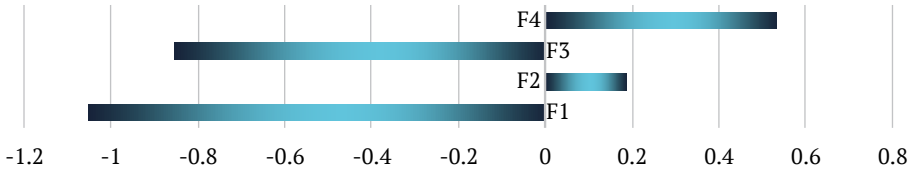

Figure 7. Actual values of innovative influence factors (F1, F2, F3, F4) on ensuring strategic changes in the sectors of the national economy of Ukraine
Source: created by the authors

Considering the indicator loading of the considered factors during modelling and thus determining their economic interpretation, it should be noted that only the "production potential of business in the country" (F4) has positive dynamics. The identified problems and risks in other innovative factors must be considered when forming a system of financial support mechanisms for strategic changes in the sectors of the Ukrainian economy. The given analysis of the level of development of innovative factors influencing the provision of strategic changes in the sectors of the national economy based on the studied countries of the world shows that the biggest problems are present in the spheres of implementation of state policy regarding the formation of the normal socio-economic situation in the country (this fact is also confirmed by the dispersion of most of the indicators of the F1 and F2), formation of relations between business and population based on social responsibility. The F3 is characterised by the least constant attention of the state, which allows to conclude that there is a lack of a comprehensive approach to the strategy of effective environmental management and financing of education, which should be based on the principles of sustainable development and the increase of human capital as a stimulant of innovative activity. But the problems with the first two factors have not been resolved yet, so this is indeed a more distant prospect, especially due to migration and security conditions. Therefore, it is necessary to lay the foundation

for their solution now, as a basis for the recovery of the business economy and the labour market.

DISCUSSION

Since the above-mentioned problematic aspects are significantly dependent on the external environment, it is appropriate further to consider the peculiarities and prospects of the functioning of the system of state regulation of structural transformations in the vector of sustainable development, considering the state of democratic processes and the specifics of relations with the public in the process of making socially responsible decisions in the context of industry changes. For example, the national economies of G10 countries have the highest level of economic growth compared to other regions. Studies of the factors of economic growth in these economies are of particular interest because they emphasise the role of natural resources, innovation, and financial globalisation as crucial factors. The significant share of global gross domestic product (GDP) of the G10 is also marked by significant developments in innovation, technological progress, and financial engagement with other developed economies and developing countries. However, the economies of these countries also show dependence on natural resources, which have an obvious impact on their extraction and use. Theoretical and empirical relationships between these variables have been identified.

For example, M. Shahzad *et al*. (2022) believed that natural resources stimulate economic growth, providing additional opportunities for earning and increasing national income. At the same time, the authors' research data showed low implementation of green innovations in the practical activities of business entities in Pakistan. In this regard, scientists developed a model for stimulating the implementation of green innovations based on the existing unified theory of acceptance and use of technology (UTAUT) model, the results of which showed that the main factor in the activity of green transformations of companies was "green behavioural intention", the level of which depends on the size of the business and companies. The authors also confirmed the significant influence of green transformations in business, such as the cost of green innovations, their expected productivity, and working conditions for personnel. The important task of ensuring strategic changes at the level of the national economy is the identification of risk factors. Thus, because of research by Ukrainian scientists T. Shtal *et al*. (2023), a methodical approach was proposed, which allows identifying those factors that have the greatest impact at each stage of the project's life cycle. Mathematical models have been developed that allow identifying exactly those risk factors that can have the most negative impact, both in terms of frequency of occurrence and the number of possible losses.

The question of the universality of the selected innovative factors of influence on ensuring strategic changes in the sectors of the national economy remains debatable. For example, research by U. Joshua *et al*. (2020) found that foreign direct investment has a limited impact on economic growth in South Africa, which contradicts data presented in other studies of the region (Muluh *et al*., 2022), as well as for Asian economies (Gbemenou *et al*., 2020). This difference in results may be explained by differences in specific countries, time periods, or data used. For example, a 1% increase in foreign direct investment leads to a small shift in GDP in the long run. Also, such an indicator as trade openness has a significant impact on GDP, which confirms the hypothesis of economic growth caused by trade. This is also confirmed by previous studies for various countries: Turkey (Alsamara *et al*., 2019), BRICS countries (Rani & Kumar, 2019), South Africa (You *et al*., 2020), etc. The case where a country abandons trade openness or reduces its level of participation in international trade can lead to the opposite effect. However, this result does not support the findings of some previous studies, such as M. Shahzad *et al*. (2022), which may be due to differences in terms of trade or prevailing economic and political factors in each specific country. The same happens with other factors.

Thus, strategic economic initiatives should focus on strengthening the underlying innovation power and sustaining economic and environmental systems by increasing the level of interaction and coordination. To achieve long-term sustainability of strategic economic initiatives, economic and environmental systems must develop interrelatedly, and coordination between them is crucial. The main aspects of SEI research usually cover the assessment of innovation performance, the analysis of economic and environmental consequences, and the relationship with economic development. Regarding innovation performance, technological progress is the main driver for improving it, according to S. Lin *et al*. (2019).

Studies conducted in the African countries (Joshua *et al*., 2020), G7 countries (Qin *et al*., 2021), Europe (Skare & Porada-Rochon, 2022), and China (Zhou *et al*., 2022) confirm the positive impact of technological innovation on economic and environmental indicators of strategic changes in the sectors of national economies. However, studies conducted in South Asia (Mughal *et al*., 2022) indicate an increase in greenhouse gas emissions because of innovation activities. In addition, Y. Chen & D. Zhang (2021) studies of incentives for total factor productivity in high-tech industries found out that they mostly depend on technological progress. Also in this direction, a logistic regression model was developed by M. Shabir *et al*. (2023) to assess the impact of SEI industrial activity on ecosystems. Focusing on marine technological innovation, threshold regression was used by X. Liu *et al*. (2021) to examine the nonlinear effects of innovation, and it was determined that when the level of innovation exceeds a certain threshold, its impact on marine economic performance decreases.

The impact of the globalisation process on the economic progress of various countries has been remarkable, due to their financial development, as noted by S. Kihombo *et al*. (2021). Since globalisation is important in bringing about strategic changes in the sectors of national economies, various studies have been conducted that examined globalisation using an index that included economic, political, and social indicators. However, some studies, like S. Gygli *et al*. (2019), considered such factors as foreign investment, international debt, international payments, reserves, investment barriers, and various investment-related agreements. The authors of this article share the opinion of these scientists from both scientific positions. Innovations are closely related to economic progress and positive structural shifts in the national economy, as they

form the basis of socioeconomic development. It is worth agreeing with the results of studies by Q. Dong *et al*. (2023), T. Shtal *et al*. (2023; 2024), and other scientists who focused on the problem of increasing CO_2 emissions due to the increase in the level of innovative activity of business entities (increasing the volume of resource consumption, production, and consumption).

These opposing trends lead scientists to a single conclusion: innovations in further structural transformations of national economies are exclusively ecological. Therefore, studies confirm that to achieve sustainable development and strategic changes in the sectors of national economies, it is important to focus on strengthening the innovative power and to promote interaction and coordination between economic and ecological systems. Studies of strategic economic initiatives usually include evaluation of innovative efficiency and analysis of economic and environmental consequences, which contribute to the development of integrated approaches to solving complex problems. Despite the positive impact of technological innovation, some studies point to potential risks, such as increased greenhouse gas emissions. The authors of the article consider the efficiency of the formed sectoral structure of the national economy of the country as an integral indicator of the effectiveness of the existing mechanism for ensuring the performance of functions and tasks of the state in solving specific socio-economic issues on the way to sustainable development.

CONCLUSIONS

Based on the conducted study of indicators expressed by socio-economic indicators of the development of the countries of the world, a sample of 16 independent variables was determined in the section of 62 national economies, which acted as the initial data of the factor analysis. As a result, the composition and content of external factors of influence on ensuring strategic changes in the sectors of the national economy based on innovations, which, unlike the existing ones, are defined by the following components: the well-being of the population and digital development of business (F1), intensity of development of the consumer base and innovative strategies for preserving biodiversity (F2); state policy of nature use and financing of education (F3); production potential of business in the country (F4). The following general conclusions were made. There is a high, directly proportional orientation of the actions of the identified components to ensure strategic changes in the sectors of the national economy. The exception is the innovative F3 (state policy of nature use and financing of education). The analysis of the actual values of the identified innovative influence factors showed a significant differentiation of countries according to the state of their development and the reasons for such changes. The assessment of factors influencing the provision of strategic changes in the sectors of the national economy makes it possible to identify directions for strengthening the innovative component of sectoral transformations. The comparative analysis of Ukraine and the countries represented in the sample was also carried out. The only innovative factor that underwent positive changes was F4 (production potential of business in the country). The outlined problems and risks in the above innovation factors must be considered when forming a system of financial support mechanisms for strategic changes in the sectors of Ukraine's economy.

Considering the results obtained, it is worth emphasising the following as further directions of scientific research in the context of assessing the impact of the innovation factor on the strategic structural transformations of sectors of the national economy of Ukraine: to conduct an analytical assessment of the losses in the innovation potential of Ukraine's economy and its sectors that resulted from the military conflict in the country; to analyse the innovation gaps between the economy of Ukraine and the EU countries that formed during the war years. It is planned to develop forecasts regarding the necessary amounts of financial support to eliminate the gaps in the state of actual innovation development of the Ukrainian economy and the economies of European countries; to determine the composition of the priority structural innovation changes that the economy of Ukraine will need to overcome the consequences of the military conflict and restore the potential for economic growth.

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CONFLICT OF INTEREST

None.

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Інноваційні чинники забезпечення стратегічних змін у галузях національної економіки

Анотація. Як суттєва складова стратегічних змін на національному економічному рівні, процес трансформації промисловості відіграє важливу роль у створенні сприятливого середовища для залучення інвестицій, розвитку нових технологій та покращення якості життя населення. Метою статті було визначити особливості сформованої галузевої структури національної економіки через оцінку факторів, що впливають на забезпечення стратегічних змін у галузях національної економіки для визначення напрямів посилення інноваційної складової галузевих перетворень. Визначено та проаналізовано економічні аспекти стратегічних змін на рівні національної економіки з урахуванням особливостей інноваційної, інвестиційної та екологічної політики країни, продуктивності самих інновацій та залучення бізнесу до інноваційного процесу. Проведено аналіз рівня розвитку інноваційних факторів, що впливають на забезпечення стратегічних змін у галузях національної економіки досліджуваних країн. Оцінка факторів впливу на забезпечення стратегічних змін галузей національної економіки (16 факторів) була проведена за допомогою побудови економіко-математичної моделі. Отримані результати показали пряму залежність стратегічних змін національної економіки від інноваційних чинників. Виключеннями стали фактори державної політики природокористування та фінансування освіти. В економіці України було виявлено зниження активності дії інноваційних чинників, за виключенням виробничого потенціалу бізнесу. Зосередження уваги на цій системі факторів сприятиме комплексному розумінню сучасних вимог та можливостей менеджменту щодо забезпечення стратегічних змін у галузях національної економіки через механізми інноваційного розвитку

Ключові слова: соціально-економічний розвиток; сталий розвиток; види економічної діяльності; галузева структура; перетворення; фактор впливу; технічний прогрес

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Competitive position of the European Union member states with regard to socio-economic development according to the Human Development Index

Abstract. The aim of the study was to analyse the competitiveness of European countries among themselves in terms of socio-economic development. 27 countries of the European Union were included in the analysis. Real gross domestic product per capita was selected for analysis as the main indicator of the economic development of the country. As the main indicator of social development – the aggregate index of human development. To determine the level of competitiveness of each country, a two-dimensional matrix was used, which was based on the calculation of integral indicators of real gross domestic product per capita and the Human Development Index in dynamics for the period

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2013-2022. The competitiveness study was able to develop nine quadrants of a two-dimensional matrix, each describing the competitive position of a European country. Countries such as Germany, France, and Italy, although they had high absolute performance both in 2013 and in 2023, but the dynamics of improvement of such performance is much lower compared to the rest of European countries. Some countries have better development of economic indicators than social indicators in the dynamics, such as Hungary and Bulgaria. The only country with predominant rates of social development over economic development is Luxembourg. The other 16 countries of the European Union occupy medium positions of competitiveness, which indicates their gradual development with low rates. Croatia, Lithuania, Poland, Cyprus, and Malta are sustainable competitive countries that, during 2013-2023, most efficiently utilised existing resources and potential for both social and economic development. The results obtained will be useful for professionals developing national competitive strategies and programmes, as the results of the analysis provided a 10-year view of the sustainable competitiveness of each European country

Keywords: two-dimensional matrix; integral indicator; quality of life; dynamics of change; sustainable growth

INTRODUCTION

The topic of a country's competitiveness is one of the most discussed topics in the world economy. It is connected with the international division of labour, globalisation. It is important for countries to identify the main criteria, thanks to which it is possible to become leaders in a certain region. Since the times of classical economics, there has been a view that it is the economic growth of a country that acts as the focus for researchers and the government of each country (Xu & Li, 2020). Other factors also include: the financial capability of the country, industrialisation aspects, technological development, international trade, and human capital (Rahim *et al*., 2021). Emphasising the importance of a country's competitiveness on the path to development in modern environment, governments of different countries are increasingly focusing on the human component of development potential. In the 21st century, with the globalisation and digitalisation of society, the development of knowledge economy and networks, more and more researchers also pay attention specifically to the development of a country's human resources as a key tool on the way to economic development of a country (Han & Lee, 2020).

By exploring social capital as a factor in the development of a country, H.M. Pylypenko *et al*. (2023) found that in the late twentieth century, many of the countries developed under the idea of integration to achieve greater success and capacity building through joint efforts in the international market in terms of economic development. One example of regional integration is the creation of the EU. But, after already ten years, the trends of world development have changed dramatically. In the process of scientific and technological development, countries began to gradually reduce their dependence on the markets of other countries (Spytska, 2023b). The overwhelming majority of investments started to be concentrated inside their borders in the development of human capital. EU countries are no exception to this process. As a consequence, this has a negative consequence in the form of development imbalances between countries. This, in turn, affects the socio-economic development of the EU on the international market. It is of interest for the economic stability and cohesion of the EU countries to assess to what extent the disparity of socio-economic development increases or decreases through the human capital development of the EU countries in pursuit of improved competitiveness.

Other researchers have repeatedly analysed the development of human capital and its impact on the development of countries. For example, in a statistical analysis of the role of human capital and natural resources for economic development, O. Zallé (2019) concluded that the theory about the development of a country's economy through natural resources is correct, but it is important to realise that natural resources can both directly and indirectly affect economic performance. Just the indirect effect is shown through the influence of human capital on them. Analysing the main indicators affecting the competitiveness of European countries, M. Simionescu *et al*. (2021) determined that changes in the gross domestic product (GDP) of a country are explained by two indicators: physical capital and human capital. Consequently, it is the human capital that plays one of the key roles in the development of the economic welfare of a country through skills and knowledge. K. Nuralina *et al*. (2023), in studying the change in the socio-economic level of 59 countries, took as a basis a composite index of the country's development consisting of an index of social, digital, economic, and environmental development. As a result, the researchers were able to establish that the highest correlation exists between economic and social indicators of a country's development.

Analysing the socio-economic development of EU countries, E. Pelinescu *et al*. (2019), as an indicator of human development, took the number of years of schooling in development and innovation as a basis. As a result of the analysis, Latvia, Lithuania, Sweden, and Romania had the maximum indicators. During a study of the long-term effects of human capital on the development of countries in Europe, C. Diebolt & R. Hippe (2019) focused the study on a time span, namely from 1850 to 2010. The researchers concluded that it is human capital that is the most significant historical determinant affecting the economic development of a country and the determinant of the current innovation and economic development of European countries. The effects of a country's human potential on its economy have a long-term effect, providing incentives for European governments to invest in the development of human capital (Dykha *et al*., 2024).

The problem with previous studies is that balancing the economic and social development of a country is important. Therefore, it is necessary to identify which countries have managed to find a balance in such development and which EU member states still need to put more resources

and efforts on a certain aspect of socio-economic development in order to improve their competitive position in the market. The research gap lies in the fact that previous studies analysed the socio-economic development and competitiveness of a country using either one indicator in dynamics or a comprehensive indicator for one calendar year. The aim of the study was to determine the competitive position of EU member states based on analysing socio-economic development. In the course of the study, the following tasks were necessary to achieve the goal: analysis of the Human Development Index (HDI) of the EU member states; analysis of real GDP per capita of the EU member states; calculation of integral indicators of social and economic development of the analysed countries; identification of the most problematic areas of human development in the EU and development of recommendations for their improvement.

MATERIALS AND METHODS

As of 2024, the EU comprises 27 countries for which the analysis was conducted. The beginning of the analysis refers to 2013, as the last country, Croatia, joined the EU in 2013 (Čular & Grbeša, 2020). Secondary data from the report of the EU statistical service are used for the analysis (Real GDP per capita, 2024). The main economic indicator selected from the report is real GDP per capita, the dynamics of change of which is calculated according to the formula:

$$GR = \frac{P_c}{P_b} \times 100\% - 100\%, \quad (1)$$

where GR – growth rates; P_c – indicators of values of the current period; P_b – indicators of values of the base period. Then the average value of the dynamics of countries by the growth rate of real GDP per capita was determined by the formula:

$$GR_{av} = \frac{1}{n} \sum_{i=1} n\ GRGDP_i = \frac{P_c}{P_b} \times 100\% - 100\%, \quad (2)$$

where GR_{av} – growth rate of real GDP per capita; n – number of countries; $GRGDP_i$ – growth rate of real GDP per capita in i-country. The calculation of this indicator was necessary in order to group countries. The distribution of countries into development groups on the basis of real GDP per capita was based on the following criteria. A country was considered to be ahead of the curve if the indicator fell within the following range:

$$\frac{\Delta GDP_i}{\Delta GDP_{av}} \geq 1, \quad (3)$$

where ΔGDP_i – growth rate of real GDP per capita of the i-country EU; ΔGDP_{av} – average value of real GDP per capita of the EU countries, which has an above-average indicator. A country was catching up if its economic development indicator fell within the following range:

$$\Delta GDP_{av} < \Delta GDP_i < \Delta GDP_{abav}, \quad (4)$$

where ΔGDP_{abav} – average value of real GDP per capita of the EU countries, which has an above-average indicator. A country was considered to be lagging behind if its economic development indicator fell within the following range:

$$\frac{\Delta GDP_i}{\Delta GDP_{av}} < 1. \quad (5)$$

A country with an economic development indicator falling within the following range was considered to have a degenerating dynamic (6):

$$\Delta GDP_i < 0. \quad (6)$$

The second stage analysed the main indicator of social development – the HDI from the United Nations Development Programme (2014; 2024) reports in comparison. With the HDI index up to 0.55 the country has a low level of human development, with 0.55-0.7 – medium, with 0.7-0.8 – high, with 0.80-1 – very high (Dasic *et al*., 2020). The change in indicators was calculated using the absolute change formula (7):

$$\Delta HDI = HDI_{end} - HDI_{beg}, \quad (7)$$

where ΔHDI – absolute change in the HDI indicator; HDI_{end} – value in the final year of analysis; HDI_{beg} – value in the initial year of analysis. In the third stage, the integral indicators were calculated using the following formula:

$$CAGR = \left(\frac{P_1}{P_2}\right)^{\frac{1}{n}} - 1, \quad (8)$$

where $CAGR$ – integral indicator; P_1 – indicator in the last year of analysis; P_2 – indicator in the first year of analysis; n – distance in years between P_1 and P_2. One of the main aspects of determining the competitive position of a country in terms of development is its comparison with other countries (De Castro Placido & Hwang, 2019). Therefore, the calculation results were used to determine the threshold values for each indicator, thanks to which it was possible to construct a two-dimensional matrix and divide it into quadrants. Each of the quadrants characterised a certain level of sustainable competitiveness of a European country.

RESULTS

One of the main indices is the Country Competitiveness Index developed by the World Economic Forum. This index consists of 12 elements and determines a country's productivity and hence a country's competitiveness (Rajnoha & Lesnikova, 2022). Since its development in 2005, this index has become much broader than the previously universally used growth competitiveness index and calculates the level of competitiveness using a different method. The index focuses not only on the technological aspects of a country's national economic development but also as a function of GDP per capita (Mirghaderi & Mohit-Ghiri, 2019). In 2008, the index was revised to have constituent elements and began to include the following indicators: basic, enhanced performance, and innovation. The basic requirements include indicators such as development of institutions and infrastructure, economy and health system, and education system. Increased efficiency indicators constitute a set of indicators that indicate the development of the education sector and the efficiency of the labour market. Innovation indicators include the efficiency of innovation implementation in entrepreneurship and scientific and technical development. Based on such indicators, the level of competitiveness of a country is calculated (De Castro Placido & Hwang, 2019). But it has been proven by researchers that it is the labour productivity of a country that directly affects

economic development (Rajnoha & Lesnikova, 2022). Consequently, the subsequent analysis of EU countries' competitiveness with regard to socio-economic development was conducted in this study based on such a claim. That is, it is not the Country Competitiveness Index that is selected for analysis, but the aggregate of the integral indices of real GDP per capita and the integral HDI index.

Speaking about analysing the competitive position of a country in the EU, it is important to note that the analysis will be carried out in dynamics because not only the indicator for the last year of functioning of each country's economy is relevant, but also the sustainability of competitiveness. The term sustainability does not imply the preservation of a country's resources for future generations from an economic, environmental, and social point of view, but the successful development of a country in the long term (Younis & Chaudhary, 2019). That is, further mentioning the sustainable competitiveness of a country implies its progress over a long period of time, or, in other words, long-term sustainable development.

The economic system of each country does not function in isolation from the international system (Moshensky, 2024). This makes it necessary to analyse the competitiveness aspect in more detail. During the period of competitiveness and development, each country's economy has experienced both decline and growth, and has been influenced by external determinants (Stychynska, 2023). Comparing data on a country's competitive position over time can provide information on which countries are more successful in coping with change and implementing effective strategies for improvement and which countries are losing their position in the competitive market. The indicator is calculated as the ratio of real GDP to the average population in a given year (Real GDP per capita, 2024). Economic growth acts as an increase in a country's output of goods per capita in the long run, because as per capita income increases, consumption will also increase, and as a result, the welfare of society will increase (Runtunuwu, 2020). It is useful to pay attention to the growth rate of real GDP per capita, which is depicted in Figure 1.

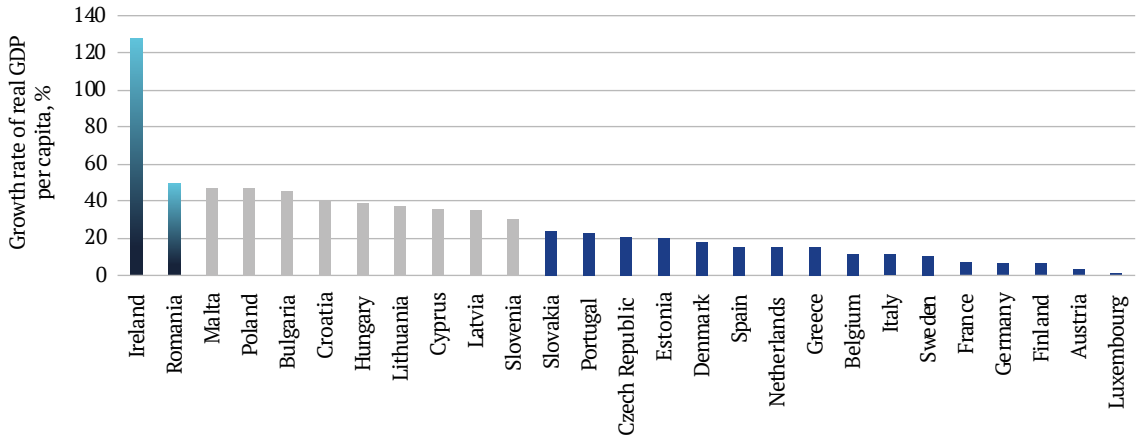

Figure 1. Growth rate of real GDP per capita of EU member states, 2013-2023
Note: green colour – leading countries; blue colour – catching-up countries; red colour – lagging countries
Source: created by the authors based on Real GDP per capita (2024)

As can be seen from Figure 1, the countries differ significantly in terms of potential, availability, and utilisation of resources. It can be concluded that the leaders by the analysed indicator are Ireland and Romania. All other countries are catching up or lagging behind. At the same time, there are much more lagging countries than catching-up countries. According to the percentage ratio of all European countries, 7% of countries are ahead in terms of growth rates of real GDP per capita, 33% of countries are catching up, and 60% of countries are lagging behind. No countries with degrading dynamics of economic development were found.

One of the indicators, the level of education, has been calculated since 2010 on the basis of the average number of years of education of adults aged 25 and over, as well as on the basis of the expected number of years of schooling of children. The standard of living started to be calculated on the basis of gross national income converted using purchasing power parity (Dasic *et al.*, 2020). In the new calculations, life expectancy characterises the long and healthy life of the population. Literacy rate and length of schooling characterise the awareness of the population, while purchasing power characterises a decent standard of living (Runtunuwu, 2020). The analysis of the four indicators has been changed from arithmetic mean calculation to multiplicative aggregation method since 2010. Consequently, the categorisation of countries into development groups has been revised. An analysis of the change in HDI for EU Member States in 2022 relative to 2013 is presented in Table 1.

Table 1. Change in HDI of EU member states in 2022 relative to 2013

Country	Absolute HDI score		Modification, Δ	Country	Absolute HDI score		Modification, Δ
	2013	2022			2013	2022	
Croatia	0.805	0.878	0.073	Slovenia	0.892	0.926	0.034
Malta	0.847	0.915	0.068	Ireland	0.916	0.95	0.034

Table 1. Continued

Country	Absolute HDI score		Modification, Δ	Country	Absolute HDI score		Modification, Δ
	2013	2022			2013	2022	
Latvia	0.814	0.879	0.065	Greece	0.86	0.893	0.033
Lithuania	0.818	0.879	0.061	Austria	0.895	0.926	0.031
Poland	0.821	0.881	0.06	Germany	0.92	0.95	0.03
Cyprus	0.848	0.907	0.059	Spain	0.885	0.911	0.026
Portugal	0.816	0.874	0.058	Italy	0.881	0.906	0.025
Estonia	0.846	0.899	0.053	Netherlands	0.921	0.946	0.025
Luxembourg	0.875	0.927	0.052	Czech Republic	0.873	0.895	0.022
Denmark	0.901	0.952	0.051	Hungary	0.831	0.851	0.020
Finland	0.892	0.942	0.05	France	0.893	0.91	0.017
Belgium	0.897	0.942	0.045	Bulgaria	0.782	0.799	0.017
Romania	0.786	0.827	0.041	Slovakia	0.84	0.855	0.015
Sweden	0.916	0.952	0.036				

Source: created by the authors based on United Nations Development Programme (2014; 2024)

From Table 1, it is worth concluding that of the European countries, in 2013, the HDI leaders were the Netherlands, Germany, and Ireland, and in 2022 the HDI leaders were Denmark, Sweden, and Germany. But these are absolute figures, while in dynamics, countries such as Croatia, Malta, Latvia, and Lithuania were more successful in improving HDI. The results in relation to Poland were unforeseen, as in 2013 the country was ranked 39th in the international HDI ranking, and in 2022, it increased its HDI score to 36th place, surpassing European countries such as Lithuania, Latvia, Croatia, and Portugal, which were previously ranked higher than Poland (United Nations Development Programme, 2014; 2024). However, thanks to a well-designed strategy and effective measures taken, the country was able to improve its social development indicator. France was of additional interest because, despite the fact that in 2013, the country ranked 20th in HDI with a score of 0.893, over the next 10 years it dropped to 28th place with a score of 0.91. Even though the indicator itself has improved, compared to other countries that have a higher rate of human capital development, France has significantly lowered its position in both the European and international rankings.

The competitive position of each EU member state is determined using a two-dimensional matrix of socio-economic development. For the vertical axis, the integral indicator of real GDP per capita is taken, and for the horizontal axis, the integral indicator of HDI is taken. Integral indicators were calculated for the period 2013 and 2022 for the HDI indicator and for the period 2013 and 2023 for the real GDP per capita indicator. The matrix thresholds were determined based on the results of the calculation of the integral indicators. For the integral indicator of real GDP per capita, the threshold values are as follows: the indicator above 3.09% – high growth, the indicator in the range of 1.44-3.09% inclusive – medium, and the indicator below 1.44% – low growth. Consequently, for the HDI integral indicator, the threshold values are as follows: the indicator above 0.0062 – high growth, the indicator in the range of 0.0037-0.0062 inclusive – medium, the indicator below 0.0037 – low growth (Table 2).

Table 2. Competitiveness matrix of EU member states

		Integral indicator of real GDP per capita		
		High	**Medium**	**Low**
HDI integral indicator	**Low**	Hungary, Bulgaria	Netherlands, Spain, Czech Republic, Slovakia	Germany, France, Italy
	Medium	Ireland, Romania	Denmark, Slovenia	Belgium, Greece, Finland, Sweden, Austria
	High	Croatia, Lithuania, Poland, Cyprus, Malta	Portugal, Estonia, Latvia	Luxembourg

Source: created by the authors based on United Nations Development Programme (2014; 2024); Real GDP per capita (2024)

In Table 2, the matrix thresholds are separated by quadrants. Consequently, as a result of the analysis, it was possible to establish nine quadrants that determine the level of socio-economic development of each analysed country. Analysing the matrix, it is worth concluding that the socially and economically stable countries include the countries in the upper right quadrant of the matrix: Lithuania, Poland, Cyprus, Malta, and Croatia. These are the countries that have the most sustainable competitiveness in the EU. Previously, the competitiveness of a country was measured by GDP, employment, government deficit and/or surplus, external debt, etc. But, in the current conditions of functioning of national economies, the concept of competitiveness goes beyond these indicators (Rajnoha & Lesnikova, 2022). The results obtained in the form of a competitiveness matrix confirm this. Of interest is the fact that the countries with the highest competitiveness do not have the highest GDP figures in the EU as of 2023. For example, Poland's GDP was EUR 0.75 trillion (sixth highest in the EU), Croatia's was EUR 0.08 trillion (twentieth highest

in the EU), Lithuania's was EUR 0.07 trillion (twenty-second most quantified in the EU), Cyprus – EUR 0.03 trillion (twenty-sixth most quantified in the EU), Malta – EUR 0.02 trillion (twenty-seventh most quantified in the EU) (Gross domestic product…, 2024).

Of interest are the countries that are not in the upper right quadrant and not in the lower left quadrant in the matrix in Table 2. That is, a clear division of countries can be seen, with catching-up and even more lagging countries in terms of competitiveness based on socio-economic development over the period 2013-2023. The countries with a socially developed but medium level of economic development are Portugal, Estonia, and Latvia. Countries with socially developed but economic problems include Luxembourg. Countries with a high level of economic development and a medium level of social development include Ireland and Romania. Countries with medium social development and economic problems include Belgium, Greece, Finland, Sweden, and Austria. Countries with social development problems and medium economic development include the Netherlands, Spain, the Czech Republic, and Slovakia. Countries with average living standards and economic development include Denmark and Slovenia. Economically developed countries but with social development problems include Hungary and Bulgaria.

Countries with economic and social development challenges include Germany, France, and Italy. As a result of the analysis, these countries are of particular interest as they are in the lead compared to other EU countries in terms of GDP as of 2023. For example, Germany ranks first in terms of quantitative GDP, with a GDP of EUR 4.12 trillion. France, ranking second in the EU, has a GDP figure of EUR 2.8 trillion. Italy, ranking third in the EU, has a GDP figure of EUR 2.09 trillion. This is many times higher than Malta, which was analysed to be in the group of highly competitive countries in the dynamics (Gross domestic product…, 2024).

It is important to note that the obtained competitiveness results indicate the development of the competitive position over 10 years for each country. Consequently, the absolute indicator can be high throughout the analysed period and not subject to significant changes, which defines a country in the square with a low rate of development. For example, Luxembourg's real GDP per capita in 2013 was EUR 83.32 thousand, and in 2023, it was EUR 82.4 thousand (Real GDP per capita, 2024). Luxembourg's HDI was 0.875 in 2013 and 0.927 in 2022. According to the ranking, the country was ranked 21st in the international list in 2013 and 20th in 2022 (United Nations Development Programme, 2014; 2024). Thus, the country, as a result of the analysis, is represented in the quadrant with a high level of social development but with a low level of economic development over the 10 years of analysis. Another example is Poland. The real GDP per capita in Poland in 2013 was EUR 10.3 thousand, and in 2023, it was EUR 14.75 thousand. Poland's HDI in 2013 was 0.821, and in 2022, it was 0.881. That is, in comparison, the difference in HDI change over 10 years for Poland and Luxembourg is not significant, while the difference in the change in real GDP per capita over the same period for the same countries is enormous. Also, for example, it is worth analysing the position of Denmark, as this country occupies the middle quadrant in the matrix. The real GDP per capita in Denmark was EUR 44.54 thousand in 2013 and EUR 52.51 thousand in 2023. Luxembourg's HDI was 0.9 in 2013 and 0.952 in 2022. The country was ranked 10th in the international list in 2013 and 5th in 202. Consequently, it can be noted that the country's position is not changing significantly, and Denmark is slowly developing in two directions at the same time, utilising its potential to the maximum.

For those countries whose integral HDI is much lower than the integral indicator of real GDP per capita, it can be concluded that the existing resources were not optimally distributed during the period under study. The development policy is aimed at a certain class of people in the country but not oriented towards the interests of the entire population. In countries where the integral HDI indicator is in the quadrant equal to the integral indicator of real GDP per capita, it is worth speaking about the harmony of existing resources in the country and the result of development. For those countries where the HDI integral indicator is much higher than the integral indicator of real GDP per capita, then it can be concluded that countries are utilising their potential in the best possible way (De Castro Placido & Hwang, 2019). According to the results of the integral indicators, it can be determined that it is Lithuania, Poland, Cyprus, Malta, and Croatia that are sustainably competitive countries.

Since the integral indicator of real GDP per capita is represented by a single indicator in dynamics, it does not require additional analysis. Another thing is the case with the integral indicator HDI, which is an aggregate indicator. It is worth considering the example of the leading countries in terms of the improvement of the main HDI indicators over the analysed period in dynamics. Lithuania has improved its HDI performance, which is evident in the improvement of the income indicator from 0.673 in 2013 to 0.715 in 2023, a percentage increase of 6.24%. For Poland, the income indicator increased from 0.666 in 2013 to 0.71 in 2022, a percentage increase of 6.6%. For Croatia, the income figure increased from 0.653 in 2013 to 0.763 in 2022, a percentage increase of 16.84%. For Cyprus, the income figure increased from 0.719 in 2013 to 0.771 in 2022, a percentage increase of 7.23%. For Malta, the income rate increased from 0.727 in 2013 to 0.778 in 2022, a percentage increase of 7.02% (United Nations Development Programme, 2014; 2024). The education indicator increased significantly for Lithuania by 6.8% compared to the 2013 value of 0.823. For Poland, the same indicator increased by 8.47% compared to the 2013 value of 0.779. For Croatia, the same indicator increased by 17.39% compared to the 2013 value of 0.690. For Cyprus, the same indicator increased by 18.41% compared to the 2013 value of 0.668. For Malta, the same indicator increased by 16.35% compared to the 2013 value of 0.691 (United Nations Development Programme, 2014; 2024).

Inequality-adjusted life expectancy improved marginally in countries with the most sustainable competitiveness. Namely, in Croatia, over the period 2013-2022, the index improved by 6 from 0.832 in 2013 to 0.882 in 2022. In Lithuania, over the same period, the index increased by 17.36% from 0.749 in 2013 to 0.879 in 2022. For Poland, over the same period, the index increased by 3.06% from 0.818 in 2013 to 0.843 in 2022. For Cyprus, over the same period, the index increased by 4.62% from 0.887 in 2013 to 0.928 in 2022. For Malta, over the same period, the index increased by 7.31% from 0.875 in 2013 to 0.939 in 2022 (United

Nations Development Programme, 2014; 2024). The results of the analysis show that in dynamic development, high competitiveness is observed in those countries that make the most efficient use of their resources over the years.

In the context of annually growing global competition between countries, those states that have been outsiders in the dynamics should take measures to improve. The main goal should be the formation of the country's human potential of high quality. For this purpose, educational standards for the population should be improved and revised. It is important to find and implement highly effective educational and scientific resources at different stages of the education of the population. Implementation should be designed in such a way that the requirements fully meet modern conditions. It is necessary to expand both the choice of professions and jobs through grants or scholarships for graduates of higher education institutions, as well as to develop a new approach to the formation of strategies, tactics, and operations to adapt the system of vocational education to the economic, social, and demographic situation in the country. Special attention should be paid to the creation of conditions that will initiate greater social responsibility of enterprises in terms of organising professional training of workers or improving their qualifications on the basis of tripartite interaction between the country, entrepreneurs, and workers. In order to most effectively implement such measures, it is necessary to improve legislation to support scientific research and innovation, as well as the commercialisation of scientific developments and the protection of intellectual property. Active introduction of lifelong learning into society, which will affect the knowledge of the population and increase HDI, which in turn will affect economic development and then the level of competitiveness of the country.

DISCUSSION

Competitiveness is an important indicator of the functioning of each country. This indicator should be based on both economic and social indicators. The competitiveness of any country is a rather relative concept, as it is not the absolute performance indicators that are of great interest, but those indicators that determine how well a country manages this performance compared to other countries. In this study, it was found that it is not reasonable to determine the competitive position of a country only by economic indicators, as shown by the results of the study. A single indicator, especially for one particular year, cannot show the real picture of changes in the country's position compared to its closest competitors over time. Similar conclusions were reached by T. Formánek (2019), who analysed the factors of economic growth in European countries. The scientist found that one of the main indicators of the economic development of the country is real GDP per capita. Similar conclusions were also reached by researchers R. Dědeček & V. Dudzich (2022), when they studied the GDP per capita as the main economic indicator of the country's development. As a result of the study, the researchers concluded that GDP per capita in purchasing power parity has limitations in the study of economic development because of its reduced ability to show the actual level of development. The researchers determined that GDP per capita does not account for income inequality in a country, hence overestimating the level of development of a country. This is also consistent with the results of this study, as it was concluded that analysing only real GDP per capita, even in dynamics, cannot show the level of development as an integral indicator.

Other researchers, analysing the level of competitiveness of countries' economies, paid attention exclusively to the indicators of social development and innovation. For example, researcher E.S. Hamid (2019), studying the Global Competitiveness Index in Asian countries, noted the positive impact of HDI on the level of competitiveness of countries. Since people act as one of the main determinants that determine the global competitiveness of a country, it is important to pay attention to this indicator. The explanation for this impact is as follows: a country's human resources shape economic growth, which in turn affects the country's increased competitiveness in the international arena. Similar conclusions were reached by A. Migała-Warchoł & M. Sobolewski (2020), who studied the socio-economic development of EU countries. The researchers found that non-economic indicators should also be taken into account when calculating the growth of each country. The competitiveness of a country is determined by the ability and skill to achieve high rates of economic growth and improvement of human capital. That is, human capital becomes a strategic resource of the country in the international arena in the struggle for a competitive position (Chornyi & Chorna, 2017). As a result of the HDI study and the assessment of a country's competitiveness on this indicator, W. Tunsi & H. Alidrisi (2023) concluded that HDI should be based on innovation. The researchers explain such results of the study by the fact that the indicator itself is not sufficient to analyse the development of a country. But HDI has a growing potential for additional changes in terms of technical measurements. Such measurements, according to the researchers, should be innovation whenever the aim is to compare countries. This statement is not consistent with the results of the study because innovation as an important indicator of a country's development was neglected during this paper, and the focus was on simultaneously analysing real GDP per capita as the main indicator of economic development and HDI as the main indicator of social development. The reasons for choosing these indicators are the impact of human capital on the country's economy through productivity. Based on these indicators, earlier studies have been conducted. E. Elistia & B.A. Syahzuni (2018), as a result of analysing the correlation between GDP and HDI, found that such correlation is strong and significant. Economic growth allows achieving a high level of human development; increasing the level of human development leads to increased opportunities for economic growth (Spytska, 2023a). That is, this indicator is complementary.

Based on the analysis of integral indicators real GDP per capita and HDI, this study developed a matrix of sustainable competitiveness of EU countries. As a result of the analysis, it is determined that those countries that have less sustainable competitiveness for 2013-2023 "lose their momentum" over time despite having good development indicators for 2023. The study found that the majority of countries developed as of 2023 fall into this category. Germany, France, and Italy are prime examples. In contrast, countries that do not have the highest GDP in the EU, such as Croatia, Poland, Lithuania, Cyprus, and Malta, are rapidly

developing in socio-economic terms. Consequently, they present a high level of competitiveness over time. It is important to note that this study was conducted in the time range of 2013-2023. According to the results of the study, it was determined that the best ratio of economic and social development was achieved by Poland, Lithuania, Cyprus, Malta, and Croatia. At the same time, these results were obtained by analysing the indicators in dynamics. Investigating the impact of human capital on the competitiveness of EU countries, E. Širá *et al*. (2020) concluded that the knowledge of the population forms the sustainable position of the country in the competitive environment. Consequently, this confirms the main idea of this study about ensuring a highly competitive position of the country in the long term, precisely through the development of human capital. The researchers also emphasised sustainable competitiveness. The analysis was carried out for 11 years of European countries' functioning, starting from 2007 to 2017. Based on the results of the calculations, the researchers identified the most competitive EU country – Sweden. As a result of this study, the country with the highest competitiveness was Croatia. It is important to note that the results of the obtained study do not reflect the full relevance of the situation of European countries compared to the research conducted in this article. This is due to the fact that at the time of the analysis, E. Širá *et al*. (2020) included 28 countries in the counts, including the UK. The study conducted in this article was based on 27 EU countries, which is relevant for the 2024 study year. The main conclusions can be drawn from the study of the competitiveness of European countries based on socio-economic development and the HDI index. Based on social and economic indicators, and dynamic changes in the development of countries, sustainable competitiveness is crucial, which is best demonstrated by Croatia, Lithuania, Poland, Cyprus, and Malta for 2013-2023.

CONCLUSIONS

As a result of the analysis, it has been established that in modern conditions of functioning, countries should pay attention to the indicator of competitiveness in comparison with other countries. In this case, the success of the country's development should be considered primarily through a set of economic and social indicators that directly affect its competitive position. The study analysed the socio-economic development of the EU countries for the period 2013-2023 and proposed an approach to determine the competitiveness of each country. This approach is based on analysing partial and integral indicators of economic and social development, assessing dynamic development based on integral indicators of social and economic growth, and determining the competitive position using a two-dimensional matrix. It was possible to determine not just the competitive position of each country in the EU but to investigate the sustainable competitiveness of the country in a dynamic calculation over the last 10 years of operation.

The main indicators for calculations were real GDP per capita as an economic indicator and HDI as the main social indicator. Initially, the growth rates of real GDP per capita in each European country were determined. It was possible to divide all EU countries into leading, catching-up, and lagging countries, where the best indicators were observed in Ireland and Romania and the worst – in Luxembourg and Austria. The absolute changes in HDI countries in 2022 compared to 2013 were then analysed separately. Such results showed that the largest absolute increases were observed in Croatia and Malta, and the smallest in Bulgaria and Slovakia. Since the results obtained for partial indicators were not appropriate for comparison, an integral index of similar indicators was calculated and a two-dimensional competitiveness matrix was constructed, which was based precisely on the integral indicators of socio-economic development of the countries. As a result of the analysis, it was determined that countries such as Poland, Lithuania, Cyprus, Malta, and Croatia have a steady increase in socio-economic development over the period 2013-2023, which makes them the most competitive countries. The least competitive in dynamic development are Germany, France, and Italy, despite high absolute values of both real GDP per capita and HDI as of 2023.

Hence, it can be concluded that countries with high absolute values in 2023 have lost their growth momentum over the 10 years of operation, while countries with low absolute values of real GDP per capita and HDI have increased their growth rate over the same period. The study analysed the change in HDI components of highly competitive countries and identified improvement measures for lagging countries based on improving the quality of human capital. A limitation of this study is the fact that HDI, although it groups countries by human development indicator, cannot include all indicators of a country's social development. Nor is the real GDP per capita a single absolute indicator of a country's economic development. It is important to conduct the next similar studies, but with improved methodology. Improvements should concern the introduction of multivariate optimisation of various economic and social indicators into the approach and calculations in order to increase the representativeness of the results obtained.

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CONFLICT OF INTEREST

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Конкурентна позиція країн-членів Європейського Союзу за рівнем соціально-економічного розвитку відповідно до Індексу людського розвитку

Анотація. Метою дослідження було проаналізувати конкурентоспроможність європейських країн між собою за рівнем соціально-економічного розвитку. До аналізу було включено 27 країн Європейського Союзу. Як основний показник економічного розвитку країни для аналізу було обрано реальний валовий внутрішній продукт на душу населення. Як основний показник соціального розвитку – агрегований індекс людського розвитку. Для визначення рівня конкурентоспроможності кожної країни використовувалася двовимірна матриця, в основу якої покладено розрахунок інтегральних показників реального валового внутрішнього продукту на душу населення та Індексу людського розвитку в динаміці за період 2013-2022 рр. Дослідження конкурентоспроможності дозволило розробити дев'ять квадрантів двовимірної матриці, кожен із яких описує конкурентну позицію європейської країни. Такі країни, як Німеччина, Франція та Італія, хоч і мали високі абсолютні показники як у 2013, так і в 2023 році, але динаміка покращення таких показників значно нижча порівняно з рештою європейських країн. Деякі країни в динаміці мають кращий розвиток економічних показників, ніж соціальних, як, наприклад, Угорщина та Болгарія. Єдиною країною, де темпи соціального розвитку переважають над темпами економічного розвитку, є Люксембург. Інші 16 країн Європейського Союзу займають середні позиції конкурентоспроможності, що свідчить про їх поступовий розвиток із низькими темпами. Хорватія, Литва, Польща, Кіпр та Мальта є країнами зі сталою конкурентоспроможністю, які протягом 2013-2023 років найбільш ефективно використовували наявні ресурси та потенціал як для соціального, так і для економічного розвитку. Отримані результати будуть корисними для фахівців, які розробляють національні конкурентні стратегії та програми, оскільки за результатами аналізу було отримано 10-річну картину сталої конкурентоспроможності кожної європейської країни

Ключові слова: двовимірна матриця; інтегральний показник; якість життя; динаміка змін; стале зростання

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Consumer psychology and the effectiveness of marketing campaigns: The influence of psychological factors on consumer preferences and purchases

Abstract. This article examined the relationship between psychological factors and consumer behaviour within the context of marketing campaigns in Ukraine. The research involved observing consumer behaviour, conducting surveys to collect quantitative data on preferences, and performing experiments to assess the impact of marketing strategies on consumer behaviour. The study found that consumers are drawn to products with appealing designs that evoke positive emotions, such as joy and satisfaction, and that are associated with pleasant memories or feelings of comfort. Products with social approval (positive reviews, recommendations) are perceived more favourably than those with neutral or negative reviews, as they significantly increase consumer interest and trust. The balance between price and product quality, as well as its environmental sustainability, are also important factors influencing purchasing decisions. Advertising is most effectively received through video. Thanks to audiovisual elements, video advertising engages with the audience more effectively and leaves a more lasting impression compared to newsletters or banners. Promotions, discounts, and product sampling are effective marketing tactics aimed at achieving short-term sales growth and enhancing consumer satisfaction. The research identified psychological consumer segments: those who value innovation and cutting-edge technology, and those who are focused on economic benefits. The findings emphasised that considering psychological factors is crucial for developing effective marketing strategies and increasing consumer interest. These insights can be practically applied by marketers when planning advertising campaigns or identifying the target audience for a product

Keywords: attractive design; social validation; video advertising; promotions; discounts

INTRODUCTION

In the context of rapid market development and changing consumer behaviour patterns, companies face the need to adapt their marketing strategies to remain competitive. The study of psychological factors, such as emotional associations and social validation, is crucial for designing effective marketing campaigns. Understanding how these factors influence consumer preferences and decision-making processes allows for the creation of personalised strategies that better meet the needs of target audiences, thereby driving increased sales and consumer loyalty. There is a need for new approaches that more effectively address consumer demands and expectations, enabling the optimisation and enhanced effectiveness of marketing strategies.

The personalisation of marketing communications (emails, tailored offers and recommendations, targeted advertising) is a key aspect in enhancing the effectiveness of campaigns. N. Stepanenko & I. Volkova (2020) and V. Zhurilo *et al*. (2023) found that personalised communications can improve consumer engagement and increase loyalty, though their effectiveness depends on data quality and integration into multichannel strategies. Gaps requiring further study include the ethical and privacy aspects of data collection, the impact of personalisation on different

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demographic groups, the cost-effectiveness of implementation, its synergy with other marketing tools, and the long-term effects on consumer-brand relationships.

The inadequate adaptation of marketing strategies to rapidly changing technological and social trends results in companies not always effectively integrating innovations into their approaches. Research by O.V. Kolomitseva & L.S. Vasilchenko (2022) and M. Bagorka & I. Abramovich (2024) revealed that companies failing to adjust their strategies in response to modern challenges miss opportunities to engage successfully with consumers and leverage new means of audience engagement. Although these authors explored the adaptation of strategies to new technologies, questions remain regarding the development of effective methods for integrating innovations, a detailed assessment of their impact on the consumer experience and campaign outcomes, as well as how swift changes in trends affect the operational efficiency of marketing initiatives.

Advertising messages with emotional content are more effective than informational ones. A. Kaur & G. Malik (2020) and Y.M. Shumilo (2021) found that an emotional connection between a brand and its consumers increases the likelihood of repeat purchases. Emotional content fosters deeper consumer engagement, and neglecting emotions may lead to incorrect brand positioning. However, these studies did not explore the impact of emotions on social and cultural factors, long-term consumer loyalty, different stages of the consumer process, individual differences in perceiving emotional content, and the mechanisms of its influence in digital and traditional media. Price sensitivity significantly influences consumers' purchasing decisions, as price changes in goods or services can determine the choice between different products and suppliers (Oleksy-Gębczyk, 2024). S. Qazzafi (2020) and T.V. Dyadyk *et al*. (2023) concluded that highly price-sensitive consumers respond more to discounts and promotions. These consumers tend to be less brand loyal and are more likely to compare prices between suppliers. Unexplored areas remain the impact of social and cultural factors on price sensitivity and its interaction with psychological aspects such as perceptions of quality and branding.

The role of cognitive biases in consumer decisions is a crucial topic, as they can lead to irrational choices and influence decisions in ways that deviate from objective criteria. C.K. Morewedge *et al*. (2021) and H. Zhaldak & A. Yatsenko (2021) indicate that cognitive biases, such as social validation, loss aversion, and information availability, significantly impact consumer decisions, causing individuals to rely on subjective beliefs and emotional responses rather than objective data. However, these studies did not address how cognitive biases evolve over time or under the influence of changes in personal circumstances, such as financial difficulties or shifts in life goals (priorities, motivations, and consumer plans). Insufficient attention to risk when introducing new products can undermine their success in the market, as consumers often exhibit high levels of uncertainty and fear regarding novelty. Studies by T. Ali & J. Ali (2020) and O. Petrunko & O. Bilenko (2022) demonstrated that consumers may negatively evaluate new products due to perceived risks, including financial costs, unfamiliar features, or the potential for a negative experience. However, strategies for mitigating risk during new product launches have not been thoroughly explored.

The choice of research topic was driven by the need to understand how individual consumer characteristics influence their preferences and purchasing decisions, allowing for the optimisation of approaches to engaging with target audiences. This study aimed to identify how psychological factors shape consumer preferences and affect the effectiveness of marketing campaigns. The objectives of this research were: to analyse the relationship between psychological aspects and consumer behaviour in the context of marketing campaigns; to explore the influence of emotional and cognitive factors on consumer preferences and purchasing decisions; to assess the effectiveness of different marketing strategies in fostering positive attitudes towards products; and to identify key psychological consumer segments and their motivations.

MATERIALS AND METHODS

From January to June 2024, a survey was conducted to collect data on consumer preferences (Table 1). The survey was administered in two ways: online via specialised platforms for surveys (Google Forms, SurveyMonkey) and offline through the distribution of paper questionnaires in shopping centres, stores, and on the streets. A total of 1,000 respondents participated in the study, comprising 500 males and 500 females.

Table 1. Consumer preferences

No.	Questions/Answers	No.	Questions/Answers
1.	Sex: ■ Male ■ Female	2.	Age: ■ 18-29 years ■ 30-39 years ■ 40-49 years ■ 50-59 years ■ 60 years and older
3.	Your city of residence (please specify):	4.	How often do you shop online? ■ Every day ■ Once a week ■ Once a month ■ Less than once a month ■ Never
5.	What influences your decision to buy a product (please select up to three options)? ■ Recommendations from friends/family ■ Advertising on social media ■ Feedback from other customers ■ Discounts and promotions ■ Product design and packaging ■ Personal experience of using the product ■ Other (please specify)	6.	What types of advertising do you find most persuasive? ■ Video advertising ■ Banner advertising ■ Content marketing (articles, blogs) ■ Advertising on social networks ■ Email (newsletters) ■ Advertising on websites ■ Other (please specify)

Table 1. Continued

No.	Questions/Answers	No.	Questions/Answers
7.	How do you respond to personalised ads (e.g. ads based on your previous purchases)? ■ Positive ■ Negative ■ Neutral ■ I do not pay attention	8.	How important are the following factors for you when choosing a product (please rate on a scale from 1 to 5, where 1 is not important at all, 5 is very important): ■ Price ■ Quality ■ Brand ■ Feedback from other customers ■ Availability in your region ■ Environmental friendliness of the product
9.	Do you pay attention to advertising campaigns that highlight the brand's social responsibility (e.g., support for charities, environmental initiatives)? ■ Always ■ Sometimes ■ Rarely ■ Never	10.	What sources of product information do you trust the most? ■ Official brand website ■ Social networks ■ Reviews on independent websites ■ Recommendations from friends/family ■ Traditional media (TV, radio) ■ Other (please specify)
11.	What factors have the greatest impact on your consumer preferences? ■ Social media ■ Advertising ■ Personal experience ■ Influence of the environment (friends, family) ■ Cultural and social trends ■ Other (please specify)	12.	How do you feel about new brands and products on the market? ■ Always ready to try new things ■ I prefer familiar brands, but sometimes I try new ones ■ Very rarely try new brands ■ I always choose only familiar brands
13.	Do your consumer preferences change under the influence of seasonal advertising campaigns (e.g. New Year's promotions, summer sales)? ■ Yes, always ■ Sometimes ■ Rarely ■ Never	14.	What platforms do you use most often to find out about new products and services? ■ Facebook ■ Instagram ■ YouTube ■ TikTok ■ Other social networks ■ Websites and blogs ■ Traditional media (television, radio)
15.	Do you pay attention to reviews from other consumers before buying a product? ■ Always ■ Sometimes ■ Rarely ■ Never	16.	Which stores do you visit most often when shopping in shopping centres? ■ Shops closer to the entrance are always a priority ■ I prefer shops on the ground floor ■ Location does not influence my choice ■ The main thing for me is the assortment, not the location
17.	What products do you prefer when shopping in a store? ■ Products located at eye level ■ Products on the lower shelves ■ Products on the top shelves ■ The location of the product does not matter	18.	Which of these factors has the greatest influence on your purchase decision? ■ Visual merchandising ■ Promotions and discounts ■ The price of the product ■ Product rating on online platforms
19.	What can be a reason for you to refuse to buy the product? ■ High price ■ Poor quality ■ Unattractive packaging design ■ Lack of necessary information	20.	What emotions do you most often experience when making a purchase? ■ Satisfaction ■ Disappointment ■ Doubt ■ Calmness
21.	How do you usually react to discounted displays compared to non-discounted displays? ■ I spend more time at discounted displays ■ I spend less time at discounted displays ■ I spend the same amount of time at discounted and non-discounted displays ■ The time I spend does not depend on the availability of discounts	22.	Which of the following types of promotional materials encourages you to buy new products? ■ Tastings ■ Promotions (discounts on the first purchase, gifts with purchase) ■ Advertising stands ■ Video adverts ■ Advertising brochures (leaflets, booklets, brochures)

Source: created by the author

Experiments were conducted online throughout May 2024 using the Qualtrics platform, which enabled respondents to interact with various marketing materials in a controlled environment. Participants were recruited via social media (Facebook, Instagram) and local online forums. Initially, they completed a brief survey to ensure their inclusion in the sample (Table 2). The sample from Table 2 was as follows: 180 respondents (85 males and 95 females) participated, divided into three age groups: Group I (18-24 years) – 70 people, Group II (25-34 years) – 80 people, and Group III (35-50 years) – 30 people. The respondents were from Zhytomyr, Chernivtsi, Poltava, Khmelnytskyi, and Uzhhorod. These participants were invited to take part in the experiment (Table 3).

The experiments aimed to assess the impact of various marketing strategies on consumer behaviour.

Table 2. Data on the participants of the experiment

No.	Questions/Answers	No.	Questions/Answers
1.	Age group: ■ Group I (18-24 years old) ■ Group II (25-34 years old) ■ Group III (35-50 years old)	2.	Sex: ■ Male ■ Female
3.	Your city of residence (please specify):	4.	Main activity ■ Student ■ Employed ■ Entrepreneur ■ Unemployed ■ Other (please specify)
5.	Your monthly income (after taxes): ■ Less than 5,000 UAH ■ 5,000-10,000 UAH ■ 10,001-15,000 UAH ■ 15,001-20,000 UAH ■ More than 20,000 UAH	6.	How often do you shop in stores or shopping centres? ■ Every day ■ Several times a week ■ Once a week ■ Once a month ■ Less than once a month
7.	What do you expect from participating in this experiment (please select all that apply)? ■ An opportunity to learn more about marketing strategies ■ Gain new knowledge about consumer behaviour ■ An opportunity to express your opinion and influence future advertising campaigns ■ Other (please specify)		

Source: created by the author

Table 3. Relationship between marketing strategies and consumer behaviour

Experiment title	Description	Aim	Metrics for measurement
1. Influence of product design and emotions	Participants are shown products with different designs (classic, modern, creative). Emotional response and purchase intent are evaluated.	Determine which design elicits the strongest positive emotions and the greatest willingness to purchase.	Level of interest, emotional response, time spent on the product page.
2. Evaluation of the impact of product advertising	Different versions of advertising campaigns (video ads, text ads, banners) are demonstrated. Interaction with advertising is analysed.	Determine which advertising strategy has the greatest impact on consumer behaviour.	Number of clicks, conversions (visiting the product page, completed forms, purchases), overall interaction with advertising.
3. Influence of positive reviews	Participants are shown products with different types of reviews (positive, neutral, negative). The impact on the purchase decision is evaluated.	Determine how positive reviews influence the willingness to purchase and trust in the product.	Number of purchases, change in interest after viewing reviews.
4. Effect of promotions on consumer behaviour	Products with different promotional offers (discounts, coupons, free shipping) are demonstrated. The impact on sales volume is evaluated.	Determine which promotions best stimulate consumers to purchase.	Number of purchases, average check size.
5. Reaction to new products	Participants are shown new products alongside old ones. Interest and willingness to purchase new products are evaluated.	Determine the impact of new products on consumer behaviour and interest in the brand.	Number of purchases, and interaction with new products.

Source: created by the author

To determine the classification of 1,180 respondents into one of two segments (consumers who value innovation and cutting-edge technology, and those who focus on economic benefits), they were surveyed regarding their preferences for product characteristics and advertising campaigns (Table 4).

Table 4. Survey for segment classification

No.	Questions/Answers	No.	Questions/Answers
1.	What is more important to you when choosing a product? ■ Innovative features and the latest technology ■ Economic benefits such as discounts and promotions	2.	How do you usually react to advertising of new technologies and innovative products? ■ I am interested and actively follow such campaigns ■ I do not pay much attention to it
3.	Which advertising offers attract your attention the most? ■ Offers that emphasise the uniqueness and novelty of the product ■ Offers that offer discounts or special promotions	4.	Are you interested in promotional offers? ■ I often take advantage of such offers ■ I rarely pay attention to them

Table 4. Continued

No.	Questions/Answers	No.	Questions/Answers
5.	How often do you buy products with innovative features? ■ Often ■ Rarely ■ Never	6.	How do you feel about advertising campaigns that emphasise economic benefits? ■ I often respond to such campaigns ■ I do not pay much attention to it

Source: created by the author

All data concerning the study participants are confidential and stored by personal information protection regulations. Data processing and analysis were conducted using Python version 3.11 and Microsoft Office Excel 2007. The research followed the ICC/ESOMAR international code on market, opinion and social research and data analytics (2016). This approach facilitated a comprehensive analysis of the impact of psychological factors on consumer preferences and purchasing behaviour, enabling the identification of statistically significant patterns and the formulation of well-founded conclusions.

RESULTS

Analysis of survey results. According to Table 1, respondents were divided into the following age categories: 18-29 years (250 respondents), 30-39 years (250 respondents), 40-49 years (200 respondents), 50-59 years (200 respondents), and 60 years and over (100 respondents). Research participants were from the following Ukrainian cities: Kyiv, Odesa, Dnipro, Poltava, Cherkasy, Chernivtsi, Ivano-Frankivsk, Ternopil, Lutsk, and Mykolaiv. Of the 1,000 survey participants, 12.3% of respondents, or 123 individuals, make purchases every day. A third of respondents (33.6%), or 336 individuals, shop online once a week. 28.3% of respondents (283 individuals) make purchases once a month, while 18.2% (182 individuals) do so less than once a month. Only 7.6% (76 individuals) reported not making online purchases. Regarding factors influencing purchasing decisions, 54.1% of respondents (541 individuals) indicated that they were influenced by recommendations from friends and family. Social media advertising influenced 47.3% of respondents (473 individuals). Reviews from other customers were important to 60.9% of respondents (609 individuals). Discounts and promotions influenced 51.9% of respondents (519 individuals), while product design and packaging mattered to 29.5% of respondents (295 individuals). Personal experience with the product was considered by 44.6% of respondents (446 individuals), and other factors were mentioned by 7.8% of respondents (78 individuals). The distribution of respondents by city was as follows: 18.1% of respondents live in Kyiv, 13.6% in Odesa, 13.2% in Dnipro, 10.3% in Poltava, 9.4% in Cherkasy, 7.6% in Chernivtsi, 10.4% in Ivano-Frankivsk, 7.2% in Ternopil, 5.8% in Lutsk, and 4.4% in Mykolaiv.

The most persuasive types of advertising were distributed as follows: video advertising was considered most effective by 336 respondents, social media advertising by 220, banner advertising by 182, and content marketing by 134. Email newsletters were perceived as effective by 72 respondents, while website ads were effective for 30. Other types of advertising (print, transportation, promotional events) were mentioned by 26 respondents. Regarding personalised ads (ads that are tailored to individual interests and user behaviour using data about their previous actions and preferences), 456 individuals reported a positive reaction, indicating their effectiveness among a significant portion of the audience. A negative reaction to such ads was reported by 124 respondents, which may indicate certain problems or discomfort caused by advertising. A neutral attitude towards personalised advertising was recorded in 274 individuals, meaning that this advertising does not evoke significant emotional reactions in them. 146 individuals indicated that they do not pay attention to such ads at all, which may indicate their low interest or disregard for personalised content.

Survey results indicate the importance of various factors when choosing a product, as rated by respondents on a scale of 1 to 5. The average score for the factor “Price” is 4.7, indicating its high significance for most respondents. The factor “Quality” received an average score of 4.8, confirming it is even greater importance. “Brand” has an average score of 3.9, indicating a lesser but still noticeable role in decision-making. “Reviews from other customers” received an average score of 4.3, also highlighting their significance. The factor “Availability in your region” has an average score of 3.7, indicating its importance but less critical compared to other factors. “Environmental friendliness of the product” received an average score of 3.5, indicating that this factor is important but less of a priority for respondents compared to price and quality. Respondents demonstrated varying levels of attention to advertising campaigns that highlight a brand’s social responsibility (a company’s commitment to acting ethically and actively supporting social, environmental, and economic initiatives for the benefit of society). Specifically, 33.6% of respondents always pay attention to such campaigns, indicating their high sensitivity to social initiatives. 44.7% of respondents sometimes react to these campaigns, showing moderate interest and appreciating their importance in certain cases. 14.4% of respondents rarely pay attention to advertising campaigns that emphasise social responsibility, demonstrating limited interest in this aspect. 7.3% of research participants never pay attention to a brand’s social responsibility, which may indicate their low level of sensitivity to such initiatives.

Official brand websites are the most reliable source of information for 41.8% of respondents surveyed, highlighting their trust in authoritative and verified sources. 27.5% of respondents consider reviews posted on independent websites to be the most credible. 15.4% trust the recommendations of friends and family, indicating the importance of personal contacts and social connections. 11.1% of respondents consider social media to be the most important source of information, reflecting their inclination towards modern digital platforms. 4% of respondents prefer traditional media such as television and radio. 0.2% of respondents noted other sources of information. The distribution of factors influencing consumer preferences is presented by data showing the number of responses from respondents (Fig. 1).

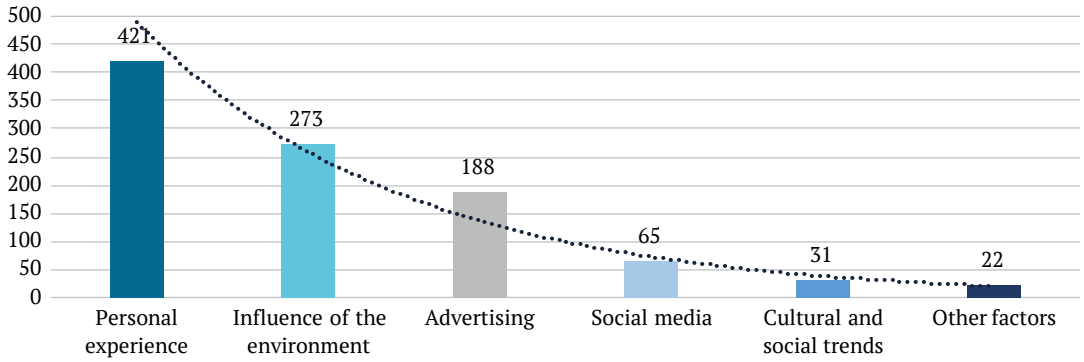

Figure 1. Factors influencing the purchase decision

Source: created by the author

These results indicate that personal experience and the opinions of others are the most significant factors shaping consumer preferences, while advertising and social media have a less noticeable impact. Survey results on respondents' attitudes towards new brands and products showed that 31.1% of them are always willing to try something new (311 people). A majority, 46.9% of respondents (469 people), prefer familiar brands but sometimes try new ones. 14.2% of respondents (142 people) very rarely try new brands, and 7.8% of respondents (78 people) always choose only familiar brands. Regarding changes in consumer preferences under the influence of seasonal advertising campaigns, 22% of respondents (220 people) indicated that this always happens. Most respondents, 39.3% (393 people), are sometimes influenced by such campaigns, while 25% (250 people) rarely change their preferences. 13.7% of respondents (137 people) never succumb to the influence of seasonal advertising campaigns.

Platforms for obtaining information about new products and services vary: 24% of respondents (240 people) use Facebook, 29.1% (291 people) – Instagram, 16.8% (168 people) – YouTube, and 13.2% (132 people) – TikTok. Other social media platforms are used by 8% of respondents (80 people), websites and blogs – 6% (60 people), and traditional media (television, radio) – only 2.9% of respondents (29 people). Regarding attention to reviews from other consumers before purchasing: 33.2% of respondents (332 people) always pay attention to them, 36.2% (362 people) – sometimes, 19.8% (198 people) – rarely, and 10.8% (108 people) – never. Consumer preferences are primarily shaped by personal experience and the influence of their social circle, while other factors play a less significant role.

For 279 individuals, stores closer to the entrance are always a priority for them (135 males and 144 females). The age distribution is as follows: 72 respondents aged 18-29, 68 aged 30-39, 50 aged 40-49, 58 aged 50-59, and 31 respondents aged 60 and over. 237 individuals prefer stores on the ground floor (125 males and 112 females). The age distribution is as follows: 64 respondents aged 1829, 55 aged 30-39, 41 aged 40-49, 48 aged 50-59, and 29 respondents aged 60 and over. 181 respondents indicated that location does not influence their choice (84 males and 97 females). The age distribution is as follows: 46 respondents aged 18-29, 48 aged 30-39, 28 aged 40-49, 32 aged 5059, and 27 respondents aged 60 and over. For 303 individuals, the most important factor is the product range, rather than location (156 males and 147 females). The age distribution is as follows: 68 respondents aged 18-29, 79 aged 30-39, 81 aged 40-49, 62 aged 50-59, and 13 respondents aged 60 and over. Younger respondents (18-29) more frequently prefer stores closer to the entrance or located on the ground floor, indicating their orientation towards convenience. Among respondents aged 30-39 and 40-49, the majority consider the product range more important than location, indicating a mature consumer attitude and an emphasis on product variety. For people aged 50 and over, the convenience of location and product range are less critical compared to younger age groups.

345 individuals prefer products placed at eye level (175 males and 170 females), 177 individuals prefer products on lower shelves (85 males and 92 females), 129 individuals choose products on upper shelves (68 males and 61 females), and 349 individuals believe that product placement does not matter (172 males and 177 females). Results suggest that most respondents prefer products at eye level, although a significant portion do not pay attention to placement. Visual merchandising (a marketing tool for the attractive display of products, including merchandise display techniques, window dressing, and visual store design to increase sales) is the most influential factor for 361 individuals (180 males and 181 females). Promotions and special offers are also important for 349 individuals (170 males and 179 females). Product price influences 196 individuals (85 males and 111 females). Product ratings on online platforms influence 94 individuals (65 males and 29 females). The majority of respondents consider visual merchandising and promotions to be the most important factors when making a purchase decision, while product price and online product ratings have a smaller influence.

312 respondents (155 males and 157 females) indicated that high prices are the main reason for not making a purchase. Low product quality is a reason for refusal for 284 individuals (140 males and 144 females). Unattractive packaging influences the decision of 160 individuals (75 males and 85 females). The lack of necessary product information is a reason for 244 individuals (130 males and 114 females). Most often, respondents refuse to purchase due to high prices and low product quality, while packaging and lack of information have a lesser impact. The results showed that consumers experience a variety of emotions during the purchase (Fig. 2). The data represents responses from 1,000 respondents.

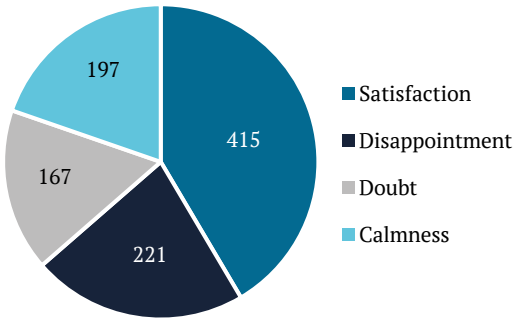

Figure 2. Distribution of emotions
Source: created by the author

The most common emotion is satisfaction, which 41.5% of respondents reported feeling. This suggests that most people have a positive experience during the purchase process. 22.1% of respondents experience dissatisfaction with the purchase process. Doubt is experienced by 16.7% of participants, indicating some uncertainty or need for additional information. Calmness is experienced by 19.7% of respondents.

412 individuals (210 males and 202 females) indicated that they spend more time at discount displays. 120 individuals (60 males and 60 females) reported spending less time at such displays. 198 individuals (105 males and 93 females) stated that they spend an equal amount of time at displays with discounts and those without. 270 individuals (165 males and 105 females) mentioned that the time they spend is not influenced by the presence of discounts. The results suggest that most respondents spend more time on shelves with discounts, but there is also a significant proportion of those who do not change their habits regarding the time spent browsing shelves, regardless of the presence of discounts.

Promotional activities (such as discounts on the first purchase and gifts with purchase) are preferred by 423 individuals (215 males and 208 females). The age distribution is as follows: 112 respondents are aged 18-29, 118 are aged 30-39, 89 are aged 40-49, 83 are aged 50-59, and 21 respondents are aged 60 and over. Tastings are favoured by 237 individuals (120 males and 117 females). The age distribution for this group is 62 respondents aged 18-29, 55 aged 30-39, 60 aged 40-49, 38 aged 50-59, and 22 respondents aged 60 and over. Video advertising appeals to 150 individuals (80 males and 70 females). The age distribution is as follows: 28 respondents aged 18-29, 37 aged 30-39, 35 aged 40-49, 32 aged 50-59, and 18 respondents aged 60 and over. Advertising stands attract 105 individuals (50 males and 55 females). The age distribution for this group is: 24 respondents aged 18-29, 27 aged 30-39, 21 aged 40-49, 22 aged 50-59, and 11 respondents aged 60 and over. Advertising brochures (leaflets, booklets, and pamphlets) are favoured by 85 individuals (35 males and 50 females). The age distribution is as follows: 12 respondents aged 18-29, 18 aged 30-39, 15 aged 40-49, 20 aged 50-59, and 20 respondents aged 60 and over. Promotions and tastings are identified as the most effective types of advertising materials for encouraging the purchase of new products, whereas video advertising, advertising stands, and brochures exert a lesser influence. The age distribution of the results indicates that promotions have the greatest impact on consumers aged 18 to 39, while tastings are more highly valued among those aged 40 to 59. Video advertising appeals to consumers aged 18-29, advertising stands are more influential for individuals aged 50 to 59, and brochures are best received by the older audience (60 years and above).

Analysis of experiment results. The experiment involved 180 participants, of which 58 were from Zhytomyr, 32 from Chernivtsi, 45 from Poltava, 25 from Khmelnytskyi, and 20 from Uzhhorod. Regarding primary occupation, 74 respondents were students, 79 were employed, 16 were entrepreneurs, 7 were unemployed, and 4 indicated "other". 22 respondents earned less than UAH 5,000, 61 earned between UAH 5,000 and 10,000, 47 earned between UAH 10,001 and 15,000, 34 earned between UAH 15,001 and 20,000, and 16 earned more than UAH 20,000. 22 respondents made purchases every day, 59 made purchases several times a week, 74 made purchases once a week, 18 made purchases once a month, and 7 made purchases less than once a month. Participants' expectations from the experiment were as follows: 86 respondents wanted to learn more about marketing strategies, 83 aimed to gain new knowledge about consumer behaviour, 52 wished to express their opinion and influence advertising campaigns, and 23 indicated "other".

Creative product design elicited the strongest positive emotions and the highest purchase intent: 112 participants expressed satisfaction and 95 indicated their intention to purchase, with an average time spent on the page of 2 minutes and 18 seconds. Modern design also received positive ratings: 103 respondents were satisfied and 82 were ready to buy, with an average page time of 1 minute and 50 seconds. Classic design demonstrated less significant results: 90 people were satisfied and 68 intended to buy, with an average page time of 1 minute and 20 seconds. Results from interacting with different ad formats were as follows: video ads attracted the attention of 130 participants, of whom 103 visited the product page, 76 completed forms, and 56 made a purchase. Text ads received 95 clicks, 68 page visits, 49 completed forms, and 40 purchases. Banners had 86 clicks, 52 visits, 29 completed forms, and 20 purchases. Video ads demonstrated the highest engagement and conversion rates compared to text ads and banners. Participants were presented with products with different types of reviews – positive, neutral, and negative. Results showed that positive reviews had a significant impact on the purchase decision.

In the age group of 18-24 years, 43 respondents who viewed products with positive reviews decided to make a purchase, compared to 33 in the neutral review group and 22 in the negative review group. Among respondents aged 25-34 years, 55 expressed interests in products with positive reviews, while 43 with neutral reviews and 30 with negative reviews also made purchasing decisions. In the 35-50 age group, 16 respondents bought a product after viewing positive reviews, compared to 12 in the neutral review group and 8 in the negative review group. Positive reviews significantly increase the likelihood of purchase, particularly among younger age groups, and positively influence the overall perception of the product. Discounted products attracted 112 respondents, with an average check size of UAH 407; discounts had the greatest impact on consumers aged 25-34 years. Coupon offers appealed to 95

respondents, with an average check size of UAH 389, and were also popular among the 25-34 age group. Free delivery influenced 85 respondents, with an average check size of UAH 374; however, this type of promotion proved less effective for respondents aged 35-50 years. Discounts were the most effective in stimulating purchases and increasing the average check size. Newly showcased products attracted the attention of 112 respondents, 85 of whom expressed an intention to purchase these new items. The average time spent on the new product page was 2 minutes and 12 seconds, significantly longer than the 1 minute and 48 seconds spent on old products. Among respondents aged 25-34 years, 40 indicated a readiness to purchase new products, while 56 spent over 2 minutes browsing them. Older products received less attention, with only 74 respondents spending more than 2 minutes on their pages, and just 58 expressing a willingness to purchase. New products generated significantly greater interest and engagement compared to older items. The results of the experiment indicate that positive reviews, promotional offers, and new products have a substantial impact on consumer behaviour, particularly in enhancing readiness to purchase and levels of engagement with products.

Consumer segmentation. A study involving 1,180 respondents aged 18 and over identified two primary psychological consumer segments (Table 5), each with unique motivations.

Table 5. Segmentation

Segment name	Description of results
Segment of consumers who value innovation and new technologies	This segment comprises 794 respondents who prefer new technologies and innovative product features. According to the results, 592 of these consumers actively respond to advertising campaigns that highlight the innovative aspects of products. 554 individuals expressed their intention to purchase such products.
Segment of consumers focused on economic benefits	This segment includes 386 respondents who are more interested in economic benefits such as promotions and discounts. According to the results, 340 of these consumers show a high interest in advertising campaigns offering discounts and special offers. 274 individuals indicated that they plan to take advantage of such offers.

Source: created by the author

These results enable marketers to create more precise and effective advertising campaigns by tailoring them to the specific needs and motivations of each consumer segment.

Recommendations for improving marketing campaigns. To enhance marketing campaigns, it is advisable to engage influencers to promote products and services, leveraging their audience to increase brand trust. Additionally, utilising social media for active consumer engagement, including the organisation of contests and promotions, can foster audience involvement. Developing content marketing strategies that generate useful and engaging content tailored to the interests of the target audience will attract and retain customers. Integrating positive reviews into campaigns is essential, as they enhance trust in the product and increase consumers' willingness to purchase. Promotional offers should be optimised by providing discounts, coupons, and free delivery as key incentives for purchases. Investing in creative and modern product design can elicit strong positive emotions, thereby fostering a greater readiness to buy. Furthermore, analysing competitors by researching their marketing strategies and campaigns will help identify weaknesses and opportunities for improving one's own approach. Implementing loyalty programmes to encourage repeat purchases by offering special deals, bonuses, and privileges to loyal customers can enhance their brand allegiance. Additionally, it is essential to develop effective strategies for promoting new products to generate consumer interest. Analysing the effectiveness of various advertising formats, such as videos, text ads, and banners, will help determine which have the most significant impact on consumer behaviour.

Personalising offers by utilising consumer data to create recommendations tailored to individual needs and interests is also vital. Ensuring a seamless shopping experience by optimising processes both online and in-store can reduce barriers to purchase and enhance convenience for consumers. The adoption of modern technologies, such as artificial intelligence and machine learning, can facilitate the analysis of consumer behaviour and the optimisation of marketing strategies. Regular evaluation of campaign effectiveness, including analysing results and making adjustments based on collected data, is crucial for ongoing improvement. The implementation of these recommended strategies will enhance the effectiveness of marketing campaigns and promote positive changes in consumer behaviour.

DISCUSSION

The findings of this research highlight the importance of considering psychological factors when developing marketing strategies. By identifying distinct consumer segments and their specific motivations, this study enables the creation of targeted campaigns that more effectively influence consumer behaviour. Understanding how various factors, such as product design, advertising strategies, positive reviews, and promotional offers, impact purchasing decisions allows companies to optimise their marketing efforts, enhance customer satisfaction, and increase sales (Oleksy-Gębczyk *et al.*, 2024). Personalised advertisements have been shown to elicit positive responses as they are tailored to individual consumer interests and behaviours, making them more effective in capturing audience attention. This aligns with the findings of a study

by J.L. Hayes *et al.* (2021), which also highlighted the high effectiveness of personalised advertising campaigns. Both studies confirm that tailoring advertising to individual preferences makes it more appealing and effective compared to generic advertising.

Consumers are infrequently swayed by seasonal advertising campaigns. This finding aligns with the research of M. Sutherland (2020), who indicated that a substantial proportion of consumers (40%) occasionally alter their preferences due to seasonal advertising. This suggests that seasonal campaigns have a moderate impact and often serve as an additional incentive for preference shifts, but do not always directly influence purchase decisions. Stores located on the ground floor of shopping centres experience significantly higher foot traffic compared to those on upper floors. J. Singh *et al.* (2020) also found in their research that store locations near the entrance significantly increase foot traffic, as consumers tend to enter the first stores they encounter. Both studies confirm that easy access and visibility are crucial for attracting customers in shopping centres, as this maximises customer flow.

New products attract consumer attention through tastings and promotional activities. This finding is somewhat at odds with the research of J. Li *et al.* (2023), suggested that advertising displays have the greatest impact on purchasing decisions. However, this current study confirms that while advertising displays do have some effect, tastings and promotional activities are the most effective. This is likely because consumers often seek opportunities to directly try a product or receive advantageous offers, which increases their motivation to purchase new items. During the purchasing process, consumers may experience satisfaction, disappointment, doubt, or peace, which is largely influenced by marketing factors such as promotions and displays. S. Khatoon & V. Rehman (2021) also found in their research that consumers exhibit various emotional responses during purchases depending on marketing elements. Both studies confirm that the effectiveness of promotions and visual merchandising can significantly influence product perception.

Consumers consistently prioritise product quality when making purchasing decisions (Shahini *et al.*, 2023). This finding aligns with the research of J. Huang *et al*. (2023), also established that consumers favour product quality over other factors such as brand or accessibility. Both studies demonstrate that high quality is a critical factor in the consumer decision-making process. This identified trend confirms that consumers value durability and functionality as primary criteria. However, this study highlights that while quality is a significant factor, it is not the sole determinant; price and reviews also exert considerable influence, a nuance not as prominently featured in the research of J. Huang *et al*. (2023). This indicates that a more comprehensive approach to evaluating products may be more effective in determining consumer preferences.

Most consumers typically prefer familiar brands but express a certain interest in new products and are willing to try them (Poltorak *et al.*, 2023). Similar results were obtained in the study by K. Thomas-Francois *et al.* (2023), which found that consumers generally favour brands with which they already have experience, yet are open to new products if they offer significant advantages or innovative features. This confirms that while consumers tend to gravitate towards established brands, they are not averse to new offerings that meet their needs or expectations. Both studies illustrate that consumers exhibit a degree of conservatism in their choices but also demonstrate curiosity towards innovations. This aspect is crucial to consider when developing marketing strategies for new products. Consumers spend more time at discount displays compared to those without discounts, with the greatest activity observed among middle-aged consumers. This finding contradicts the research conducted by R. Lavuri & P. Thaichon (2023), which noted that younger consumers spend more time at discount displays compared to other age groups. This discrepancy may be attributed to differences in financial capacity or personal preferences across various age groups, which influence their responses to marketing promotions (Ievseitseva & Mihalatii, 2024).

Visual merchandising and promotions play a crucial role in influencing consumer decisions, particularly for respondents aged 30 to 44, who show the strongest responses to promotions. This aligns with the research conducted by S. Bin (2023), which also highlights the significant impact of promotions on consumer decisions, emphasising that middle-aged consumers exhibit heightened sensitivity to discounts and offers. In both studies, promotions and merchandising are identified as critical factors in driving purchases. This may be attributed to the perception of benefits and savings that promotions provide, which is particularly appealing to middle-aged consumers who possess more stable financial circumstances and are seeking optimal spending options. Video advertising emerges as the most effective and persuasive format for the majority of respondents, while other types, such as social media and banner advertisements, demonstrate lower levels of effectiveness (Lewinski *et al.*, 2016). This finding corroborates the results of the study by I. Idris *et al*. (2020), which also emphasised the effectiveness of video advertising in capturing consumer attention. In both studies, video advertising is perceived as the most effective format, which can be explained by its ability to convey more information and emotions through audiovisual elements, thereby enhancing its impact on consumers. This capability allows brands to engage better with their audience and leave a more lasting impression, often resulting in higher conversion rates compared to other forms of advertising.

High prices and low quality are the most significant reasons for consumers to decline a purchase. In their research, F. Skwara (2023) also concluded that price and quality are key factors in the consumer decision-making process. Both studies found that consumers are inclined to reject products if their price seems excessive or if the quality falls short of expectations. This underscores the importance of price and quality as fundamental factors in shaping consumer decisions. A high price may be perceived as unjustified compared to the benefits offered by the product, while low quality can negatively impact the overall perception of a product, even if other marketing elements are appealing (Oklander *et al.*, 2024).

Products placed at eye level attract the most consumer attention. This aligns with the findings of G. Cordova *et al*. (2020), which also revealed that products positioned at

eye level have an advantage due to their easy visibility and accessibility. Such a product placement strategy ensures an optimal balance between physical accessibility and psychological impact (Myroshnyk, 2023). Both studies demonstrate that positioning products at eye level is a critical factor that enhances consumer attention and can significantly influence their choices, thereby boosting sales. Positive reviews have a significant impact on purchasing decisions, especially among younger age groups. Similar results were obtained in the study by M.V. Zwicker *et al.* (2023), where it was found that positive reviews build trust in the product and reduce consumer uncertainty, thus increasing the likelihood of purchase. Both studies confirm that positive reviews help alleviate consumer anxiety and increase confidence in product choices.

The research identified two primary consumer segments: one that values innovation and cutting-edge technology, and another that prioritises economic benefits such as promotions and discounts. This finding contradicts the study by A. Braca & P. Dondio (2023), which focused on consumers driven by social impact and environmental aspects of products. A. Braca & P. Dondio discovered that most consumers expressed interest in products that met environmental standards and social trends, while innovative features were less significant in their purchasing decisions. This discrepancy could be attributed to differences in geographical and cultural contexts of the studies or to the possibility that innovation may be less important for consumers in certain markets compared to social and environmental responsibility.

Consumers exhibit varying levels of attention to advertising campaigns that highlight a brand's social responsibility, with a third consistently paying attention, while a significant portion responds less actively. This finding does not align with the research of J.A. Clithero *et al*. (2024), which indicated that a majority of consumers (approximately 61%) actively pay attention to a brand's social responsibility and consider it an important factor in their purchasing decisions. The discrepancy may be attributed to differences in cultural and social contexts influencing the perception of social responsibility in various regions. Younger and middle-aged individuals have greater trust in advertising compared to older generations. This outcome is consistent with the research of V. Nesterenko (2023), which revealed that younger generations, particularly Gen Z and Millennials, are significantly more susceptible to advertising through digital media and social networks compared to older generations, who prefer traditional communication channels and often exhibit scepticism towards contemporary marketing strategies. Such a difference in perception can be explained by the greater integration of young people into the digital space, where advertising is an integral part of their daily lives, and their inclination to quickly adopt new technologies and trends.

The factors influencing consumer decisions are multifaceted and dependent on various aspects such as the type of advertising, product placement within stores, and personal emotional states of consumers. It has been found that positive reviews significantly influence the likelihood of purchase, and product placement at eye level attracts more attention. Additionally, promotions and discounts are confirmed as key factors that stimulate purchases. Segmenting consumers based on their interests, such as innovation or economic benefits, aids in creating more effective advertising campaigns.

CONCLUSIONS

To understand the impact of psychological factors on consumer preferences and the effectiveness of marketing campaigns, a comprehensive analysis was conducted, examining the influence of emotional states, brand social responsibility, types of advertising, and other marketing elements on the purchasing process. The study identified several key aspects regarding the influence of psychological factors on consumer behaviour and the effectiveness of marketing campaigns. It was established that positive reviews significantly increase the likelihood of purchase; among respondents aged 18-24, 42 individuals who viewed products with positive reviews decided to purchase, whereas only 22 individuals who viewed negative reviews made a purchase. Similar trends were observed among other age groups. It was also confirmed that 794 respondents who value innovation and cutting-edge technology actively respond to advertising campaigns that emphasise these aspects. Within this group, 592 individuals demonstrated a high interest in innovative products, and 554 intended to purchase them. This highlights the importance of focusing on innovation in marketing campaigns for this consumer segment. Furthermore, 386 respondents who prioritise economic benefits actively respond to advertising campaigns offering discounts and promotions. Among them, 340 individuals expressed a strong interest in such offers, and 274 individuals plan to take advantage of them. This indicates the importance of incorporating economic incentives into marketing strategies for this segment.

The study revealed varying levels of attention to brand social responsibility: 33.6% of respondents always pay attention to such campaigns, 44.7% do so sometimes, 14.4% rarely, and 7.3% never consider brand social responsibility. This indicates that brand social responsibility is not universally important for all consumers. Official brand websites are the most trusted source of information for 41.8% of respondents. Meanwhile, 27.5% trust reviews on independent sites, 15.4% rely on recommendations from friends and family, 11.1% look to social media, and 4% trust traditional media. This highlights the difference in perceptions of information credibility based on the source. The findings confirm that psychological factors, such as the perception of positive reviews and innovation, as well as brand social responsibility, significantly influence consumer preferences and the effectiveness of marketing campaigns. The numerical data underscore the need to adjust marketing strategies according to individual consumer needs and motivations to enhance their effectiveness. The discussion emphasised the importance of considering these factors when developing marketing strategies to improve the efficacy of advertising campaigns.

The limitations of the study include potential biases among respondents in self-assessing the influence of psychological factors and restricted access to detailed data regarding marketing campaigns and their effectiveness in various market conditions. Key directions for future research in the field of consumer psychology and marketing

campaign effectiveness include examining the impact of different psychological triggers on long-term consumer loyalty, analysing the effectiveness of personalised marketing strategies, and investigating the influence of cultural and social factors on consumer preferences.

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CONFLICT OF INTEREST

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Психологія споживання та ефективність маркетингових кампаній: Вплив психологічних факторів на споживчі вподобання та купівлю

Анотація. У статті розглянуто взаємозв'язок між психологічними аспектами й поведінкою споживачів у контексті маркетингових кампаній України. Під час дослідження було проведено спостереження за поведінкою споживачів, анкетування для збору кількісних даних про вподобання та експерименти для оцінки впливу маркетингових стратегій на споживчу поведінку. У процесі дослідження було встановлено, що споживачі звертають увагу на продукти з привабливим дизайном, який викликає у них позитивні емоції, такі як радість і задоволення, а також асоціюється з приємними спогадами або відчуттям комфорту. Продукція, яка має соціальне схвалення (позитивні відгуки, рекомендації) сприймається краще, ніж із нейтральними або негативними відгуками, адже вона значно підвищує інтерес та довіру в покупців. Відповідність ціни та якості товару, його екологічність також є важливими факторами, які впливають на здійснення покупки. Найбільш ефективно реклама сприймається через відео. Завдяки аудіовізуальним елементам відео-реклама краще взаємодіє з аудиторією та залишає після перегляду більш стійке враження, ніж розсилки та банери. Акції, знижки та дегустації є ефективними маркетинговими тактиками. Вони націлені на досягнення короткострокового збільшення обсягу продажів, а також сприяють підвищенню рівня задоволеності споживачів. У процесі дослідження було виявлено психологічні сегменти споживачів: які цінують інновації та новітні технології, і ті, які орієнтуються на економічні вигоди. Отримані результати підкреслили, що врахування психологічних аспектів є критично важливим для розробки ефективних маркетингових стратегій і збільшення споживчої зацікавленості, та можуть бути використані маркетологами практично під час планування рекламної кампанії або визначення цільової аудиторії товару

Ключові слова: привабливий дизайн; соціальне підтвердження; відео-реклама; акції; знижки

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The impact of artificial intelligence on marketing communications: New business opportunities and challenges

Abstract. The purpose of this study was to analyse the impact of the integration of artificial intelligence (AI) technologies on modern approaches to marketing communications, with an emphasis on identifying new opportunities for optimising business processes. A wide range of technologies have been explored to automate, optimise, and personalise marketing processes, enabling companies to interact more effectively with customers and improve the results of their marketing campaigns. Technologies such as machine learning and natural language processing have been examined, which contribute to the analysis of large amounts of data, the formation of forecasts and recommendations, and the automation

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of content creation and advertising campaign management. In particular, AI allows personalising communication with customers, which increases the effectiveness of marketing campaigns and ensures maximum efficiency of advertising costs. The study provides examples of successful implementation of AI in the marketing strategies of companies such as Netflix, Amazon, Sephora, Coca-Cola, and Google Ads, which allowed them to substantially increase the level of customer loyalty, reduce the cost of storing goods and optimise advertising budgets. The main limitations and risks of using AI are analysed, such as the high cost of implementation, the possibility of algorithm bias, and data privacy issues. Rozetka has developed an AI marketing strategy that includes analysis of current processes, selection of tools and technologies, integration of AI into content personalisation and advertising campaign management, automation of advertising budget management, demand forecasting, and inventory management. Expected economic effects include increased conversions, reduced advertising costs, an increase in the average receipt, and increased company profitability. Thus, AI becomes a key tool for transforming marketing strategies, providing companies with competitive advantages and the ability to quickly respond to changes in consumer behaviour and market conditions

Keywords: automation; personalisation; forecasting; technological change; customer loyalty; marketing communications

INTRODUCTION

The rapid development of artificial intelligence (AI) technologies has dramatically changed many aspects of business, in particular, marketing communications. These changes are not only revolutionary but also inevitable, forcing companies to adapt to new market realities. AI offers tools that substantially improve the effectiveness of marketing campaigns by automating processes that previously required substantial resources. Therewith, the use of AI in marketing communications raises a number of challenges, such as ethics, data privacy, and dependence on new technologies, which makes research on this topic particularly relevant. The relevance of the subject is due to the growing competition in the field of marketing, where each company strives to stand out and attract a large audience. The use of AI in marketing communications can substantially improve the accuracy of targeted marketing by offering consumers personalised offers based on big data analysis. However, despite the substantial advantages, many companies face difficulties in integrating AI into their strategies. Thus, exploring new opportunities and challenges associated with the use of AI in marketing communications is essential to ensure business competitiveness. The problem of using AI in marketing communications includes several critical aspects. The issue of adapting businesses to new technologies requires substantial investment in personnel training and updating the technical infrastructure. It is important to consider the ethical aspects of the use of AI, in particular, in matters of data privacy, when personalised marketing campaigns can turn into a violation of consumer privacy. Companies face challenges in measuring the effectiveness of AI use, as traditional evaluation methods may not fully reflect the impact of new technologies.

General information about the use of AI in marketing communications covers several key areas. In particular, AI allows to automate data analysis processes, which provides a deeper understanding of consumer needs and behaviour. AI is also used to create and optimise content, which can substantially improve the effectiveness of campaigns in social networks and other digital platforms (Bilovodska *et al.*, 2024). In addition, AI helps improve customer service through chatbots and other automated communication systems. In marketing communications, there is a key problem – how to effectively use AI to optimise processes and improve the effectiveness of campaigns (Oklander *et al.*, 2024). This problem has already attracted the attention of many researchers, each of whom has examined different aspects of the impact of AI on marketing. A. Haleem *et al*. (2022), for example, emphasised that the use of AI algorithms can substantially improve the accuracy of ad campaign targeting by analysing large amounts of data and identifying consumer behavioural patterns. S.L. Wamba-Taguimdje *et al*. (2020) focused on how integrating AI into the content creation process helps generate relevant content faster and test it against different target audiences, which increases communication efficiency. K. Shakhovska *et al*. (2020), in turn, investigated the use of AI in analysing consumer sentiment through social networks, pointing to the ability to better understand customer needs and adapt strategies to these expectations. A study by P. Van Esch & J. Stewart Black (2021) focused on automating marketing processes, such as using chatbots and automated data processing systems, which can substantially improve customer interaction. R. Srinivasan & G. Sarial-Abi (2021) highlighted the possible negative consequences of imperfect machine learning models, which can lead to discriminatory strategies and damage the company's reputation.

G. Overgoor *et al*. (2019) drew attention to new opportunities for conducting A/B testing (split testing to identify the most effective version of the page and increase the conversion rate) in real time, which is made possible by AI, allowing for a quick adaptation of the marketing campaigns to market requirements. V.V. Vorobiova *et al*. (2023) investigated the impact of AI on improving the effectiveness of loyalty programmes, emphasising that algorithms can predict consumer behaviour and provide personalised offers, which increases customer retention. A. Maedche *et al*. (2019), in turn, reviewed the use of AI to create virtual agents that can interact with consumers at different stages of their purchases. M. Stone *et al*. (2020) examined how AI helps optimise the distribution of advertising budgets across different communication channels. A.F. Borges *et al*. (2021) emphasised that AI allows companies to automatically collect and analyse data about competitors, providing the ability to respond faster to market changes and adjust their strategies accordingly.

The analysis of the papers of these authors highlights both the substantial potential of AI in the transformation of marketing communications and the challenges that companies face when implementing these technologies. Despite the substantial contribution of researchers to the

examination of the impact of AI on marketing communications, there are still several aspects that require more in-depth analysis. There is a limited amount of research analysing how small and medium-sized enterprises implement AI in their marketing strategies, given the limited resources and technical infrastructure. Insufficient research was focused on the impact of personalised marketing communications on long-term customer loyalty. It is particularly relevant to consider the possible negative consequences of automating interaction with consumers. The purpose of this study was to identify and analyse various aspects of the impact of AI on marketing communications in the digital economy. The objectives of the study were to assess the impact of AI integration in marketing on long-term customer loyalty and identify the risks of algorithm bias in marketing communications and develop ways to minimise them.

MATERIALS AND METHODS

A comprehensive methodological approach was used to examine the impact of AI on the transformation of modern marketing communications, which combines the analysis of practical cases and the development of strategic recommendations based on the data obtained. Modern AI technologies such as machine learning, natural language processing, and computer vision were analysed, as well as their applications in various aspects of marketing, including automation, optimisation, and process personalisation. This process allowed identifying the main directions of AI application in marketing and formulating the following critical hypotheses: AI improves the personalisation of marketing messages, increases the effectiveness of interaction with consumers through process automation, allows predicting user behaviour based on data analysis, optimises advertising budgets through more accurate targeting, promotes content creation based on natural language analysis, and increases the overall effectiveness of marketing campaigns through real-time data analysis.

For practical analysis, examples of successful implementation of AI in the marketing strategies of leading international companies were selected, such as Netflix, Amazon, Sephora, Coca-Cola, and Google Ads. Each example was reviewed in detail to identify specific approaches to AI integration and assess the economic effects achieved, such as increasing conversions and customer loyalty, and optimising advertising budgets. Comparing the results of AI implementation in different companies identified trends and effective practices. In particular, it was investigated how AI affects content personalisation, ad campaign management, demand forecasting, and customer service automation. Several key indicators were considered to evaluate the effectiveness of AI implementation, such as increased conversions, increased customer loyalty, reduced advertising costs, improved inventory management, and delivery times.

Based on theoretical analysis and the reviews of practical cases, a strategy for integrating AI into Rozetka's marketing processes was developed. The strategy includes several stages: analysis and planning, selection of tools and technologies, integration of AI into content personalisation and advertising campaign management, automation of advertising budget management, demand forecasting, inventory management, and performance monitoring. Each stage is accompanied by specific measures and expected economic effects that ensure a systematic approach to implementing AI and maximising its potential. Key performance indicators, such as conversion rate, return on investment, customer loyalty, and average receipt, were identified to evaluate the effectiveness of implementing AI in Rozetka's marketing processes.

In the process of developing an AI integration strategy, specific tools and platforms were selected that best meet the needs of Rozetka. Among them are Google Cloud AI for data analysis and creating personalised recommendations, Market Brew for optimising search rankings and predicting the impact of changes in search engine positions, and Emarsys for automating and personalising marketing campaigns. The choice of these tools was based on their effectiveness, scalability, and ability to integrate into the company's existing marketing processes. The examination of AI integration considered the ethical and social aspects of technology use.

RESULTS

AI is rapidly gaining a key role in changing modern approaches to marketing communications. The term covers a wide range of technologies that enable machines to perform tasks that previously required human involvement. In marketing, AI helps automate, improve efficiency, and personalise various processes, allowing companies to communicate more effectively with consumers and improve the effectiveness of their campaigns. These technologies include machine learning, natural language processing, computer imaging, etc. Through machine learning, AI can analyse large amounts of information, identify specific patterns, and provide predictions or recommendations. Natural language processing allows systems to understand text or speech like humans, which is particularly useful in the context of automated customer service or content generation (Chintalapati & Pandey, 2022).

In marketing, AI acts as a powerful tool to help brands reach their audiences more accurately. For example, using AI algorithms, user behaviour can be tracked in real time, their preferences can be analysed, and personalised recommendations or advertising messages can be provided, which substantially increases audience engagement. This increases the likelihood that the consumer will respond to the marketing message, as it will meet their expectations and needs. In addition, AI allows automating many routine marketing processes. This includes automatic content creation, managing advertising campaigns, processing customer requests using chatbots, and much more (Vlačić *et al.*, 2021; Butenko *et al.*, 2023). Such technologies not only save time and resources but also increase the overall effectiveness of marketing efforts, allowing specialists to focus on strategic tasks.

However, the essence of AI in marketing communications goes far beyond simple automation. An important aspect is the AI's ability to learn and adapt based on new data. This means that marketing campaigns can be not only accurate but also dynamic, constantly adapting to changes in consumer behaviour and market conditions. This gives the business a substantial competitive advantage, allowing it to quickly respond to changes and take advantage of new opportunities. Therewith, the use of AI in marketing communications raises a number of ethical and social issues.

For example, there is a risk that algorithms may be biased or use data in a way that violates consumer privacy. These aspects require careful analysis and consideration when developing and implementing AI-based strategies.

AI has become an important tool for transforming marketing strategies in business environment (Trusova *et al.*, 2022). Its capabilities allow companies to interact more effectively with customers, optimise resource usage, and improve the results of marketing campaigns. An important advantage of AI is its ability to analyse huge amounts of data and adapt to changes, making it an indispensable tool in modern marketing strategies (Eriksson *et al.*, 2020). Figure 1 shows in which areas AI is most used or tested for marketing automation.

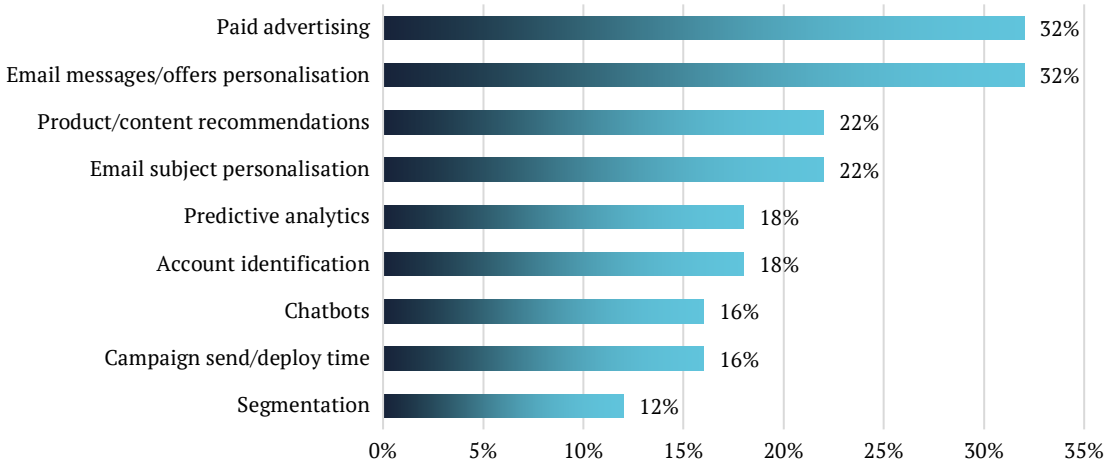

Figure 1. Areas where AI is tested or used for marketing automation
Source: compiled by the authors based on The state of marketing automation (2022)

The figure shows that the largest share of AI use in marketing communications is accounted for by the personalisation of electronic messages and offers and paid advertising. Personalisation of electronic messages can substantially increase the effectiveness of marketing campaigns, as individually adapted offers better meet the interests of users, which encourages increased sales and customer loyalty. Paid advertising optimised with AI ensures maximum efficiency of advertising costs, which allows companies to get high results at a lower cost. Next in value are product or content recommendations and personalisation of the email subject. Recommendation systems using AI allow users to offer products or services that best suit their interests, which increases the likelihood of purchases. Personalising the subject of an email also substantially improves email opening rates, as adapted headers make emails more attractive to recipients.

AI-based predictive analytics provides companies with important insights to make decisions by predicting customer behaviour and market trends, which helps them better plan their marketing strategies. Account identification provides increased security and accuracy in personalising services, but this is not yet widely used in marketing. Chatbots are used to automate customer service, enabling the provision of information and resolving issues in real time, reducing customer support costs. Segmentation, while important for accurate campaign targeting, is currently used on a smaller scale, which may be due to the complexity and need for specialised knowledge to implement it.

One of the main areas of use of AI in marketing is the personalisation of content and communications. AI allows analysing data about consumer behaviour, preferences, purchase history, demographics, and other parameters to create individually tailored offers (Hermann, 2022a). For example, the Netflix platform uses AI to analyse user views and provide personalised recommendations for movies and TV shows, which increases the probability of renewing a subscription by 75% and increases customer loyalty (Annual reports & proxies, n.d.). This personalisation not only improves the customer experience but also increases companies' revenue by about 20%, as customers are more likely to shop when they receive offers that match their interests.

Another important area of AI application is demanding forecasting and inventory management. AI helps businesses predict demand for goods and services, allowing them to manage inventory more efficiently and reduce costs. For example, Amazon uses machine learning algorithms to analyse historical sales data and determine future trends (Annual reports..., n.d.). This helps the company reduce the delivery time of goods by 40% and the level of product shortages – by 30%. Due to such technologies, companies can reduce the cost of storing goods by 15% and ensure timely delivery of products to consumers, which contributes to increasing customer satisfaction.

AI is also actively used to automate customer service. AI-based chatbots and virtual assistants are able to respond to customer requests, provide information or solve problems without human intervention. For example, Sephora's chatbots help customers find the right cosmetics by giving recommendations based on an analysis of previous purchases and preferences (DE&I annual report, 2024). Due to the use of chatbots, the level of customer satisfaction increased by 50%, and the response time to requests was reduced by 70%. AI also plays an important role in analysing social media sentiment (Carles & Vila, 2024). With natural language processing, AI algorithms can analyse the tone of comments, reviews, and other text data to determine the overall attitude to a brand or product. For

example, Coca-Cola uses AI-based social media analytics to monitor responses to ad campaigns and adjust strategies in a timely manner (Annual reports, n.d.). This approach allows companies to be more sensitive to changes in public opinion and quickly adapt to new conditions.

Another area of AI application is the smart management of advertising campaigns. AI is able to automate ad campaign management processes, optimising budget allocation and audience selection. AI-based systems can analyse the effectiveness of ads concurrently, determine the best platforms for placing them, and set up targeting to achieve maximum return on investment. Google Ads, for example, uses machine learning algorithms to automatically optimise bids and select keywords, which helps advertisers achieve better results at a lower price. This allows companies to maximise the return on their marketing costs while minimising the risk of overspending. Table 1 shows examples of the use of AI in marketing strategies.

Table 1. Examples of the use of AI in marketing strategies by different companies and their effects

Company	Use case	Effect
Netflix	Personalisation of movie and TV series recommendations based on view analysis	Increasing the probability of subscription renewal by 75%, customer loyalty – by 60%, revenue – by 20%
Amazon	Demand forecasting and inventory management optimisation using machine learning	Reduction of delivery time by 40%, product shortages – by 30%, and storage costs – by 15%
Sephora	Using chatbots to automate customer service	Increased customer satisfaction by 50%, reduced response time to inquiries by 70%
Coca-Cola	Social media sentiment analysis using natural language processing to monitor responses to advertising campaigns	Increasing the effectiveness of advertising campaigns by 35%, the positive perception of the brand – by 20%
Google Ads	Automatic optimisation of bids and selection of keywords for advertising campaigns	Return on investment increase by 50%, cost price reduction by 30%

Source: compiled by the authors

AI plays a vital role in transforming approaches to managing advertising budgets, offering new opportunities to optimise costs and improve the effectiveness of advertising campaigns. By utilising the power of machine learning algorithms and the processing of large volumes of data, companies can perform accurate and operational market analysis, which allows for more informed decisions about the allocation of resources. One of the key ways AI is impacting the management of advertising budgets is through its ability to analyse vast amounts of data in real time. Modern AI-based tools can instantly evaluate the effectiveness of advertising campaigns, determining which channels and strategies bring the highest return on investment (Peyravi *et al.*, 2020). In addition, AI allows for more precise and personalised targeting. Instead of spending money on ads that are shown to a wide audience with low conversion rates, AI helps identify specific groups of consumers who are most likely to make a purchase. AI also plays an important role in ad spend forecasting. By analysing historical data and considering external factors such as seasonality, the economic situation or changes in consumer behaviour, AI can predict future advertising campaign costs with high accuracy.

Despite the substantial benefits of using AI in marketing, there are certain limitations that should be considered. One of the key limitations is the high cost of implementing AI technologies. Integrating AI into marketing processes requires substantial investment in technology and skilled personnel. For a small business, this can be an overwhelming task, limiting the availability of these technologies to a wide range of companies. The high cost of implementation can also hold back the development of companies that already use AI but need to expand its capabilities (Shaw *et al.*, 2019). In addition, there is a risk of AI algorithms being biased. Algorithms can be biased if they were trained on incorrect or incomplete data. This may lead to discrimination or false conclusions. For example, ad campaigns using AI for targeting can exclude certain groups of consumers if the algorithm deems them less profitable. Such bias can have negative consequences for the brand if customers perceive that they are being discriminated against.

Data privacy is also an important issue. The use of AI to analyse personal data raises questions about privacy and data protection. Failure to comply with relevant regulations may result in loss of customer confidence and legal sanctions. In the context of growing attention to the protection of personal data, companies need to carefully monitor the use of AI and comply with all necessary standards and regulations (Murdoch, 2021). Data dependency is another limitation of using AI in marketing. The effectiveness of AI systems directly depends on the quality and quantity of data they use. Insufficient or poor-quality data can lead to wrong decisions and ineffective marketing strategies. Therefore, companies need to ensure access to quality data and constantly update it so that AI systems can work as efficiently as possible.

Small businesses with limited resources often face the challenge of limited budgets for marketing campaigns (Lewinski *et al.*, 2016). In such conditions, choosing the right tools becomes vital to expanding advertising opportunities. Due to the development of AI, even small businesses can gain access to powerful tools that were previously only available to large corporations. For example, using Google Cloud AI allows such companies to quickly integrate AI into their marketing strategies. This service provides convenient and secure access to a pre-trained AI model and the ability to customise model to work with images, speech, dialogues, and structured data. With this tool, even inexperienced marketers can easily get started with AI, using it to automate processes, analyse data, and improve customer interactions. For small businesses, this is extremely important because they can save time and resources while receiving high efficiency from the use of advanced technologies.

Large companies looking to gain a competitive edge are turning to search engine optimisation-based AI tools to optimise their digital strategies. One such tool, Market Brew, helps search engine optimisation teams better understand how the search engine landscape is changing. This tool allows not only to analyse the current positions in the search results but also to predict changes that may occur in the future. Using new forecasting services, Market Brew provides for testing website changes in a conditional model, allowing for the understanding of how these changes will affect real-world ranking results. This is especially important for large companies that strive to always stay one step ahead of their competitors. They can predict in advance the impact of their actions on search results and thus adjust their strategies according to the expected changes.

Another important tool used by both large companies and small businesses is Emarsys. This platform provides a single omnichannel solution that allows for large-scale personalisation of marketing campaigns. Emarsys helps brands not only improve the efficiency of their interaction with customers but also substantially increase sales due to an individual approach to each customer. Using data from various channels, the platform creates targeted campaigns that meet the needs and expectations of specific customers. This increases the level of customer satisfaction and increases brand loyalty, which, in turn, leads to an increase in company revenues.

The use of AI in marketing communications raises a number of ethical and social issues that are becoming increasingly relevant. While AI provides marketers with powerful tools to improve the effectiveness and accuracy of ad campaigns, its adoption also raises concerns about privacy, transparency, equality of access, and societal impact (Kurmanov, 2023). Many consumers may feel uneasy about their personal data being used without their consent or even their knowledge. This raises the question of the ethical responsibility of companies regarding the collection, storage, and use of personal data, as well as the need to ensure transparency in this process (Hermann, 2022b). Another important ethical aspect is the possibility of discrimination and bias in AI algorithms. If algorithms were trained on data containing discriminatory patterns, they may reproduce or even reinforce these biases in their work.

The social aspects of the use of AI also include the availability of technology and its impact on jobs. The use of AI in marketing may require highly skilled professionals, creating barriers for smaller companies or developing countries where access to such resources is limited. This can lead to increased digital inequality between different regions and economies (Mikalef *et al.*, 2022). In addition, the automation of marketing processes through AI could lead to job cuts in traditional marketing sectors, raising concerns about the social consequences for workers who may lose their jobs due to technological change.

Another important social aspect is the impact of AI on consumer behaviour. AI algorithms are capable of analysing and predicting the wants and needs of consumers, which can influence their decisions and even manipulate choices. This raises questions about the ethics of such practices, as manipulative marketing can undermine consumer autonomy and lead to overconsumption, which in turn can have negative social and environmental consequences (Ehsan *et al.*, 2021). With the growing role of AI in marketing communications, it is important to develop ethical standards and regulations that will ensure the responsible use of technology. Companies must adhere to the principles of transparency, providing consumers with clear information about how their data is used and giving them the ability to control this process. In addition, it is important to ensure that AI algorithms are designed with the principles of equality and non-discrimination in mind and consider the social implications of implementing these technologies.

Integrating AI into marketing processes is critical for companies seeking to maintain a competitive advantage and improve the efficiency of their operations. A strategy was developed for the implementation of AI in the marketing of the Ukrainian company Rozetka (Table 2). For this company, one of the largest online retailers in Ukraine, the introduction of AI is a strategic step that will allow increasing the level of personalisation, optimising advertising budgets, improving inventory management, and ensuring a high level of customer service.

Table 2. Strategy for implementing AI in the marketing of the Rozetka company

Stage	Description	Expected economic effect
Analysis and planning	Detailed analysis of current marketing processes, identification of opportunities for AI integration	Optimisation of resources, reduction of AI implementation costs, improvement of planning efficiency
Selection of tools and technologies	Choice of tools such as Google Cloud AI, Market Brew, Emarsys for integration into marketing processes	Increasing forecasting accuracy, improving personalisation, reducing customer service costs
Integration of AI in marketing	Implementation of AI in the personalisation of content, management of advertising campaigns, and forecasting of demand	Increase conversion by 15-20%, customer loyalty, and the average check by 10-15% while reducing advertising costs by 20%
Automation of advertising management	Optimising the distribution of the advertising budget, adjusting bids based on the analysis of the effectiveness of ads	Maximising return on investment, reducing advertising costs, increasing conversion rates
Demand forecasting and inventory management	Use of AI to forecast demand for goods, optimisation of logistics processes	Reduction of delivery time, prevention of shortage or surplus of goods, reduction of storage costs, increase of customer satisfaction

Table 2. Continued

Stage	Description	Expected economic effect
Performance monitoring	Constant analysis of key performance indicators, making corrections in processes, scaling up successful initiatives	Increasing the efficiency of operations, cost efficiency, and revenues by 10-15% due to attracting new customers

Source: compiled by the authors

The first stage of the strategy is analysis and planning, which includes a detailed analysis of Rozetka's current marketing processes and the identification of opportunities for AI integration. It is important to determine which of the existing processes can be automated or improved with AI. In particular, attention should be paid to personalisation of content and communications, management of advertising campaigns, and demand forecasting. The next step is to select the appropriate AI tools and technologies that will be integrated into marketing processes. For example, Google Cloud AI can be used to analyse data and create personalised recommendations, Market Brew – to optimise search rankings and predict the impact of changes in search engine positions, and Emarsys – to automate and personalise marketing campaigns.

The integration of AI into marketing processes includes several key areas. To begin with, personalisation of content and communications is necessary. The company must configure AI algorithms to analyse data about user behaviour and provide personalised recommendations to do this. Such personalisation is expected to increase conversion by 15-20% and increase customer loyalty. For example, users who regularly purchase electronics will receive personalised offers for accessories or related products that match their previous purchases. This can increase the average order check by 10-15%. The next step is to automate the management of advertising campaigns, which will allow optimising the allocation of the advertising budget and increase the effectiveness of each ad. For example, AI algorithms can analyse the effectiveness of ad campaigns in real time and automatically adjust bids to ensure maximum return on investment, resulting in a reduction in ad spend of around 20% while maintaining or even increasing conversion rates. The next important area is demand forecasting and inventory management. Using AI to forecast demand will allow the company to better plan purchases and avoid shortages or overstocks. For example, based on the analysis of previous years and current trends, AI can predict increased demand for certain categories of goods during the holiday period, which will allow preparing in advance and avoiding losses due to a lack of goods.

After the integration of AI, the company must ensure constant monitoring of the effectiveness of the new processes. This includes regular analysis of key performance indicators such as conversion, return on investment, customer retention time, etc. For example, if the personalisation of the content does not produce the expected results, it is necessary to make adjustments to the algorithms or to expand the data set used for analysis. Depending on the monitoring results, the company can optimise processes and scale the use of AI to new areas. For example, if the automation of advertising campaigns is successful, the company can expand this approach to all advertising platforms, including social networks and email marketing. This can lead to a 10-15% increase in revenue by attracting new customers and improving cost efficiency. Integrating AI into Rozetka's marketing processes has substantial potential to improve operational efficiency and increase revenue. However, this process requires careful planning, selection of appropriate tools and constant monitoring of results. Given the scale of the company's operations and the amount of data it processes daily, the introduction of AI will allow Rozetka to remain competitive and meet the growing needs of customers for high-quality service.

DISCUSSION

The use of AI in marketing communications is becoming an increasingly important factor in the transformation of modern business strategies. The results show that AI not only facilitates the automation and optimisation of processes but also provides deep personalisation of communications, which increases the effectiveness of marketing campaigns and interactions with customers. One of the key aspects is the ability of AI to analyse huge amounts of data and make predictions based on the patterns determined (Prymostka & Kysil, 2023). This enables companies to quickly respond to changes in consumer behaviour and market conditions, which is a substantial competitive advantage. For example, personalised emails created with AI have substantially higher open and engagement rates, increasing the chances of conversion and building customer loyalty. C.G.M. Arce *et al*. (2024) investigated how AI affects the management of advertising budgets in small and medium-sized businesses. They came to the conclusion that the introduction of AI allowed substantially increasing the efficiency of the use of advertising resources. In addition, K. Abrokwah-Larbi & Y. Awuku-Larbi (2024) focused on how AI helps optimise staff costs by automating routine tasks and freeing up time for more strategic actions. They noted that by automating processes such as ad campaign management, data analysis and reporting, companies were able to reduce labour costs and increase team productivity. Compared to the results of this study, the authors' papers confirm an increase in efficiency, but the current data show a higher level of this efficiency (by 10-15%). This may be explained by the fact that the study used different AI algorithms or a different sample.

H.A. Lari *et al*. (2022) investigated the impact of AI on the effectiveness of advertising campaigns in the field of e-commerce. They established that the introduction of AI in advertising campaigns allowed a 30% increase in efficiency due to the personalisation of ads and the automation of the ad-buying process. Importantly, AI has substantially reduced customer acquisition costs and improved conversion rates. The results are consistent with current research on improving the effectiveness of advertising campaigns through the use of AI. However, the authors focused on e-commerce, whereas this study covers a wider

range of industries, including traditional businesses, and also includes implications for managing advertising budgets, which was not mentioned in this paper.

However, along with the advantages, the results indicate a number of challenges and limitations associated with the implementation of AI in marketing processes. The high cost of implementing AI technologies, the need for investments in technological infrastructure, and attracting qualified specialists can become barriers for small and medium-sized enterprises (Zelisko *et al.*, 2024). In addition, the risk of biasing algorithms that may be trained on incomplete or incorrect data raises ethical issues and may lead to discrimination against certain groups of consumers. N. Soni *et al.* (2019) investigated the impact of AI on the management of advertising budgets in small businesses. They concluded that the implementation of AI allowed for substantial improvements in targeting accuracy, but the impact on the overall budget remained minimal due to the limited resources of small businesses. The current study confirms that small businesses are indeed limited in their ability to widely adopt AI, but even partial use of AI can lead to some positive results, especially in the context of cost reduction.

K. Nair & R. Gupta (2021) focused on studying the impact of AI on the creative campaigns of large brands. Their investigation showed that the use of AI greatly simplifies and automates the process of creating promotional materials, which has led to a reduction in creative content costs. This study also confirmed the effectiveness of AI in the creation of advertising content, but it examined its role in personalising content to further reduce costs, which was not considered by the author. Ethical and social aspects of the use of AI are another important subject of discussion. Using consumers' personal data without their knowledge or consent can raise concerns among users, highlighting the need for transparency in data collection and use. In addition, the automation of marketing processes may lead to job cuts in traditional marketing sectors, creating social challenges for workers who may lose their jobs due to technological change (Makedon *et al.*, 2022). L. Ouchchy *et al.* (2020) in their study also emphasised the ethical aspects of using AI in advertising, highlighting the risks of discrimination and privacy violations. They noted that insufficient control over algorithms can lead to unequal distribution of budgets based on biased data. The current results also indicate possible ethical issues, but they focused more on the economic aspects of using AI, while the author focused on the ethical challenges. This indicates the need to combine these approaches in future research.

Dependence on data quality is also a substantial limitation in the use of AI. The effectiveness of AI systems directly depends on the quality and quantity of data they use. Cases of wrong decisions due to poor data quality can lead to ineffective marketing strategies (Savytska *et al.*, 2024). This highlights the importance of ensuring access to quality data and regularly updating it. A study by P. Boozary (2024) investigated the impact of data quality on the use of AI and the adaptation of advertising strategies. The author established that AI can substantially improve the effectiveness of advertising campaigns by adapting strategies according to changes in consumer behaviour, resulting in increased efficiency, but the quality of the data must be considered. T. Davenport *et al.* (2020) also emphasised the importance of integrating AI with other technologies to achieve maximum results, noting that the use of AI alone without such integration may limit the potential for efficiency gains. The authors' results are consistent with the findings of this study about the importance of using real-time to adapt advertising strategies.

Looking ahead, AI technologies continue to evolve, and over time many of the current limitations may be overcome. For example, implementing ethical standards and regulating the use of AI can reduce the risks associated with algorithmic bias and the protection of personal data (Gashi *et al.*, 2024). A decrease in the cost of technologies can also be expected, which will make them more accessible to a wider range of enterprises. M.A. Al Khaldy *et al.* (2023) analysed the impact of AI on return on investment in advertising campaigns. They determined that using AI can increase return on investment by 25-35%, especially in highly competitive industries. G. Shanmugam *et al.* (2023), in turn, noted that a substantial increase in efficiency is observed when AI is used to analyse and adjust campaigns in real time. In particular, the automation of processes based on data allows better adaptation of advertising strategies to changes in consumer behaviour, which leads to more efficient use of advertising budgets. The results of this study support the authors' conclusions regarding the increase in return on investment due to the implementation of AI. However, this effect can be even greater if AI is integrated with other marketing technologies, such as automated data analysis and behavioural analytics.

In general, the implementation of AI in marketing communications brings substantial benefits, such as increased efficiency, automation of processes, and personalisation of communications. However, there are also certain challenges that require a careful approach, including ethical issues, cost of implementation, and dependence on data quality. Companies need to consider these aspects and actively work to overcome them while ensuring ethical standards and increasing consumer trust to successfully use AI in marketing.

CONCLUSIONS

The study confirmed that AI is becoming an increasingly influential factor in the transformation of modern marketing communications. AI encompasses a wide range of technologies that enable machines to perform tasks that traditionally require human intelligence. In the context of marketing communications, AI provides the ability to automate, optimise and personalise many processes, allowing companies to interact more effectively with customers and improve the results of their advertising campaigns. In particular, machine learning allows AI-based systems to analyse large volumes of data and make predictions or recommendations based on detected patterns. Natural language processing allows machines to understand and interact with text or language the way humans do, which is especially valuable for automated customer service or content generation. These technologies create opportunities to automate routine marketing processes, such as content creation, management of advertising campaigns, processing of customer inquiries using chatbots, etc.

An important advantage of AI is its ability to self-learn and adapt based on new data. This allows marketing

campaigns to remain dynamic and respond in time to changes in consumer behaviour and market conditions, which provides companies with a substantial competitive advantage. The study also identified that AI is actively used to manage advertising budgets, which allows for more efficient allocation of resources and maximum return on investment. An important part of the research is also the consideration of the ethical and social issues of using AI. The use of AI can raise questions about data privacy, algorithm bias, and the impact on jobs. It is necessary to develop ethical standards and regulations that will ensure the responsible use of technologies and reduce possible negative consequences. It was determined that AI substantially optimises the planning, distribution, and analysis of the effectiveness of advertising campaigns. Examples of companies such as Netflix, Amazon, Sephora, Coca-Cola, and Google Ads have demonstrated the successful use of AI to improve the effectiveness of marketing strategies and personalise the user experience.

As part of the study, a strategy for introducing AI into the marketing processes of the Rozetka company was also developed. It involves the use of machine learning algorithms to analyse user behaviour and predict their needs. This strategy includes the integration of modern technologies to automate the management of advertising campaigns, which will allow the company to allocate advertising budgets more efficiently and increase return on investment. By implementing AI, Rozetka will be able to reduce advertising costs and increase targeting accuracy and customer satisfaction through personalised offers. Successful implementation of AI can provide substantial economic benefits and improve customer service, but requires careful planning, selection of appropriate tools and continuous monitoring of results. A limitation of the study is the insufficient number of companies examined and possible differences in market conditions that may affect the results of AI implementation. Further research could focus on analysing a wider range of companies and investigating the impact of AI on different marketing industries in different economic contexts.

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CONFLICT OF INTEREST

None.

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Вплив штучного інтелекту на маркетингові комунікації: нові можливості та виклики для бізнесу

Анотація. Метою цього дослідження було проаналізувати вплив інтеграції технологій штучного інтелекту (ШІ) на сучасні підходи до маркетингових комунікацій з акцентом на виявленні нових можливостей для оптимізації бізнес-процесів. Досліджено широкий спектр технологій для автоматизації, оптимізації та персоналізації маркетингових процесів, що дозволяє компаніям більш ефективно взаємодіяти з клієнтами та покращувати результати своїх маркетингових кампаній. Розглянуто такі технології, як машинне навчання та обробка природної мови, які сприяють аналізу великих обсягів даних, формуванню прогнозів та рекомендацій, автоматизації створення контенту та управління рекламними кампаніями. Зокрема, ШІ дозволяє персоналізувати комунікацію

з клієнтами, що підвищує результативність маркетингових кампаній та забезпечує максимальну ефективність рекламних витрат. У дослідженні наведено приклади успішного впровадження ШІ в маркетингові стратегії таких компаній, як Netflix, Amazon, Sephora, Coca-Cola, Google Ads, що дозволило їм суттєво підвищити рівень лояльності клієнтів, знизити витрати на зберігання товарів та оптимізувати рекламні бюджети. Проаналізовано основні обмеження та ризики використання штучного інтелекту, такі як висока вартість впровадження, можливість упередженості алгоритмів та питання конфіденційності даних. Rozetka розробила маркетингову стратегію ШІ, яка включає аналіз поточних процесів, вибір інструментів і технологій, інтеграцію ШІ в персоналізацію контенту та управління рекламними кампаніями, автоматизацію управління рекламним бюджетом, прогнозування попиту та управління запасами. Очікувані економічні ефекти включають підвищення конверсії, зниження витрат на рекламу, збільшення середнього чека та підвищення прибутковості компанії. Таким чином, ШІ стає ключовим інструментом трансформації маркетингових стратегій, надаючи компаніям конкурентні переваги та можливість швидко реагувати на зміни в поведінці споживачів і ринкової кон'юнктури

Ключові слова: автоматизація; персоналізація; прогнозування; технологічні зміни; лояльність клієнтів; маркетингові комунікації

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Mechanisms for ensuring energy security in the system of international relations considering economic sanctions and political conflicts

Abstract. In the context of globalisation and growing interdependence of economies, energy security has become a critical component of national security. Sanctions and changes in energy markets have forced countries to adapt their strategies to maintain energy independence and competitiveness. The aim was to investigate the mechanisms of ensuring energy security in the system of international relations, in particular, the role of economic sanctions as an instrument of influence on the energy policy of states. The adaptation strategies of countries under sanctions pressure in the energy sector were analysed. The study demonstrated how states diversify their energy supply, seek new markets and suppliers, and promote the development of renewable energy sources as alternatives to fossil fuels. Particular emphasis was placed on the European Union's experience in formulating an energy security policy in response to sanctions imposed on Russia,

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resulting in substantial alterations to energy infrastructure and supply methodologies. The implementation of this systems allows managing energy resources more efficiently, optimising energy supply and storage processes, and reducing costs. The results of the study showed that sanctions have affected global energy markets, changed energy flows, raised prices and created new challenges for countries that depend on energy imports. The study also revealed how countries affected by sanctions are looking for new ways to strengthen their energy positions through international cooperation and partnership. This analysis helped to better understand the mechanisms of countries' adaptation to the conditions of restrictions, and identify key factors that contributed to their success in the context of changing energy policies. The study aimed to formulate robust suggestions for states regarding effective measures to respond to sanctions pressure, thereby enhancing energy security and economic sustainability amid global problems

Keywords: diversification of energy supplies; renewable energy sources; energy policy; global energy markets; adaptation strategies; energy stability

INTRODUCTION

The global economy faces acute challenges in the field of energy security, which have significant economic consequences for the development of states. Political conflicts and economic sanctions imposed on the main energy supplier countries cause instability in the energy markets, which affects the economic stability and competitiveness of energy importing countries. Rising energy prices, limited access to key markets and the need to diversify supplies significantly change the economic strategies of states, forcing them to adapt to new conditions. The economic mechanisms of countries' adaptation to sanctions pressure and new challenges to energy security remain insufficiently studied. The scientific literature on mechanisms for ensuring energy security covers a variety of studies that explore both theoretical aspects and practical cases at the global level.

One of the key studies in this area is the paper by O.A. Shevchenko (2022), in which the author argued that without stable access to energy resources, it is impossible to ensure economic development and social stability in the country. The study by M. Li *et al*. (2024) established sanctions indices and employed the TVP-VAR-DY model to examine the effects of EU economic sanctions on Russia on oil prices and the market shares of third-country energy firms, specifically China and the United States. Energy sector sanctions are key drivers of volatility, with Chinese energy companies being more sensitive to these impacts, while U.S. ones are more sensitive to them; direct sanctions are better at explaining stock fluctuations, while indirect sanctions are better at explaining oil prices. Practical aspects of energy security are also discussed in detail by N. Ryabets & I. Tymkiv (2024), who focused on identifying and analytically assessing the impact of geopolitical changes, particularly the war in Ukraine, on global energy security and sustainability, highlighting destructive factors such as the monopolisation of critical resources. B.O. Pokhodenko (2023) analysed approaches to energy security in the EU and Ukraine, analysing aspects of energy independence, supply stability, energy efficiency and the use of renewable resources. Common features are identified, such as the importance of source diversification and improving energy efficiency, and differences in energy infrastructure, where the EU has an advantage.

Energy security research also focused on the global context (Kyshakevych *et al*., 2023). I. Shchurov (2022) noted that new global challenges and problems of energy security in Ukraine analyse the definition of economic security, offers the author's vision of energy security as a multi-factor category, reveals modern determinants of its development, substantiates the directions of integration of Ukraine's energy markets with the EU, examines the impact of climate change, and also emphasises the conflict over the implementation of various mechanisms for ensuring energy security. The studies by V.P. Konenko *et al*. (2022) and A. Lisovyi (2023) emphasised that international cooperation can contribute to the development of joint energy projects and optimise the use of resources. Furthermore, Yu. Kharazishvili *et al*. (2021) presented a model for evaluating energy security that incorporates the dynamics of technological, political, and economic issues on a global scale. It underscored a methodical approach to establishing strategic objectives in energy security, highlighting the necessity for a comprehensive evaluation and formalisation of energy security as a management entity. C. Drago & A. Gatto (2022) highlighted the importance of policies and regulations for sustainable energy development and access to renewable resources. The developed interval indicator evaluates the transparency and effectiveness of institutional mechanisms governing energy policy, comparing 110 countries, among which the United Kingdom, the United Arab Emirates, and the United States stand out in terms of high institutional characteristics.

I. Sotnyk *et al*. (2021) presented methodological frameworks for evaluating the influence of renewable energy advancement and energy efficiency on the energy security of emerging nations. It is recommended to enhance the current technique for evaluating energy security by incorporating new indices that would offer a thorough assessment of energy security in light of contemporary concerns, including the COVID-19 pandemic, which has impacted the Ukrainian energy industry. O. Sukhodolia (2019) examined a new model for describing energy security based on a systematic approach, with an emphasis on the importance of goal setting in the field of energy security as part of strategic planning in the national security system. Q. Wang *et al*. (2024) used bibliometric methods to analyse research dynamics, indicating an increase in publications, a focus on the energy transition, and identifying China as a leading country in research partnerships. I. Zharsovska & A. Bobko (2024) emphasised the need for digital technologies to improve energy systems, while acknowledging the associated risks, such as increased vulnerability to cyber threats, potential digital inequality among EU countries, and data privacy concerns that require a clear regulatory framework.

There is a need for a comprehensive analysis of the economic strategies that countries use to minimise the impact of sanctions: in particular, diversification of energy supplies, investment in renewable energy sources, search for new trading partners, and the introduction of energy-efficient technologies. The significance of this topic is determined by the reality that economic sanctions influence not only present macroeconomic statistics but also shape the long-term economic development prospects of nations reliant on oil imports. This study aimed to evaluate the economic mechanisms for ensuring energy security amid sanctions and to identify viable ways for countries' economic adaptation to changing energy market conditions. This will enhance the comprehension of the economic aspects that influence the sustainability of states in situations of restricted access to energy resources and will assist in formulating pragmatic recommendations for bolstering the economic resilience of nations amidst global difficulties.

MATERIALS AND METHODS

A sample of 200 respondents was established, which included representatives of government agencies (30%), energy industry experts (40%), and businessmen (30%). The respondents' ages varied from 25 to 65 years, with a balanced representation of both genders. The criteria for inclusion in the sample included experience in the energy sector or the field of policy, which allowed collecting information from individuals with a sufficient level of expertise to assess energy security issues. In the course of the study, a documentary analysis was conducted, during which a systematic review of scientific literature, reports of international organisations and government documents related to the topic of energy security was carried out. O.A. Shevchenko (2022) and M. Li *et al*. (2024) provided a conceptual framework for further analysis. A survey was conducted, for which a structured questionnaire of 15 questions was developed, covering issues related to energy policy, energy consumption, the impact of international sanctions and technological innovation (Table 1). The questions were formulated based on previous research in this area. All participants were apprised of the study's objective and provided their agreement to engage in it (American Sociological Association's code of ethics, 1997).

Table 1. Questions for the survey

No.	Questions	Answers
1	What is your role in the energy sector?	a) representative of the state structure; b) energy industry expert; c) businessman; d) other (please specify)
2	How old are you?	a) 25-34 years old; b) 35-44 years old; c) 45-54 years old; d) 55-64 years old; e) 65 years or more
3	What is your evaluation of the energy security status in your country?	a) very good; b) good; c) satisfactory; d) bad; e) very bad
4	Which of the following factors do you think are most important for ensuring energy security? (choose up to three options)	a) diversification of energy sources; b) development of renewable energy sources; c) energy independence from importers; d) investment in energy infrastructure; e) reduction of energy consumption
5	What impact do you think international sanctions have on your country's energy policy?	a) very positive; b) positive; c) neutral; d) negative; e) very negative
6	Do you think that your country is responding adequately to sanctions in the energy sector?	a) yes; b) no; c) not sure
7	What strategies for adapting to sanctions, in your opinion, are the most effective? (choose up to three options)	a) supply diversification; b) search for new sales markets; c) investments in energy saving technologies; d) development of partnerships with other countries; e) increase in renewable energy production
8	What impact do you think technological innovations have on energy security?	a) very positive; b) positive; c) neutral; d) negative; e) very negative

Table 1. Continued

No.	Questions	Answers
9	What are the main challenges that you think your country faces in ensuring energy security? (open response)	
10	Do you have any suggestions for improving your country's energy policy? (open response)	
11	What is the role of international cooperation, in your opinion, in ensuring energy security?	a) very important; b) important; c) insignificant; e) not important
12	What sources of information do you consider most reliable for assessing the state of energy security? (choose up to three options)	a) government agencies; b) international organisations; c) scientific research; d) mass media; e) professional associations
13	Have you personally felt the impact of changes in energy policy (for example, due to changes in energy prices)?	a) yes; b) no; c) not sure
14	What types of energy do you consider the most promising for your country in the next 10 years? (open response)	
15	Do you have any additional comments on the topic of energy security? (open response)	

Source: compiled by the authors

To collect in-depth interviews, 10 experts, politicians and business representatives were involved, which allowed to obtain detailed data on their views on energy security, and on specific cases that they encountered in their professional activities. Interview recordings were saved and analysed to identify key topics and trends. The gathered data was evaluated utilising the SPSS statistical analysis program. The Students' *t* test was employed for quantitative data to compare average values between groups, while correlation analysis was utilised to examine linkages among several energy security indicators, facilitating the identification of significant correlations that substantiate the research hypotheses. Computers, tablets, and interview recording programmes, were used to collect data during the survey and interview. The collected data was stored in secure files, which ensured the confidentiality of respondents. All materials used in the study included archived data, statistical reports, and regulatory documents related to energy policy.

RESULTS AND DISCUSSION

The results showed that 75% of respondents believe that economic sanctions significantly affect the country's energy security, causing an increase in energy prices. This is confirmed by data from the International Energy Agency, which indicate an increase in average gas prices by 30% and electricity prices by 20% in 2023 compared to 2022. The majority of respondents emphasised that limitations on access to international markets and resources result in heightened energy production costs, according to the International Energy Agency (2023). 90% of experts emphasised the significance of cultivating indigenous resources, particularly renewable energy, which can diminish reliance on imported energy sources and enhance the nation's energy autonomy. Investments in emerging technologies within the energy sector are essential for maintaining energy security. In 2023, international groups reported that global investments in innovative technologies within the energy industry reached USD 180 billion, with USD 35 billion allocated to renewable energy in the European Union. In contrast, investments in renewable energy in Ukraine were about USD 1.5 billion, which is far smaller. Table 2 presents a comparative analysis of investments in innovative technologies between Ukraine and other nations.

Table 2. Analysis of investments in emerging technologies within the energy industry (2023)

Country	Investments (billion USD)
EU	35
USA	60
China	70
Ukraine	1.5

Source: compiled by the authors based on O. Gavrylko (2023)

Questions about the impact of political conflicts on energy security showed that 80% of respondents believe that international and regional conflicts significantly threaten energy stability. The main problems identified by respondents include declining investment in the energy sector, risks of disrupting energy supplies, and unstable energy prices. The survey participants pointed out the importance of Ukraine's active participation in international energy projects, such as the Trans-European energy network, to improve the reliability of energy supplies. The advancement of renewable energy, including solar and wind, is a critical focus that can assist Ukraine in attaining energy independence and fulfilling obligations to diminish greenhouse gas emissions while transitioning to sustainable development (Shebanin *et al.*, 2024). Domestic investment in this sector can provide employment, foster technological advancement, and enhance the competitiveness of the Ukrainian economy. Attracting investors and partners

to finance renewable energy projects will help to achieve ambitious goals faster. Encouraging the adoption of renewable energy at the local level through support programs, incentives for homes and companies, and public education on the advantages of renewable energy sources can greatly enhance energy efficiency (Zakharchuk *et al.*, 2023). It will also diminish reliance on centralised energy sources, which is particularly crucial amid political volatility. Consequently, the advancement of renewable energy is not merely a stride towards energy autonomy, but also a crucial element for guaranteeing sustainable economic development and environmental conservation in Ukraine. Investments in renewable energy might significantly increase Ukraine's energy independence, namely by increasing the amount up to 30% of the energy mix by 2030.

Economic sanctions imposed on energy exporting countries lead to significant changes in supply structures and approaches to ensuring energy security. In particular, sanctions force importing countries to actively look for alternative suppliers or diversify energy sources. This increases the cost of energy resources, creating economic pressure on the economies of countries that depend on imports. Respondents stressed the need to establish new international partnerships to ensure stable energy supplies. Enhancing collaboration with the EU, the US, and additional partners can facilitate the attraction of investments in infrastructure, technology, and energy initiatives, thereby offering Ukraine diverse supply sources. International alliances can facilitate the adaptation of new technologies, the exchange of experiences, and the training of workers, so enhancing the overall efficiency of the energy system.

Political conflicts related to energy resources affect international relations, stimulating the creation of new alliances and economic agreements to ensure the stability of energy supplies (Shukurov, 2022). For example, some EU countries are expanding cooperation with suppliers from the Middle East, Africa and Central Asia, reducing dependence on resources supplied from regions that are subject to sanctions. The implementation of new mechanisms, such as energy contracts with guaranteed supplies or strategic energy reserves, can be an effective tool for ensuring the stability of supplies in the event of a crisis. The diversification of energy sources and the enhancement of local resources are essential for bolstering Ukraine's energy security within the framework of contemporary international relations. The survey also showed that 70% of respondents believe that political conflicts negatively affect the investment climate in the energy sector, hindering attracting foreign investment. The lack of stability in international relations, in particular in the region, forces potential investors to look for safer alternatives, which further worsens the situation in the energy sector. The study identified several key mechanisms for ensuring energy security in the context of international relations, which are essential for reducing Ukraine's dependence on external factors and improving the sustainability of the energy sector. The findings indicate that the diversification of energy sources, including solar, wind, and LNG, is among the most successful ways to enhance energy security. This reduces dependence on individual suppliers and minimises the economic risks associated with sanctions or political conflicts that restrict access to certain types of energy resources.

Market diversification relies on critical procedures that enhance energy solutions in Ukraine, diminish reliance on conventional energy resources, and bolster the nation's energy independence (Dykha *et al.*, 2024). Respondents asked about the need to supply alternative energy sources, such as solar, wind and bio-energy, and nuclear energy. Diversification will reduce the risk associated with instability from traditional resources and political instability. Ukraine is actively advancing solar power facilities in the Odesa Region and other regional initiatives that positively influence the local economy and generate new employment opportunities. Nuclear energy can become an important component of the energy balance, ensuring the stability of stability and reducing the amount of greenhouse gases. Technological advancements, like battery systems and intelligent models, significantly contribute to the swift progression of alternative energy sources (Bandura *et al.*, 2023). Government policies aimed at supporting these initiatives may include financing and investment programmes that allow the organisation of investments.

Economic sanctions and geopolitical tensions have led to fluctuations in energy prices, forcing consumer governments to develop stabilisation policies. These methods encompass subsidies for energy resources for the populace, the advancement of national energy sources, and energy efficiency programs that mitigate reliance on imported resources. The execution of these procedures enhances energy security and stability during extended political confrontations. According to the data obtained, the majority of respondents believe that renewable energy sources can significantly change the energy landscape of Ukraine. Solar and wind energy have already shown their effectiveness in a number of countries, and their introduction in Ukraine can significantly reduce energy dependence on imports. In particular, solar power plants can be implemented on the roofs of buildings, and wind installations – in rural and remote regions, which will ensure energy independence. Participants emphasised the significance of investing in nuclear energy, which continues to be one of the most reliable sources of electricity. The advancement of novel nuclear technologies, including next-generation reactors, presents more prospects to enhance energy efficiency.

Diversification includes the establishment of strategic energy reserves and the enhancement of infrastructure for their conveyance. This will allow Ukraine to reduce the risks associated with unstable energy supplies from other countries. Commissioning of new energy projects using renewable sources will reduce the vulnerability of energy infrastructure to external threats, such as political conflicts or economic sanctions. The study confirmed that deepening international cooperation is a key factor in strengthening Ukraine's energy security. The country's active participation in international organisations, the European Union and the International Energy Agency, and in joint energy projects, contributes to expanding access to energy resources and technologies.

One of the important components of international cooperation is Ukraine's participation in Trans-European energy networks. These networks provide additional energy supply channels, which significantly reduces the risks associated with dependence on a single source of supply. In particular, integration into European energy systems can

improve supply reliability, reduce vulnerability to political and economic shocks, and create favourable conditions for attracting investment in the energy sector. The exchange of technology and knowledge is also an important aspect of international cooperation. Engagement in collaborative initiatives enables Ukraine to implement cutting-edge technology in renewable energy, energy conservation, and energy efficiency (Parkhomets *et al.*, 2023). This, in turn, helps to reduce energy production costs and improve environmental performance. In addition, sharing experience in developing energy security strategies with other countries can help Ukraine better adapt to the challenges that arise in the energy sector.

Collaboration with global partners can also enhance the infrastructure development for energy initiatives. Securing foreign investment in the modernisation and development of new energy infrastructure, including power plants and gas pipelines, is essential for achieving energy independence. Participation in international financing programmes can help Ukraine implement ambitious projects in the energy sector. An important aspect that respondents emphasised is the support of innovative developments in the energy sector. Investing in new technologies for energy storage, transportation, and production can significantly improve resource efficiency and reduce costs. The advancement of contemporary energy storage technology, including high-capacity batteries, is crucial for maintaining the stability of energy networks, particularly given the increasing proportion of intermittent renewable energy sources.

The use of innovation in energy transportation is also of great importance. For example, the introduction of Smart Grid technologies can significantly optimise the distribution of electrical energy. These technologies facilitate the incorporation of renewable energy sources into the grid, minimising losses and enhancing energy transfer efficiency. With Smart Grid, energy companies can monitor consumption in real time, respond to changes in demand, and manage resources, making the system more resistant to external shocks. In addition, the introduction of new pipelines and systems for gas and oil transportation based on modern materials and technologies can reduce the risk of leaks and improve the security of energy infrastructure. The use of composite materials that are more resistant to corrosion and mechanical damage can extend the service life of pipelines and reduce the likelihood of accidents. Monitoring systems that use sensors and automated technologies help to quickly identify potential threats and respond to them before they lead to serious consequences.

Energy storage systems, in particular batteries, can ensure a stable supply of electricity during periods of peak loads or insufficient generation, reducing dependence on traditional energy sources. Integrating energy technologies with electric vehicles can also create additional opportunities for storing and distributing electricity. Furthermore, the advancement of novel technology for the treatment and processing of waste in the energy sector, along with the implementation of a circular economy, can mitigate the environmental impact of energy operations and foster sustainable development. Utilising secondary resources, such as biogas or agricultural waste, can serve as an alternative energy source and diminish reliance on fossil fuels (Dovgal *et al.*, 2024). Investments in research and development, as well as the modernisation of existing capacities, will enable Ukraine to maintain competitiveness in the international energy resources market. Assistance for start-ups and creative enterprises in the energy sector can facilitate the development of novel solutions that address contemporary demands and difficulties. Investments in renewable energy technology, such as advanced solar panels and high-efficiency wind turbines, can substantially lower energy expenses and enhance environmental conditions.

To ensure energy security, Ukraine needs to develop a long-term national energy strategy that considers all the challenges associated with economic sanctions and political conflicts (Shahini *et al.*, 2024). This strategy should be based on an in-depth analysis of the current situation in the energy sector, and include forecasting possible risks that may arise as a result of changes in international relations. The main components of such a strategy are risk analysis, which allows assessing both external and internal threats to energy security; investment planning, which sets priorities for the development of energy infrastructure, including renewable energy sources and modernisation of traditional capacities; vulnerability reduction measures, which include the creation of reserve capacities and integration into European energy networks; and the involvement of all stakeholders, which will contribute to an integrated approach to ensuring energy security. The implementation of such a strategy will not only improve energy stability, but also ensure the country's sustainable development in a changing international environment. Having a clear national energy strategy will also help attract international investment and partnerships, which is critical for the development of the Ukrainian economy and increasing its competitiveness on the world stage.

The procedures for guaranteeing energy security within the framework of international relations encompass various critical elements. Diversification of supply sources is critical to reducing dependence on traditional energy resources. Ukraine ought to concentrate on advancing alternative energy sources, including renewable (solar, wind, biofuel) and nuclear energy. This will not only increase the country's energy autonomy, but also reduce the vulnerability of energy infrastructure to external threats. Deepening international cooperation is necessary to strengthen energy security. Ukraine's active participation in international energy projects, such as the Trans-European energy network, can provide new energy supply channels, reduce risks and improve the reliability of energy supplies. Collaboration with international entities, including the European Union and the International Energy Agency, will enhance access to technology and resources.

Investment in innovative technologies is an important aspect that will help Ukraine to remain competitive in the international energy market. The use of new technologies for energy storage, transportation and production can significantly improve resource efficiency and reduce costs. For example, advanced energy storage systems allow storing excess electricity generated from renewable sources, which ensures stable supply during peak consumption (Sikorska *et al.*, 2024). Innovations in the field of energy transportation, such as "smart" power grids, can reduce losses during electricity transmission. In addition, the introduction of new production technologies that use clean energy sources

can help to reduce emissions of pollutants, which, in turn, will improve the environmental situation in the country.

The development of a national energy strategy is a key element for ensuring energy security. The strategy should consider all the challenges associated with economic sanctions and political conflicts, including risk analysis, investment planning, and measures to reduce the vulnerability of the energy system. In summary, it may be contended that the execution of these actions can markedly enhance the stability of Ukraine's energy system, diminish reliance on external influences, and secure the nation's energy autonomy throughout political and economic adversities. Diversification of supply sources, advancement of renewable energy, investment in cutting-edge technology, and formation of new international alliances are essential elements that will foster the foundation of a stable and autonomous energy system. Diversifying energy sources and enhancing domestic resources are essential for fortifying Ukraine's energy security within the framework of contemporary international relations. Ukraine must prioritise attracting investment in innovative technologies that enhance energy efficiency and mitigate the energy system's susceptibility to external threats.

The data obtained indicate that deepening international cooperation, diversification of supply sources and investment in innovative technologies are key aspects for ensuring Ukraine's energy autonomy. This study is significant not only for Ukraine but also for other nations aiming to diminish their reliance on conventional energy resources and promote sustainable development. The results of the study showed that energy security is a complex concept that covers economic, social, and technological aspects. An important conclusion is that cooperation with international partners can significantly contribute to the development of infrastructure for energy projects. This is confirmed by researchers such as O. Gavrylko (2023), who highlighted the importance of attracting foreign investment to modernise energy infrastructure. Without proper funding and technologies, Ukraine will not be able to implement its ambitious projects in the energy sector. Diversification of energy sources, which is supported by the results of this study, is an important mechanism for reducing dependence on traditional suppliers. This aligns with the findings of V. Omelchenko (2022), who asserted that the advancement of renewable energy sources, including solar and wind energy, can substantially enhance Ukraine's energy autonomy. Research demonstrates that the active development of alternative energy sources ensures energy independence and mitigates environmental damage.

Countries that actively implement green technologies demonstrate examples of successful transformation of their energy systems (Ivashura *et al.*, 2022). Thus, the study by E. Assareh *et al*. (2023) focused on the benefits of implementing energy storage technologies that can solve problems related to the instability of renewable sources. Energy harvesting also requires processes, technologies, arrangements and operations that convert a form of energy (such as electrical) into a more economical form of energy (such as mechanical) for further utilisation (Namrata *et al.*, 2024; Yang, 2024). Thus, the findings are consistent with the available studies, but also indicate the need for in-depth analysis in this area, in particular, regarding the real possibilities of introducing new technologies and investing in the energy infrastructure of Ukraine.

O.A. Shevchenko (2022) observed that investment in innovative technology for energy storage and transportation can markedly enhance the efficiency of the energy sector. The researcher underscores the significance of emerging technologies in cost reduction and enhancement of energy system efficiency. The implementation of these technologies can enhance flexibility in energy production and consumption, essential for adapting to fluctuating market conditions. The research conducted by N.P. Reznik *et al*. (2024) underscored the principal challenges of bioenergy advancement in Ukraine, accentuating its significant function as an alternative to conventional fuel sources. Notwithstanding the substantial potential of biomass for energy generation in Ukraine, its development rate is markedly inferior to that of European nations. The world is entering the fourth energy transition, which requires the creation of a new concept of energy security for both energy supplier countries and consumers (Hamidova *et al*., 2022). The paper by A. Mazaraki & T. Melnyk (2024) aimed to develop a conceptual framework for energy security management, considering current challenges, in particular, the "green" transition and growing dependence on renewable energy sources. The findings confirm that not only investment in alternative sources, but also active participation in international programmes and cooperation with foreign partners can play an important role in achieving Ukraine's energy independence. Thus, analysing the results obtained, it can be argued that Ukraine needs to continue developing strategic partnerships and introduce innovative technologies to ensure stability and security in the energy sector.

In conclusion, the results show that while Ukraine has already made some progress in diversifying energy sources, there are still many challenges that need to be overcome. Studies in this domain should concentrate on examining the effects of international collaboration on the advancement of energy initiatives in Ukraine, as well as investigating particular technologies that might be employed to enhance energy efficiency. The research carried out as part of this study opens up new prospects in the field of energy security. It is important to investigate how specific innovative technologies can be adapted to the conditions of Ukraine, and to assess their impact on the overall efficiency of the energy system. For example, it is necessary to investigate what energy storage technologies can be implemented, considering the geographical and climatic features of Ukraine. This will help to determine the best solutions for integrating renewable energy sources into existing energy systems. Also, it is advantageous to examine the influence of international collaboration on the advancement of energy initiatives in particular areas of Ukraine. This will identify regional characteristics and obstacles that may influence the execution of energy programs. The study of local conditions and needs can help in the development of adapted development strategies that consider the specifics of each region.

The examination of public policy's role in promoting investment in renewable energy sources is equally significant. This may include examining the effectiveness of existing policies and their impact on the investment climate. An analysis of successful government regulation practices

in other countries, such as Germany and Denmark, where renewable energy sources are actively being implemented, can provide useful lessons for Ukraine. For example, it is important to analyse how various support mechanisms, such as subsidies, tax breaks, and government programmes, affect investment attraction. In general, these areas of research can significantly deepen the understanding of the mechanisms for ensuring Ukraine's energy security and contribute to the development of effective strategies for strengthening it. The primary objectives will be to tailor international expertise to domestic circumstances and foster innovation in the energy industry, thereby enhancing Ukraine's energy independence and sustainability. The results show that, despite the existing successes, Ukraine still faces serious challenges in the field of energy security. The need to intensify international cooperation, which contributes to attracting investment and new technologies, is urgent. Diversification of energy sources will diminish reliance on conventional providers and create new prospects for the advancement of alternative energy sources, including wind and solar energy. Investments in novel technology can markedly enhance the efficiency of the Ukrainian energy sector, hence reducing costs and optimising resource utilisation.

CONCLUSIONS

The study of Ukraine's energy security has identified several key aspects that are critical for its stability and development. In particular, the results obtained confirmed that energy security is a complex concept that covers economic, social and technological dimensions. The importance of international cooperation, diversification of energy sources and investment in innovative technologies proved crucial for ensuring the country's energy autonomy. Active diversification of energy sources is necessary to reduce dependence on traditional suppliers, in particular from the Russian Federation. Attracting foreign investment, which accounts for 70% of all investment in new technologies, is a key factor for modernising the energy infrastructure. Without this, Ukraine will not be able to implement its ambitious projects, such as the development of a renewable energy network.

The findings indicated that investments in solar and wind energy might substantially enhance Ukraine's energy independence, namely by elevating the proportion of renewable energy sources to 30% in the energy mix by 2030. It will positively affect the country's environmental conditions by diminishing greenhouse gas emissions. Investment in new technologies can significantly improve the efficiency of the energy sector, reducing the cost of energy production and transportation. However, despite the potential of alternative energy sources, Ukraine remains highly dependent on imported energy resources – more than 60% of the gas consumed is imported, which is a serious threat to energy security.

The study highlighted the importance of Ukraine's active participation in international energy projects and financing programmes, which can lead to the strengthening of energy infrastructure. For example, participation in European energy initiatives can provide access to the technologies and funding needed for modernisation. The issues of interaction between economic sanctions and political conflicts remain relevant for further research. It is recommended to conduct a deeper study of specific innovative technologies that can be adapted to Ukrainian conditions, and analyse the impact of international cooperation on the development of energy projects in different regions of Ukraine. This will help to identify features and problems that need urgent solutions, and contribute to the development of effective policies in this important area.

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CONFLICT OF INTEREST

None.

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Механізми забезпечення енергетичної безпеки в системі міжнародних відносин з урахуванням економічних санкцій та політичних конфліктів

Анотація. В умовах глобалізації та зростаючої взаємозалежності економік енергетична безпека стала критичною складовою національної безпеки. Санкції та зміни на енергетичних ринках змушують країни адаптувати свої стратегії для збереження енергетичної незалежності та конкурентоспроможності. Метою дослідження було вивчення механізмів забезпечення енергетичної безпеки в системі міжнародних відносин, зокрема, ролі економічних санкцій як інструменту впливу на енергетичну політику держав. Проаналізовано адаптаційні стратегії країн, що перебувають під санкційним тиском в енергетичному секторі. Дослідження показало, як держави диверсифікують постачання енергоресурсів, шукають нові ринки та постачальників, заохочують інвестиції у відновлювані джерела енергії як альтернативу викопним видам палива. Особливу увагу було приділено досвіду Європейського Союзу, який створив стратегію енергетичної безпеки під впливом санкцій проти Росії, що призвело до значних змін в енергетичній інфраструктурі та стратегіях постачання. Системи планування ресурсів підприємства є важливим інструментом для країн, що перебувають під санкціями. Впровадження цих систем дозволяє ефективніше управляти енергетичними ресурсами, оптимізувати процеси постачання та зберігання енергії, а також знизити витрати. Результати дослідження показали, що санкції вплинули на світові енергетичні ринки, змінили енергетичні потоки, підвищили ціни та створили нові виклики для країн, які залежать від імпорту енергоносіїв. Дослідження також показало, як країни, що постраждали від санкцій, шукають нові шляхи зміцнення своїх енергетичних позицій через міжнародну співпрацю та партнерство. Проведений аналіз допоміг краще зрозуміти механізми адаптації країн до умов обмежень, а також виявити ключові фактори, які сприяли їхньому успіху в умовах зміни енергетичної політики. Практичне значення дослідження полягає у розробці обґрунтованих рекомендацій для держав щодо ефективних стратегій адаптації до санкційного тиску, які сприяли підвищенню енергетичної безпеки та економічної стійкості в умовах глобальних викликів

Ключові слова: диверсифікація енергопостачання; відновлювані джерела енергії; енергетична політика; глобальні енергетичні ринки; стратегії адаптації; енергетична стабільність

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The non-oil sector of the Republic of Azerbaijan's economy: Prospects and directions for development within the framework of contemporary economic policy

Abstract. This study aimed to evaluate the critical variables and techniques that facilitate the sustainable development of Azerbaijan's non-oil economic sector. The contribution of the non-oil sector to Azerbaijan's economic development amid global transformations and economic concerns was examined. The focus was on diversifying the economy and reducing dependence on oil revenues, which is a major step towards sustainable economic growth. The study found that the development of sectors such as agriculture, industry, and services, contributes to the creation of new sources of income and ensures economic stability. The advancement of the non-oil sector is crucial for job creation, bolstering small and medium-sized firms, and enhancing the living conditions of the populace, particularly in rural and isolated regions.

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The study stressed that agriculture and tourism can benefit substantially from the introduction of innovative technologies and infrastructure modernisation. The non-oil sector's contribution to the economy is evident in the enhancement of transport and logistics infrastructure, facilitating the increase of export potential. The development of quality services in areas such as healthcare, education, and tourism, also contributes to improving the social well-being of citizens and enhancing the country's international competitiveness. The findings of the study showed that further development of the non-oil sector requires active investment, improvement of the business climate, and removal of administrative barriers. Diversification of the economy, development of innovative solutions, and infrastructure modernisation are the key factors contributing to Azerbaijan's sustainable economic growth in the long term

Keywords: diversification; investments; transport infrastructure; service industry; education system

INTRODUCTION

The advancement of the non-oil sector in the Republic of Azerbaijan's economy is a primary objective of the current official economic policy. In the context of changing world energy markets and instability of oil prices, the country, which has vast hydrocarbon reserves, has faced the challenge of diversifying its sources of income to ensure sustainable economic growth. This is particularly relevant considering the global economic changes and transformation of world economies, which are gradually breaking away from the dominance of commodity-based industries. The non-oil sector, which includes agriculture, tourism, information technology, transport, manufacturing, and other areas, holds immense potential for long-term economic growth and reducing dependence on the oil industry (Danylyshyn & Koval, 2022). However, despite major efforts on the part of the government, the development of these sectors faces a series of challenges. These include a lack of investment, limited infrastructure support, low labour productivity, and the necessity of modernising legislation and increasing the level of professional training.

The development of Azerbaijan's non-oil sector is not only an urgent economic task, but also a strategic priority aimed at ensuring the sustainability and stability of the economy in the face of global changes. Z. Nadjafova (2019) contended that economic diversification via the advancement of many industries may serve as a pivotal element for sustainable economic growth in Azerbaijan. The researcher noted that the agricultural sector holds immense potential for exports, which can substantially reduce dependence on oil revenues. N.A.A. Mohammed *et al*. (2021) stressed the need to integrate innovative technologies into non-oil sectors such as information and communication technologies (ICT) and industry. In their opinion, the development of these sectors will increase the country's competitiveness in the global market and improve the investment climate. B. Surya *et al*. (2021) analysed the role of small and medium sized enterprises (SMEs) in diversifying the economy and concluded that supporting entrepreneurship through access to finance and tax reforms can accelerate the development of non-oil industries. U. Aydin (2019) emphasised the need to improve transport and energy infrastructure, which will considerably increase the production capacity and export potential of the country. M. Raid *et al*. (2024) investigated the role of state regulation in stimulating the non-oil sector. Tax incentives and state support programmes can become a catalyst for the active growth of key industries.

E. Koberg & A. Longoni (2019) focused on the importance of international cooperation and Azerbaijan's integration into global supply chains. The authors argued that this would enable the country to enter new export markets and reduce economic risks associated with oil price volatility. F. Yang (2019) examined the function of the financial sector in economic diversification. The development of non-oil sectors requires the active involvement of the banking system, which should provide affordable loans and financial instruments for entrepreneurs. M. Ahmad *et al*. (2021) underscored the importance of environmental sustainability within economic diversification, arguing that the advancement of non-oil industries must be paired with the implementation of environmental norms. S. Rahim *et al*. (2021) argued that the country should invest in the development of human capital, which will increase labour productivity and innovation in key industries. E. Ahmadova *et al*. (2021) considered the role of international investors in the diversification of Azerbaijan's economy. She contended that enticing foreign direct investment by establishing special economic zones and enhancing the business environment can expedite the expansion of non-oil sectors.

Notwithstanding the significant focus on the advancement of Azerbaijan's non-oil sector, several areas remain inadequately examined. The research on the services industry and its impact on the country's socio-economic growth is insufficient. A more thorough analysis of the transport sector and the impact of its activities on international transit projects is also required. The issue of improving the capacity of the higher education system is also poorly explored. This study aimed to evaluate the primary developmental areas of Azerbaijan's non-oil sector, emphasising the effects of digitisation and sustainable practices. The study aimed to investigate the critical elements of services sector development in the country, analyse the transport sector and its management through public-private partnerships, and explore enhancements to the higher education system in light of international practices.

MATERIALS AND METHODS

The study was based on the collection, processing, and analysis of data obtained from various official sources (State Statistical Committee..., 2024), as well as international reports and databases (Economic growth: The rate..., 2024). The data used covered the period from 2014 to 2023, which enabled a long-term analysis of trends and changes in the country's gross domestic product (GDP) structure. One of the key methods applied in this study was the analysis of statistical data. The analysis of Azerbaijan's GDP involved a division into oil and non-oil sectors, elucidating the contribution of each sector to

the national economy throughout the examined period. To comprehend the alterations in Azerbaijan's economic structure, both the absolute growth rates of the non-oil sector and its proportion of the overall GDP were examined. The structure of investment in the economy was also examined, with a particular focus on comparing the shares of the oil and non-oil sectors.

The comparison method helped to contrast the dynamics of the non-oil sector with other developing countries, which allowed highlighting key trends and specific features of Azerbaijan's economic growth. This method was also employed to analyse the international practices of attracting investment in the non-oil sector, which allowed assessing the prospects and challenges faced by Azerbaijan on the path towards economic diversification. To visualise the findings, graphs and tables were used to visualise the changes in Azerbaijan's economic structure, investment volumes, and the sectors' share in GDP. An essential element of the analysis was the comparison of non-oil sector indicators with analogous data for the oil sector, which helped to identify notable trends and key factors contributing to sustainable economic growth.

The examination of policies and programmes enacted by the Azerbaijani government to bolster agriculture, tourism, and industry encompassed an inquiry into the nation's Sustainable development cooperation framework 2021-2025 (2021). These sections delineate the goals and objectives through 2025, centred on economic diversification and diminishing reliance on the oil sector. The qualitative analysis method was employed to examine the social dimensions of non-oil sector development. This facilitated the evaluation of the sector's influence on employment generation, the advancement of SMEs, and the enhancement of living conditions, particularly in rural and isolated regions. The experience of Azerbaijan was compared with the experience of other countries that underwent the economic diversification process, such as the USA, China, and Germany. This helped to draw conclusions regarding the applicability of successful international practices in the context of Azerbaijan and to identify possible areas for improving the diversification strategy. As a result of using these research methods, it was possible to perform a comprehensive analysis of the state and prospects of the non-oil sector of the economy of Azerbaijan and offer recommendations for its further development.

RESULTS

The non-oil sector is becoming an indispensable component of sustainable economic growth for countries with considerable reserves of natural resources. The role of the non-oil sector in the economy of Azerbaijan cannot be overestimated. It represents a significant reserve for diversifying the country's economic base, reducing its dependence on oil revenues, and ensuring long-term stability. The primary aim of the non-oil sector is to diminish the economy's reliance on oil price volatility. The energy industry, while generating large revenues, makes the country vulnerable to external economic shocks and fluctuations in world markets. The advancement of non-oil sectors, including agriculture, industry, and services, can generate new revenue streams and enhance economic resilience. Diversification promotes a more equitable allocation of resources and fosters sustainable economic development.

The challenge of diversifying Azerbaijan's economy involves not only establishing new revenue streams but also enhancing the export capacity of the non-oil sector (Musayeva *et al.*, 2024). The country has already made steps towards liberalising the economy and attracting foreign investors, but the question persists as to what extent these efforts contribute to increasing the competitiveness of non-oil industries in the international arena. Sustainable growth requires not only attracting investment, but also creating an innovative environment that will enable the development of high-tech sectors and improve the business environment. The topic of non-oil sector development is closely linked to the notions of economic diversification and sustainable development. Diversification entails altering the economic structure to diminish reliance on a single sector, hence enhancing resilience against external shocks, such as commodity price volatility (Karimli *et al.*, 2022). This strategy in Azerbaijan seeks to establish conditions for sustained growth by fostering SMEs, enhancing the technological advancement of industries, and integrating the nation into global supply chains.

The non-oil sector plays a key role in creating jobs and supporting SMEs. Agriculture, tourism, services, and manufacturing are major sources of employment for the local population. The development of these sectors contributes to improving living standards and reducing unemployment, especially in rural and remote areas. Supporting local businesses through the creation of a favourable business environment and infrastructure development helps to develop new enterprises and stimulate local economic activity. The non-oil sector also contributes to sustainable economic development through the introduction of innovative technologies and improved infrastructure. Agriculture, for example, can benefit from modern agro-technology to improve productivity and climate resilience. Information technology and digitalisation offer fresh opportunities for business development and the creation of more efficient business processes. Investments in these areas contribute to modernising the economy, improving the quality of goods and services, and increasing competitiveness in international markets (Adeosun & Gbadamosi, 2021).

The growth of the non-oil industry is correlated with enhanced infrastructure, which is essential for broadening export options. Transport and logistics infrastructure, encompassing highways, ports, and trains, is crucial for the effective transportation of products and services to global markets. The development of tourism infrastructure attracts foreign tourists and contributes to the growth of tourism revenues (Al-Abri *et al.*, 2019). Infrastructure development in the non-oil sector helps to strengthen economic ties with other countries and expand export potential. The non-oil sector also contributes to social development and improving the quality of life. Services, including healthcare, education, and tourism, play a significant role in meeting the social needs of the population. The development of quality services and increased access to education and medical care contribute to the general well-being of citizens. Tourism not only generates income but also promotes cultural exchange and understanding, strengthening ties between regions and countries (Ajudua *et al.*, 2021). Still, to ensure

sustainable development of the country, investments in other economic sectors and the development of human capital are also required. Figure 1 illustrates the volume of Azerbaijan's non-oil economy from 2014 to 2023.

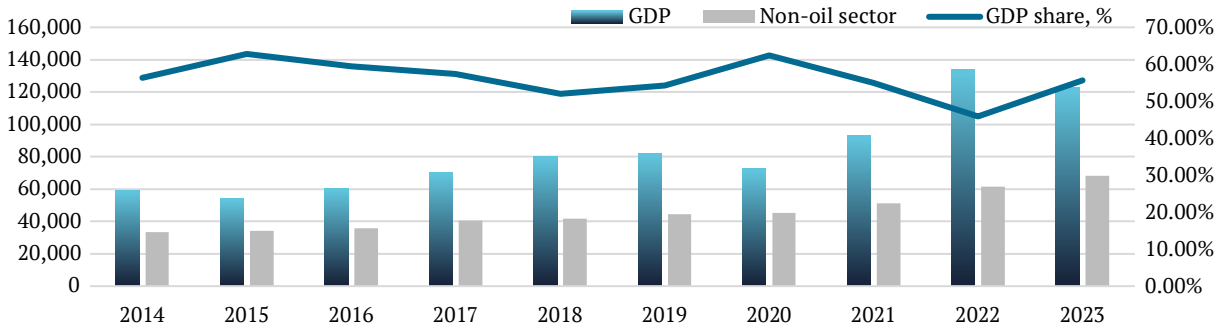

Figure 1. 1. Volume of non-oil sector in Azerbaijan, 2014-2023, AZN million

Note: USD 1 = AZN 1.70

Source: compiled by the authors based on data from the State Statistical Committee of the Republic of Azerbaijan e-versions of publications (2024)

Figure 1 shows successful efforts to increase the non-oil sector, although fluctuations in its share show that the economy is still vulnerable to external shocks and dependence on world oil prices. This emphasises the importance of continuing policies aimed at sustaining and developing non-oil sectors to ensure sustainable economic growth. One of the major challenges facing the non-oil sector in Azerbaijan is the lack of economic diversification. The country is still dependent on energy exports, which creates risks for economic stability in case of changes in global oil prices. The low level of technological modernisation and innovation also hampers the development of such sectors as agriculture and manufacturing. Another challenge is the limited access to capital for SMEs, which form the backbone of the non-oil sector. Lack of government programmes to support entrepreneurship and affordable financing limits growth opportunities. Bureaucratic barriers, low legal protection of businesses, and administrative obstacles also complicate investment attraction. These factors require a systematic approach to reforms aimed at improving the business climate and modernising key sectors of the economy. Azerbaijan has taken steps to attract investment in the non-oil sector in an effort to reduce dependence on energy exports. The government is actively promoting areas such as tourism, agribusiness, and transport logistics, offering tax incentives and creating special economic zones to attract foreign investors. Figure 2 shows investment in Azerbaijan's economy, including in the non-oil sector.

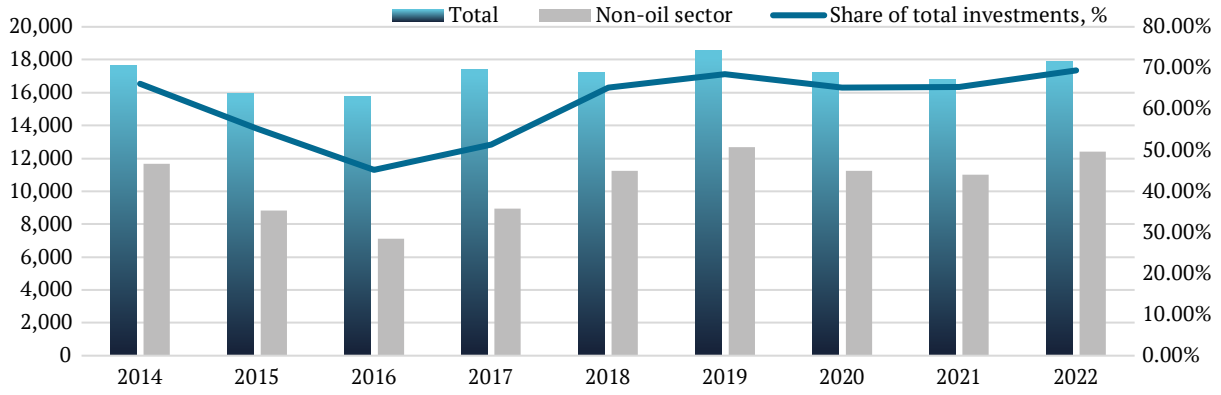

Figure 2. 1. Investments in the economy of Azerbaijan, 2014-2020, AZN million

Source: compiled by the authors based on data from the State Statistical Committee of the Republic of Azerbaijan e-versions of publications (2024)

Figure 2 shows that although investment in the non-oil sector experienced temporary downturns, it has been steadily increasing. The growing share of the non-oil sector in the total investment structure suggests that Azerbaijan continues its successful policy of economic diversification, reducing dependence on oil revenues and increasing investment in other sectors. Competitive development of the service sector is a vital aspect in the diversification of the economy and contributes to its socio-economic development. Services, including healthcare, education, tourism, and financial services, play a key role in creating jobs, improving the quality of life, and supporting consumer demand growth. The development of a competitive environment in this sphere stimulates innovation and improvement of the quality of services, which attracts investment and enhances economic growth (Salunke *et al.*, 2019). Prospects for competitive development of the service sector in Azerbaijan include

expansion of services based on modern technologies, improvement of infrastructure, and raising the level of employees' qualification. These initiatives will enhance the internal market and render the country more appealing to international investors, facilitating its inclusion into the global economy. Figure 3 illustrates the proportion of services within the GDP of Azerbaijan and many other nations globally.

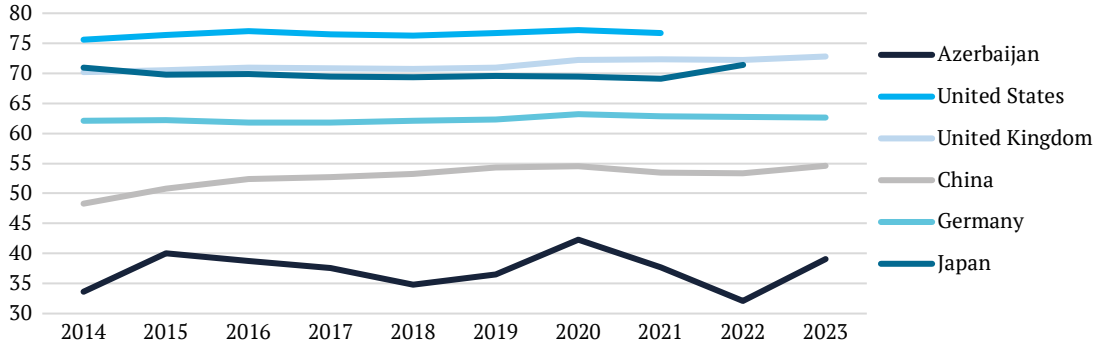

Figure 3. Share of services in GDP of various countries, 2014-2023, %
Source: compiled by the authors based on Economic growth: The rate of growth of real GDP (2024)

The proportion of services in GDP fluctuates based on a country's economic development level. In developed economies, such as the US and the UK, services dominate, while in developing economies, such as Azerbaijan and China, the share of services is increasing but is still lower. This emphasises the differences in the extent to which the services sector is developed and the necessity for developing countries to continue to invest in its development to reach a higher level of economic diversification. Public-private partnerships (PPPs) in transport and logistics services play a key role in developing infrastructure and optimising logistics processes, especially in countries seeking to improve their transport network and competitiveness (Ramsey & El Asmar, 2020). Azerbaijan, being located at a strategically important crossroads between Europe and Asia, is actively developing its transport and logistics services through the PPP mechanism. However, to achieve effective results and sustainable development, it is necessary to accommodate both internal aspects and international practices.

The Government of Azerbaijan is diligently soliciting private investment to modernise and enhance transport infrastructure, encompassing the construction and rehabilitation of ports, highways, and trains. Examples of successful projects include the reconstruction of the Baku-Tbilisi-Kars railway and the development of a new container terminal at the port of Baku. However, the PPP projects often face problems of lack of transparency and legal ambiguity, which can complicate the attraction of private investors. Lack of coordination between public and private partners sometimes leads to delays in project implementation and increases project costs. The need to improve the regulatory framework and increase the confidence of private investors stays relevant.

Private enterprise in the transport sector is developing gradually in Azerbaijan, but this process requires increased attention and support. The key areas include attracting private investment to modernise infrastructure, expand services, and improve the quality of transport solutions. Active development of private companies in the maritime and aviation sectors is observed, as well as the introduction of innovative solutions and technologies in railway transport. Joint management of state-owned transport companies involving private investors is an effective mechanism for improving the performance of transport infrastructure. PPPs allow combining the resources and expertise of the public and private sectors, which contributes to more efficient management, reduces the financial burden on the state budget, and accelerates project implementation.

International practices show that PPPs in transport and logistics can be successful if there is a clear legal and institutional framework, transparency in the processes and effective coordination between public and private partners. Singapore's PPPs in transport infrastructure projects serve as a model for many countries. Singaporean authorities have successfully attracted private investment to build and manage key transport facilities such as new terminals and subways. Transparent tender procedures and clear contractual terms favour efficient partnerships and high-quality services. In the Netherlands, PPPs have been used extensively for the development of port and transport infrastructure. A project to expand the port infrastructure in Rotterdam was implemented involving private investors, increasing throughput capacity, and improving logistics services. The modernisation of ports and the development of logistics centres through private investment has enabled the Netherlands to sustain its leadership in international logistics.

Australia also demonstrates successful examples of PPPs in the transport sector. The project to build a new airport in Sydney was implemented through private investors, which helped not only to modernise the infrastructure, but also to reduce the financial burden on the state budget. In the UK, PPPs are successfully applied in the railway sector. An example is the High Speed 1 project, where private companies jointly with the state took part in the modernisation of a high-speed railway, which greatly improved transport services and increased capacity. China is actively using PPPs to develop its extensive transport network. Examples encompass the development of high-speed railroads and the enhancement of port facilities. Private investment and governmental assistance in China are facilitating the development of contemporary transport corridors that are essential to international logistics (Hakim *et al.*, 2022).

The establishment of transport companies based on public-private partnership in Azerbaijan can have a considerable impact on international transport transit projects passing through the country. Azerbaijan is strategically located at the intersection of several key transport corridors such as the Trans-Caspian International Transport Route (TMTM), also known as the Silk Road, and North-South. Through PPPs, transport companies can upgrade and optimise existing infrastructure, improving the quality of transport services, and accelerating integration into international logistics chains. One major aspect of private companies' involvement in transport projects is their ability to attract latest technologies and innovations, which helps to improve Azerbaijan's transit capacity and increase its competitiveness in international markets. For example, private operators can introduce advanced logistics management systems, automation of port and railway processes, which will reduce cargo transit times and increase the reliability of transit through the country.

Private companies involved in the management of transport infrastructure such as the Baku International Sea Trade Port, railway networks and airports can substantially improve the capacity of these facilities and their integration into global routes. For example, the Trans-Caspian route, which connects China to Europe via Central Asia and the Caucasus, passes through Azerbaijan and its Caspian ports. The establishment of joint transport companies on a PPP basis will accelerate cargo handling at the ports, reduce bureaucratic hurdles, and increase the competitiveness of Azerbaijani ports compared to other transit corridors.

In the case of national private transport companies based on state-owned railway, maritime, and air transport enterprises, the effect on international transport projects could be even more pronounced. Private companies operating in a highly competitive environment will seek to improve efficiency and reduce costs. This will lead to an improvement in the quality of services provided and, consequently, increase the attractiveness of Azerbaijan as a transit hub. Reducing dependence on exclusive state management will allow private companies to adapt more quickly to changes in global markets and respond more quickly to demand from international operators and exporters. Furthermore, private transport companies integrated into international logistics networks will be able to offer comprehensive cargo transport solutions, which will increase Azerbaijan's competitiveness as a transit route compared to alternative routes.

The liberated lands of Karabakh present Azerbaijan with distinctive prospects for economic advancement, with the expansion of the non-oil sector being a pivotal strategy for their rehabilitation. This strategy fosters sustainable regional growth by diversifying the economy and diminishing reliance on oil. The non-oil sector's function in the development of these regions is to attract investment, provide employment, restore agricultural and industrial infrastructure, and integrate the area into national and international supply networks. The non-oil sector's agriculture, tourism, construction, and light industry have the potential to drive Karabakh's restoration. In post-conflict reconstruction, there is an urgent need to develop infrastructure, which involves the construction of roads, power grids, water supply facilities, and other key facilities. This will boost the construction industry, which will not only generate jobs but also create the foundation for further economic growth.

The key potential of the liberated territories of Karabakh lies in the revival of the agricultural sector, which has historically been an important part of the region's economy. Due to its fertile lands, the restoration of agriculture can ensure Azerbaijan's food security and export opportunities for the country. Another major area of focus is the development of tourism. Karabakh has unique natural and historical sights, which creates opportunities for ecotourism, cultural tourism, and outdoor recreation (Guliyeva, 2021). The construction of hotels, the development of infrastructure for tourism, and the creation of cultural facilities will not only revitalise the economy of the region, but will also attract international investors and tourists, which will also contribute to the growth of income of the local population.

Particular emphasis is placed on the enhancement of transport infrastructure in the freed regions, with the Zangezur transit corridor being the principal initiative in this domain. This corridor connects the western areas of Azerbaijan to the Nakhichevan Autonomous Republic and subsequently to Turkey, thereby creating new transportation options for Azerbaijan and the entire region (Rehimov, 2024). The establishment of this corridor will incorporate Karabakh into global transport networks, enhancing logistics and market access in Europe and Asia. The Zangezur transport corridor holds strategic significance for Azerbaijan, as it has the potential to become a crucial component of the Trans-Caspian international transport route and the North-South corridor. Upon effective completion of this project, Karabakh could evolve into a logistics hub connecting the West and the East. This will draw more investments in transport infrastructure, including the development of new roads, railway lines, airports, and other facilities, thereby establishing circumstances for the expansion of the non-oil industry.

The development of the non-oil sector in the liberated areas of Karabakh and the potential of the Zangezur transport corridor are pivotal to the region's rebuilding. This approach will not only ensure economic growth and job creation but will also strengthen Azerbaijan's geopolitical position in the international arena, opening new opportunities for transit and integration into the global economy. SMEs play an essential role in the non-oil sector of the economy, providing diversification of production, job creation, and support for innovative solutions. The national government actively promotes SME support programmes, offering access to financing, tax incentives, and educational initiatives (Abdelatif & Mahieddine, 2024). The key areas for SME development are agriculture, tourism, light industry, information technology, and transport. Opportunities for SME growth are also related to the expansion of export markets and involvement in international supply chains, which creates new prospects for strengthening economic sustainability and independence from the oil sector.

The improvement of the digital economy in Azerbaijan is a vital component of the strategy to diversify the economy and diminish reliance on the oil sector. The government is actively introducing technology in various spheres, including industry, agriculture, tourism, and

public administration. Particular emphasis is placed on the advancement of ICT infrastructure, the enhancement of digital services, and the encouragement of start-ups in the innovation sector (Abdullayev *et al*., 2022). These measures contribute to productivity growth, increase employment in high-tech sectors, and improve the country's competitiveness in the global market. Table 1 summarises the key indicators of the ICT sector.

Table 2. Principal metrics of the ICT sector in Azerbaijan, 2014-2023, AZN million

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Output in the ICT sector	1,577.5	1,589.2	1,555.9	1,688.0	1,826.8	2,083.2	2,158.2	2,249.7	2,514.8	2,988.8
Value added in the ICT sector	963.3	970.7	958.7	1,038.1	1,112.0	1,293.3	1,600.9	1,663.8	1,822.2	2,144.9
Share of ICT value added in GDP, %	1.6	1.8	1.6	1.5	1.4	1.6	2.2	1.8	1.4	1.7
Investments by the ICT enterprises	147.2	338.4	198.2	170.2	183.7	294.7	177.2	135.0	392.7	385.8
Imports of ICT goods	214.4	268.6	371.1	565.1	883.8	901.6	1,055.9	1,083.2	998.7	1,510.2
Computers and computer equipment	74.6	60.0	99.2	168.4	315.8	198.1	287.0	299.8	345.0	417.8
Telecommunication equipment	92.5	99.8	160.5	244.0	328.6	458.2	503.8	543.8	384.9	777.3
Electronic equipment	19.6	34.0	74.9	99.8	145.9	177.4	176.3	190.5	205.2	245.0
Other ICT goods	27.7	74.8	36.5	52.9	93.5	67.9	88.8	49.1	63.6	70.1

Source: compiled by the authors based on data from the State Statistical Committee of the Republic of Azerbaijan e-versions of publications (2024)

Table 1 reflects the stable development of Azerbaijan's ICT sector from 2014 to 2023. Production in the sector shows gradual growth. The value added of the ICT sector is also growing, which indicates an increase in the sector's contribution to the country's economy. However, the share of ICT value added in GDP stays at around 1.4-2.2%, suggesting the necessity of further development of the sector to increase its significance. At the same time, enterprise investment in ICT varies substantially by year, peaking in 2022 and 2023. Imports of ICT goods, especially telecommunication and computer equipment, shows a considerable increase, reflecting the strong reliance on foreign technology to support the sector's growth. Table 2 shows the ranking of countries in the 2023 Innovation Index.

Table 2. Country rankings by Global Innovation Index (GII) 2023

Countries	Total GII	Institutions	Human capital and research	Infrastructure	Market development	Business development	Knowledge and technological outcomes	Creative outcomes
Switzerland	1	2	6	4	7	5	1	1
Sweden	2	18	3	2	10	1	3	8
The USA	3	16	12	25	1	2	2	12
The United Kingdom	4	24	8	6	3	13	7	2
Singapore	5	1	2	8	6	3	10	18
Finland	6	3	5	1	12	4	4	16
The Netherlands	7	6	13	14	15	8	8	9
Germany	8	22	4	23	14	16	9	7
Denmark	9	5	9	3	21	12	12	10
South Korea	10	32	1	11	23	9	11	5
France	11	27	17	22	9	17	16	6
China	12	43	22	27	13	20	6	14
Japan	13	21	18	13	8	11	13	25
Israel	14	40	20	36	11	6	5	33
Canada	15	14	10	30	4	18	19	22
Azerbaijan	89	42	87	95	85	64	114	100

Source: compiled by the authors based on GII 2023 results. The GII unveils the world's innovation leaders, gauging the innovation performance of 132 economies (2023)

Table 2 shows Azerbaijan's considerable underperformance compared to the world leaders. The country takes 89th place in the overall ranking, which suggests the necessity of further improvements in innovation. Despite its relatively prominent position in the "Institutions" indicator, other key areas require major progress. The weakest indicators for Azerbaijan are "Knowledge and technological outcomes" (114th) and "Creative outcomes" (100th), indicating the necessity of investments in education, research activities, and innovation infrastructure to improve the country's position in the global innovation environment. The creative potential significantly contributes to the

diversification of Azerbaijan's economy, particularly with the advancement of the non-oil sector. It stimulates innovation in areas such as information technology, tourism, and agriculture, creating new products, services, and solutions, which contributes to the country's competitiveness in the global market. The development of creative industries, such as design, architecture, media, and arts, not only supports Azerbaijan's cultural heritage, but also attracts investment, promotes the growth of entrepreneurship, and shapes the country's modern image (Abdullayev *et al.*, 2024).

Inbound tourism significantly contributes to the advancement of Azerbaijan's economy, positively influencing several essential sectors. The arrival of international tourists results in heightened incomes for both the populace and the service industry. Tourists visiting the country stimulate demand for hotels, restaurants, travel agencies, and transport services, which creates more jobs and contributes to increased employment. For example, the growth of tourist flow directly affects the hotel industry, where increased hotel occupancy rates lead to the expansion of hotel infrastructure, the creation of new jobs, and improved quality of services (Sustainable development…, 2021).

Transport companies also benefit from the increased tourist flow. Foreign visitors actively use both internal and international transport services, from air travel to local transport. This creates demand for expansion and modernisation of transport infrastructure – improving roads, railways, seaports, and airports, which then positively affects the entire transport and logistics chain (Kanwal *et al.*, 2020). Travel agencies and companies providing excursion services are actively developing due to the increased interest in the natural and cultural attractions of Azerbaijan, such as Baku, Gobustan, Sheki, and the Karabakh Mountains. This expansion enhances internal tourism and increases service exports, hence augmenting foreign cash inflows into the economy.

Nonetheless, despite the favourable outcomes, there are specific issues in the advancement of the tourism business. One of them is the insufficient tourism infrastructure in the regions outside Baku. Local hotels, transport routes, and service companies often face problems of lack of investment and professional staff. In rural and remote areas, tourists may struggle to find comfortable accommodation, quality transport, or informative tourism services, which limits their desire to visit such places. Furthermore, the quality of customer care and service levels in many companies are still at a low level compared to international standards. This requires greater efforts to train staff, develop hotel chains, and introduce strict quality standards. To increase the country's attractiveness in the international arena, it is also necessary to promote Azerbaijan more actively as a tourist destination at the global level through marketing campaigns, participation in international exhibitions, and the development of national brands.

Enhancing the higher education system in Azerbaijan is crucial for augmenting the nation's competitiveness on the global stage and fostering sustained economic development. Higher education is pivotal in the cultivation of human capital, particularly in the context of economic diversification intended to diminish reliance on the oil sector and promote non-oil sectors. Furthermore, the quality of customer service and the level of servicing in many companies is still at a low level compared to international standards. This requires extra efforts to train staff, develop hotel networks, and introduce strict quality standards. Azerbaijan's higher education faces challenges aligning with labour market needs, despite modernisation efforts. Universities often fail to equip graduates with competitive skills, and there's a disconnect between academic research and economic requirements. This necessitates stronger university-business collaboration and market-oriented educational programmes. International examples offer valuable insights: Germany and Finland demonstrate effective university-industry collaboration, China successfully attracts global talent, while North American institutions excel at developing globally relevant skills.

Investments in research and development (R&D) are one of the most important factors affecting the economy. They ensure long-term economic growth, promote technological progress and enhance competitiveness. Investments in R&D are becoming a strategic direction for both countries and businesses. Investments in R&D stimulate economic growth by creating new products, services and production processes. This increases labour productivity, reduces production costs, and allows businesses to adapt to changes in market conditions. Companies that actively invest in research and development gain competitive advantages, become leaders in their industries, and ensure their long-term development. R&D development contributes to the creation of new jobs, especially in high-tech industries. The process of developing and implementing innovations requires qualified specialists, such as engineers, scientists, programmers, and designers. This helps to increase employment and creates opportunities for professional development. In addition, a high level of investment in R&D allows countries to attract international companies looking for opportunities for cooperation in the field of technology. Innovations created through R&D help countries integrate into global markets, increasing exports and strengthening the national economy. For example, the development of new technologies in renewable energy, biotechnology, or artificial intelligence allows countries to take leading positions in global markets. This, in turn, contributes to the growth of incomes and the improvement of living standards.

The prospects for the development of the higher education system in Azerbaijan are related to further integration of international practices, strengthening of practical orientation of educational programmes, and active application of digital technologies. Increasing academic mobility, improving scientific research, and developing partnerships with foreign universities will also be crucial steps in improving the education system, which will contribute to the development of human capital and strengthening the country's economy. Despite significant progress, Azerbaijan's non-oil sector still has numerous problems that must be resolved to guarantee sustainable growth. The potential for continued advancement in this sector is linked to economic diversification, the enhancement of SMEs, the elevation of service and infrastructure quality, and the attraction of investment in transportation, education, and tourism. The effective execution of these sectors can enhance the nation's economy and diminish its reliance on oil earnings.

DISCUSSION

The findings of the study suggest that in the context of global change and economic uncertainty, the non-oil sector is becoming an essential component of sustainable economic growth for countries with large reserves of natural resources. In this context, the role of the non-oil sector in the economy of Azerbaijan can hardly be overestimated. This sector represents a considerable reserve for diversifying the country's economic base, reducing dependence on oil revenues and ensuring long-term stability. L. Charfeddine & K. Barkat (2020) focused on analysing the impact of economic diversification on reducing dependence on oil revenues. The findings showed that countries with high diversification of the economy were better equipped to manage economic shocks and fluctuations in the world markets. The current study and the researcher's study emphasise the significance of economic diversification in reducing dependence on energy resources. The studies also highlight the prominence of developing non-oil sectors to ensure economic stability.

The principal aim of the non-oil sector is to diminish Azerbaijan's economic reliance on oil price volatility. The oil industry, although generating large revenues, makes the country vulnerable to external economic shocks and fluctuations in world markets (Ismayil-Zada, 2023). The expansion of non-oil sectors, including agriculture, industry, and services, generates new income streams and enhances economic resilience. Diversification contributes to a more balanced allocation of resources and promotes sustainable economic growth. S.M. Albert *et al*. (2020) focused on the challenges and prospects of the non-oil sector. The findings revealed the key problems such as insufficient diversification of the economy, low level of technological modernisation, and limitations in access to capital. The researcher noted that these problems hinder the development of the sector and require a comprehensive approach to address them. The current study also identified comparable problems: insufficient diversification and low level of modernisation. This shows the convergence in recognising the principal issues that impede the advancement of the non-oil economy.

F. Alam *et al*. (2023) proposed recommendations to address the problems identified in the non-oil sector, including reforming the business climate and improving the investment climate. His recommendations include measures to increase the availability of capital, stimulate innovation and improve the business environment. The current study also indicated areas for improving the business and investment climate, demonstrating commonalities in approach. Both studies emphasised the necessity of reforms and improvements to stimulate the development of the non-oil sector. The non-oil sector plays a key role in creating jobs and supporting SMEs. Agriculture, tourism, services, and manufacturing are major sources of employment for the local population. The development of these sectors helps to improve living standards and reduce unemployment, especially in rural and remote areas. Supporting local businesses by creating a favourable business environment and infrastructure development helps to develop new businesses and stimulate local economic activity (Sadikhov, 2024). A. Oluwatoyin *et al*. (2020) investigated the role of SMEs in the development of the non-oil sector. Researchers found that supporting small businesses and creating favourable environment for entrepreneurship helped to increase employment and improve economic activity. I.E. Ajayi & K.A. Omotunde (2022) also observed great success in developing local enterprises and improving the business climate. The current study also emphasised the significance of SMEs in creating jobs and sustaining economic activity. However, the current study also considered the impact on infrastructure and services, whereas the cited studies focused mainly on entrepreneurial activity and its impact on jobs.

The non-oil sector also contributes to sustainable economic development through the introduction of innovative technologies and improved infrastructure. Agriculture, for example, can benefit from modern agricultural technologies to increase productivity and climate resilience. Information technology and digitalisation offer fresh opportunities for business development and the creation of more efficient business processes. Investments in these areas contribute to modernising the economy, improving the quality of goods and services and increasing competitiveness in international markets. S.Q. Al-Khalidi Al-Maliki (2021) investigated the adoption of innovative technologies in the non-oil sector. The findings showed that the use of latest technologies in agriculture and industry helped to increase productivity and competitiveness. The researcher also noted that modernisation of business processes considerably affected the sustainability of the economy. The current study highlighted the role of innovative technologies and digitalisation in modernising the non-energy sector, demonstrating similarities in approach. However, the current study emphasised not only technology but also social development and infrastructure, unlike S.Q. Al-Khalidi Al-Maliki (2021) study.

The development of the non-oil sector is also linked to improved infrastructure, which is key to expanding export opportunities. Transport and logistics infrastructure, including roads, ports, and railways, play a major role in ensuring the efficient supply of goods and services to international markets (Kim *et al.*, 2025). The development of tourism infrastructure attracts foreign tourists and contributes to the growth of tourism revenues. C. Wang *et al*. (2020) investigated the impact of infrastructure development on economic development. His study found that improving transport and logistics infrastructure greatly contributes to the expansion of export opportunities and tourism income. A. Banerjee *et al*. (2020) observed that upgrading transport networks and developing logistics centres lead to increased exports and attract tourists, which further stimulates economic growth. The present analysis highlighted the significance of infrastructure development in maintaining economic growth and improving export prospects. The similarity between the studies lies in the emphasis on the value of infrastructure in improving the business climate and stimulating economic development.

The non-oil sector furthermore contributes to social advancement and enhances the quality of living. The services industry, encompassing healthcare, education, and tourism, is crucial in addressing the social requirements of the populace. The development of quality services and increased accessibility to education and medical care contribute to the overall well-being of citizens. Tourism not only generates income but also promotes cultural exchange

and understanding, strengthening ties between regions and countries (Mayis *et al.*, 2021). J.C.F. De Guimarães *et al*. (2020) focused on social development and improving the quality of life. His study showed that the development of the service sector in areas such as healthcare and education greatly improve the standard of living of the population. S. Eslami *et al*. (2019) noted that tourism development promotes cultural exchange and strengthens social ties, which positively affects the social structure. The present study also examined the influence of the non-oil industry on social development and quality of life, aligning with the researchers' conclusions. The studies highlight the significance of the service sector in enhancing living standards and reinforcing social connections, hence underscoring the importance of these elements for comprehensive development. While the oil sector is pivotal to Azerbaijan's economic advancement, facilitating diversification, employment generation, enhanced infrastructure, and augmented export revenues, investment in alternative economic sectors and human capital development is essential for the nation's sustainable progress. Data analysis suggests that despite the stable growth of the non-oil sector, there are challenges such as insufficient diversification of the economy, low level of technological modernisation, and limited access to capital for SMEs.

CONCLUSIONS

This study investigated the contribution of the non-oil sector to the economic development of the Republic of Azerbaijan and assessed its importance in economic diversification and sustainable growth. The emphasis was on the imperative to diminish the country's economic reliance on oil exports, a principal priority for securing long-term security amid global transformations and economic volatility. The research indicated that the non-oil sector significantly influences Azerbaijan's economy by fostering job creation, enhancing resilience to external economic shocks, and diminishing reliance on oil price volatility. Sectors such as agriculture, industry, and services become the primary drivers for growth and stable development. The development of these sectors was found to contribute to a more balanced distribution of resources, greater economic stability, and improved living standards, especially in rural and remote areas. This study's principal finding was that the consistent expansion of the non-oil sector from 2014 to 2023 signifies favourable progress in the diversification of the nation's economy. The non-oil sector has shown steady growth, indicating progress in areas such as agriculture, tourism, and information technology. The introduction of innovative technologies and digitalisation offers further opportunities to improve competitiveness and create more efficient business processes.

The role of investment in the non-resource sector was assessed. The study showed that the volume of investment in non-resource industries is gradually increasing, which indicates the interest of both the state and private investors in the development of these industries. This trend, among other things, has been supported by the creation of special economic zones and programmes aimed at attracting foreign investors in areas such as agribusiness, tourism, and transport logistics. The study paid special attention to infrastructure development and its impact on a country's export opportunities. The enhancement of transport and logistics infrastructure, including highways, ports, and railway systems, is crucial for optimising the supply of goods to global markets. Specifically, the development of tourism infrastructure helps to attract foreign tourists and increase revenues from this sector, which contributes to economic growth and diversification of the economy.

The education system is crucial for the advancement of Azerbaijan's non-oil sector, facilitating the preparation of skilled professionals for essential economic sectors, including agriculture, industry, and services. The study found that the modernisation of the educational system, the introduction of professional training programmes, and the improvement of the qualification level of specialists contribute to an increase in labour productivity. A constraint of this study was the absence of pertinent data regarding the agricultural and industrial sectors, along with the influence of external factors such as global economic shocks. Subsequent research should concentrate on a comprehensive examination of the enduring effects of the rehabilitated regions and the significance of innovation in the advancement of non-oil industries.

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CONFLICT OF INTEREST

None.

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Ненафтовий сектор економіки Азербайджанської Республіки: перспективи та напрямки розвитку в рамках сучасної економічної політики

Анотація. Дослідження мало на меті оцінити критичні змінні і методи, які сприяють сталому розвитку ненафтового сектору економіки Азербайджану. Було проаналізовано внесок ненафтового сектору в економічний розвиток Азербайджану на тлі глобальних трансформацій та економічних проблем. Основна увага була приділена диверсифікації економіки та зменшенню залежності від нафтових доходів, що є важливим кроком на шляху до сталого економічного зростання. Дослідження показало, що розвиток таких секторів, як сільське господарство, промисловість і сфера послуг, сприяє створенню нових джерел доходу і забезпечує економічну стабільність. Розвиток ненафтового сектору має вирішальне значення для створення робочих місць, підтримки малих і середніх фірм та покращення умов життя населення, особливо в сільській місцевості та ізольованих регіонах. У дослідженні підкреслюється, що сільське господарство і туризм можуть отримати значну вигоду від впровадження інноваційних технологій та модернізації інфраструктури. Внесок ненафтового сектору в економіку проявляється у покращенні транспортної та логістичної інфраструктури, що сприяє збільшенню експортного потенціалу. Розвиток якісних послуг у таких сферах, як охорона здоров'я, освіта та туризм, також сприяє покращенню соціального добробуту громадян та підвищенню міжнародної конкурентоспроможності країни. Результати дослідження показали, що подальший розвиток ненафтового сектору потребує активних інвестицій, покращення бізнес-клімату та усунення адміністративних бар'єрів. Диверсифікація економіки, розвиток інноваційних рішень та модернізація інфраструктури є ключовими факторами, що сприятимуть сталому економічному зростанню Азербайджану в довгостроковій перспективі

Ключові слова: диверсифікація; інвестиції; транспортна інфраструктура; сфера послуг; система освіти

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Economic efficiency of investment in innovation in a knowledge-based economy

Abstract. The purpose of the study was to analyse the impact of gross domestic expenditure on research and development on key indicators of knowledge-based economy performance in the short- and long-term using data from developed and developing countries. The results of the study showed an increase in attention to investment in innovation in a global sense. The leading countries and regions for investment in innovation are the United States of America, the EU, China, and Japan. Regression analysis of the short-term impact of gross domestic expenditure on research and development on key indicators of economic efficiency (level of human development, productivity, and gross domestic product (GDP) per capita) revealed a statistically significant impact only on the indicator of the level of human development. But the analysis of the long-term impact of this indicator on the example of data from the EU countries revealed the statistical significance of this impact on all dependent variables. This proved that investments in innovation have a cumulative effect that manifests itself in the long term. The identified impact on the indicator of the level of human development in both the short and long term indicates the fundamental role of investment in innovation in such development. The analysis of data from Kosovo revealed an inverse correlation between gross domestic expenditure on research and development and GDP per capita and human development. This revealed the low efficiency of investment in innovation in the country and suggested that Kosovo may need more time to achieve a positive cumulative effect from investments. Accordingly,

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the government of Kosovo should build on the successful international experience of developed countries in developing innovation investment initiatives and establishing international cooperation. In addition, investing in innovation may not have an immediate positive effect, and it takes longer to achieve it

Keywords: gross domestic expenditure on research and development; human development index; productivity; gross domestic product per capita; cumulative effect; short-and long-term perspective; level of development

INTRODUCTION

Industry and agriculture are priority sectors of the economy for developing countries. In turn, advanced economies focus their efforts on the development of the service sector, an important element of which is knowledge-based activities. This concept is called the "knowledge economy" or "knowledge-based economy". The key factor in the development of a knowledge-based economy is human capital, in particular, its intellectual abilities and knowledge (Novykova *et al.*, 2022). An important role is played by investment in innovation, which provides the development of a knowledge-based economy with wider opportunities for creating new knowledge. The pace of transition to a knowledge-based economy on the part of developing countries, in particular Kosovo, is significantly delayed (Phale *et al.*, 2021; Fazliu, 2024). During the last reporting period, Kosovo has achieved very limited progress in research and development (R&D). The country did not maintain previous results in the EU research and innovation framework, and most of the Commission's recommendations from the previous year remained unfulfilled (Kosovo 2024 report, 2024). Improving the quality of education and aligning existing educational approaches with market requirements remain key challenges (Melnikova & Gilsanz, 2024). In addition, Kosovo lags significantly behind in terms of funding for research and innovation, because in 2024 only EUR 15 million were allocated for R&D, which is about 0.1% of GDP, and according to the law, this figure should be at least 0.7% of GDP (Law of the Republic of Kosovo No. 04/L-135, 2013). Kosovo's Horizon Europe results also declined significantly in 2023, with a drop of about 75% compared to the previous period. Among the positive aspects is the support of female students by the Ministry of Education, Science, Technology and Innovation, although the country lacks a clear gender strategy (Kosovo 2024 report, 2024).

Problems in the development of innovation activities in Kosovo encourage national researchers to carefully analyse successful world practices and find ways to solve existing challenges. L. Aliu Mulaj & B. Dedaj (2022) concluded that achieving long-term success in the economy requires constant innovation. Researchers noted the importance of intellectual human capital and science for effective technological development and investment in R&D. A comparison was made between the share of R&D in the GDP of thirty countries, including the Balkan countries. The researchers concluded that investment in R&D in the Balkan countries significantly lags behind the indicators of economically powerful countries. The comparison was made to assess different opinions, which can lead to the identification of ways to increase economic growth. G. Jusufi & S. Ajdarpasic (2020) assessed the impact of EU research and education programmes on higher education institutions in the Balkan countries, focusing on Kosovo. It was found that higher education institutions in the region lack the financial capacity to update curricula, programmes, and develop research projects. That is why national educational institutions should rely on EU research programmes that can solve the funding problem. The need for close cooperation with the EU was also emphasised by Z. Dedaj (2022), who noted that at the present stage, the efforts of universities to create knowledge in Kosovo are contradictory, but the positive aspect is the deepening of cooperation with international donors such as the EU.

E. Krasniqi *et al*. (2020) demonstrated the structure of Kosovo's R&D initiatives. The researchers noted that Kosovo's economy has experienced some growth, not least due to consumption and investment. However, the number of innovative enterprises in the country remains quite small. According to Z. Dedaj *et al*. (2022), innovation processes and knowledge circulation between enterprises can be stimulated through open innovation. However, a significant proportion of companies operating in the innovation sector in Kosovo are not familiar with the mechanisms of innovation relations. Using the example of two successful companies in Kosovo, it was found that the main source of innovation is investment in R&D. Such investments would allow companies to gain access to the new equipment and skilled labour necessary for successful innovative development. In most of the research papers, there was a lack of information about investments in R&D in Kosovo. Moreover, little attention has been paid to comparing the short- and long-term effects of such investments. This study sought to fill in the gaps identified by summarising available information on Kosovo's innovation and investment activities and analysing the impact of investment in innovation using the example of leading countries. The purpose of the study was to analyse the impact of R&D costs on the main indicators of the effectiveness of a knowledge-based economy in the short and long-term using the example of countries with different levels of development.

MATERIALS AND METHODS

The research procedure was initiated with the disclosure of the indicator of investment in R&D in a knowledge-based economy. A statistical analysis of the indicators of total global spending on R&D (Total global spending..., 2022) and R&D investment by industry and world region (Distribution of the 2,500..., 2024) was carried out. Analysis of the first of the presented indicators determined the rapid growth of the indicator values. The analysis of the second indicator provided an opportunity to identify which regions of the world are leaders in R&D investment, including priority industries for investment. These indicators enabled a rapid analysis of the status and priority areas of investment in R&D. However, in the subsequent course of the study, the gross domestic expenditure on research and

development (GERD) indicator was used (Leading countries..., 2024). This indicator is more indicative, because it allows estimating investment in R&D as a percentage of GDP in individual countries, eliminating the impact of the absolute size of the economy.

A predictor of the development of the knowledge economy is human capital, which justifies the introduction of the Human Development Index (HDI) into the analysis (Human Development Index..., 2024). This indicator can demonstrate long-term changes in human development that form the basis for the development of a knowledge-based economy. Along with the noted indicator, an indicator of labour productivity was included in the analysis process (GDP per hours worked), which is effective for evaluating current economic activity (Most productive countries, 2024). The analysis also includes the GDP per capita indicator, which assesses well-being and characterises the potential for further development in a knowledge-based economy. HDI, GDP per hours worked, and GDP per capita were the main indicators of economic efficiency of the countries under study. The characterised indicators became the information basis for conducting correlation and regression analysis, during which the GERD indicator acted as an independent variable, and HDI metrics, GDP per hours worked, and GDP per capita (alternately) – as dependent. The idea of the study was to conduct correlation and regression analysis in two stages. Initially, indicators for a number of leading countries for a single period were taken to assess the short-term impact of investment in innovation on economic efficiency (Table 1).

Table 1. Data for Stage 1 of the correlation and regression analysis

Region	GERD, % of GDP	GDP per capita	HDI	GDP per hours worked
Austria	3.2	56,505.97	0.926	95
Belgium	3.41	53,475.29	0.942	100
Czech Republic	1.96	30,427.42	0.895	57
Denmark	2.89	67,967.38	0.952	104
Estonia	1.78	29,823.75	0.899	55
Finland	2.96	53,755.91	0.942	85
France	2.18	44,460.82	0.91	87
Germany	3.13	52,745.76	0.95	91
Greece	1.49	22,990.01	0.893	45
Hungary	1.39	22,147.21	0.851	52
Iceland	2.66	78,811.06	0.959	90
Ireland	0.96	103,684.9	0.95	163
Italy	1.32	38,373.17	0.906	74
Japan	3.41	33,834.39	0.92	53
Latvia	0.76	23,184.31	0.879	58
Lithuania	1.02	27,102.78	0.879	61
Luxembourg	0.98	128,259.4	0.927	131
Netherlands	2.3	62,536.73	0.946	92
Norway	1.56	87,961.78	0.966	162
Poland	1.46	22,112.86	0.881	56
Portugal	1.7	27,275.11	0.874	56
Slovakia	0.98	24,470.24	0.855	57
Slovenia	2.11	32,163.51	0.926	62
South Korea	5.21	33,121.37	0.929	50
Spain	1.44	32,676.98	0.911	69
Sweden	3.41	56,305.25	0.952	96
Türkiye	1.32	12,985.75	0.855	61
United States	3.59	81,695.19	0.927	92
China	2.43	12,614.06	0.788	14.6

Source: compiled by the authors based on Leading countries by research and development (R&D) expenditure as share of gross domestic product (GDP) worldwide in 2022 (2024), GDP per capita (current US$) (2024), Human Development Index (HDI) by country 2024 (2024), Most productive countries (2024)

The second phase covered indicators for a single region (EU countries) over a ten-year period to assess the long-term impact of R&D investment on the economic efficiency (Table 2).

Table 2. Data for Stage 2 of the correlation and regression analysis

Period	GERD, % of GDP	GDP per capita	HDI (average)	GDP per hours worked
2013	1.58	46,003.71	0.874	55.2
2014	1.59	46,657.58	0.876	55.8
2015	1.91	47,656.09	0.878	56.7
2016	1.91	48,517.05	0.88	57.4

Table 2. Continued

Period	GERD, % of GDP	GDP per capita	HDI (average)	GDP per hours worked
2017	1.91	49,894.32	0.882	58.1
2018	1.85	50,933.56	0.884	58.9
2019	1.99	51,884.56	0.885	59.6
2020	2.01	48,901.39	0.886	59.2
2021	1.91	51,916.83	0.886	60.3
2022	2.17	53,758.88	0.887	61

Source: compiled by the authors based on Leading countries by research and development (R&D) expenditure as share of gross domestic product (GDP) worldwide in 2022 (2024), Most productive countries (2024), Human Development Index (HDI) by country 2024 (2024)

An additional stage of work was the correlation and regression analysis based on data from Kosovo (Table 3). Access to data for analysis for Kosovo is very limited, in particular, there is no data on the indicator GDP per hours worked and GERD. The first of these indicators was not considered in the analysis, because it is partially compensated by data on other dependent variables – HDI and GDP per capita. However, GERD as the only independent variable in the analysis cannot be excluded, so the paper used the average GERD for the Balkan countries instead of the GERD indicator for Kosovo.

Table 3. Data for an additional stage of correlation and regression analysis based on Kosovo data

Period	GERD, % of GDP (Balkans average)	HDI	GDP per capita
2010	3.333333	0.713	2.981
2011	0.9	0.722	3.524
2012	1.025	0.732	3.411
2013	0.88	0.736	3.705
2014	0.86	0.741	3.903
2015	0.8	0.746	3.521
2016	0.74	0.749	3.759
2017	0.74	0.754	4.009
2018	0.78	0.757	4.384
2019	0.78	0.756	4.416
2020	0.9	0.755	4.311
2021	0.925	0.756	5.271
2022	0.533333	0.757	5.291

Source: compiled by the authors based on Leading countries by research and development (R&D) expenditure as share of gross domestic product (GDP) worldwide in 2022 (2024), Kosovo GDP per capita 2008-2024 (2024), Subnational HDI (v8.1) (2024)

The selection of countries and regions for analysis considered the data of statistical analysis, which helped to identify the leading countries in R&D investment. Focusing on data from advanced countries allowed assessing the specifics of investing in R&D in countries that set trends in global innovative development. Consideration of the data from Kosovo helped to assess the relationships under study using the example of a developing country. The final data sample was compiled after multicollinearity analysis, and the exclusion of individual countries for which data were not available on official sources of information. The analysis used data for 2022, because these were the latest data available on official sources.

RESULTS AND DISCUSSION

Statistical overview of key trends in innovation investment

Knowledge-based economics focuses on the production and sale of innovations and research results, such as scientific discoveries, which are transformed into commodities by applying various mechanisms to protect intellectual property. Investments provide activities related to research and innovation development with the necessary funds and resources. The structure of the R&D indicator provides an idea of the world leaders in investment in innovation, and priority industries for investment. Figure 1 shows the dynamics of Total global spending on R&D during the period from 1996 to 2022.

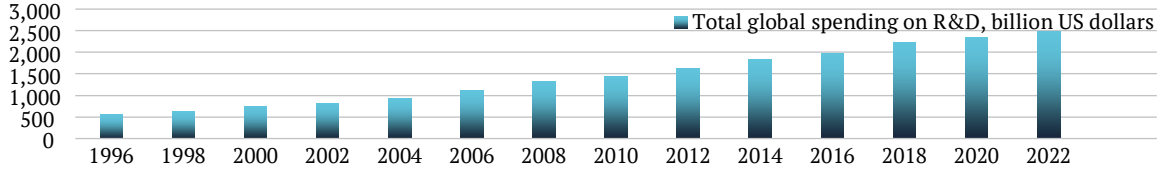

Figure 1. Global spending on R&D

Source: compiled by the authors based on Total global spending on research and development (R&D) from 1996 to 2022 (2022)

As can be seen from Figure 1, spending on R&D has only increased over the past quarter-century, and global spending has increased almost 4.5-fold over this period. The only period when the indicator experienced some decline was 2020. The main players in the R&D market are developed countries, in particular, the United States of America (USA) and the EU countries, although China and some other countries make a great contribution (Fig. 2).

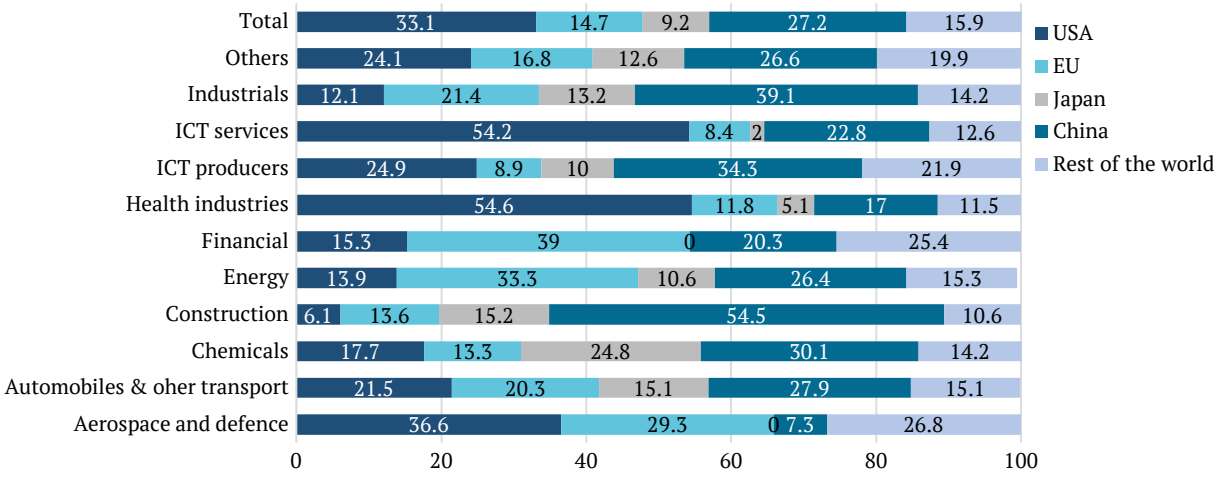

Figure 2. Countries' investment in R&D by industry, billion EUR

Source: compiled by the authors based on Distribution of the 2,500 leading global research and development (R&D) spending companies in 2022, by region and industry (2024)

As can be seen from Figure 2, the leader in investment in priority industries is the United States. The EU, China and Japan also play an important role. Along with material investment, the effective use of human knowledge and intellectual experience is important in the knowledge-based economy. The development of human capital is a key predictor of the transition to a knowledge-based economy, because it provides the basis for its development (Bokovets *et al.*, 2024). Potentially, between investments in innovation, in particular the GERD indicator, and the HDI indicator, GDP per hours worked, and GDP per capita have a mutual relationship. These indicators show the effectiveness of a knowledge-based economy, because they describe such efficiency at the intersection of the economic and social spheres. They comprehensively characterise human capital as a key element of a knowledge-based economy in terms of intellectual and physical potential, productivity, and well-being, forming the basis for short-and long-term growth. Thus, by measuring the impact of investment in innovation on the observed indicators, it is possible to describe the economic efficiency of investment in innovation in a knowledge-based economy.

Correlation and regression analysis of the short-and long-term impact of investment in innovation according to data from leading countries

At this stage of correlation and regression analysis, the short-term impact of investment in innovation was analysed. For this purpose, the GERD indicator and knowledge-based economy performance indicators – GDP per capita, HDI, and GDP per hours worked – were used to sample countries over a single time period (Table 4). The results of correlation analysis for a sample of countries over a single period do not show a close correlation between GERD and performance indicators of knowledge-based economics.

Table 4. Results of correlation analysis for a sample of countries for a single period

GERD, % of DGP	GDP per capita	HDI	GDP per hours worked
1			
0.081899934	1		
0.404316266	0.70345033	1	
–0.038939625	0.88735315	0.742319	1

Source: calculated by the authors based on Leading countries by research and development (R&D) expenditure as share of gross domestic product (GDP) worldwide in 2022 (2024), GDP per capita (current US$) (2024), Most productive countries (2024), Human Development Index (HDI) by country 2024 (2024)

There is a fairly strong relationship between GDP per capita, HDI, and GDP per hours worked indicators. This indicates a complex mutual influence between the studied indicators, in particular, it can be assumed that human capital and productivity form the basis for improving the overall well-being of the population. Table 5 shows the results of regression analysis between GERD indicators (as an independent variable) and GDP per capita for sample countries for one period. The resulting model has little explanatory power, and the effect of GERD on GDP per capita is not statistically significant in the short term. Statistical significance Intercept ($p < 0.05$) indicates the possible existence of influential variables not considered in the calculations. The next stage of regression analysis describes the effect of the GERD indicator on HDI (Table 6).

Table 5. Results of regression analysis for a sample of countries for a single period, dependent variable – GDP per capita

	Coefficients	Standard error	*t* stat	*p* value	Lower 95%	Upper 95%	Lower 95%	Upper 95%
Intercept	41,936.57	12,289.8	3.41	0	16,719.99	67,153.15	16,719.99	67,153.15
GERD, % of DGP	2,179.14	5,103.39	0.43	0.67	−8,292.15	12,650.43	−8,292.15	12,650.43

Source: calculated by the authors based on Leading countries by research and development (R&D) expenditure as share of gross domestic product (GDP) worldwide in 2022 (2024), GDP per capita (current US$) (2024)

Table 6. Regression analysis results for a sample of countries for a single period, dependent variable – HDI

	Coefficients	Standard error	*t* stat	*p* value	Lower 95%	Upper 95%	Lower 95%	Upper 95%
Intercept	0.88	0.02	53.73	0	0.84	0.91	0.84	0.91
GERD, % of DGP	0.02	0.01	2.3	0.03	0.00	0.03	0.00	0.03

Source: calculated by the authors based on Leading countries by research and development (R&D) expenditure as share of gross domestic product (GDP) worldwide in 2022 (2024), Human Development Index (HDI) by country 2024 (2024)

The results of the analysis show that the GERD indicator has a statistically significant impact on the level of human development ($p = 0.002$). Accordingly, such an impact can be tracked already at the stage of short-term analysis. Results of regression analysis of the impact of investment in innovation on GDP per hours worked are shown in Table 7.

Table 7. Regression analysis results for a sample of countries for a single period, dependent variable – GDP per hours worked

	Coefficients	Standard error	*t* stat	*p* value	Lower 95%	Upper 95%	Lower 95%	Upper 95%
Intercept	80.87	14.49	5.58	0	51.15	110.6	51.15	110.6
GERD, % of DGP	−1.22	6.02	−0.2	0.84	−13.56	11.12	−13.56	11.12

Source: calculated by the authors based on Leading countries by research and development (R&D) expenditure as share of gross domestic product (GDP) worldwide in 2022 (2024), Most productive countries (2024)

As in the case when the dependent variable was GDP per capita, this model does not show high explanatory ability. The impact of GERD on GDP per hours worked is not statistically significant, but the *p* values for Intercept suggest the existence of influential variables that are not represented in the model. Thus, in the short term, investment in innovation has the greatest impact on the human development indicator. To analyse the long-term impact of investment in innovation on the performance indicators of a knowledge-based economy, indicators for one region – EU countries – over a ten-year period of time were used. The results of correlation analysis for this sample are presented in Table 8.

Table 8. Results of correlation analysis for EU countries over a ten-year period

	GERD, % of DGP	GDP per capita	HDI (average)	GDP per hours worked
GERD, % of DGP	1			
GDP per capita	0.794888	1		
HDI (average)	0.851443	0.898074	1	
GDP per hours worked 2022	0.853218	0.954637	0.981321	1

Source: calculated by the authors based on Leading countries by research and development (R&D) expenditure as share of gross domestic product (GDP) worldwide in 2022 (2024), GDP per capita (current US$) (2024), Most productive countries (2024), Human Development Index (HDI) by country 2024 (2024)

All the indicators under study are closely correlated with each other. This may indicate a significant long-term relationship between investment in innovation and the performance indicators of a knowledge-based economy. These results should be supplemented using regression analysis (Tables 9-11).

Table 9. Results of regression analysis for EU countries over a ten-year period, dependent variable – GDP per capita

	Coefficients	Standard error	*t* stat	*p* value	Lower 95%	Upper 95%	Lower 95%	Upper 95%
Intercept	28,724.33	5,660.31	5.07	0	15,671.63	41,777.03	15,671.63	41,777.03
GERD, % of DGP	11,098.48	2,995.21	3.71	0.01	4,191.51	18,005.45	4,191.51	18,005.45

Source: calculated by the authors based on Leading countries by research and development (R&D) expenditure as share of gross domestic product (GDP) worldwide in 2022 (2024), GDP per capita (current US$) (2024)

The observed model has a significant explanatory capacity, since changes in GDP per capita by about 58% are explained by changes in GERD (as evidenced by the coefficient of determination). The effect of GERD on GDP per capita is significant, because $p = 0.01$. Thus, in the long run, investment in innovation significantly affects the GDP per capita indicator, and therefore, the well-being of the population. Table 10 contains the results of regression analysis for EU countries over a ten-year period using an indicator as a dependent variable HDI (average value).

Table 10. Results of regression analysis for EU countries over a ten-year period, dependent variable – HDI (average)

	Coefficients	Standard error	*t* stat	*p* value	Lower 95%	Upper 95%	Lower 95%	Upper 95%
Intercept	0.84	0.01	94.06	0	0.82	0.86	0.82	0.86
GERD, % of DGP	0.02	0	4.59	0	0.01	0.03	0.01	0.03

Source: calculated by the authors based on Leading countries by research and development (R&D) expenditure as share of gross domestic product (GDP) worldwide in 2022 (2024), Human Development Index (HDI) by country 2024 (2024)

This model also has a high explanatory capacity – approximately 69.1%. Impact of GERD on HDI (average) is statistically significant, as is the influence of Intercept, and therefore, the influence of other variables on the dependent indicator is not excluded. Table 11 shows the results of regression analysis for EU countries over a ten-year period using the GDP per hours worked indicator as an independent variable.

Table 11. Results of regression analysis for EU countries over a ten-year period, dependent variable – GDP per hours worked

	Coefficients	Standard error	*t* stat	*p* value	Lower 95%	Upper 95%	Lower 95%	Upper 95%
Intercept	41.03	3.73	11	0	32.44	49.63	32.44	49.63
GERD, % of DGP	9.13	1.97	4.63	0	4.58	13.68	4.58	13.68

Source: calculated by the authors based on Leading countries by research and development (R&D) expenditure as share of gross domestic product (GDP) worldwide in 2022 (2024), Most productive countries (2024)

The high explanatory capacity of this model is indicated by an updated coefficient of determination equal to 0.69. A statistically significant effect on GDP per hours worked is observed by both GERD and intercept. In general, all regression models for EU countries built to characterise the long-term impact of investment in innovation on economic efficiency have demonstrated high explanatory capacity and significant impact of GERD on other variables.

The inclusion of different approaches to correlation regression analysis allowed evaluating two prospects – short-term and long-term. Analysis of a sample of countries over a single period showed that the impact of GERD on some performance indicators of a knowledge-based economy may be weak at some stage, given the diversity of the economies under study. Accordingly, it can be assumed that in the short term, GERD is not a key factor in economic efficiency. An analysis of EU indicators over a ten-year period showed that in the long term, GERD significantly affects economic efficiency, and therefore, investment in innovation can have a cumulative effect, the consequences of which are manifested over time.

Special attention should be paid to the relationship identified between GERD and HDI, after all, a significant impact GERD on the latter indicator was observed both in the short and long term. This demonstrates the critical role of investment in innovation in human development, which is that investment in innovation often involves spending on science and education (Fernández-Villarán & Cuenca, 2023). This directly affects the improvement of access to knowledge and the well-being of the population. Investment in innovation is accompanied by technological development, which contributes to better working conditions, greater educational opportunities, and economic development in general (Ketners & Petersone, 2021). In the process of correlation analysis for both approaches, it was confirmed that the growth of HDI is associated with both increased productivity and GDP per capita growth. However, unlike GDP per capita, the HDI indicator considers longer trends and is not significantly affected by short-term fluctuations. It is more stable, which explains the close relationship between HDI and GERD in the short and long term.

Correlation and regression analysis based on data from Kosovo

One of the key results of the analysis is that investment in innovation can have a positive impact on the level of human development, labour productivity, and well-being in the long term. The impact on the level of human development was also observed in the short term. However, this analysis was mainly focused on the indicators of advanced countries. Therefore, it is worth checking the conclusions obtained from data from less developed countries, in particular, on the example of Kosovo. A comparison of Kosovo's indicators with those of EU countries is shown in Table 12.

As can be seen from Table 12, Kosovo lags far behind EU countries in terms of all the indicators mentioned. This highlights the need for an additional phase of analysis for Kosovo, which will help to understand the relationship between the indicators studied for less developed countries. The results of the correlation analysis between Kosovo's indicators are presented in Table 13.

Table 12. Comparison of average indicators of EU countries and Kosovo

	GERD, % of GDP	GDP per capita	HDI
EU	1.88	49,612.4	0.8818
Kosovo	0.79*	4,257	0.7507

Note: *average for the Balkan countries
Source: calculated by the authors based on Leading countries by research and development (R&D) expenditure as share of gross domestic product (GDP) worldwide in 2022 (2024), GDP per capita (current US$) (2024), Human Development Index (HDI) by country 2024 (2024), Kosovo GDP per capita 2008-2024 (2024), Subnational HDI (v8.1) (2024)

Table 13. Results of correlation analysis for indicators of Kosovo

	GERD, % of GDP (average for Balkans)	HDI	GDP per capita
GERD, % of GDP (average for Balkans)	1		
HDI	−0.70515	1	
GDP per capita	−0.52329	0.792085	1

Source: calculated by the authors based on Leading countries by research and development (R&D) expenditure as share of gross domestic product (GDP) worldwide in 2022 (2024), Kosovo GDP per capita 2008-2024 (2024), Subnational HDI (v8.1) (2024)

In the example of Kosovo, there was a significant negative correlation between GERD, % of GDP, and HDI and GDP per capita indicators. This may indicate a low efficiency of investment in innovation. It can also be assumed that Kosovo may need more time to achieve a positive long-term investment effect. In addition, a strong positive relationship was found between HDI and GDP per capita. This may indicate that the level of human development in Kosovo contributes to the improvement of the overall well-being, but this is not through innovation, but through other sectors of the economy. Table 14 contains the results of regression analysis of GERD effects, where the dependent indicator is HDI.

Table 14. Results of regression analysis based on data from Kosovo, dependent variable – HDI

	Coefficients	Standard error	*t* stat	*p* value	Lower 95%	Upper 95%	Lower 95%	Upper 95%
Intercept	0.76	0.01	141.24	0	0.75	0.77	0.75	0.77
GERD, % of GDP (Average for Balkans)	−0.01	0	−3.30	0.01	−0.02	0	−0.02	0

Source: calculated by the authors based on Leading countries by research and development (R&D) expenditure as share of gross domestic product (GDP) worldwide in 2022 (2024), Subnational HDI (v8.1) (2024)

The analysis confirmed the presence of a negative relationship between GERD and HDI for Kosovo. The detected effect is statistically significant for both GERD and Intercept, but the effect of Intercept is direct. This may indicate that the level of human development in Kosovo is positively affected by indicators not considered in the study. Table 15 contains the results of regression analysis, where GDP per capita acts as a dependent variable.

Table 15. Results of regression analysis based on Kosovo data, dependent variable – GDP per capita

	Coefficients	Standard error	*t* stat	*p* value	Lower 95%	Upper 95%	Lower 95%	Upper 95%
Intercept	4,554.47	305.43	14.91	0	3,882.23	5,226.71	3,882.23	5,226.71
GERD, % of GDP (Average for Balkans)	−509.38	250.1	−2.04	0.07	−1,059.85	41.09	−1,059.85	41.09

Source: calculated by the authors based on Leading countries by research and development (R&D) expenditure as share of gross domestic product (GDP) worldwide in 2022 (2024), Kosovo GDP per capita 2008-2024 (2024)

In this case, the impact GERD is also negative, but less statistically significant ($p < 0.1$). Instead, the influence of Intercept is direct and statistically significant, which, as in the previous model, may indicate the presence of other influential variables. Thus, the assumption of low efficiency of investment in innovation in Kosovo was confirmed, as supported by information from the report, which should be a signal for government officials to review existing policies in the investment and innovation sectors (Kosovo 2024 report, 2024). The results of the analysis for Kosovo differ significantly from the results for EU countries. It was found that GERD in the country is inversely correlated with HDI and GDP per capita indicators. Differences in results for Kosovo and leading countries indicate the feasibility of using world practice in state initiatives. The development of appropriate strategies should consider that investment in innovation may not have an immediate effect, and it takes a longer period of time to achieve positive results.

Knowledge is an essential requirement for the economic growth of any country in the world (Pons Vives *et al.*, 2022) and knowledge-based capital is a source of innovation and contributes to productivity growth (Zakharchyn & Sytnyk, 2023). Based on innovations and technologies, the movement towards the development and progress of states is accelerating. Knowledge-based capital covers a variety of intangible assets, including R&D, data sets, software, etc. (Ismayil-Zada, 2023). The rapid development of technology in the knowledge economy is leading to an

increasing focus on investing in knowledge-based capital. The conclusions of the study regarding the leading role of human capital in a knowledge-based economy coincide with the opinion of B.C. Olopade *et al*. (2020), R. Rohimah (2021) and S.K. Singh *et al*. (2021). The researchers have noted that people's knowledge and skills and human development are key factors for achieving sustainable and innovative development. Z.T. Bimagambetova *et al*. (2023) identified the level of human development as a process of increasing human opportunities through improving health and education, longevity, gaining broader political and economic freedoms, ensuring human rights and respect for the individual. The researcher considered the level of human development to be the main factor in the transition to a knowledge-based economy. In addition, B.H. Mohamed *et al*. (2021) found that factors influencing human development can vary significantly across countries and regions, which was confirmed in this paper by comparing the results of the analysis for the EU countries and Kosovo. Moreover, I. Bąk *et al*. (2022) proved that even within the EU, the level of development of the knowledge economy based on people's knowledge and skills varies significantly in different regions, which significantly affects the innovation capabilities of countries. Similar conclusions were reached by C.F. Albu *et al*. (2020), who noted that such differences are conditioned by the fact that some countries do not invest enough in innovation, R&D.

The next key conclusion from the paper is to identify the fact that investment in innovation can have different impacts on HDI and other indicators studied in the short and long term. J. Hao *et al*. (2020) concluded that a lower intensity of investment in R&D has a positive effect on short-term results, and an increase in this intensity reflects well on the long-term effectiveness of innovation. These conclusions can serve as a confirmation of the thesis of this paper regarding the cumulative effect of investment in innovation. Another study that focused on the differences in short- and long-term results of investment in innovation was conducted by T.Y. Leung & P. Sharma (2021). The researchers have shown that the intensity of R&D can have a negative impact on short-term financial indicators, but they have a positive impact on long-term indicators. This may indicate the validity of the findings of this paper that Kosovo needs a longer period to demonstrate the positive impact of investment in innovation. Now, as noted in the paper, investment in innovation in Kosovo has an inverse relationship with the level of human development and GDP per capita.

In this paper, some additional conclusions were also drawn about the mutual relationship of the indicators under study. In particular, it was noted that investment in innovation has a long-term positive impact on productivity. In contrast to these conclusions, D.B. Audretsch & M. Belitski (2020) proved that R&D are less important for productivity than knowledge dissemination. In addition, the paper revealed a positive relationship between the level of human development, well-being and productivity. These conclusions were confirmed by H. Ostrovska *et al*. (2020), which substantiated the link between well-being, health, intellectual potential, innovation, and economic growth. In addition, such results were reflected in the study by T. Gulcemal (2020), who noted that human development contributes to economic growth by analysing the HDI and GDP indicators of a number of developing countries. R. Dědeček & V. Dudzich (2022) identified the shortcomings of using such an indicator as GDP per capita as an indicator of economic development and well-being. The results of the study showed that countries with higher income inequality may be characterised by a lower level of development than their GDP per capita indicator suggests. In this paper, the HDI indicator was also used as an indicator of the level of development, and therefore, the conclusions of researchers can be relevant in the context of this study, which also revealed that GDP per capita is not stable enough for an accurate assessment of economic development. Thus, the conclusions of the study correlate with the conclusions of other studies. In addition, the results of this paper provide a new vision of the relationship between investment in innovation and the level of human development, productivity, and GDP per capita through an in-depth analysis of the impact of investment in innovation in the short and long term.

CONCLUSIONS

The results showed an increased focus on investment in innovation at the global level. As of 2022, global innovation spending totalled USD 2,475.7 billion. Leading countries such as the US, EU countries, China, and Japan are increasingly investing in R&D. Their share in global R&D spending is more than 70% in the aerospace and defence industries, automotive, energy, finance, and other industries. This allows them to maintain their competitiveness in the international arena. Based on the results of a regression analysis conducted on the data of these countries to identify the short-term impact of GERD on HDI, productivity, and GDP per capita, a statistically significant impact at the level of $p = 0.002$ was recorded only on the human development indicator. The results of the regression analysis for EU countries, which included an assessment of the long-term impact of GERD, showed a statistically significant ($p < 0.05$) effect on all dependent indicators. Consequently, investment in innovation has a cumulative effect that manifests itself over time. The identified impact of GERD on HDI in the short and long term suggests that investment in innovation plays a key role in human capital development. In turn, human capital development is a more stable, sustainable, and indicative predictor of economic growth than other indicators under study, such as GDP per capita, reflecting longer-term trends.

Along with analysing data from the world's leading countries, the study included regression analysis based on data from Kosovo. This analysis showed the long-term impact of investment in innovation on the country, although given the limited data for Kosovo, the analysis did not include a national GERD indicator, but the average GERD indicator for the Balkan countries. This is a limitation of the study, because it can slightly distort the results due to the combination of national indicators with a regional indicator. Regression analysis of Kosovo data revealed an inverse relationship between the average GERD and indicators of GDP per capita and the level of human development. The regression coefficients were −509.38 and −0.01 at significance levels $p = 0.07$ and $p = 0.01$, respectively. Such results of the analysis show the low efficiency of investment in innovation in Kosovo, which should be a signal for officials

to reconsider the existing policy in the investment, innovation and education spheres. Kosovo may need a much longer period of time to achieve the positive effect of investment in innovation compared to advanced countries, which is conditioned by the cumulative effect of such investments. This may indicate the need to reorient development policies from short-term goals to more sustainable and long-term ones. Future studies should include a wider range of additional indicators for in-depth analysis of their impact on economic efficiency, such as indicators of investment in education, considering short-and long-term prospects.

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CONFLICT OF INTEREST

None.

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Економічна ефективність інвестицій в інновації в економіці, заснованій на знаннях

Анотація. Метою дослідження було проаналізувати вплив валових внутрішніх витрат на дослідження та розробки на ключові показники ефективності економіки, заснованої на знаннях, у короткостроковій та довгостроковій перспективі, використовуючи дані розвинених країн та країн, що розвиваються. Результати дослідження засвідчили зростання уваги до інвестицій в інновації у глобальному вимірі. Провідними країнами та регіонами за обсягами інвестицій в інновації є Сполучені Штати Америки, Європейський Союз, Китай та Японія. Регресійний аналіз короткострокового впливу валових внутрішніх витрат на дослідження та розробки на ключові показники економічної ефективності (рівень людського розвитку, продуктивність праці та валовий внутрішній продукт (ВВП) на душу населення) виявив статистично значущий вплив лише на показник рівня людського розвитку. Але аналіз довгострокового впливу цього показника на прикладі даних країн Європейського Союзу виявив статистичну значущість цього впливу на всі залежні змінні. Це довело, що інвестиції в інновації мають кумулятивний ефект, який проявляється в довгостроковій перспективі. Виявлений вплив на показник рівня людського розвитку як у короткостроковій, так і в довгостроковій перспективі свідчить про фундаментальну роль інвестицій в інновації у такому розвитку. Аналіз даних по Косово виявив зворотну кореляцію між валовими внутрішніми витратами на дослідження і розробки та ВВП на душу населення і людським розвитком. Це свідчить про низьку ефективність інвестицій в інновації в країні та припускає, що Косово може знадобитися більше часу для досягнення позитивного кумулятивного ефекту від інвестицій. Відповідно, уряд Косова повинен спиратися на успішний міжнародний досвід розвинених країн у розробці інноваційно-інвестиційних ініціатив та налагодженні міжнародного співробітництва. Крім того, інвестиції в інновації можуть не мати негайного позитивного ефекту, і для його досягнення потрібно більше часу

Ключові слова: валові внутрішні витрати на дослідження і розробки; індекс людського розвитку; продуктивність; валовий внутрішній продукт на душу населення; кумулятивний ефект; короткострокова і довгострокова перспектива; рівень розвитку

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