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Returns, interest rate variations and changes in foreign exchange rates in Asia

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Abstract. The aim of the paper was to resolve the contradictory findings on exchange rate variability and stock returns on the basis of comparative evidence from Asian markets with interest rate variation serving as a moderator of the observed effect. The study applied the quantile and Bayesian Vector Autoregression technique from 2000 to 2023. The findings suggest that currency rate volatility and interest rate risk are two market risk variables that have a large and negligible direct influence on stock return, particularly over the long term. The results demonstrated a significant positive relationship between variations in exchange rates and return on assets, the latter being established at the medium to higher quantile of exchange rates. Return on assets reacts favourably to shocks related to interest rates and exchange rates. This may suggest that stock markets with substantial international operations are robust enough to withstand the volatility and risk brought on by currency rate swings. The results indicate that interest rate variations, which are favourable to the market, have a positive effect on returns. It implies that banks are motivated to extend credit to more people. When these factors move in same direction, there is a low sentiment in the market, a low risk and positive investor behaviour. Additional quantification of the magnitude and direction of volatility spillovers between exchange rates and stock returns show how these linkages are dynamic and vary depending on nations, time periods and market. The interdependence of exchange rate changes and stock returns within the larger financial ecosystem is highlighted by the volatility spillover that influences economic policy decisions, risk management techniques and investment strategies. The study concluded that during the analysed periods in Asia, the market risk variables taken into account in this model are important and substantial predictors of return on assets

Keywords: risk; quantile regression; fluctuations; credit; volatility; financial crisis

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INTRODUCTION

Due to currency volatility, exchange rate risk is now considered one of the primary issues with foreign portfolio diversification. Risk of losing money (financial losses) due to hostile and unfavourable fluctuations in exchange rates is commonly referred to as exchange-rate risk or currency risk. Currency risk exposes investors and business owners, who operate internationally and have assets to financial losses. Higher profits are among the advantages of a stable currency and a reduced risk profile from foreign portfolio diversification. Thus, managing exchange rates and currency volatility are crucial aspects of portfolio management, which is the primary focus of this research. Currency risk can result in erratic gains and losses. Foreign exchange or currency risk can be divided into three categories: the risk that occurs when the exchange rate changes before the deal is finalised (transaction risk); the currency risk, with which a vulnerability to exchange rate swings lower than a company's market value (economic risk); the currency risk associated with a business, retaining a sizable amount of its assets, liabilities, or stocks in foreign currencies (translation risk).

In this sense, J.W.M. Mwamba *et al*. (2019) demonstrated that when looking for advantages from foreign portfolio investment and international diversification, African investors face with significant currency rate risk. Hence, when there is less currency fluctuation, greater diversification worldwide yields higher returns at lower risk. The succession of local currency depreciations in major regional economies over the past two years has shown that foreign exchange is likely the most important component of the risk equation for any organisation. H. Napitupulu & N. Mohamed (2023) pointed out that the unanticipated COVID-19 epidemic increased stock market volatility and extreme price shocks since the markets are vulnerable to events that limit investors' mobility. The results obtained by A. Gbadebo (2023) suggest that share prices respond positively to positive shocks in exchange rates in one-way, whereas share prices do not react negatively to negative changes in exchange rates. This implies that the depreciation of the naira serves as a motivator for investors to engage in more stock market trading. According to C. Chikwira & J.I. Mohammed (2023), there is a considerable positive link between growth success and the stock market.

According to C. Urom *et al*. (2023), energy markets are the main sources of shocks and have poor connections with other markets. The analysis also showed that equity markets in France and South Africa communicated the highest volatility spillover. S.R.M. Ali *et al*. (2022) examined the connection between oil and stock market volatility and discovered that the returns of both markets were positively correlated. The findings further revealed that the currency rate, stock market and oil market all supported co-movement. S.A. Nusair & D. Olson (2022) presented scientific evidence supporting the connection that runs from stock prices and exchange rates in the G7, apart from the Italian economy. Using the spillover index, I. Jebabli *et al.* (2022) studied volatility spillovers between the global energy market and the stocks markets. They realised that the energy industry was impacted by global equities markets. After conducting research for the BRICS, K. Rai & B. Garg (2022) came to the conclusion that during the pandemic, an increase in stock returns had a negative impact on the changes in exchange rate. Y. Li *et al*. (2021) also proposed compelling evidence of COVID-19 fatality instances. The stock market responds to patients' deaths more than to their recoveries. Using the VAR-GARCH technique, B. Aydogan *et al*. (2024) examined the spillover between cryptocurrency and stocks in seven developing nations and the G7. The study discovered significant return and volatility spillover between cryptocurrencies and G7 stock markets, with most developing countries experiencing unidirectional spillover and most G7 markets experiencing bidirectional spillover.

The purpose of this research was to evaluate empirically how stock returns react to changes in foreign exchange rates and interest rates in Asia countries. The significance of this study derives from the fact that the research focuses on the analysis of volatility connectivity and spillover rather than their causation. The research has looked into the relationships and spillovers of volatility between exchange rates and stock price returns in Asia countries. The volatility of "giver" and "receiver" has been measured. As is can be seen from the analysed literature, a lot of attention is paid to the study of exchange market or stock market connection. Stock market and exchange rate volatility have been measured, and potential correlations between financial markets in Asia have been examined. Additionally, the volatility connection between exchange rates and asset returns, which has not been extensively studied in the past, has been explored.

LITERATURE REVIEW

The international Fisher effect theory and the portfolio theory provide the theoretical foundation for the relationship between the foreign exchange and stock markets. The co-movement of stocks and exchange rates can be explained by both theories; however, they may have an impact on a market at the same time. International Fisher effect theory upholds that currency rate fluctuations throughout time are based not on inflation rates but on market interest rates. The Fisher hypothesis simply states that as long as financial market arbitrage opportunities exist, which usually occurs in the form of capital flows, real interest rates are the same across nations. Real interest rate equality eventually leads to a slow drop in the real value of the country's currency since the country with the higher interest rate is supposed to have a greater inflation rate as well. The interest rate theory of exchange rate predictions explains the connection between foreign currency rates and comparative interest rates.

Exchange rate changes are sometimes reflected in the nominal interest rate differentials between two nations. Interest rate parity theory upholds the idea that changes in two nations' currency exchange rates balance out differences in interest rates. According to this hypothesis, when two countries have different interest rates, the difference in forward and spot exchange rates is also present. Interest rate parity, which links interest rates, spot exchange rates and foreign exchange rates, is crucial to the operation of foreign currency markets. R. Aydin *et al*. (2024) validated portfolio theory for the BRICS, excluding China, prior to the pandemic; nevertheless, the same authors could only establish the traditional theory for the Chinese stock market. For the G7 countries, S.A. Nusair & D. Olson (2022) found evidence in favour of the portfolio balancing approach over

the long term. The crux of the PBT is an inverse relationship between interest rates and stock prices based on the idea that falling stock prices lead to declining wealth, which in turn causes capital outflows and currency devaluation since falling money demand also lowers interest rates.

N. Mwenda Mutwiri *et al*. (2021) investigated the performance of the Kenyan stock market and systematic risk. The efficient market hypothesis, APT, and integration analysis served as the study's pillars and were used to determine the correlations between its variables. The analysis revealed a strong, long-term positive correlation between Kenya's stock market performance, inflation and interest rates. For the sake of investors, the research recommends investment businesses and financial analysts to forecast future stock exchange performance using historical data on the rate of 91 Treasury notes and inflation. Bidirectional volatility spillovers across the global equities, gold and energy markets were identified by M.M. Elgammal *et al*. (2021). Substantial evidence of volatility connectivity and spillover in the worldwide exchange market has been discovered by I.O. Fasanya *et al*. (2021). In their investigation of the connections and spillover between the oil, stock and foreign exchange markets, E. Bouri *et al.* (2021) discovered spillover between these asset markets. K. Morema & L. Bonga-Bonga (2020) discovered a notable correlation between the volatility of the gold and equities markets in Africa, as well as between the equity market in South Africa and crude oil.

From 2000 to 2016, D.F. Kassi *et al*. (2019) examined how market risk affected the financial performance of companies listed on the Casablanca exchange. The differenced and system GMM methodologies, as well as panel regression with fixed and random effects, were used. The findings suggested that the financial performance of 31 firms, taken into consideration in the sample, was significantly negatively impacted by several indicators of market risk, including the degree of financial leverage, the gearing ratio and the book-to-market ratio. From 2015 to 2007, considerable influence of market risk indicators on the return on Indonesian stocks was reported by T. Farlian *et al*. (2019). The Chow test technique and the common effect were applied. Earlier researches investigating the relationship between foreign exchange and stock markets primarily used linear regression approaches and models, disregarding the possibilities of cross-variable dynamics that enables interactions. This is due to the fact that financial economics encompasses a variety of related topics, including exchange rate passed on effects, interdependence and co-movements in financial markets, transmission effects of currency crises and volatility spillover.

MATERIALS AND METHODS

The Bayesian vector autoregression (BVAR) model is used to evaluate the stock return effects of exchange rate and interest rate changes in Asian countries. The SBVAR model combines panel data with traditional VAR models. It is widely used in several sectors. Similar to the traditional VAR model, the SBVAR model considers each variable in the system to be endogenous. Panel data analysis, which can regulate the individual variability that is not discovered, is another advantage. This suggests that the SBVAR model may capture the relationship between economic variables more accurately and distinctly. Additionally, variance decompositions have been performed using the BVAR model. In real-world applications, a BVAR model with excessive delays has less freedom and a larger chance of multicollinearity. To avoid this, a number of lags in the model were fixed using the Schwarz's Information Criterion (SIC), the Akaike's Information Criterion (AIC) and additional lag length selection criteria. In this paper, the lag order and duration in this model were estimated using the Akaike, Bayesian, and Hannan-Quinn information criteria. This criterion was selected due to its ability to yield more consistent and durable outcomes. Basing the methodology on the asset pricing model that is applicable to scenarios in which foreign variables, common to all or specific asset classes, are mixed with local variables that effect exclusively domestic markets, the information, used to identify the BVAR model, was chosen based on the characteristics that the economies of the Asia nations are most affected by. The estimated model is derived from the return-generating process for a portfolio in terms of a particular reference currency, which is a linear function of exchange rate and interest rate:

$$ROA_t = \beta_0 + \beta_1 EXR_t + \beta_2 INTR_t + e_t, \quad (1)$$

where *ROA* is the return on assets in Asia pacific; *EXR* is the real exchange rate volatility; and *INTR* is the short-term interest rate. The standard VAR model is specified as:

$$X_t = c + \sum D_t X_{t-1} + e_t, \quad (2)$$

where X_t is a $K \times 1$ vector of response variables in period t; D_i is the coefficient matrix of the i^{th} lag of X_t. The relevant BVAR model to capture the interactions amongst exchange rate, *ROA* inflows and interest rate is thus specified as:

$$ROA_t = \alpha_0 + \sum_{j-1}^{p} \alpha_1 ROA_t - i + \sum_{j-1}^{p} \alpha_2 EXR_t - i + \\ + \sum_{j-1}^{p} \alpha_3 INTR_t - i + \mu_{1t}; \quad (3)$$

$$EXR_t = \beta_0 + \sum_{j-1}^{p} \beta_1 EXR_t - i + \sum_{j-1}^{p} \beta_2 INTR_t - i + \\ + \sum_{j-1}^{p} \beta_3 ROA_t - i + \mu_{1t}; \quad (4)$$

$$INTR_t = y_0 + \sum_{j-1}^{p} y_1 INTR_t - i + \sum_{j-1}^{p} y_2 ROA_t - i + \\ + \sum_{j-1}^{p} y_3 EXR_t - i + \mu_{1t}. \quad (5)$$

The robustness of the BVAR model estimation was ascertained on the basis of quantile regression estimations. The α-quantile of the *ROA* in a nonparametric context may be expressed as follows, initially:

$$ROA_t = \beta^{\alpha} EXR_t + \beta^{\alpha} INTR_t + \varepsilon^{\alpha}_t, \quad (6)$$

where *ROA*, *EXR* and *INTR* represent return on assets, exchange rate and interest rate. The linearisation of the coefficient vector was based on the first-order Taylor expansion of β^{α} around EXR^{μ} and $INTR^{\mu}$ which generates the following equations:

$$\beta^{\alpha}(EXR_t) = \beta^{\alpha}(EXR^{\mu}) + \beta^{\alpha}(INTR^{\mu})(INT_t - EXR^{\mu}); \quad (7)$$

$$\beta^{\mu}(EXR_t) = \beta_0(\alpha, \mu) + \beta_1(\alpha, \mu)(INT_t - EXR^{\mu}). \quad (8)$$

Equation (8) can be substituted with equation (7) to get the following equation:

$$ROA_t = \beta_0(\alpha, \mu) + \beta_1(\alpha, \mu)(INT_t - EXR^{\mu}) + \varepsilon^{\alpha}_t. \quad (9)$$

Equation (9) captures the connection between the α^{th} quantile of exchange rate and interest rate and the μ^{th} quantile of the *ROA*, given that β_0 and β_1 are reciprocally indexed in α and μ. Accordingly, the estimated values of α and μ were used in equation (10) respectively:

$$min_{b0,\ b1}, \sum_{t-1} \partial_{\alpha}(ROA_t - b_0, -b_1(INT_t - EXR^{\mu})G(F_n EXR_t - \mu), \quad (10)$$

where ∂_{α} represents the tilted absolute value, which provides the α – conditional quantile of ROA_t as a solution. The sample of 20 Asia stock markets in the study includes the stock markets of Bangladesh, India, Pakistan, Sri Lanka, North Korea, Singapore, China, Taiwan, Malaysia, Cambodia, Thailand, New Zealand, Indonesian, Maldives, Mongolia, Vietnam, Philippines, Australian, Russia and Japan. The World Trade Organisation (2024) and United Nations Conference on Trade and Development (Free access..., n.d.; The trade data..., n.d.) were the major sources of the research data. The covered period is from 2000 to 2023. The interest rate variable was calculated as the variation in the short-term rate of the central monetary authorities. The foreign exchange rate changes were calculated as the percentage change in the bilateral exchange rate measure.

Since the US dollars is the currency that is traded most frequently worldwide, the value of each currency in the Asiatic nations included in the study was measured in relation to the US dollars, which was used to determine the percentage change in the bilateral exchange rate measurement. Hence, the percentage changes were obtained in the BDT/USD, INR/USD, PKR/USD, LKR/USD, KPW/USD, SGD/USD, CNY/USD, TWD/USD, MYR/USD, KHR/USD, THB/USD, NZD/USD, IDR/USD, MVR/USD, MNT/USD, VND/USD, PHP/USD, AUD/USD, RUB/USD and JPY/USD. The rationality behind the use of the bilateral exchange rates was the daily exposure of businesses and consumers to these rates when making travel-related purchases, ordering goods and services from other nations, purchasing input from international markets, and signing agreements to export their goods and services abroad. Return on a stock was calculated as the difference between the current price of the most traded stock and the immediate former price of the stock in each Asian market is divided by the stock's immediate former price multiplied by 100. The calculation was done iteratively in order to account for longer time periods. Augmented Dickey-Fuller (ADF), panel unit root (IPS), Perdoni co-integration and Pairwise Granger causality tests were also conducted.

RESULTS

Selected series were descriptively tested to ensure that they followed a normal distribution. The descriptive statistics results are shown in Table 1-3 for returns exchange rate and interest rate respectively as follows: each series' average (i.e., mean and median) in Table 1 above demonstrates a high degree of consistency. None of their values were too high or low, which served as evidence for this. When it came to how the selected series were distributed around their average, almost all of them were distributed quite equally. This was demonstrated by the low standard deviation values that each series possessed. As a result, the series lacked truly large values. Every single variable had a positive skewness statistic. Given that each series was symmetrical around the mean, the coefficient of skewness suggests that they were all very close to having a normal distribution. The kurtosis values of each variable were more than 3. This suggested that they were all fairly distributed. At the 5% level of significance, the Jarque Bera statistics for the return series showed that all the variables were not normally distributed since the pro-value was less than 0.05. The results also show that the kurtosis of the distribution of return is greater than 3 meaning that stock market return of all countries is not normally distributed.

Table 1. Descriptive statistics for *ROA*

Countries	Mean	Skewness	Jarque-Bera	Std. deviation	Kurtosis
Bangladesh	13.0467	1.386	124.587	4.73377	3.39213
India	10.0699	0.356	179.585	5.033917	2.45758
Pakistan	10.9365	5.387	123.489	4.147537	6.44638
Sri Lanka	14.1143	1.289	190.487	3.253622	9.13422
China	10.7955	0.948	176.489	1.813415	3.42306
Taiwan	11.9871	0.187	166.380	2.713514	3.41891
Japan	19.5141	1.267	120.346	1.733901	8.43258
Malaysia	16.3479	1.387	190.347	1.753104	7.9344
Cambodia	14.2529	1.938	145.387	3.190895	8.38456
Thailand	13.3466	1.224	129.300	2.990663	8.86787
New Zealand	10.1306	1.763	188.256	1.888456	9.34234
Indonesian	15.8946	1.092	199.367	3.729956	9.82245
Maldives	17.3558	1.284	144.367	3.915112	10.3245
Vietnam	18.4193	1.654	123.346	3.755022	9.16666
Russia	11.1277	1.902	190.267	3.041525	7.25833
Philippines	13.5641	1.327	189.367	3.571426	4.3568
Australia	10.1423	0.387	100.373	3.592145	5.44167
North Korea	11.0145	0.445	122.346	4.137363	7.53333
Singapore	19.5001	0.192	135.287	3.338271	9.62589
Mongolia	19.2896	1.387	187.267	4.077459	2.71666

Source: created by the authors

Table 2 shows the exchange rate volatility of all countries. The volatility in the exchange rate of Malaysian Ringgits is the highest with a standard deviation of 112.733901, followed by Indian Rupee and Thai Baht with volatility of 110.05363 and 33.190895 respectively. The Chinese Yuan has the lowest volatility of a single digit of 9.098929. The kurtosis of Singapore is normally distributed since their kurtosis value is less than 3, i.e. 1.071432.

Table 2. Descriptive statistics for *EXR*

Countries	Mean	Skewness	Jarque-Bera	Std. deviation	Kurtosis
Bangladesh	21.306573	0.457612	12.172500	21.045201	6.977792
India	61.123786	0.486592	123.75190	110.05363	3.795228
Pakistan	21.123983	0.515571	110.96160	22.053045	2.914132
Sri Lanka	71.124190	0.544551	134.94540	23.053342	2.928003
China	21.326146	0.57353	121.07030	9.098929	3.056633
Taiwan	22.000000	0.576191	146.00002	17.000000	25.78090
Japan	31.88395	0.578852	100.07005	11.34840	3.817673
Malaysia	22.403678	0.581513	111.733901	112.733901	9.459200
Cambodia	33.832343	0.584174	113.753104	13.753104	3.248800
Thailand	40.698363	0.586834	123.190895	33.190895	6.248800
New Zealand	41.713812	0.589495	122.990663	12.990663	11.248800
Indonesian	33.102332	0.592156	161.888456	31.888456	10.588200
Maldives	31.903075	0.594817	113.729956	23.729956	2.0000005
Vietnam	22.732926	0.597478	156.915112	26.915112	14.82003
Russia	17.030536	0.600139	199.755022	13.755022	7.214293
Philippines	16.5920868	0.603833	124.041525	14.041525	6.428572
Australia	19.253379	0.607528	113.571426	27.571426	15.64286
North Korea	19.599323	0.611222	167.592145	29.592145	4.857152
Singapore	18.674762	0.614917	189.137363	24.137363	1.071432
Mongolia	16.984415	0.618611	123.338271	25.338271	3.285712

Source: created by the authors

Table 3 shows the interest rate volatility results of all countries. The Pakistan has the highest volatility in interest rate with a standard deviation of 97.74769. The average rates of Japan, North Korea and Singapore are negative. The implication is that banks are encouraged to lend more. Similar to this, businesses and consumers are drawn to the very low cost of borrowing to ease businesses and this goes a long way to increase investment expenditures.

Table 3. Descriptive statistics for *INTR*

Countries	Mean	Skewness	Jarque-Bera	Std. deviation	Kurtosis
Bangladesh	17.04991	2.218530	128.50	25.41591	1.887133
India	12.16513	1.863000	158.800	34.81709	1.616117
Pakistan	5.566063	2.381717	374.840	97.74769	54.73799
Sri Lanka	23.81629	2.568400	127.520	44.19648	45.47097
China	7.020982	8.014310	493.890	5.16843	2.875120
Taiwan	13.32735	1.831267	877.380	22.33962	1.891009
Japan	2.434138	4.222402	142.02	56.60517	3.287907
Malaysia	20.25127	3.069062	132.54	13.77857	2.9309
Cambodia	16.29240	1.346505	141.772	17.25714	6.187029
Thailand	6.27121	41.92525	152.004	20.73571	1.4111
New Zealand	−13.58754	3.78133	172.236	24.21429	−2.891078
Indonesian	31.48709	7.385528	122.468	27.69286	1.1810345
Maldives	5.466435	0.161560	182.712	31.17143	7.002164
Vietnam	13.84138	14.00937	142.75	14.01865	6.454617
Russia	4.099958	4645.183	102.816	35.66667	1.525560
Philippines	10.02946	0.000000	173.875	36.68333	12.34874
Australia	8.294092	2.820468	192.933	23.48951	2.691256
North Korea	−5.4828943	5.007325	123.991	30.54582	1.289723
Singapore	−2.3802873	11.3873	128.052	21.48464	
Mongolia	7.3673442	9.36745	124.591	29.46759	

Source: created by the authors

The results of unit root test are shown in Table 4. Table 4 above presents the unit root result for the ADF and IPS test, which was calculated using intercept and trend. It shows that the exchange rate became stationary after the

first difference I(1), while the return on assets and interest rate were stationary at levels I(0), using a maximum 5% threshold of significance. The cointegration test must be performed to ascertain whether a long-term relationship exists since the I(0) and I(1) variables have been mixed together. Table 5 results showed that most tests had probabilities less than 0.5%, which allowed accepting the hypothesis of cointegrating relation amongst the variables.

Table 4. Unit root results

Variables	ADF		IPS		
	Levels	First difference	Levels	First difference	Remarks
ROA	9.1651** (0.0004)	–	−1.72889 (0.0419)	–	1(0)
EXR	1.98257 (0.2002)	130.11* (0.0001)	0.27152 (0.6070)	3.19809** (0.007)	1(1)
INTR	189.544* (0.0000)	–	−223.06557* (0.0000)		1(0)

Note: *(**) significant at 1% (5%)

Source: created by the authors

Table 5. Perdoni cointegration test result and Pairwise Granger causality test

Statistics	Statistic	Prob.
Group RHO statistic	0.286601	0.008
Group PP statistic	−2.191460	0.002
Group ADF statistic	0.552223	0.006

Source: created by the authors

At 1%, 5%, or 10% level of significance, accepting the null hypothesis implies that there is no causal relationship between the variables, while rejecting it implies that no variable truly Granger causes the other (Table 6). This is used to show the way in which the rising commercial activity of international and local investors in developing nations is leading to the causality emissions.

Table 6. Pairwise Granger causality test results

Null hypothesis	Obs	*F* statistic	Prob.
EXR does not Granger cause *ROA*	839	0.04185	0.9590
ROA does not Granger cause *EXR*		0.14622	0.8640
INTR does not Granger cause *ROA*	839	0.08308	0.9203
ROA does not Granger cause *INTR*		0.08118	0.9220
INTR does not Granger cause *EXR*	839	0.10159	0.9034
EXR does not Granger cause *INTR*		0.08587	0.9177

Source: created by the authors

This suggests that the degree of production activities is considerable enough to induce *ROA*, which validates the study's results that *EXR* and *ROA* have a positive relationship. The general economic activity of the nation is what drives the investment seen in the nations of Asia Pacific. Table 7 illustrates the selection-order criteria.

Table 7. Selection-order criteria

Lag	Log of lags	Likelihood ratio	Final prediction error	Akaike information criterion	Hannan-Quinn information criteria	Schwarz-Bayesian information criteria
0	−29,961.95	NA	7.54e+28	75.00613	75.02371	75.01288
1	−27,769.39	4363.152	3.19e+26	69.54041	69.61075	69.56743
2	−27,555.57	423.8961*	1.91e+26*	69.02772*	69.15081*	69.07501*
3	−27,549.44	12.10453	1.92e+26	69.03490	69.21075	69.10246

Source: created by the authors

Table 8 indicates that, within a narrow range of 100.00%, the fluctuations in exchange rates contributed to 0.00 to 0.019% of the variation in return on assets, which is generally considered to be a negligible portion. The fact that this ratio seems to be relatively small implies that certain large public investments with delayed economic consequences may have been motivated by a different exchange rate regime. Over the long term, interest rates had a bigger impact on the variation of return on assets than exchange rates. Nevertheless, with a positive value range, the contributions of the interest rate and currency rate components appear negligible. This demonstrates a significant impact of foreign events on the economies of these continents. An excessive dependence on external factors outside the system might seriously damage the economy and make it more susceptible to shocks from outside sources.

Table 8. *BVAR* forecast error variance decomposition results of *ROA*

Variance decomposition of *ROA*				
Period	**S.E.**	***ROA***	***EXR***	***INTR***
1	5.37E+09	100.0000	0.000000	0.000000
2	5.99E+09	99.99843	0.001001	0.000568
3	7.35E+09	99.99707	0.000665	0.002263
4	8.16E+09	99.99733	0.000545	0.002129
5	9.13E+09	99.99682	0.000501	0.002676
6	9.96E+09	99.99668	0.000537	0.002788
7	1.08E+10	99.99626	0.000720	0.003022
8	1.16E+10	99.99585	0.001012	0.003143
9	1.24E+10	99.99528	0.001443	0.003276
10	1.32E+10	99.99463	0.001999	0.003372
Variance decomposition of *EXR*				
Period	**S.E.**	***ROA***	***EXR***	***INTR***
1	376.1175	0.005890	99.99411	0.000000
2	519.8602	0.003737	99.99514	0.001127
3	634.8596	0.003004	99.98947	0.007529
4	734.1258	0.004593	99.98336	0.012044
5	823.4512	0.009404	99.97510	0.015494
6	905.8253	0.017228	99.96476	0.018008
7	983.0464	0.028561	99.95154	0.019902
8	1,056.292	0.043423	99.93521	0.021367
9	1,126.383	0.062108	99.91536	0.022534
10	1,193.922	0.084752	99.89176	0.023487
Variance decomposition of *INTR*				
Period	**S.E.**	***ROA***	***EXR***	***INTR***
1	6.780775	0.109191	0.014776	99.87603
2	6.897255	0.105642	0.017052	99.87731
3	6.935274	0.105286	0.016868	99.87785
4	6.939097	0.108597	0.017036	99.87437
5	6.939921	0.113307	0.017436	99.86926
6	6.940213	0.118793	0.017931	99.86328
7	6.940452	0.124786	0.018472	99.85674
8	6.940696	0.131167	0.019035	99.84980
9	6.940951	0.137921	0.019612	99.84247
10	6.941218	0.145039	0.020199	99.83476

Source: created by the authors

Return on assets is insignificantly related to changes in the exchange rate. According to impulse response function in Table 9, a positive influence on one variable might have a positive or negative level effect on another (Fig. 1). In terms of short-term analysis, exchange rate shocks and interest rate shocks, *ROA* reacts positively.

Table 9. *BVAR* impulse response of *ROA*

Period	***ROA***	***EXR***	***INTR***
1	5.376709	0.000000	0.000000
2	2.6648709	−18,940,706	−14,269,797
3	4.2538709	498,225.6	31,892,940
4	3.562309	−1,999,631.3	14,060,142
5	4.093009	7,397,729.3	28,509,171
6	3.982909	10,725,980	23,118,157
7	4.212009	17,596,120	27,711,049
8	4.2628909	22,908,618	26,706,638
9	4.422909	29,397,543	28,621,343
10	4.5220909	35,617,783	28,976,573

Source: created by the authors

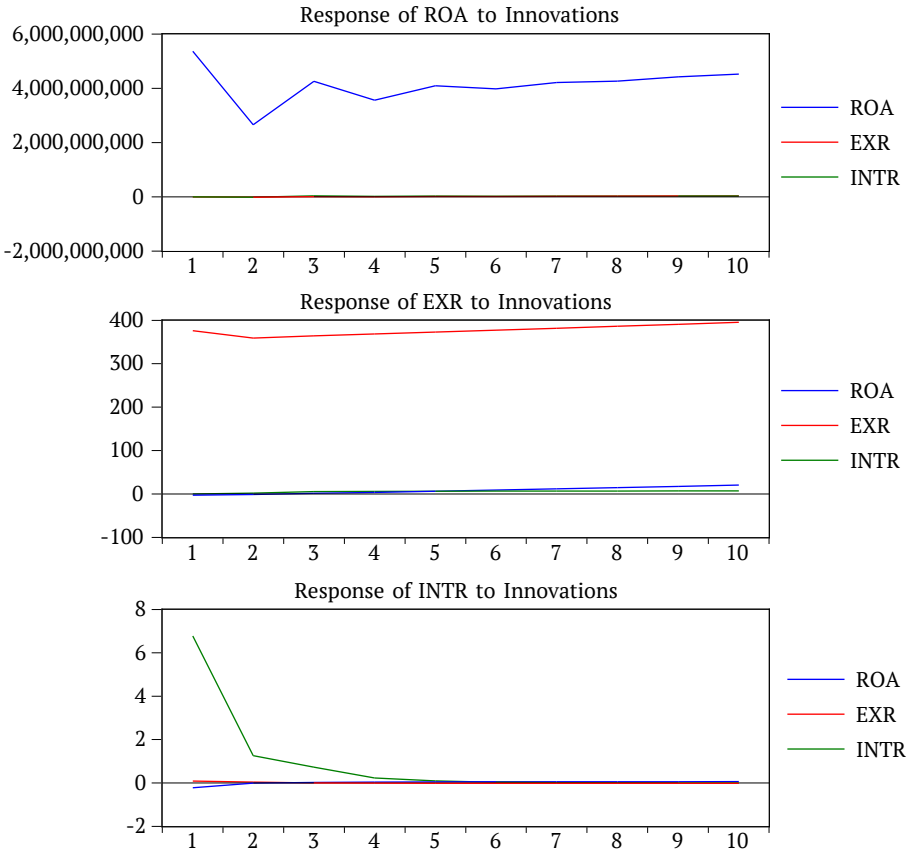

Figure 1. BVAR impulse response

Source: created by the authors

This could suggest that stock markets with significant international operations have the resilience due to hedging to withstand the risk and uncertainty that characterised exchange rate movements. The findings corroborate those of E. Endri *et al*. (2021), who previously reported strong positive effect of the changes in interest rates on stock returns in emerging economies. Negative changes in interest rates are indeed market friendly and it positively affects stock prices and exchange rates simultaneously, leading to higher return. It implies that banks are motivated to extend greater credit. In a similar vein, consumers and businesses are driven to the extremely low cost of borrowing to facilitate businesses, which significantly raise investment return. All these result in low market sentiment, low risk appetite and investor behaviour, aligned in a positive direction. Accordingly, exchange rate risk is priced in equity markets. This is the outcome of the research conducted by L. Bonga-Bonga & S. Mpoha (2024), where the generalised linear model regression, a two-stage model estimation technique was executed, and it was discovered that the South African equities market requires a greater risk premium than the US equity market. Findings vary based on time periods, countries and specific market conditions, highlighting the dynamic and evolving nature of these relationships. Volatility spillover between stock returns and exchange rates underscores their interconnectedness within the broader financial ecosystem, impacting investment strategies, risk management practices and economic policy decisions.

Taking into account the abovementioned, this study has identified three key patterns in the connectivity of financial market volatility. There is a considerable interdependence between the stock and foreign exchange markets in Asia. The authors think there is a variety of explanations for this high correlation. For instance, as a result of bilateral connections and economic cooperation, the economies of Russia and India have grown more intertwined (Mukherjee *et al*., 2022). Increased economic activity has taken place between Russia and India as a result of the two nations' strengthening economic links, the opening up of the Indian economy and the growth of Russian financial markets. Likewise, the findings indicate that there is a substantial correlation between volatility and financial markets in Africa. The fact that Africa has strong political and economic linkages may perhaps be the driving force behind such results. Particularly, the multinational companies operating in the African Economic Community of West African States have partnerships and joint ventures (Diko & Sempijja, 2021), leading to cross-border financial transactions and investments. The financial markets in both nations have seen remarkable growth, which has enhanced bilateral and international investment between them. *BVAR* impulse response of *ROA* can be seen in Table 9.

Table 10 combined the lower and upper quantiles of the interest rate (0.10-0.90) with the lower and upper quantiles of the exchange rate (0.10-0.90) to illustrate the impact of varying exchange rates on returns at various conditional distribution levels. From the medium quantile to the higher

quantile of the exchange rate (0.40-0.90), there is a substantial and significant influence of the exchange rate on return on assets. However, at the lower quantile of the exchange rate (0.10-0.30), the degree of the exchange rate's beneficial effect on return on assets diminishes. Ultimately, it can be pointed out that the exchange rate exhibits a positive impact at all quantiles (low, medium and high) with the strongest positive influence occurring at lower quantiles.

Table 10. Results of the quantile regression

Explanatory variable	10th	20th	30th	40th	50th
EXR	1.05	1.45	0.425	3.925**	17.35**
INTR	4.63	3.94	0.10	−0.02	−0.92
Constant	−0.83	−1.22	−0.25	−1.28	−1.65
Explanatory variable	60th	70th	80th	90th	
EXR	29.96**	5.07**	52.65**	11.22**	
INTR	0.13	0.68	3.34**	10.63**	
Constant	−0.32	0.39	2.91**	15.94**	

Note: (***), (**) and (*) indicate significance at 1%, 5% and 10%, respectively

Source: created by the authors

Additionally, the analysis demonstrates that the interest rate is substantial at the upper quantile (0.80-0.90). This implies that the return on assets in Asia due to changes in exchange rates and interest rates remunerates the markets. According to the findings at the quantile, Asian stocks are mostly net transmitters (receivers) of shocks. There are notable increases with the start of the Russia-Ukraine war and the pandemic, which occurred around November 2021. On the other hand, the majority of financial assets and commodities are net receivers. The switching between net transmitters and receivers of shocks is significantly more prominent at the tail-end distribution of the quantile connectivity than it is at the median quantile. Nonetheless, with this distribution, certain markets are reliably net receivers/transmitters. For instance, exchange was a significant shock transmitter at the fifth quantile. The quantile regression coefficients in Table 11 were compared, which displayed the symmetric quantile results.

Table 11. Symmetric quantiles test results

Test Summary	Variables	Chi-Sq. statistic	Chi-Sq. d.f.	Prob.
Wald Test		53.95121	3	0.0000
Quantiles		Restr. value	Std. error	Prob.
0.25, 0.75	*EXR*	−133,626.9	37,320.83	0.0003
	INTR	4,119,102.0	1,965,871.0	0.0361
	C	1.23E+08	18,993,628	0.0000

Source: created by the authors

In both the lower and upper quantiles, a bidirectional causal relationship between the exchange rate and asset returns was found. Overall, the findings demonstrated bidirectional causation, which holds those changes in the exchange rate influence return on assets and vice versa. There are a few noteworthy findings. Most of the currencies demonstrated strong sensitivity to at least one of the two volatility measures, even after accounting for the typically large impacts of dollar and yen fluctuations. Compared to the more volatile index, estimated sensitivities to the composite index often have a higher statistical significance. It is important not to exaggerate the distinctions between the two sets of estimated sensitivity, though. Second, as volatility increases, the yen tends to climb versus the dollar due to its negative sensitivity to the volatility indicators. Conversely, developing market currencies typically see a decline in value when volatility is high. The Australian, Indonesian, Korean, New Zealand, and Philippine currencies exhibit particularly high levels of sensitivity to fluctuations in global volatility as compared to other currencies in the Asia region. Under the flexible exchange rate system (market forces), the monetary authority is expected to have a modest role in stabilising the market rate. The central bank frequently intervenes in the foreign exchange market because maintaining this regulation would have significantly changed the country's destiny. As a result, there are now fewer incentives for private banks and investors to engage in arbitrage, or speculative activity, and more credit is available to the economy's real sector, promoting growth and development.

Conversely, the exchange rate had little effect on returns in the BVAR results. The outcome demonstrated that whereas interest rate variations have large and favourable influence on returns, currency rates have negative impact on returns. This suggests that a unit change in this variable lowers return in the short term and considerably lowers return in the long term. The research findings thus revealed that while integrating markets tended to increase returns, currency exchange had a negative impact on each market separately. Thus, it may be concluded that portfolio return yield is improved by diversity. The findings demonstrated the need for African investors to place a greater emphasis on certain Asian stock markets if they want to optimise their investments while accounting for exchange rate risk.

The study discovered that during the analysed periods in Asia, the market risk variables taken into account in this

model are important and substantial predictors of return on assets. Multinational corporations and investment managers that aim to achieve high returns at little risk seem to be concentrating mostly on international portfolios. When it comes to international portfolio diversification, exchange rate risk is crucial since financial assets are mostly denominated in other currencies are subject to exchange rate risk. The findings suggest that the Singaporean dollar and Chinese Yuan have a negative influence on portfolio performance due to volatility in foreign exchange rates. Additionally, it was observed that the volatility of the current period is negatively impacted by the results from all of the sample markets' prior periods. As a result, these stock markets are more vulnerable to the leverage effect, which suggests that negative news affects currency market volatility more than positive news does. It is also discovered that raising the model's shape parameter tends to enhance its performance, and that increasing the fatness and skewness of the left tails considerably lessens the influence of exchange rates.

As a result, the study suggests the following: in order to maximise their profits, rational investors may utilise fundamental analysis to examine the actions of these market risk variables prior to making any decisions on investments in the stock market or other financial markets. Determining the proper monetary policy decisions is a tough task for policymakers, as the effects of exchange rate volatility vary throughout companies. More importantly, this study's findings suggest that the influence of exchange rate fluctuations vary according to the condition of the stock market and the exchange rate. Consequently, policymakers might utilise the findings of this study to avoid making monetary policy decisions when they are not required. As this study's findings identify the slope coefficients at quantiles, regulators may mitigate the negative impacts of exchange rate volatility on listed businesses by determining when to interfere in the market. Foreign investors exposed to exchange rate risk would need to get higher yield compensation for holding local currency bonds when there is increased uncertainty about the future direction of the currency rate.

The proven empirical result is advantageous to investors and portfolio managers, as it can aid in taking action regarding stock market behaviour by providing knowledge of the dynamics between the two financial markets. Fund managers need to be cautious of fluctuations in interest and exchange rates in their search for the ideal portfolio. In order for protect market investors from the consequences of exchange rates spilling over into the stock markets, investors and portfolio managers need to actively manage and rebuild their portfolios in accordance with the state of the market. Stock market regulations like demutualisation and transparency should be implemented by stock exchange market authorities. In order to promote the growth in stock turnover, which contributes to stock return increase, it is advisable to improve stock market patronage, while minimising transaction costs and market uncertainty.

DISCUSSION

The obtained results imply that Asia stocks are more resilient to market shocks in calm market conditions but more vulnerable in turbulent ones. This supports the idea that, especially in the post-COVID era, African stocks have grown increasingly intertwined with international markets (Agyei & Bossman, 2023). In terms of diversification, stock returns show resistance to interest rate shocks in a variety of market conditions, which means that investors, looking to diversify their portfolio, should give these investments some thought. These results run counter to those of M. Omane-Adjepong & I.P. Alagidede (2021), who contend that cryptocurrency diversification is superior for Asia equity investments. According to the quantile results, the findings also demonstrate that interest rate risk has a non-substantial short-term impact on asset return before becoming important over the long term. This suggests that interest rates have a major catalytic influence on stock return in Asia not only in the long run but over the periods under study.

According to research by J.C. Odionye *et al*. (2023), a 3.68% interest rate differential threshold indicates that a large interest rate variation above the predetermined threshold results in an enormous inflow of foreign money into the country. Additionally, I. Haruna *et al*. (2023) discovered that a two-way directional nexus of the positive and substantial contribution of interest rates lags in explaining the fluctuations in the exchange rate of currencies. J. Hambuckers & M. Ulm (2023) provided empirical support for theories of currency crash risk on the role of interest rate changes or variations in the dynamic asymmetry of exchange rate changes. An increase in the monetary policy interest rate is known to appreciate currency rates, decrease stock prices and lower bond yields, according to empirical findings published by S. Indra & J.A. Cep (2022). T.Y. Liu & C.C. Lee (2022) observed a considerable nexus between variations in interest rates and changes in the currency exchange rates in the US and China. However, S. Mohammed *et al*. (2021) discovered that fluctuations in interest rates lead to instability in exchange rates. A strong positive association between variations in interest rates and exchange rate instability in emerging economies was also discovered by I. Haruna *et al*. (2023). In contrast to conventional carry trading techniques, J. Yung (2021) found out that interest rate variance plays a crucial role in explaining exchange rate changes that occur both within and outside of sample, especially over longer time horizons, and producing highly profitable currency portfolios.

Results obtained by A. Gashchyshyn *et al*. (2020) indicate that short-term fluctuations had significant positive impact on the changes in the currency exchange rate. The argument that market unpredictability is a reflection of stock market volatility, which significantly restricts portfolio investment management analysis, was reinforced by R. Chaudhary *et al*. (2020). T. Shoko *et al*. (2020) found robust scientific evidence of an uptrend between the currency exchange rate of Zimbabwe's economy and GDP growth, based on the ARDL model specification but they also revealed a negligible positive link between interest rate changes and GDP growth. Z. Xie *et al*. (2020) identified a causal link between stock prices and exchange rate returns in both industrialised and emerging nations. Markov switching model, which took structural breaks into account, was the basis for T.M. Karimo (2021) analysis, which provides evidence of the significant impact of interest rate differentials on foreign portfolio investment. According to A.O. Adewuyi & J.O. Ogbode (2019) and T.M. Karimo (2021), interest rate

changes and forward premium spot exchange rates are critical factors that explain capital mobility. According to S. Capasso *et al*. (2019), positive changes in the exchange rate result in reduced variation in interest rates in Mexico.

Following the collapse of the Bretton Woods system in 1971, the 1944 fixed exchange rate system was dismantled and replaced with a flexible exchange rate scheme, sometimes referred to as the Nixon shock. Globally, currencies have significantly increased in volatility. For instance, South Africa, which implemented a floating exchange rate system in March 1995, has similarly seen fluctuations in exchange rates over time (Thaba *et al*., 2023). However, with the Asian currency crisis of 1997 and the Latin American crisis of 1994, exchange rate risk management started getting attention (Agarwal & Vandana, 2022). African businesses have faced a considerable rise in financial risks since the global financial crisis of 2007 and the Marikana strikes. In particular, currency risk has grown due to recent increases in major currency volatility. Given that the exchange rate is influenced by factors that also affect bond rates, evaluating the effect of exchange rate risk on local currency sovereign yields is not straightforward. Bond rates are influenced by investor risk preferences, worldwide variables shared by all EMEs and country-specific factors (Fathi *et al*., 2024). Changes in inflation, local interest rates and sovereign credit risk in relation to other EMEs and major currency zones are examples of country-specific variables. Exchange rate fluctuations throughout the EMEs as a whole can be influenced by external shocks, interest rates in key currency regions and shifts in the risk appetites of international investors. This agrees with Z. Venter (2020) study, where a SVAR model was employed to examine the influence of monetary policy shocks on three proxies for financial market stability. The representation of monetary policy included policy rates for emerging market economies and shadow rates for advanced economies. The main findings from the research revealed that, in most cases, monetary policy rate was utilised to address asset mispricing, managed fluctuations in the real business cycle and curbed credit cycles. Additionally, the study indicated that, consistent with traditional economic wisdom, positive monetary policy shocks tend to result in the appreciation of local currencies in the majority of instances.

Mature financial markets may experience spillover effects that extend to developing markets. One rising nation's instability might potentially spread to the emerging economies nearby. For instance, the study results published by X. Hao *et al*. (2024) demonstrated that the time-varying sensitivity of African bond spreads to exchange rate movements and showed the dynamic effects of worldwide economic shocks on African bond investors. P. Engler *et al*. (2023) showed that monetary policy stance of the United States and economic news considerably influenced the financial conditions of emerging markets. Particular findings suggest that the principal channel with which the US economic news was transmitted internationally to emerging markets was through risk perception. Additionally, Y. Ying & D. Xinyu (2023) discovered that prior to COVID-19, developed markets most often sent jump risk to emerging markets. This supports M. Tumala *et al*. (2023) findings, which proved that greater percentage of risks associated with the Nigerian Stock Exchange were stimulated by global shock. Additionally, the analysis demonstrated a robust association between the global financial crises heighten volatility and return spillovers.

Similarly, the findings of M. Khan *et al*. (2023) demonstrated that the stock markets of Taiwan and South Korea are two largest spillover transmitters in the Asian developing economies. Also, X. Zhou *et al*. (2022) discovered that developed capital markets had a sizable global risk spillover effect on the Chinese capital market during the era of financial crisis. A. Panda *et al*. (2021) findings demonstrated that during crisis situations, the Asia-Pacific equities markets experienced more spillover shocks. The findings of A. Shaghil *et al*. (2021) further support this, showing that higher US interest rates had generated spillovers to the economic activities of emerging market economies with stronger fundamentals, while such rates had harmful spillovers for vulnerable EMEs. On the other hand, all EMEs experienced a significant slowdown in activities as a result of US monetary tightening brought on by a more aggressive policy approach. Moreover, it has been observed that all through the last twenty-five years, spillovers from developing markets to grown economies have only accounted for 5% of those from developed to emerging markets (Liu & Arezki, 2021). The direction of causation between local currency sovereign yields and exchange rate risk presents another challenge. The authors' approach has been formed by the theory that local currency sovereign yields are causally related to exchange rate risk.

The findings of B.A. Nugroho (2021) and D.C. Yildirim *et al*. (2022) somewhat support the notion that Asia nations offer the highest risk reduction for foreign investors during the global financial crisis (GFC) and Employment and Social Development Canada (ESDC). China's restrictions on foreign capital flows, such as the limited influence that foreign investors have over shares on Chinese stock exchanges, may have contributed to the crisis's containment in other markets. Consequently, there may be a decrease in foreign investment, commerce and opportunities for cross-border liquidity. Considering how undeveloped the Asian markets are, compared to the size of their economies, these possibilities make sense. From the standpoint of the transmission route, the overall orientation of the arrows offers additional proof. The other markets appear to be ahead of the Asian markets when contagion is considered. Before the housing bubble of 2006, the US was the most significant market due to its domination over the markets in Asia and the strong interconnectedness over an extended period of time. The Chinese markets, however, do better than the US, according to the GFC and ESDC. It is clear and revealing how much exchange rate risk affects return on assets. Investors are the main forces behind employment and economic expansion. Therefore, it would seem that these industries can function better when the exchange rate is stable, which might lead to an increase in employment and higher economic production.

It suffices to outline that in Singapore, the monetary policy is intended at guaranteeing low and stable inflation. As a result, the intermediate goal of monetary policy set by the Singaporean central bank is the nominal value of the Singapore dollar. This is due to the fact that the exchange rate has a significantly greater impact on inflation than the sizeable portion of the economy's tradable sector. When

there are large short-term capital flows that would cause the nominal exchange rate to diverge from a level consistent with the inflation rate, the central bank of Singapore effectively uses consistent intervention in the foreign exchange market to carry out its monetary policy stance. Thailand has kept the Thai baht exchange rate under strict control since July 1997. The Thai baht was once linked to a currency basket (Wuthisatian, 2021). Since 2016, Malaysia, a small open economy, has used the ringgit as its internal currency under a floating exchange rate framework. Prior to this, the Asian financial crises of 1997-1998 led to the ringgit being fixed to the US dollar. In July 2005, following the crisis, Malaysia moved to a managed float exchange rate system. The ringgit does not track a peg, instead, the exchange rate is set in the interbank market.

Indonesia has maintained a free-floating exchange rate regime with the Indonesian Rupiah since August 1997 (Aggarwal & Jha, 2023). According to this system, the supply and demand of Indonesian Rupiahs on the foreign exchange market determine the exchange rate. Comparably, the controlled exchange rate floating system is used in Cambodia. When the Riel exchange rate deviates from the predefined range and becomes too volatile, the National Bank of Cambodia committee steps in to maintain the stability of the exchange rate. Amidst some crawling pegs, the Vietnamese government runs the managed floating system with a constant pace of depreciation of the Vietnamese dong. Vietnam had a system of several exchange rates up until March 1989, with separate rates applied to trade transactions. Presently, there are trade reforms that entail tariff rationalisation, lowering non-tariff barriers etc. Burma has recently adopted a system of multiple parallel currency rates following the imposition of foreign exchange restrictions by the State Bank of Vietnam that limited access to US dollars. These foreign exchange restrictions include licenses for trading foreign exchange to specific companies subject to approved conversion rates, mandatory surrender requirements for converting export revenue, limited options for citizens to purchase foreign exchange with a maximum of 500 USD, and a requirement for foreign nationals living abroad to remit home 25% of their foreign exchange income. However, these restrictions have also seriously distorted the foreign exchange markets.

Australia has had floating exchange rate system since 1983. Prior to this, Australia experienced several different regimes, one of which was a fixed exchange rate regime. Hong Kong Special Administrative Region uses a US dollar-based exchange rate system (Rathke *et al.*, 2024). Given that the Hong Kong Special Administrative Region is a small, open economy whose growth is impacted by external factors, adopting a currency board helps reduce exchange rate volatility and external risks. India's exchange rate strategy has evolved over time as the country's economy has progressively opened up since the early 1990s as part of a broader plan of macroeconomic reforms and liberalisation. Korea implemented a freely floating exchange rate system in 1997. The won exchange rate is freely determined by supply and demand. Rising inflation and exchange rate volatility led New Zealand's central bank to move from a fixed to a floating exchange rate regime in 1985 (Albagli *et al.*, 2020; International Monetary Fund, 2023).

The pace at which information is transmitted from the foreign market to the stock market and the reaction of investors to that information may be used to assess the effectiveness of the market. This will undoubtedly advance understanding of the nature of market efficiency that the financial market possesses and even advance understanding of behavioural finance. The research findings serve as a foundation for further research. More investigation into the relationship between the foreign exchange and stock market might lead to the possibility of hedging policies or arbitrage possibilities. Since there is evidence to suggest that exchange rates are good diversifiers in stock portfolios, even though the precise nature of their effectiveness is unknown, authors would advise further research on the subject. Just as commodity prices are influenced by price, exchange rates should likewise have an impact on supply and demand. This might be very useful information for commodity investors, as they will be able to more accurately predict future prices if they have a better grasp of how exchange rates affect supply and demand for certain commodities.

CONCLUSIONS

The aim of this study was to evaluate how stock returns and associated risk premium react to changes in foreign exchange rates in order to resolve the contradictory findings seen in the literature. The data were analysed using quantile regression and BVAR method. According to the study results, two market risk variables that have a large and negligible direct influence on stock return are currency rate volatility and interest rate risk, respectively, particularly over the long term. Furthermore, currency rate risk becomes apparent only over a longer period. Return on assets responds favourably to exchange rate changes and variations in short-term interest rate. This may indicate that stock markets with sizable global operations are resilient enough to resist the risk and unpredictability associated with fluctuations in exchange rates, which may affect their stock values due to hedging expenses or operational concerns.

The findings suggest that market-friendly negative fluctuations in interest rates have a beneficial impact on returns. It suggests that banks have an incentive to give out more credit. Similarly, the incredibly low cost of borrowing to support enterprises that greatly increase investment return drives consumers and businesses. This research has certain boundaries. Given the financial market's dynamic and quickly changing nature, it is recommended to conduct a similar study in other financial markets and with a wider range of currencies. To further understand the magnitude and direction of the spillover effects, more advanced econometric models may be used, which will further increase the significance of this research. Analogous tests, conducted in developing, would be undoubtedly helpful to investors, who are particularly interested in diversifying their foreign portfolios.

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CONFLICT OF INTEREST

None.

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Прибутковість, коливання процентних ставок та зміни валютних курсів в Азії

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Анотація. Метою статті було вирішити суперечливі питання щодо мінливості обмінного курсу та доходності акцій на основі порівняльних даних з азійських ринків, де варіація відсоткових ставок виступає модератором спостережуваного ефекту. У дослідженні було застосовано квантильну та байєсівську векторну авторегресію з 2000 по 2023 рік. Отримані дані засвідчили, що волатильність валютних курсів і процентний ризик є двома змінними ринкового ризику, які мають великий і незначний прямий вплив на прибутковість акцій відповідно, особливо в довгостроковій перспективі. Результати продемонстрували значний позитивний зв'язок між коливаннями валютних курсів і прибутковістю активів, водночас останній встановлюється у середньому та вищому квантилі валютних курсів. Дохідність активів позитивно реагує на шоки, пов'язані з відсотковими ставками та обмінними курсами. Це може свідчити про те, що фондові ринки зі значними міжнародними операціями є достатньо стійкими, щоб протистояти волатильності та ризикам, спричиненим коливаннями валютних курсів. Показано, що сприятливі для ринку коливання процентних ставок позитивно впливають на прибутковість. Це означає, що банки вмотивовані надавати кредити більшій кількості людей. Коли ці фактори рухаються в одному напрямку, на ринку спостерігаються низькі настрої, низький ризик і позитивна поведінка інвесторів. Додаткова кількісна оцінка величини і напряму впливу волатильності між обмінними курсами і доходами від акцій показує, наскільки ці зв'язки є динамічними і змінюються залежно від країн, часових періодів і ринків. Взаємозалежність змін обмінних курсів і доходності акцій у рамках ширшої фінансової екосистеми підкреслюють наслідки волатильності, які впливають на економічні політичні рішення, методи управління ризиками та інвестиційні стратегії. Зроблено висновок, що впродовж аналізованих періодів в Азії змінні ринкового ризику, враховані в цій моделі, є важливими і суттєвими предикторами дохідності активів

Ключові слова: ризик; квантильна регресія; коливання; кредит; волатильність; фінансова криза

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Economic efficiency of co-operatives and their impact on socio-economic development of rural areas

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Abstract. The study aimed to analyse how cooperatives influence the development of the socio-economic situation in rural Albania. To achieve this goal, a detailed analysis of the main socio-economic indicators was conducted and the results were summarised, which helped to identify general trends and patterns in the development of Albania. The study determined that the cooperative sector in Albania is crucial in promoting sustainable development in rural areas and improving the quality of life in communities. Between 2015 and 2023, cooperatives contributed to the creation of 12,456 new jobs, a 25% reduction in poverty and a 30% reduction in out-migration. In addition, the sector has invested in social services and local infrastructure, improving living conditions and maintaining economic stability. The growth of the cooperatives was driven by a 40% increase in infrastructure investment, a 20% increase in credit availability, a 35% improvement in market access, and the expansion of logistics and marketing channels. The positive impact of cooperatives on the economy and social conditions was reflected in the growth of Albanian gross domestic product from USD 13.25 billion in 2015 to USD 18.31 billion in 2023, an increase of 38%. The results of the study can be useful for the development of evidence-based policies and strategies that support the growth and sustainability of the cooperative sector in Albania and beyond

Keywords: infrastructure; employment; poverty; integration; sustainable growth; innovation

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INTRODUCTION

Cooperatives as an organisational form of business have deep roots in the history of global economic development. They are collective enterprises established by a group of people to meet common economic, social and cultural needs. On the global stage, cooperatives are an important tool for increasing economic stability through a collective approach to entrepreneurship, which helps to reduce economic risks and increase financial stability for their members. In addition, cooperatives generate jobs and income for their members, contributing to overall economic growth and community development. They are also crucial in ensuring social well-being by meeting the social and cultural needs of their members, which contributes to social cohesion, equality and well-being. Despite this potential, Albanian cooperatives face several challenges, including insufficient funding, lack of effective government support, and insufficient awareness of the benefits of the cooperative movement among residents. In this regard, the study of the economic efficiency of cooperatives and their impact on the socio-economic development of rural areas in Albania is relevant and necessary for the development of strategies for their support and development.

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In addition to their economic contribution, cooperatives are vital in providing basic services such as healthcare, education and infrastructure in underserved rural communities. T.S. Sujith & M. Sumathy (2022) and A. Adetoyinbo & D. Mithöfer (2023) argued that in India and Africa, agricultural cooperatives are key to improving food security. They help smallholder farmers gain access to markets and technology, which helps to increase their productivity and income, as well as strengthen the economic resilience of farming communities. By empowering smallholder farmers and entrepreneurs through market access and technical assistance, these institutions mitigate socioeconomic barriers and promote sustainable livelihoods. K. Hakelius & J. Nilsson (2020) noted that the principles that guide cooperatives emphasise democratic control and community care, thus useful for addressing local needs and promoting co-management. Cooperatives are diverse in their forms and functions. W. Liu *et al*. (2020) and S.A. Husseini (2022) highlighted that cooperatives can be dedicated to agriculture, financial services, housing, and other areas.

Around the world, cooperatives have demonstrated their effectiveness in improving economic conditions and raising the quality of life. As noted by G. Maia *et al*. (2023), in the United States, cooperatives provide millions of jobs and generate more than USD 75 billion in annual revenue, highlighting their significant impact on local economies. According to a study by A. Mints *et al*. (2020), European cooperatives, including consumer and producer cooperatives, demonstrated significant results in providing stable jobs and developing local economies. Global experience shows that cooperatives can be substantial for social and economic development. Following A. Yunitsyna *et al*. (2021), cooperatives can stimulate economic growth and provide access to critical services. However, along with these capabilities, S. Mirzabeigi & M. Razkenari (2022) determined that cooperatives face numerous challenges, such as limited access to finance, the need to improve organisational structures, and difficulties in accessing markets. Taking these aspects into account is key to formulating strategies that will ensure the sustainability and effectiveness of cooperatives at various levels.

In Albania, cooperatives are central to the socio-economic development of rural areas. According to A. Afezolli (2022) and E. Aliaj & E. Tiri (2023), cooperatives bring together agricultural producers, helping jointly solve problems that arise during the production and marketing of their products. In a context of underdeveloped infrastructure and limited access to markets, cooperatives help reduce costs and create added value, which is critical for the national economy. The socio-economic impact of cooperatives in Albania is manifested, in particular, through the creation of jobs in rural areas, which contributes to a reduction in unemployment and emigration. However, there is a problem of insufficient integration of cooperatives into the national economy, which limits their potential for local community development. Due to demographic challenges, cooperatives can be critical in preserving and developing these communities by providing stable income and supporting infrastructure projects. This topic has already been explored by various authors. In particular, A. Caso & S. Giordano (2022) analysed the impact of cooperatives on economic development and social inclusion in rural areas, while K. Mboho *et al*. (2024) emphasised the importance of cooperatives in improving living conditions in rural communities.

After analysing the literature, the following research gaps can be identified. A lack of research on the role of cooperatives in ensuring food safety in the broader context of coordination processes in agricultural value chains, as well as a lack of data on the impact of cooperatives on the socio-economic development of rural areas, in particular, job creation, improving the living standards of the local population and developing local infrastructure, is present. The study aimed to examine the economic efficiency of cooperatives and their impact on rural development in Albania. Study goals included analysis of the economic efficiency of cooperatives in Albania during the period from 2015 to 2023; assessment of the impact of cooperatives on job creation, poverty reduction and emigration, as well as the development of social projects; determination of the impact of cooperatives on the standard of living and social infrastructure in local communities.

MATERIALS AND METHODS

Data from the Institute of Statistics of Albania were used to inform the study (Statistical literacy, 2024). The study structured information on cooperatives with a focus on their economic performance and social impact. This was used to organise the data for further analysis. Based on specific examples of cooperatives' activities, general principles of their effectiveness were formulated, which was used to conclude the main trends. Based on these conclusions, recommendations were developed to strengthen the impact of cooperatives on the socio-economic development of the region and improve their efficiency. This identified the links between various aspects of cooperatives and their impact on the socio-economic development of the region.

Various methods were used to achieve the research objective. The choice of methods is based on the specificity of the results obtained, which allowed for a detailed analysis and evaluation of the efficiency of cooperatives in quantitative and qualitative aspects. To assess the economic efficiency of cooperatives, a detailed analysis of financial indicators was carried out. In particular, the dynamics of income and expenses of cooperatives during 2015-2023 were studied, which was used to assess trends in profitability and cost. A profitability analysis was also carried out, assessing the return on sales, assets and capital to determine the efficiency of the cooperatives' use of resources. Furthermore, an analysis was carried out to assess the performance of cooperatives in Albania, comparing it with other countries such as Poland, Greece, Romania and Bulgaria. This analysis of the financial and social performance of Albanian cooperatives in comparison to similar structures in other countries identified the strengths and weaknesses of Albanian cooperatives at the international level.

A correlation analysis was conducted to determine the relationships between various economic and social indicators. This analysis assessed the correlation between the amount of investment in cooperative infrastructure and their economic performance, including revenues and profitability. It was also used to analyse the correlations

between cooperative performance and social indicators such as employment, wages and poverty. A SWOT (strengths, weaknesses, opportunities and threats) analysis was used to comprehensively assess the performance of the cooperatives and determine their impact on socio-economic development. The SWOT analysis identified strengths, including the internal advantages of cooperatives, such as effective resource management and resilience to economic change. It also identified weaknesses that affect the effectiveness of the cooperatives, including limited access to finance and insufficient infrastructure. The opportunities assessment showed potential for expanding the activities of cooperatives and improving their social role, while the threats analysis identified external factors, such as economic or political risks, that could affect the functioning of cooperatives. Finally, the impact of social projects implemented by cooperatives in Albania was analysed to determine their contribution to social development. The number and types of social projects implemented by cooperatives were assessed, as well as their impact on living standards, employment and social integration in communities.

RESULTS

In the face of economic and social challenges, cooperatives can contribute to the sustainable development of rural communities and agriculture in general. They are the basis for mobilising local resources, creating opportunities for better access to markets, and ensuring economic stability and development of rural areas. This is especially important in countries where agriculture is the main sector of the economy, as in the case of Albania, where cooperatives play an important role in socio-economic development. The economic efficiency of cooperatives is a key indicator of their ability to adapt to changing market conditions, maintain competitiveness and ensure profitability for their members. An analysis of the activities of cooperatives in Albania for the period 2015-2023 shows a steady improvement in their financial performance (Table 1). The total income of cooperatives during this period increased by 41%, indicating positive changes in the economic situation of cooperatives. This growth is the result of effective resource management, improved access to markets, and growing demand for the products they produce.

Table 1. Economic efficiency of cooperatives

Value	2015	2016	2017	2018	2019	2020	2021	2022	2023
Total revenues, million ALL	850	880	900	950	1,000	1,050	1,000	1,100	1,200
Total expenses, million ALL	750	780	800	850	900	950	900	900	950
Net profit, million ALL	100	100	100	100	100	100	100	200	250
Average income per member, thousand ALL	12	13	14	15	16	17	15	18	20

Source: compiled by the authors based on Statistical literacy (2024)

Notably, cooperative expenditures also increased during this period, but their growth rate was slower than that of income. This demonstrates the effectiveness of cost management, which maintained a stable level of net profit of cooperatives and, in some years, even achieved significant growth. In particular, the net profit of cooperatives increased by 150% by the end of the period, indicating an improvement in their financial stability and ability to adapt to market challenges. Another important indicator is the average income per cooperative member, which increased by more than 60% during this period. This is an indicator of the improvement in the living standards of cooperative members and their economic well-being. Despite a short-term decline in the average income per cooperative member in the middle of the study period, its steady growth in subsequent years indicates the recovery and further strengthening of the financial capacity of cooperatives.

Thus, cooperatives in Albania demonstrated significant progress in their activities during 2015-2023, which is reflected in the growth of financial performance, profitability and improved living standards of their members. This experience can be used as an example of an effective model of rural community development based on joint activities and cooperation to achieve sustainable economic growth. Table 2 illustrates Albanian economic and social performance over 2015-2023, highlighting key trends and dynamic changes in various areas of national life.

Table 2. Dynamics of economic and social indicators in Albania

Value	2015	2016	2017	2018	2019	2020	2021	2022	2023
Population	2,891,000	2,870,000	2,850,000	2,830,000	2,810,000	2,790,000	2,818,000	2,811,000	2,761,785
Employment	54.5%	55%	55.5%	56%	56.5%	56.8%	55.8%	56.3%	57%
Average gross monthly salary, ALL	65,000	66,500	67,800	68,900	70,000	71,200	70,125	72,450	73,641
Minimum wage, ALL	32,000	33,000	34,000	35,000	36,500	37,000	37,000	38,500	39,750
Retail	98.5	99.8	100.1	100.5	101.2	102	100.2	102.5	104.8
Active business units	200,000	205,000	210,000	215,000	220,000	225,000	215,678	220,350	226,778
Number of constructions permits	250	260	270	280	290	295	275	290	311
Arrival of foreign nationals	800,000	850,000	900,000	950,000	1,000,000	1,100,000	1,000,456	1,150,678	1,244,967

Table 2, Continued

Value	2015	2016	2017	2018	2019	2020	2021	2022	2023
Average household size	3.4	3.5	3.5	3.5	3.6	3.6	3.5	3.6	3.7
Average monthly household expenditure, ALL	80,000	82,000	83,500	84,000	85,000	86,000	85,450	87,560	88,367
Average monthly disposable equivalent income, ALL	31,000	31,500	32,000	32,500	33,000	33,500	33,600	34,875	35,725
Households with internet access	90%	91.5%	92%	93%	94%	94.5%	94.5%	95.8%	96.7%

Source: compiled by the authors based on Population of Albania (2023), Household budget survey (2024)

During this period, there was a gradual decline in the population, possibly due to low birth rates and increased emigration, which is typical for transition economies. Emigration remained a major challenge for the country, affecting the labour market and economic activity in various sectors. Despite demographic challenges, the labour market showed steady improvement, with employment increasing due to the creation of new jobs, especially in the service sector, indicating an expansion of economic activity. This process was accompanied by an increase in average gross wages and the minimum wage, reflecting the government's efforts to provide social protection and fight poverty. The increase in incomes allowed households to improve their living conditions, which in turn stimulated increased consumer activity, as seen in the retail trade indices. In addition, the number of registered businesses in Albania has been growing steadily, indicating that entrepreneurial activity has intensified and conditions for the development of small and medium-sized businesses have been created. This trend has a positive impact on employment and economic growth, as entrepreneurial activity provides additional employment opportunities and contributes to economic diversification.

Changes in demographics have also affected household structure. The average household size has been growing, which may indicate the return of emigrants or an increase in the number of multi-generational families. Household expenditures grew alongside incomes, indicating an overall improvement in wealth and living standards. The growth in disposable equivalent household income confirms the trend towards increased purchasing power. Alongside economic performance, Albanian digital infrastructure has also improved significantly over the period. The share of households with internet access has increased significantly, reflecting government and private sector efforts in digitalisation. The expansion of digital opportunities has facilitated access to information services, education, healthcare, and e-commerce, which had a positive impact on the quality of life of citizens.

One of the most important socio-economic factors in Albanian development has been the active growth of the role of cooperatives. During the period under review, their activities contributed to the creation of a significant number of new jobs, especially in the agricultural sector, which reduced poverty and emigration from rural areas. Cooperatives also actively supported social projects aimed at improving the quality of life of the local population, making them an important factor in social stability. Importantly, cooperatives have made a significant contribution to the development of infrastructure and social services at the local level. By attracting investment and government support, cooperatives have been able to facilitate the development of communication and transport networks, improve access to healthcare and education services, and thus raise the standard of living of the population. This approach not only reduced dependence on external assistance but also contributed to sustainable economic growth and development of local communities. Thus, the analysis of Albanian economic and social indicators for 2015-2023 confirms positive dynamics in many areas of national life. Sustained economic growth, support for entrepreneurial activity, the development of digital infrastructure and the important role of cooperatives have created a solid foundation for further improving the quality of life and socio-economic development of the country. It is worth noting that from 2015 to 2023, cooperatives in Albania demonstrated a significant impact on the development of local communities, becoming the basis for economic and social growth. An important aspect of their development was the growth of investments in various areas, which significantly improved living conditions in rural areas. Increased overall investment in infrastructure has contributed to the creation of a more efficient transport and logistics network, which has facilitated access to markets and improved the overall productivity of cooperatives.

During the period under review, especially in 2020-2023, infrastructure investment increased significantly, which can be attributed to the intensification of government programmes for the development of local communities. This included road construction, modernisation of electricity and water supply, and improved internet access, which has become an important factor in the digitalisation of rural areas. These measures not only improved the business environment but also contributed to the competitiveness of products at the national and international levels. Lending to cooperatives also showed positive dynamics. Financial support from banks and state institutions allowed cooperatives to increase their production capacity, expand their product range, and invest in innovative technologies. This contributed to improving the efficiency of their operations and ensuring stable economic development. The steady growth in lending helped cooperatives attract more financial resources for long-term projects, which ensured their competitiveness and financial sustainability (Table 3).

Table 3. Impact assessment on local infrastructure and services

Value	2015	2016	2017	2018	2019	2020	2021	2022	2023	Change of 2022-2023
Total investment in infrastructure, million ALL	25	28	30	32	35	38	40	45	50	+5
Loans to co-operatives, million ALL	150	180	200	220	250	280	300	350	400	+50
Improved access to markets, %	60%	62%	64%	66%	67%	68%	70%	72%	75%	+3%
Investments in social services, million ALL	10	12	14	16	18	19	20	30	50	+20

Source: compiled by the authors based on Social condition (2024)

Another important aspect of development was the improvement of cooperatives' access to markets. By improving logistics and developing marketing strategies, the cooperatives were able to significantly expand their presence in domestic and foreign markets. This has resulted in increased sales, improved product quality, and a stable income for members. Improved terms of trade, including new cooperation agreements and partnerships, have had a positive impact on Albanian export potential. Increased investment in social services was also an important achievement of cooperatives in the period 2015-2023. Investments were directed at improving healthcare, education and cultural services for rural communities, which increased the level of social support for the population. This was important for fighting poverty and improving social inclusion. Reaching their peak in 2023, investments in social services demonstrated the cooperatives' commitment to supporting not only economic development but also social stability, providing better living conditions for the population (Table 3). Thus, the activities of cooperatives in the period from 2015 to 2023 in Albania are characterised by an effective combination of economic development and social support. Their ability to adapt to market conditions and attract investments in infrastructure and social services contributed to the sustainable development of local communities. Cooperatives continued to play a key role in creating new jobs, developing the local economy and improving the quality of life of the population, which underlines their importance in the national overall economic and social development strategy.

In the context of the socio-economic transformation that has taken place in Albania, cooperatives have become key agents of change that have helped to promote sustainable development at the local level. They actively contributed to improving living conditions by creating jobs, developing infrastructure and implementing social initiatives. The analysis shows a significant increase in the number of new jobs created by cooperatives, which grew by 50% between 2015 and 2023. The largest increase occurred in the last two years of the study period, in 2022 and 2023 when cooperatives were able to step up their investment projects and expand their areas of operation. This development was the result not only of the efforts of the cooperatives themselves but also of support from government and international organisations that helped to attract investment and support rural development programmes (Table 4).

Table 4. The impact of cooperatives on socio-economic development

Value	2015	2016	2017	2018	2019	2020	2021	2022	2023
Created new jobs, round up	5,000	5,500	6,000	6,500	7,000	7,500	8,000	9,000	10,000
Poverty reduction, %	8%	8%	7.5%	7%	7%	6.5%	7%	6%	5%
Decrease in emigration, %	7%	6.5%	6%	5.5%	5%	4.5%	5%	4.5%	4%
Number of social projects	30	35	40	45	50	55	60	60	75

Source: compiled by the authors based on Social condition (2024)

Co-operatives contributed to the creation of 12,456 new jobs, which indicates their ability to provide new employment opportunities. Along with creating jobs, cooperatives have had a positive impact on the socio-economic situation of the population. Due to the expansion of employment opportunities, the poverty rate in the regions where the cooperatives operated gradually decreased. Household incomes grew, leading to improved living conditions. Reducing the level of emigration was another important achievement of cooperatives. In recent years, there has been a tendency for emigrants to return, seeing new prospects for development in their home country thanks to the activities of cooperatives. In terms of social projects, cooperatives have significantly stepped up their activities in this area. In the period from 2015 to 2023, the number of social initiatives implemented by cooperatives grew steadily. Particular attention was devoted to projects in education, healthcare, and local infrastructure development. This contributed to strengthening local social infrastructure and improving the quality of life of the population, which in turn ensured more stable socio-economic development.

The active role of cooperatives in improving the living conditions and socio-economic development of local co mmunities has been particularly noticeable in recent years. The increase in the number of social projects aimed at supporting local initiatives and improving social infrastructure has become one of the key factors in positive changes in the lives of the population. This underscores the importance of cooperatives not only as economic entities but also as agents of social transformation in the context of Albanian sustainable development (Table 4). Thus, cooperatives play an important role in the positive development of

the economy and social conditions in Albania, especially in the period from 2015 to 2023. Not only do they contribute to job creation and unemployment, but they also actively stimulate the national economic growth. Through their social initiatives, cooperatives help to reduce poverty and out-migration, improving the overall socio-economic conditions of local communities. Investments in social services and local infrastructure significantly improve the living conditions of the population, which increases the quality of life and contributes to overall economic stability (Fig. 1).

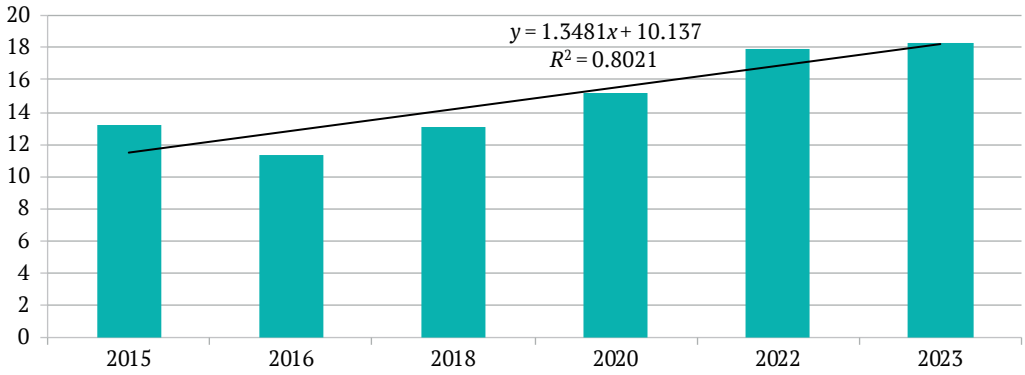

Figure 1. Gross domestic product (GDP) in Albania, billion USD

Source: compiled by the authors based on National accounts (GDP) (2024)

In addition, cooperatives actively invest in the development of local infrastructure, which includes not only economic but also social components, supporting both economic development and social integration. This, in turn, ensures more sustainable development and stability in the long term. An analysis of the relationship between cooperatives and Albanian GDP over the period 2015-2023 shows a strong correlation. The national GDP increased from USD 13.25 billion in 2015 to USD 18.31 billion in 2023, indicating stable economic growth. The active participation of cooperatives in this process is evident, as their activities significantly contribute to economic development through increased employment, infrastructure development and the implementation of social projects. The contribution of cooperatives to the economy also helps to maintain macroeconomic stability and create the basis for further development of the country. These results indicate that cooperatives have become an integral part of the economic structure of Albania and continue to be central in the socio-economic transformation taking place in the country.

Thus, cooperatives are substantial in ensuring sustainable agricultural development and improving living standards in rural areas. The effective functioning of cooperatives contributes to resource mobilisation, improved market access and sustainable economic growth. Cooperatives have a positive impact on the economy and social conditions by creating new jobs, reducing unemployment and stimulating economic growth. They also implement social initiatives that reduce poverty and out-migration, improving socio-economic conditions. Co-operatives invest in social services and local infrastructure, improving living conditions and maintaining economic stability. Together, these factors contribute to GDP growth and economic stability.

A comparative analysis of the performance of cooperatives in different countries shows different levels of efficiency and social impact. The analysis of financial and social indicators shows certain trends and differences between countries. Albania has an average income per cooperative member and household compared to other countries. The average income per cooperative member in Albania is lower than in Poland, Greece, Romania and Bulgaria, indicating less financial stability compared to these countries. However, the employment rate in Albanian cooperatives is one of the lowest among all countries, which may indicate that cooperatives have a smaller impact on the labour market. The poverty rate in Albania is higher than in Poland, Greece and Bulgaria, but lower than in Romania.

Poland shows higher incomes per cooperative member and household than Albania. These figures indicate a more developed cooperative economy in Poland, which is also reflected in higher profitability and lower poverty rates. However, the level of employment in cooperatives in Poland is slightly higher than in Albania, indicating a greater positive impact of cooperatives on the labour market. Poland also has more social projects, which may indicate that cooperatives are more active in social activities. Greece has the highest average profitability and income per cooperative member. These data indicate a high level of economic efficiency of cooperatives in Greece. The employment rate in Greek cooperatives is the lowest, which may be due to the high profitability and less need for additional jobs. Greece also has the lowest poverty rate among the countries analysed, and the number of social projects is the highest, indicating that cooperatives are actively involved in social initiatives.

Romania is average in all categories. Income per cooperative member and household in Romania is lower than in Poland and Greece, but higher than in Albania. The poverty rate in Romania is the highest among the countries analysed, which may indicate that cooperatives have a less effective impact on socio-economic development compared to other countries. Bulgaria has similar indicators to Romania but with some differences. The average income per cooperative member and household in Bulgaria is USD 200 higher than in Romania, but USD 100 and USD 700 lower than in Poland and Greece, respectively. The employment rate in Bulgarian cooperatives is better than in Romania, but worse than in Poland and Greece (Table 5).

Table 5. Comparison of financial and social indicators of cooperatives, 2015-2023

Country	Average income per cooperative member, USD	Average income per household, USD	Average expenditure per cooperative member, USD	Average yield, %	Employment rate, %	Poverty rate, %	Average gross monthly salary, USD	Number of social projects
Albania	2,500	7,500	1,500	20%	10%	15%	320	4
Poland	3,200	8,500	1,800	25%	12%	10%	350	6
Greece	3,800	9,000	2,000	30%	8%	12%	370	7
Romania	2,900	8,000	1,600	22%	11%	18%	340	5
Bulgaria	3,100	8,200	1,700	24%	9%	14%	360	5

Source: compiled by the authors based on Exploring the cooperative economy (2023)

The SWOT analysis demonstrated that cooperatives in Albania have several strengths, such as effective resource management and strong local support, but face serious weaknesses, including limited access to finance, insufficient business skills and poor infrastructure. Growth opportunities include expanding markets, improving infrastructure and attracting government support, while threats such as economic instability, political risks and competition from large companies can pose significant challenges to their development.

An analysis of the impact of social projects implemented by cooperatives in Albania demonstrates their significant contribution to the social development of local communities. During 2015-2023, cooperatives carried out several significant social initiatives that impacted various aspects of life in rural and remote areas of the country. The social projects of cooperatives in Albania cover a wide range of areas, including education, healthcare, infrastructure and support for socially vulnerable groups. In the field of education, cooperatives are actively investing in the modernisation of schools and educational institutions, providing the necessary resources, such as textbooks, equipment and additional training programmes. This helps to improve the level of education and ensure access to quality educational services for children and adults in local communities.

In the area of healthcare, the cooperatives conduct medical check-ups, vaccinations and educational campaigns to raise awareness of healthy lifestyles. These initiatives include both periodic medical clinics and ongoing health support through preventive measures, which ensures access to healthcare and improves the overall health of the population. In terms of infrastructure, the cooperatives are engaged in improving local infrastructure, including road reconstruction, water supply and waste management systems. This has a direct impact on the quality of life in rural areas, as improved infrastructure contributes to economic development and improves the comfort of residents. Projects supporting socially vulnerable groups are another important component of the cooperatives' activities. These projects aim to help the elderly, people with disabilities and other vulnerable groups. Support may include the provision of material resources, social services or special programmes to facilitate their social integration and improve their quality of life.

The impact of these social projects on communities is significant. The implementation of education and healthcare projects directly improves the living standards of residents. Access to quality education and medical services is critical to improving living conditions overall. At the same time, infrastructure projects help to reduce unemployment by creating new jobs and providing a stable income for the population. Social projects also have a positive impact on social inclusion, helping to reduce social tensions and promote greater cohesion among residents. Supporting socially vulnerable groups helps to integrate them into the community and improve social stability.

In the period from 2015 to 2023, 44 social projects were implemented in Albania, which had an important impact on various areas of life, such as education, healthcare, infrastructure, and support for vulnerable populations (Yunitsyna *et al*., 2021). As part of the educational projects, schools have been modernised, which has significantly improved the quality of education by providing access to modern technology and improved conditions for students. This has improved not only the level of education but also the overall prospects for youth development in the communities. In the health sector, several medical clinics have been built and renovated, significantly improving access to healthcare in remote areas. The expansion of the medical infrastructure facilitates faster and more efficient service to the local population, which has a positive impact on the overall health of the community. In the long term, the implementation of such projects ensures the sustainability of the regions, which has a positive impact on their socio-economic development.

DISCUSSION

In Albania, cooperatives are central to promoting economic efficiency, especially in rural areas, through a variety of operational strategies and community engagement practices. The economic efficiency of cooperatives depends on their ability to leverage member participation and financial support, which ultimately leads to sustainable community growth and development. A study of the impact of cooperatives in Albania during the period from 2015 to 2023 shows a positive impact of their activities on the national economic development. Many authors, including O. Skydan *et al*. (2021) and E. Aliaj & E. Tiri (2023), pointed out that rural cooperatives are central to expanding economic opportunities in rural communities. Due to their organisational structure and principles of collective interaction, cooperatives create a platform for cooperation between small farmers and entrepreneurs, which is especially important in conditions of limited resources and access to markets.

By providing access to credit, markets and technical assistance, cooperatives enable small producers to increase

productivity, adopt new technologies and diversify their income sources. This, in turn, not only improves the financial situation of individual members but also has a positive effect on the entire community. The collective action of co-operatives helps to overcome socio-economic barriers that often hinder rural development, such as lack of access to markets, inequality in resource allocation and lack of information. In addition, according to S. Razavi (2021) and H. Silvennoinen *et al*. (2023), an important problem in both rural and urban areas is the problem of money circulation. This is because traditional commercial enterprises dominate most communities, hindering the normal circulation of money. In contrast, cooperatives keep money in the community, as any profits are reinvested in the business, which then uses the money to benefit the community, for example by lowering prices and hiring new workers. This study correlates with the findings of F. Su *et al*. (2021) and S. Ahado *et al*. (2022), which emphasise that in addition to economic empowerment, rural cooperatives play a key role in providing basic services such as improved access to markets, financial resources, and training for residents. Co-operatives also contribute to infrastructure development, which is an important factor for the socio-economic development of rural communities.

The research conducted and the views expressed by scholars such as O. Budnik (2019) and S.A. Al-Jundi *et al*. (2020), demonstrate the importance of strengthening institutional capacity and promoting multi-stakeholder partnerships as vital strategies to improve the effectiveness of rural development initiatives. Research shows that cooperatives have a significant mitigating effect on the vulnerability of smallholder farmers to poverty, especially among those with higher levels of human capital and income. This suggests that the poverty reduction impact of cooperatives may vary depending on household characteristics, highlighting the need for inclusive and gender-sensitive approaches to ensure equitable outcomes for marginalised groups. A similar view is also expressed by Q. Deng *et al*. (2020) and E. Donkor & J. Hejkrlik (2021), who emphasised that agricultural cooperatives play a key role in enhancing rural socio-economic development by facilitating market access, improving food security and promoting community resilience. They allow farmers to pool resources, which leads to economies of scale and results in lower input costs and increased profitability for members. At the same time, according to S. Esmaeilizadeh *et al*. (2020), despite the obvious advantages, the activities of cooperatives face numerous challenges, including insufficient access to finance, limited opportunities for expanding production, and lack of adequate support from the state. In addition, decentralised small-scale agricultural market owners often face high transaction costs and difficulties in accessing high-value markets. This is due to factors such as inadequate information and lack of competitiveness, which requires collective action through co-operatives as a market entry strategy.

The organisational sustainability of cooperatives is also one of the most important internal challenges they must overcome to succeed. While cooperatives can enhance their bargaining power and reduce individual barriers to entry, their effectiveness is often compromised by general market conditions. As noted by W. Li *et al*. (2019) and R. Matheus *et al*. (2020), the sustainability of cooperatives depends on their multidimensional nature and the development of collective capabilities in five areas. First, cooperatives need to attract and retain members who share common goals and values. This can be achieved by creating an attractive offer for members, ensuring their participation in decision-making and developing their skills. In addition, cooperatives need to develop their capabilities in other areas such as building a strong network of relationships, management skills, innovation and engagement with government institutions. Developing these areas allows co-operatives to strengthen their bargaining power, reduce individual barriers to entry and succeed in the long term.

N. Denissova & R. Born (2021) also emphasised that cooperatives play an important role in socio-economic development, as they contribute to strengthening social capital in communities. Based on the principles of mutual assistance and collective responsibility, cooperatives provide economic benefits to their members, increase competitiveness and create sustainable income. To maximise their potential, government support is needed, including legislative initiatives, access to finance and training programmes, to enable cooperatives to contribute to improved welfare and social cohesion. Therefore, the potential of cooperatives to enhance socio-economic development depends on overcoming these obstacles and adapting to the changing economic landscape. Despite these challenges, according to this study and others, such as M. Sultana *et al*. (2020), cooperatives remain a promising model for economic empowerment and community development. Their ability to adapt to technological advances and use collective action to access the market is crucial to increasing their effectiveness and relevance. Scholars also note that prospects for cooperatives include strengthening governance structures and exploring innovative practices that are consistent with sustainable development goals, ensuring their continued impact on the socio-economic context of rural areas (Zinchuk *et al*., 2019; Zhu & Wang, 2024).

The study reflects the assertions of L.P. Dos Santos *et al*. (2020), who also emphasised the interconnection between economic development, social inclusion, environmental sustainability and cooperative development, which is key to the development of effective rural development strategies. In addition, the study also highlighted the importance of involving local communities in the decision-making process to ensure that the development of cooperatives is in line with the needs of the local population. It is worth noting that the results of this study are confirmed by Z. Zou *et al*. (2020), who emphasised the importance of cooperatives in rural development, especially in the context of sustainable development. The author argued that cooperatives can be effective tools for achieving sustainable development goals, such as poverty reduction, increased access to education and healthcare, and environmental improvement. In summary, cooperatives in Albania demonstrate significant potential for the development of local communities, by supporting sustainable development, poverty reduction and improved living conditions.

CONCLUSIONS

It is established that the activities of cooperatives in Albania in 2015-2023 had a positive impact on the socio-

economic development of the country. The reduction in the poverty rate from 8% to 5% demonstrates the positive impact of cooperatives on the social well-being of the population. In addition, cooperatives have implemented 75 social projects, demonstrating their active role in the development of social infrastructure. The growth of cooperatives' investments in infrastructure has been observed with a significant increase from ALL 25 million to ALL 50 million. This indicates their active contribution to infrastructure development. As a result, loans to cooperatives also increased significantly from ALL 150 million to ALL 400 million, indicating an increase in support for cooperatives through credit financing. This in turn has led to improved market access, which has increased from 60% to 75%. This improvement in logistical and marketing channels has further enabled cooperatives to invest in social services, with a marked increase from ALL 10 million to ALL 50 million, highlighting the importance of social support in local communities through cooperative activities. Co-operatives play a key role in Albanian economic development, contributing to economic growth, improved social conditions and infrastructure development. They ensure comprehensive progress and stability in the country. Albanian total GDP increased from USD 13.25 billion in 2015 to USD 18.31 billion in 2023, reflecting the overall growth trend of the national economy.

The activities of cooperatives in Albania demonstrated an initial contribution to improving economic conditions and living standards in local communities, which demonstrates their important role in ensuring the national sustainable development. It is expected that cooperatives will continue to play an important role in the socio-economic development of Albania, contributing to the creation of new jobs, improvement of social conditions and development of infrastructure. This can be achieved by increasing investment in infrastructure, lending to cooperatives, improving access to markets and social services, and intensifying social projects. The prospect of further research is to explore the possibilities of developing cooperatives in Albania by creating new business models that combine traditional cooperative principles with modern technologies and innovations. The limitations of the study are that assessing the impact of cooperatives on socio-economic development is a complex and lengthy process. The analysis based on data for 2015-2023 may not account for long-term effects and changes that may occur in the future.

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CONFLICT OF INTEREST

None.

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Економічна ефективність кооперативів та їх вплив на соціально-економічний розвиток сільських територій

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Анотація. Метою дослідження був аналіз впливу кооперативів на розвиток соціально-економічної ситуації у сільській місцевості Албанії. Для досягнення цієї мети було проведено детальний аналіз основних соціально-економічних показників та узагальнено результати, що допомогло виявити загальні тенденції та закономірності розвитку Албанії. Дослідження визначило, що кооперативний сектор в Албанії відіграє вирішальну роль у сприянні сталому розвитку сільських територій та підвищенню якості життя у громадах. У період із 2015 по 2023 рік кооперативи сприяли створенню 12 456 нових робочих місць, зниженню рівня бідності на 25 % та скороченню відтоку населення на 30 %. Крім того, сектор інвестував у соціальні послуги та місцеву інфраструктуру, покращуючи умови життя та підтримуючи економічну стабільність. Зростання кооперативів відбулося завдяки збільшенню інвестицій в інфраструктуру на 40 %, підвищенню доступності кредитів на 20 %, покращенню доступу до ринків на 35 %, а також розширенню логістики та каналів збуту. Позитивний вплив кооперативів на економіку та соціальні умови відобразився у зростанні валового внутрішнього продукту Албанії з 13,25 млрд доларів США у 2015 році до 18,31 млрд доларів США у 2023 році, тобто на 38 %. Результати дослідження можуть бути корисними для розробки науково обґрунтованої політики та стратегій, спрямованих на підтримку зростання і стійкості кооперативного сектору в Албанії та за її межами

Ключові слова: інфраструктура; зайнятість; бідність; інтеграція; стале зростання; інновації

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Bodies and mechanisms of state regulation of the insurance market in Ukraine in the context of European integration

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Abstract. The purpose of the study was to identify the main areas of optimisation of the Ukrainian system of state regulation of the insurance market, taking into account the European experience. The research methodology included three stages, namely, analysing the role and functions of government agencies in regulating the insurance market, conducting interviews, and identifying the main trends in the development of the insurance market. The results showed the importance of the National Bank of Ukraine, which performs the functions of regulating financial services, including insurance. The Law of Ukraine No. 1909-IX "On Insurance" and Law of Ukraine No. 2664-III "On Financial Services and State Regulation of Financial Services Markets" were studied. Considerable attention was paid to the implementation of the Solvency II Directive, which sets new requirements for risk management capital in the context of European integration in Ukraine. The survey results indicated that competition in the services sector drives organisations to innovate and improve their offerings. The study found that the adaptation of Ukrainian legislation to European standards contributes to the reliability of the insurance market. In particular, negative trends include problems with the implementation of new regulations and the adaptation of insurance companies to European requirements. Adjusting to new regulatory standards includes modifying internal procedures and using modern technology. However, the general direction of regulation contributes to strengthening the insurance sector in the context of European integration. The practical significance of the study is to provide specific recommendations for improving the mechanisms of insurance market regulation in Ukraine, which will help to increase the transparency and reliability of insurance companies, as well as their adaptation to European standards in the context of European integration

Keywords: financial services; licensing; legislative norms; enterprises; financial markets

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INTRODUCTION

The influence of state regulatory authorities and mechanisms of the insurance market in Ukraine is being revealed in a new way in the context of European integration and requires scientific exploration, as integration into the European Union sets new requirements for the system of financial market regulation. The Ukrainian insurance market needs to be adapted to European standards, which includes improving the regulatory framework, strengthening control over insurance companies, and ensuring transparency of their operations. A key element is the implementation of principles that protect the rights of insurance consumers, as this increases confidence in the market and promotes its development. The study of the influence of regulatory authorities allows assessing the effectiveness of existing mechanisms, identifying their weaknesses, and developing recommendations for their improvement. Specifically, this could include an analysis of international practices in regulating insurance markets to help Ukraine adopt best practices.

Many researchers have analysed the issues of state regulation of the insurance market, focusing on various aspects from the regulatory framework to risk control and management mechanisms. For example, A. Nechyporenko (2021) examined the theoretical aspects of state regulation

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of insurance activities in Ukraine and identified the key functions and mechanisms used by the country to regulate these activities. Furthermore, the researcher investigated the major areas for improving regulation, including consumer protection and ensuring stable conditions for insurance companies. R. Van Oirbeek *et al*. (2024) examined the effect of insufficient attention from government agencies on the development of the insurance market. In their study, researchers noted that due to the lack of effective regulatory mechanisms, many insurance companies operated in a non-transparent manner, which led to a loss of consumer confidence. Their findings are consistent with the view that a stronger regulatory framework is required to ensure market stability. J. Sadowski (2024) investigated the implementation of European consumer protection standards in the insurance market of various countries. Their study showed that this improved the quality of insurance services and increased the level of trust in insurance companies. They also emphasised the significance of strengthening control over the observance of consumer rights and introducing liability mechanisms for insurance companies.

V. Bratyuk (2022) focused on identifying the problems affecting the demand for insurance services, such as consumer distrust, economic instability, and low financial capacity of the Ukrainian population. The researcher also outlined ways to develop the market, emphasising the significance of effective regulation to build trust in insurers and stimulate the economy. Furthermore, A. Tayebi *et al*. (2024) analysed the barriers to the integration of various insurance markets into the European space. Insufficient capitalisation of insurance companies and weak state control are the main obstacles to the implementation of European standards in weak states. Their studies highlighted the need for financial support and professional development of insurance company employees to achieve compliance with the standards. N. Verma (2024) identified the mechanisms of state regulation of the insurance market in the context of the economic crisis. Their study pointed to the need to increase the role of government agencies in creating conditions for market stability through the introduction of effective regulatory instruments, such as liquidity and capital ratios.

Y. Skaf *et al*. (2024) addressed the problems of supervision of insurance companies. The researchers pointed to the insufficiency of institutional mechanisms for effective control and noted that a lack of resources and weak institutions impede the full supervision of insurance companies. R.D. Banker *et al.* (2024) addressed the specifics of reinsurance market regulation, investigated the international reinsurance mechanisms and their effect on the financial stability of national markets. The researchers' conclusions pointed to the need to harmonise national legislation with generally accepted international standards in the field of reinsurance. A. Tasdemir & E. Alsu (2024) studied the insurance market regulation processes in the context of globalisation, which significantly affects national markets by integrating them into global financial systems. Their study focused on the role of international financial institutions and organisations. National regulators, according to these researchers, should adapt international standards to the specifics of national markets, maintaining a balance between the requirements of globalisation and internal market characteristics. F.A. Oquendo-Torres & M.J. Segovia-Vargas (2024) pointed out the role of educational programmes aimed at raising consumer awareness of their rights and options in insurance. The researchers suggested that information campaigns should be more actively implemented to help consumers understand complex insurance products and use them effectively.

The above-mentioned researchers made a valuable contribution, but the issue of state regulation of the Ukrainian insurance market in the context of European integration is still understudied. The purpose of this study was to identify the key areas for improving the Ukrainian system of state regulation of the insurance market according to European standards and requirements. The objectives of this study were to define the role and functions of state authorities in regulating the insurance market of Ukraine; to analyse the mechanisms of state regulation used in the EU and the possibility of their adaptation in Ukraine; to identify problems and aspects for improvement related to the regulation of the insurance market in Ukraine in the context of European integration.

MATERIALS AND METHODS

Three leading insurance companies of Ukraine were selected for the study, namely insurance company (IC) Providna (Information of the issuer..., n.d.), IC Arsenal Insurance (n.d.), IC TAS Insurance Group (n.d.). The study employed an experimental method consisting of three key stages. The first stage involved analysing the role and functions of government agencies in regulating the insurance market. At this stage of the study, the activities of the National Commission for State Regulation of Financial Services Markets were analysed, which from 2011 to 2020 was the main state regulator of the insurance market (after June, 2020, the commission's powers are divided between the National Bank of Ukraine and the National Securities and Stock Market Commission). The key functions of state financial institutions in ensuring that insurers comply with legal requirements were defined.

The following criteria were used to analyse the role and functions of state authorities in regulating the insurance market in Ukraine. **Licensing and control over the activities of insurers.** The study assessed the processes of issuing licences to insurance companies, the conditions for obtaining them, and monitoring compliance with licensing requirements. The study determined how efficiently the National Commission for Regulation of Financial Services Markets performs these functions and how insurers assess licensing requirements. Supervision and monitoring. This study analysed the process of ongoing supervision of insurance companies, including compliance with legislation, financial stability, reserves, and reporting. The study examined how monitoring affects companies' operations and whether it contributes to market transparency. **Compliance with legal requirements.** The ways in which the National Securities and Stock Market Commission (NSSMC) is effective were identified. This criterion included a study of the implementation of new regulations and their influence on the insurance market. Implementation of European standards. The criteria for adapting the Ukrainian insurance market to the standards of the European Union, specifically the Solvency II Directive (Solvency II Hub..., n.d.),

were analysed. The study assessed how Ukrainian legislation is changing in the context of European integration and how this affects the activities of Ukrainian insurance companies. Enforcement mechanisms and sanctions. The study identified the mechanisms used by the NSSMC to hold insurers accountable for violations of the law and assessed their effectiveness.

The second stage of the study involved interviews with representatives of the selected companies for a total of 15 expert participants, including 7 women and 8 men, aged 25 to 45 years. The participants represented various positions, including heads of departments, analysts, and risk management specialists, which enabled a comprehensive examination of the practical aspects of the companies' work in the context of regulatory requirements and strategic approaches to adapting changes in legislation. Questions for the representatives of insurance companies were as follows:

1. How do you assess the effectiveness of the NSSMC's licensing process for insurers?
2. Do you think that monitoring of compliance with licensing requirements is effective? What aspects need to be improved?
3. What are the major challenges you observe in supervising the activities of insurance companies?
4. How well are the requirements of national legislation and European standards implemented?
5. How do you assess the NSSMC's control and sanctioning mechanisms?
6. Is the reporting system for licensing and supervision sufficiently transparent?

The study was conducted following the ICC/ESOMAR international code on market, opinion, and social research and data analytics (2016) ethical norms and standards. All participants agreed to take part in the study, explaining the purpose of the study, potential risks and benefits, and the possibility of withdrawing at any time without negative consequences. The third stage was to identify the key trends in the development of the insurance market and recommendations for European integration.

RESULTS

Theoretical foundations and analysis of the Ukrainian insurance market

Ukraine's insurance market is a vital part of the financial system, playing a role in economic development through the accumulation of long-term investments. According to the National Bank of Ukraine, 126 insurance companies operated in the market in 2023, which is a stable figure (Financial sector statistics, 2024). However, in recent years, there has been a gradual decline in the number of insurers, due to stricter competition and capitalisation requirements. In 2023, gross written insurance premiums reached UAH 52.8 billion, indicating that the market is growing even in the face of macroeconomic uncertainty. This is 7.5% more than in the previous year. The key areas of insurance are still car insurance, life insurance, and health insurance, which are growing in demand due to the increase in health-related risks. Despite the overall positive trends, the level of insurance penetration (the ratio of insurance premiums to GDP) continues to be low. Compared to developed countries, this indicator is much lower in Ukraine, which indicates an insufficient insurance culture among households and businesses. The low level of citizens' ability to pay, as well as distrust in insurance services stemming from historical fraud problems in the 1990s, continue to hamper market development.

Ukraine's insurance companies play a vital role in ensuring economic stability, as they allow for the accumulation of significant long-term investments. This is particularly true for life insurance, which attracts funds for a long period and is a source of investment in the economy. The insurance market also helps to reduce business risks, which is a principal element in the risk management system of enterprises. Life and health insurance programmes are gradually becoming increasingly attractive to Ukrainian companies, as they help to provide social guarantees to employees and minimise business risks. At the same time, economic instability and military operations are affecting the insurance market. Companies are forced to adapt their products to the new reality, including military risks and related threats. This has led to an increase in demand for insurance products that were not previously popular, such as war insurance or building insurance against destruction due to hostilities.

One of the major challenges is the lack of public trust in insurance companies. Many citizens continue to view insurance as unprofitable or risky due to negative past experiences. There is also the problem of insufficient financial security of the population, which reduces the ability to pay for insurance services. Furthermore, economic instability, frequent exchange rate fluctuations, and inflation affect the solvency of both individuals and legal entities. Another major issue is the regulatory framework and its compliance with European standards. Ukraine is gradually adapting its laws to European requirements, but the harmonisation of legislation will take time. The effectiveness of regulatory mechanisms and monitoring of licensing requirements are also still questionable. For the market to grow further, the level of public confidence in insurance companies needs to be increased by ensuring transparency of their operations and implementing European regulatory standards. Improving financial literacy among the population and introducing new, more affordable insurance products could be a crucial step. Market expansion may also be driven by growing demand for specialised insurance products that meet the modern needs of businesses and individuals. Products such as health insurance or insurance against cyber threats are gaining popularity and may become new drivers for market development in the coming years.

The NSSMC is the central executive body responsible for regulation and supervision of financial services, including the insurance market. The primary objective of this institution is to create conditions for the stable development of the insurance sector, ensure transparency of insurance companies' activities and protect the rights and interests of financial services consumers. One of the key functions of the commission is to issue licences for insurance activities, which includes assessing applicants for compliance with the requirements of laws and regulations, including verification of financial stability, business reputation, and relevant experience. Licensing helps to prevent unreliable companies from entering the market, which could pose a threat to consumers. After obtaining a licence, insurers are subject to constant supervision by the NSSMC. The commission monitors the financial performance of insurance companies,

their solvency, compliance with insurance reserves, and other financial obligations, which are performed through regular reports that insurers must submit to the commission. Monitoring allows for prompt detection of possible problems in the operations of insurers that may adversely affect their ability to perform their obligations to customers.

The NSSMC is responsible for ensuring that all insurance market participants act according to the legislation. This includes overseeing compliance with insurance reserve requirements, solvency, reporting standards, and the terms and conditions of insurance contracts. In case of violations, the commission is entitled to take relevant measures, ranging from imposing fines to revoking the insurance licence. The commission reviews customer complaints against insurance companies, ensures compliance with legal regulations on the payment of insurance claims and other obligations to customers. Furthermore, the commission is working to improve financial literacy among the population, which enables consumers to choose insurance products more consciously. The NSSMC promotes competition in the insurance market by encouraging the introduction of new insurance products and services and compliance with strict service standards. The commission actively cooperates with international organisations and experts to implement best practices and improve the efficiency of insurance regulation in Ukraine. This includes the harmonisation of Ukrainian legislation with European standards, which is a crucial step towards integration with the EU. At the legislative level in Ukraine, two key laws play a major role in regulating the insurance market, namely the Law of Ukraine No. 2664-III (2001) and the Law of Ukraine No. 1909-IX (2021). Both of these documents have common goals related to Ukraine's integration into the European financial system and the creation of a stable environment for financial institutions. The Law of Ukraine No. 1909-IX (2021) regulates the provision of insurance services, consumer protection, and the activities of insurers. In the context of European integration, this law needs to be modernised to meet European standards, particularly the requirements for insurance companies' capitalisation, financial reporting and transparency of operations. Importantly, the new provisions of this law may be aimed at increasing public confidence in insurance services and ensuring greater competitiveness in the market. Specifically, the Law of Ukraine No. 2664-III (2001). This law regulates not only insurance, but also other financial services, which allows establishing common rules of the game for all market participants. In the context of European integration, this law requires the implementation of principles that ensure the competitiveness, transparency and stability of financial services markets.

Compliance with European standards in this area will also help protect consumer rights and increase confidence in financial institutions. The common features of the above legislative acts include the commitment to transparency, enhanced consumer protection, and a competitive environment for financial institutions. European integration requires Ukraine to adapt to European standards, and therefore it is essential to analyse the current legislation and identify its shortcomings to ensure adequate regulation of the insurance market. Thus, the Law of Ukraine No. 2664-III (2001) the and Law of Ukraine No. 1909-IX (2021) are of great significance for the development of the insurance market in Ukraine, as they create the basis for further integration with the European financial area.

Data collection and processing based on the assessment of the NSSMC licensing process and the effectiveness of monitoring compliance with licensing requirements

The survey of 15 representatives of insurance companies was aimed at assessing the licensing processes of the NSSMC and the effectiveness of monitoring compliance with licensing requirements. The survey findings are presented in Figure 1.

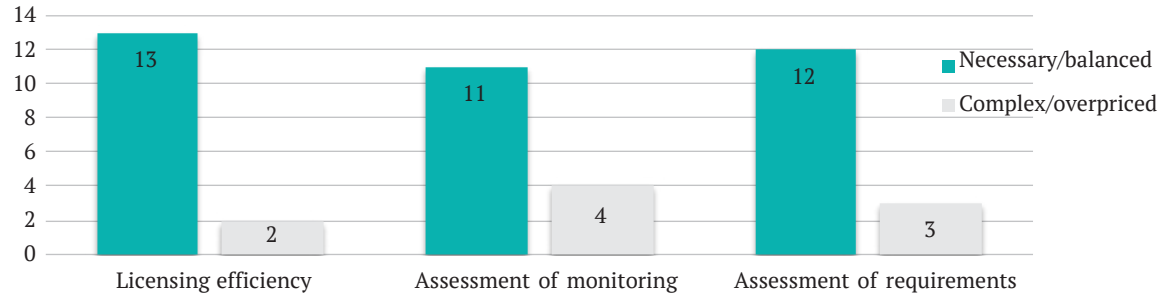

Figure 1. Results of the analysis of interviews by the criterion "licensing and control of insurers", number of participants

Source: created by the author

According to the survey, 87% of respondents recognised the licensing process as necessary to ensure the reliability of the insurance market. At the same time, 13% of respondents noted that the requirements for obtaining a licence are too complex and require considerable time and financial resources. One of the respondents from Arsenal Insurance noted that the licensing process is often delayed due to complex documentation and inspections, which can delay the launch of new products. On the other hand, 40% of participants believed that the process is balanced and meets the need to protect the interests of consumers, as licensing guarantees the stability and financial strength of companies.

The procedure for compliance with licensing requirements is strict, which helps to avoid unreliable companies from entering the market. 80% of survey respondents said that capital and reserve requirements are necessary to ensure stability, although 33% considered

them too high, especially for medium-sized companies. A representative of IC Providna noted that they understood the significance of financial stability, but that excessive capital requirements could limit the ability to invest in the development of new products and services. In terms of licensing timeframes, 60% of the companies surveyed believed that the process took longer than necessary to verify financial solvency and compliance. According to one of the representatives of Arsenal Insurance, bureaucratic delays sometimes prevent them from responding quickly to market opportunities and expanding into new segments. Next, the study analysed the NSSMC's ongoing supervision of insurance companies, as presented in Figure 2.

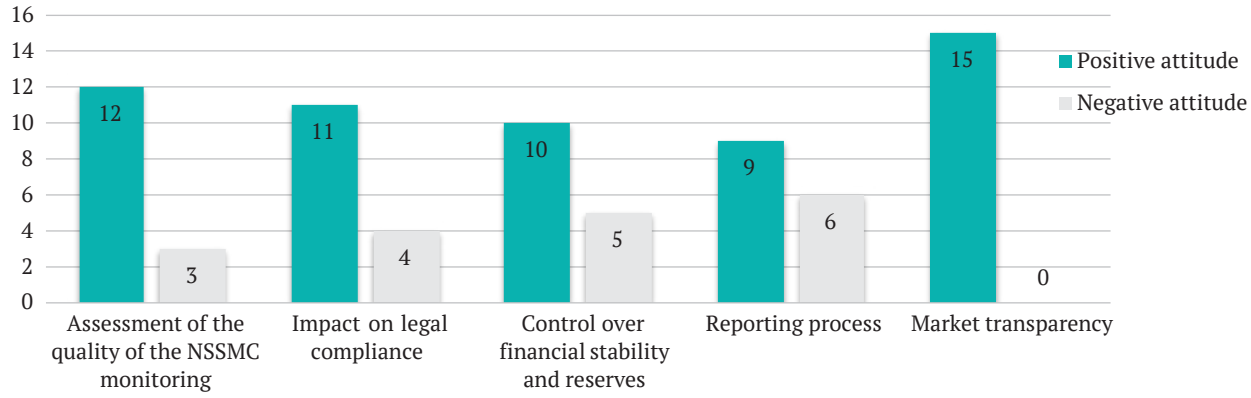

Figure 2. Results of the analysis of interviews by the criterion "supervision and monitoring", number of participants
Source: created by the author

Most respondents positively assessed the monitoring by the NSSMC, as 80% of respondents stated that constant supervision contributes to market transparency and stability of insurance companies. One of the representatives of IC Providna noted that monitoring ensures prompt detection of problems in the financial stability of companies and facilitates their prompt resolution. Furthermore, 73% of respondents noted that close supervision of compliance with the law by the NSSMC is critical to maintaining fair competition in the market. This includes checking the correctness of insurance reserves and financial indicators. However, 27% of respondents believed that excessive attention to reporting detail sometimes diverts companies' resources from their core business.

The NSSMC monitors the financial stability and reserve formation of insurance companies, which is why 67% of respondents stated that strict control over these indicators helps to strengthen customer confidence in insurance companies and reduces the risk of bankruptcy in the market. At the same time, 33% of respondents noted that reserve requirements can be excessively high for medium-sized companies, which sometimes hampers their operations. The reporting that insurance companies have to provide to the NSSMC is an effective tool for monitoring their activities, according to 60% of respondents. However, 40% noted that the preparation of the reports is time-consuming and resource-intensive, which can create operational difficulties. All respondents agreed that monitoring by the NSSMC greatly contributes to the transparency of the insurance market. This is crucial for customers, who have confidence in the reliability of companies thanks to state control. To obtain a more comprehensive result, the study assessed the effectiveness of compliance with the NSSMC's regulations, which is illustrated quantitatively in Figure 3.

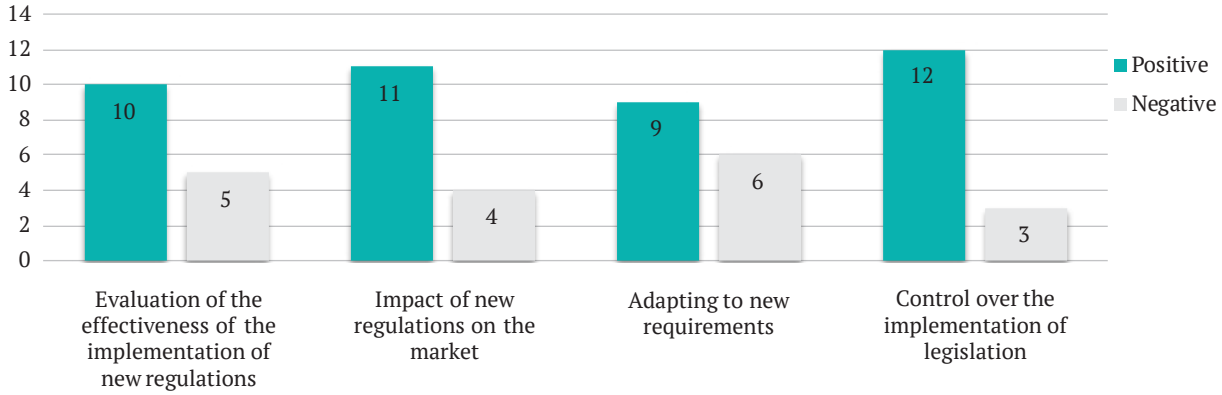

Figure 3. Results of the analysis of interviews according to the criterion of "compliance with legal requirements", number of participants
Source: created by the author

This analysis covered the introduction of new regulations and their impact on the insurance market. Thus, 67% of the survey participants believed that the NSSMC effectively implements new regulations that ensure market stability and protect the rights of policyholders. One of the representatives of IC Providna noted that the new requirements help to increase the reliability of insurance companies and ensure customer protection, which is vital for building trust in the market. Meanwhile, 33% of respondents believed that sometimes new regulations are introduced without sufficient time for adaptation. This can create difficulties for insurance companies, especially in matters related to changes in reporting or provisioning.

In terms of the introduction of new regulations, 73% of participants noted that this positively affects the market, stimulating the improvement of the quality of insurance products and services. This is especially true of transparency requirements and financial reserve requirements. For example, a representative of Arsenal Insurance noted that most new regulations help to raise service standards and improve the financial stability of companies. However, 27% believe that the new requirements may create more financial burdens for companies, especially for medium and small market players. This sometimes hinders their competitiveness. 60% of respondents said that the adaptation to new regulations is usually easy, as the NSSMC provides sufficient information and support during changes. However, 40% stated that some innovations are being implemented too quickly, which complicates the adaptation process, especially in financial terms. Most respondents (80%) agreed that the NSSMC's enforcement of legislation is strict but fair. This contributes to market stability and customer protection. However, 20% stated that sometimes the control becomes excessive, which can lead to unnecessary administrative costs and inspections that divert resources from the development of companies.

Interviews with representatives of insurance companies on the implementation of European standards and adaptation to the Solvency II Directive provided important insights into changes in the Ukrainian insurance market in the context of European integration. According to the quantitative data obtained, 53% of respondents indicated that their companies have already implemented the key provisions of the directive, specifically in terms of capital requirements and risk management. At the same time, 27% reported that the adaptation process is still ongoing and that companies are facing difficulties, especially in changing their reporting systems. Another 20% of respondents indicated that their companies are at the stage of preparing for full implementation of the standards.

The key challenges in adapting to the Solvency II Directive were the difficulty of integrating the new requirements into their internal processes (60%) and the financial costs of preparing for the new requirements (33%). Some participants (7%) also noted a lack of qualified staff to implement the new requirements. In terms of the impact of European integration changes in legislation, 67% of respondents positively assessed their effect on companies' operations, especially in the context of increased market transparency and risk management. However, 20% of respondents believe that legislative changes may create more administrative burdens. The remaining 13% were unable to assess the long-term implications as the process of adaptation had only just begun (Fig. 4).

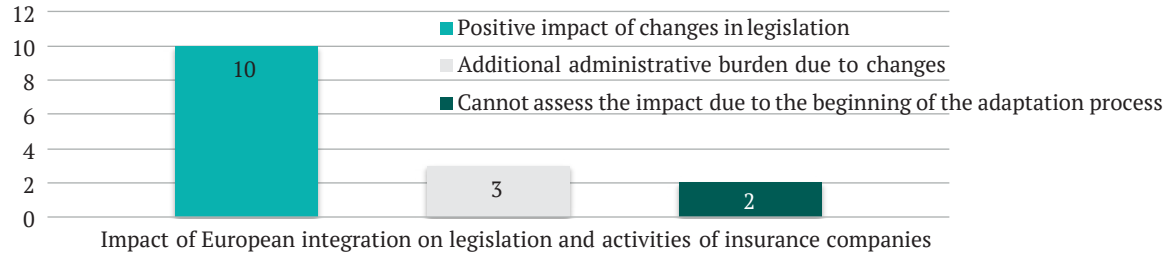

Figure 4. Results of the analysis of interviews by the criterion of "implementation of European standards", number of participants

Source: created by the author

Expectations from the introduction of European standards also appear encouraging. Most participants (80%) anticipate increased confidence in the Ukrainian insurance market on the part of European investors and partners, and 53% of respondents believe that this will open new opportunities for expanding services in international markets. Overall, the adaptation to the Solvency II Directive is fraught with difficulties, but most insurance companies are positive about it, as the introduction of European standards will contribute to further market development and Ukraine's integration into the global economic space.

Interviews with representatives of insurance companies indicate that they generally have a positive assessment of the NSSMC's control and sanctions mechanisms, but stress the need to improve their effectiveness, especially in terms of increased accountability and better communication. According to the survey, 47% of respondents believed that the NSSMC's mechanisms were effective in ensuring market discipline and forcing companies to follow the legislation requirements. They noted that regular inspections and strict sanctions contribute to compliance with insurance legislation. At the same time, 33% of participants stated that while the mechanisms are formally effective, they are not always used promptly or to the fullest extent. In their opinion, some inspections are merely a formality and do not lead to any substantial changes. Another 20% of company representatives noted that sanctions have limited effectiveness due to the lack of transparency of the NSSMC and the possibility of avoiding responsibility for large market players. As for the types

of sanctions, 53% of participants indicated that the key sanctions applied to insurers are fines for non-compliance with financial requirements and violation of reporting standards. These fines have a disciplining effect, but their amount is sometimes insufficient for large companies. 27% of respondents said that a ban on certain types of activities is an effective lever of influence, especially for small and medium-sized insurance companies. While 20% of the participants mentioned other sanctions, such as revocation of licences, they stressed that such drastic measures are rarely applied and mainly to companies that are already in a dire financial situation.

The respondents identified the difficulty of adapting to new legislative requirements, especially in the context of rapid changes in the regulatory sphere, as the key challenge in enforcement, which sometimes complicates the observance of standards (40%). 33% of participants noted that low level of communication between the NSSMC and insurance companies often leads to misunderstandings and compliance issues. Another 27% of respondents believe that sanctions are sometimes delayed, which may result in violations not being corrected for a long time. Participants also suggested several ways to improve the enforcement system. 53% of respondents said that liability for violations should be increased by increasing the amount of fines and the frequency of inspections. 27% suggested improving communication between the NSSMC and insurance companies, particularly through the establishment of joint working groups to discuss new legislative requirements. 20% of participants said that more transparency in the NSSMC's decision-making is needed to avoid situations where large companies can avoid severe sanctions.

Government regulation has both a positive and somewhat restrictive effect on the activities of insurance companies. It helps to ensure market stability and consumer protection, but sometimes causes an excessive burden due to complex licensing and reporting procedures. Overall, respondents noted that the licensing process is instrumental in ensuring market transparency and stability. However, some companies pointed to major administrative barriers and excessive bureaucracy in the process, which can impede the development of new products or services. Some interviewees noted that reporting requirements are complex and resource-intensive, especially for companies with limited financial resources. They also pointed out that regulatory inspections are often more focused on compliance with formalities than on the actual financial soundness of companies. Representatives of insurance companies positively assessed state control in the area of consumer protection, as it increases customer confidence in the insurance market. However, they believed that dispute resolution procedures should be more efficient and quicker. Interviewees also highlighted the need to reform the regulatory system to facilitate the introduction of innovative products and services. They emphasised that current regulation often does not address the specifics of digital solutions and emergent technologies, such as online platforms for selling insurance products.

Key trends in the development of the insurance market and recommendations for European integration

The analysis of insurance market trends revealed both positive and negative aspects that affect its development and adaptation to European standards. This allowed to identify key recommendations for ensuring effective integration into the European market and creating conditions for sustainable development of the insurance industry in Ukraine. One of the key positive developments in the insurance market is the increasing level of consumer confidence in insurance products. Over the past few years, the number of insurance contracts concluded has increased substantially, which indicates that people are becoming increasingly aware of the benefits of insurance. This is explained by both an increase in the number of insurance companies and an improvement in the quality of their services. Specifically, the introduction of compulsory insurance for certain types of activities has stimulated activity in the market. Another significant positive trend is the gradual improvement in the quality of insurance services. In an effort to attract more customers, insurance companies have started to introduce modern technologies that streamline processes, reduce service times, and increase transparency of operations. For example, an increasing number of companies are offering online services for signing contracts, applying for insurance payments and monitoring the status of insurance policies. This helps to simplify the interaction between the insurer and the consumer and increases customer satisfaction. Another positive aspect of the market development is the increasing number of international insurance companies entering the Ukrainian market, as well as the strengthening of cooperation between Ukrainian insurers and their foreign counterparts. This contributes to increased competition and the introduction of European standards in the Ukrainian insurance industry. The influence of foreign capital also encourages insurers to follow international norms and standards in financial management and reporting, which positively affects the market overall.

Despite the positive trends, the Ukrainian insurance market faces a series of challenges that hinder its development and transition to European standards. One of the primary challenges continues to be the lack of transparency in the operations of insurance companies. Despite the reporting requirements, many companies do not disclose sufficient information about their operations and financial position. This creates obstacles for customers in choosing reliable insurance companies and may negatively affect the overall level of confidence in the market. The lack of clear standards for financial transparency is also a problem in the context of European integration, as European insurance companies operate under strict regulations in this area. Although the number of insurance companies in the Ukrainian market is growing, competition between them is still relatively weak. This is caused by the concentration of a large market share in the hands of a few large companies, which can dominate certain market segments, reducing the incentive to improve the quality of services and lower the cost of insurance policies. Insufficient competition can also hinder the adoption of advanced technologies and innovations, as the absence of strong competitive pressure does not encourage companies to innovate.

A major challenge for the Ukrainian insurance market is the need to implement European standards, particularly the requirements of the Solvency II Directive, which regulates the activities of insurance companies in the EU.

Presently, only a fraction of Ukrainian companies has adapted to these requirements, which creates unequal conditions in the market and impedes its integration with the European market. The implementation of European standards is a lengthy process that requires extensive financial and organisational resources, which is why many companies postpone this process, reducing their international competitiveness. To successfully integrate the Ukrainian insurance market into the European economic environment and overcome the existing challenges, a series of measures should be taken. The first step to improve the situation is to ensure transparency of insurance companies. Clear reporting requirements should be established that are in line with European standards, specifically the Solvency II Directive. Furthermore, regular monitoring of compliance with these requirements should be ensured and the audit results should be made public to increase confidence in the insurance market by clients and investors. To increase competition in the insurance market, favourable conditions should be created for the entry of new companies, particularly by reducing barriers for small and medium-sized insurance companies. This will increase the number of players in the market and create incentives to improve the quality of services and reduce prices. Innovations should also be encouraged, for example by supporting digital solutions in insurance that can make services more accessible and efficient.

A crucial step towards European integration is the active implementation of European standards in the operations of Ukrainian insurance companies. It is necessary to ensure that legislation is gradually harmonised with the Solvency II Directive and other EU regulations governing insurance activities. For this, companies must be supported in adapting to the new requirements, particularly through consultations and training programmes. It is also worth intensifying cooperation with European insurance regulators to ensure the exchange of experience and best practices. Thus, the Ukrainian insurance market demonstrates both positive and negative trends that affect its development and adaptation to European standards. For successful European integration, it is necessary to improve the transparency of insurance companies, stimulate competition and implement European standards. These measures will help increase confidence in the market, increase the number of international partners, and ensure the sustainable development of the insurance industry in Ukraine.

DISCUSSION

The findings of the present study showed that the insurance market is one of the key components of Ukraine's financial system, and its regulation requires due attention at both the national and international levels. Harmonisation of national legislation and regulatory mechanisms with European standards is a necessary step towards integration into the European Union. A. Nechyporenko (2021) explored the problems associated with the control and supervision of insurance companies in Ukraine and emphasised the need to improve regulation to increase the stability of the insurance market. It was found that the regulation of the insurance market in Ukraine before the start of the European integration process was characterised by some instability and imperfection. This was conditioned by the fact that the Ukrainian insurance sector had been developing for a long time without clearly defined regulatory frameworks and due attention from the government. This situation led to fragmentation of the market, with different segments operating under different standards, which created difficulties for comprehensive regulation and supervision. According to S. Ghorashi *et al*. (2024) and K. Ha *et al*. (2024), this period was a time when the foundations of the insurance market were being formed, but the lack of a clear regulatory framework did not allow for a unified structure that would facilitate the stable development of the market. This confirms the conclusions of the present study that due to the lack of a sufficient regulatory framework and regulatory mechanisms; individual market sectors cannot function properly overall. Specifically, the key areas of insurance, such as life insurance, continued to be underdeveloped due to low public confidence.

A. Gupta & S. Venkataraman (2024) highlighted that insufficient attention by government agencies to insurance market regulation is often one of the reasons for low confidence in insurance services among the population. The lack of effective supervision and a clear legal framework meant that many insurance companies did not always act transparently, and consumers were not confident in receiving compensation in case of an insured event. This was reflected in the lack of insurance traditions and the unwillingness of citizens to enter into insurance contracts, which negatively affected the dynamics of market development. To overcome the existing problems and on the path towards European integration, the state has begun to introduce new regulatory mechanisms and adapt Ukrainian legislation to European standards. M. Eling (2024) and Y. Elgargouh *et al*. (2024) identified the value of knowledge management and digital transformation for improving the efficiency of insurance companies. Y. Elgargouh *et al*. (2024) emphasised that proper knowledge management is a critical factor for the successful digital transformation of insurance companies, which allows them to increase their competitiveness. M. Eling (2024) found that to ensure the sustainability of the insurance industry, it is essential to implement digital solutions and adapt to changes in the market environment. Both studies agreed that digital transformation and knowledge play a key role in supporting the sustainable development and resilience of insurance companies.

A. İlkaz & F. Çebi (2024) and J. Montero *et al*. (2024) confirmed the findings of the present study, namely that the creation of independent bodies to regulate the insurance market was positively assessed by experts as it contributed to market regulation, reduced the number of unscrupulous insurance companies, and increased consumer protection in many countries. It also created the conditions for the introduction of European corporate governance and financial reporting standards, which are in line with EU directives. Such measures improved the regulatory system of insurance markets, enabling the countries implementing these reforms to integrate more effectively into the global market and meet international standards. X. Pei *et al*. (2024), emphasised the significance of implementing the Solvency II system in each European country, as it is the basis for ensuring the stability of the insurance market and increasing its international competitiveness. This also supports the conclusions of this study, which

shows that the adaptation of Ukrainian legislation to Solvency II will help attract foreign investment, as European investors will be able to operate in a more predictable and secure legal environment. However, according to N.Y. Asabere *et al*. (2024), B. Srbinoski *et al*. (2024), and M. Farrugia *et al*. (2024), the implementation of Solvency II in many countries has faced a series of challenges, particularly due to underdeveloped financial infrastructure and lack of qualified personnel. The researchers argued that the adaptation of this system requires extensive investment in training and modernisation of insurance companies, which coincides with the findings of the present study, which stressed the need for institutional support and technical aid from the EU.

Harmonisation of Ukrainian legislation with European standards forms an integral part of the European integration process. This includes the introduction of legal norms that regulate the activities of insurance companies, the procedure for supervising them, and consumer protection. For example, V. Bratyuk (2022) proved that the Ukrainian insurance market continues to develop despite economic difficulties and political challenges. The researcher showed that the market is undergoing structural changes, including a reduction in the number of insurance companies, but at the same time an increase in the volume of insurance premiums. V. Bratyuk (2022) found that the financial stability of many insurance companies is still under threat, especially due to the unstable economic situation. Furthermore, I. Alley (2024) and S. Cosma & G. Rimo (2024) confirmed that the implementation of these standards contributed to improving the quality of insurance products and increasing consumer confidence in insurance companies. This is consistent with the findings of the present study. The harmonisation of legislation is a prerequisite for the creation of a competitive insurance market, which is also in line with the presented findings.

Despite the achievements in insurance market regulation, Ukraine faces a series of challenges that hinder the full integration into the European insurance market. According to M. Çetin (2024) and K.F. Čiković *et al*. (2024) one of the primary barriers is the lack of sufficient financial resources to modernise insurance companies, which is necessary to meet European standards. Most global insurance companies are still unable to ensure the required level of capitalisation, which is one of the key requirements of Solvency II. Notably, the supervision of insurance companies in Ukraine is not yet fully in line with European requirements. According to E. Mojali *et al*. (2024), although government agencies are trying to strengthen control over insurance companies, a lack of resources and institutional weaknesses mean that some insurance companies continue to operate without proper supervision. This is in line with the findings of this study, which point to the need to strengthen the regulatory framework and develop institutional control mechanisms. However, despite the challenges, the European integration of Ukraine's insurance market has great potential. According to C. Amanda & A.D. Pradipta (2024) and J.C. Acosta-Prado *et al*. (2024), opening the market to European insurance companies can stimulate competition, which will improve the quality of insurance services. Attracting foreign investors will help to increase the level of market capitalisation, which is a prerequisite for its stable development. Therefore, state regulation of Ukraine's insurance market in the context of European integration is essential for ensuring the stability of the financial system and the development of the national economy. However, further reforms, institutional support, and cooperation with the EU are needed to achieve full compliance with European standards.

CONCLUSIONS

Thus, the study confirmed the role of state regulation in the activities of insurance companies in Ukraine, especially in the context of European integration. The analysis of legislative acts, specifically the Law of Ukraine No. 1909-IX and the Law of Ukraine No. 2664-III, revealed that these documents not only provide the legal framework for the market functioning, but also define principles that promote transparency, consumer protection, and competitiveness. Interviews with representatives of insurance companies showed that changes in legislation directly affect business strategies. Many respondents noted that adapting to new regulatory requirements requires extensive efforts, including retraining, changing internal processes, and introducing advanced technologies. However, despite the challenges, company representatives also stressed that the correct implementation of government regulations can stimulate market development and improve the quality of insurance services. Specifically, increased capitalisation and financial reporting requirements help to reduce risks and increase consumer confidence.

Interviews with representatives of insurance companies on the implementation of European standards and adaptation to the Solvency II Directive revealed several important findings. Thus, 53% of the survey participants indicated that their companies have already implemented the key provisions of the Directive. At the same time, 27% of participants said that companies are still in the process of adapting, facing difficulties, especially in changing their reporting systems. Another 20% of experts said that companies are currently preparing to implement the standards. The major challenges are the difficulty of integrating new requirements into internal processes (60%) and financial costs (33%). Some companies face a lack of qualified staff to implement the requirements. The impact of the legislative changes was positively assessed by 67% of respondents, while 20% believe that these changes may create an incremental burden.

The survey findings confirmed that competition in the services market encourages companies to innovate and improve their services. The survey participants noted that the existence of clear and transparent rules of the game contributes to the growth of interest from investors and international partners, which is an essential aspect of the European integration process. At the same time, some limitations of the study were identified, including the insufficient number of respondents. Further research perspectives may include the issue of insurance companies' adaptation to technological changes, including the introduction of digital platforms and the use of artificial intelligence in regulating and providing insurance services. This will contribute to a better understanding of the challenges and opportunities facing the insurance market in the context of globalisation and European integration.

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None.

CONFLICT OF INTEREST

None.

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Органи та механізми державного регулювання страхового ринку в Україні в контексті євроінтеграції

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Анотація. Мета дослідження полягала у виокремленні основних напрямків оптимізації української системи державного регулювання страхового ринку, враховуючи європейський досвід. Методологія дослідження включала три етапи, а саме аналіз ролі та функцій державних органів у регулюванні страхового ринку, проведення інтерв'ю та виокремлення основних тенденцій у розвитку страхового ринку. Отримані результати показали важливість Національного банку України, який виконує функції щодо регулювання фінансових послуг, включаючи страхування. Було досліджено Закон України № 1909-IX «Про страхування» та Закон України № 2664-III «Про фінансові послуги та державне регулювання ринків фінансових послуг». Значну увагу було приділено імплементації Директиви Solvency II, яка встановлює нові вимоги до капіталу управління ризиками в умовах євроінтеграції в Україні. Результати опитування показали, що конкуренція у сфері послуг спонукає організації впроваджувати інновації та вдосконалювати свої пропозиції. У дослідженні виявлено, що адаптація українського законодавства до європейських стандартів сприяє підвищенню надійності страхового ринку. Зокрема, серед негативних тенденцій виявлено проблеми з імплементацією нових норм та адаптацією страхових компаній до європейських вимог. Адаптація до нових регуляторних стандартів передбачає зміну внутрішніх процедур та використання сучасних технологій. Однак загальний напрямок регулювання сприяє зміцненню страхового сектору в умовах євроінтеграції. Практичне значення дослідження полягає у наданні конкретних рекомендацій для вдосконалення механізмів регулювання страхового ринку в Україні, що сприятиме підвищенню прозорості та надійності страхових компаній, а також їхньої адаптації до європейських стандартів в умовах євроінтеграції

Ключові слова: фінансові послуги; ліцензування; законодавчі норми; підприємства; фінансові ринки

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The impact of artificial intelligence on risk management in the operational activities of financial institutions

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Abstract. The purpose of the study was to determine the impact of artificial intelligence (AI) on the quality of management decisions in the process of risk assessment and forecasting. For this purpose, the role of AI in risk management was analysed, and the practices of using AI in risk management were studied. The study results confirmed that the introduction of AI significantly improves the speed and quality of risk management decisions. It was found that with the help of machine learning algorithms that use numerous variables to analyse the creditworthiness of customers, financial institutions are more efficient in credit scoring. The algorithms allow banks to reduce default rates and at the same time improve the quality of their loan portfolio by making assessments more informed. In addition, machine learning technologies are used to quickly identify suspicious activities or abnormal patterns of customer behaviour, reduce the number of fraudulent transactions, improve customer security and reduce the cost of identifying and eliminating such threats. Another result of the study was the confirmation of the effectiveness of automating routine processes, such as updating risk registers and generating reports, which can significantly reduce operating costs and speed up management decision-making. Importantly, the use of AI not only improves the accuracy of risk forecasting and decision-making, but also contributes to the personalisation of services for customers, which increases their loyalty and satisfaction. Together with the implementation of compliance systems, AI technologies ensure compliance with legal requirements and increase transparency in financial transactions, which reduces the likelihood of non-compliance with regulatory standards and minimises the risks involved. The findings indicated that the introduction of AI for risk management requires not only technological optimisation, but also a deep review of ethical standards, transparency of algorithms and adaptation of regulatory mechanisms, which will ensure both increased efficiency and trust in such systems

Keywords: machine learning; credit scoring; algorithms; transparency of decision-making; fraud prevention

INTRODUCTION

The use of artificial intelligence (AI) in risk management has increased significantly since the early 2010s. With the emergence of Industry 4.0, characterised by a high level of digitalisation, big data processing and the integration of AI into various sectors of the economy, traditional risk management methods have begun to show their limitations. This is especially evident in the financial sector, where processes are becoming increasingly complex and the amount of data that needs to be analysed to predict risks is growing significantly. The inability of organisations to adapt to new challenges can lead to a number of problems. For example, banking institutions that do not implement AI for risk forecasting or fraud detection risk incurring financial losses due to the inefficiency of traditional risk analysis models. However, the use of AI is also accompanied by challenges: transparency of AI algorithms, bias in decision-making, ethical aspects, management of large amounts of data, and customer privacy. If these issues are not effectively addressed, the introduction of AI may create more risks than it solves.

Research in the field of digital banking and financial technology has covered various aspects of the implementation of digital solutions in financial institutions and

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their impact on the financial services market. A. Medvid & D. Dmitrishyn (2024) studied the transformation of Ukraine's banking system due to the impact of digital banking. The authors found that digital banks not only increase the availability of financial services, but also stimulate other banks to innovate, which contributes to the development of market competition. K. Kraus *et al*. (2021) researched the success of Monobank as an example of the effective integration of digital technologies into the Ukrainian banking sector. Thanks to its mobile approach and continuous innovation, Monobank has managed to significantly improve the user experience and reduce operating costs, H. Arslanian & F. Fischer (2019) expanded the understanding of the impact of FinTech, AI, and cryptocurrencies on traditional banking models and demonstrated how these technologies accelerate automation and increase the efficiency of financial transactions. At the same time, the researchers described the regulatory and security challenges that arise in the process of technology adoption.

The reviewed studies on the use of AI in project management have revealed important aspects of the introduction of innovative technologies to improve project management efficiency and minimise risks. E. Vyhmeister & G.G. Castane (2024) developed a risk management system based on trust in AI systems and the ethical and responsible aspects of its implementation. The authors emphasised the importance of integrating AI into project management processes, taking into account the new requirements of Industry 5.0, which can contribute to safer and more efficient project management.

The issues of AI for improving risk management in financial and production systems have been addressed in the works by G. Baryannis *et al*. (2019), H. Zhou *et al*. (2019) and G. Piao & B. Xiao (2022). The use of IoT technologies in combination with big data and neural networks for financial risk management was investigated by H. Zhou *et al*. (2019). The researchers found that the use of particle swarm optimisation and neural networks allows for more accurate processing of large amounts of data and a quicker response to changing market conditions. Research by G. Piao & B. Xiao (2022) complemented this topic by confirming the effectiveness of identifying behavioural patterns of customers and investors by integrating behavioural financial theory with neural networks to more accurately predict risks in commercial banks. G. Baryannis *et al*. (2019) reviewed the ways in which AI can be applied to supply chain risk management and found that traditional risk management methods are not always effective in the context of globalisation and the complexity of modern supply chains.

The reviewed studies pointed to insufficient research on the behavioural aspects of AI in risk management, ethical issues in the use of AI, and the lack of research covering the comprehensive impact of AI on various areas of risk management. The purpose of this study was to analyse the effectiveness of AI in risk management in financial projects. To achieve this goal, the following objectives were set: to study global trends in the use of AI; to analyse risk management practices and identify key challenges to the implementation of AI by financial institutions; to provide recommendations for the implementation of AI in risk management processes.

MATERIALS AND METHODS

The statistical data and current trends in the use of AI in risk management were considered (Sizing the prize..., 2017; Agarwal *et al*., 2021; Governing AI responsibly, 2022; Calvery, 2024; IBM cost..., 2024). The reports considered the areas of application and weaknesses of the following technologies: automation of risk identification, risk analysis, monitoring and early detection of risks, decision support, automation of routine tasks, cybersecurity, and information risk management. The next step was to study the areas of AI application in banks. To analyse how financial institutions use AI for risk management, available information was collected from open sources, including academic sources, publications in specialised organisations, and other documents. The study of credit scoring analysed the machine learning methods and algorithms used to assess creditworthiness, as well as the factors that influence the speed and accuracy of credit decision-making. The process of collecting and analysing customer data considered included financial history, demographic and behavioural data, and other variables used to train machine learning models. To study the fraud detection process and assess its effectiveness, the algorithms used to analyse real-time transactions and detect suspicious activity were reviewed. Procedures for using anomaly and suspicious behaviour detection algorithms to prevent fraudulent transactions were considered, and the way to integrate these solutions into the overall banking cybersecurity strategy was analysed.

The data collected allowed analysing in detail the process of integrating AI-based threat detection systems and their role in ensuring the information security of banks. The study also looked at compliance processes: anti-money laundering and countering the financing of terrorism. This stage of the study analysed how AI is used to automate the process of detecting suspicious transactions and to comply with regulatory requirements. Data was collected on how algorithms analyse customer transactions and identify abnormalities that may indicate a possible financial crime. The analysis process included consideration of the use of AI in the "know your customer" procedure and its role in reducing operational risks. The information was processed using the synthesis method, which allowed to formulate recommendations for the successful implementation of AI in risk management, as well as outline the prospects for using AI in business processes.

RESULTS

Theoretical foundations of AI impact on risk management of financial institutions' operational activities

In the business environment of the early 2020s, AI has become an integral element of risk management strategies. Organisations of various sizes and industries are actively implementing AI technologies to improve the efficiency of risk identification, analysis and monitoring, driven by the growing complexity of risk factors, the speed of market changes and the need to process large amounts of data. Global trends in the implementation of AI in risk management cover several key areas. The use of machine learning to predict financial risks is becoming a standard practice in financial institutions. Algorithms are used to analyse data, identify patterns, and predict possible scenarios, allowing companies to proactively manage financial threats.

In addition, natural language processing is used to analyse unstructured data such as reports, news and social media. This practice helps to identify potential risks related to a company's reputation, changes in the regulatory environment, or market trends; textual data analysis provides a more complete picture of the risk landscape and allows for informed decision-making. In cybersecurity, AI plays a critical role in detecting and preventing cyber threats: deep learning algorithms are used to analyse network traffic and user behaviour in real time, identifying anomalies and potential attacks. This is especially important as the number and complexity of cyber threats increase, requiring a quick and effective response.

Statistical data from a survey conducted by A. Agarwal *et al*. (2021) have shown that more than 50% of companies already use AI in business processes, including risk management, which increases forecasting accuracy by 10-15% and reduces costs by 5-10%. According to PwC, the use of AI is expected to increase global gross domestic product by up to 14% by 2030, with the financial services sector becoming one of the most profitable (Sizing the prize…, 2017). Gartner predict that by 2025, 45% of all organisations will be subject to cyberattacks (Gartner identifies…, 2022), and according to IBM, companies that implement AI for security can reduce the time to detect cyber threats by 108 days compared to those that do not use these technologies (IBM cost…, 2024). In addition, organisations that use AI and automation save an average of USD 1.76 million per incident, which demonstrates the potential of technology to reduce operational risks. At the same time, according to KPMG, 61% of executives do not trust AI systems, which may slow down their adoption (Governing AI responsibly, 2022).

These trends have shown that AI is becoming a key tool in risk management, enabling organisations to more accurately predict, effectively respond to, and strategically plan actions in the face of uncertainty. AI has significantly changed approaches to risk management, affecting various aspects of the process; it has automated risk identification and assessment processes that were traditionally labour-intensive and dependent on subjective assessments by specialists. With the help of machine learning and big data analytics, organisations can process large amounts of information from various sources, including financial indicators, market trends and internal operational data, which helps to identify potential risks at an early stage and provides more informed assessments of their impact.

AI has enabled organisations to conduct deeper and more accurate risk analysis: deep learning algorithms and neural networks are able to identify complex patterns and relationships between different risk factors that may not be available to traditional analysis methods. Technology has made it possible to predict the likelihood of risks and their potential impact with high accuracy, which is critical for strategic planning and informed decision-making. AI technologies have enabled continuous monitoring of internal and external factors affecting an organisation's risks. Real-time systems are able to quickly detect deviations from normal behaviour or anomalies in processes, which is especially important in areas where risks can progress rapidly (e.g., financial markets or cybersecurity). Early detection of risks allows organisations to respond in a timely manner and minimise potential negative consequences.

In addition, AI can act as a decision support tool, providing managers with access to up-to-date and detailed information. AI-powered analytics systems can model different scenarios, assess potential outcomes, and suggest optimal response strategies to help allocate resources efficiently and maximise the effectiveness of investments. AI can automate many routine and repetitive risk management tasks, including updating risk registers, generating regular reports, monitoring compliance, and other administrative processes. Automating these tasks can reduce the likelihood of human error, increase efficiency, and allow staff to focus on more strategic aspects of risk management.

In the digital world, cybersecurity has become one of the key areas of risk management, and AI plays a crucial role in detecting and preventing cyber threats. Machine learning algorithms are aimed at analysing network traffic, user behaviour, and system logs to detect anomalies that may indicate unauthorised access attempts or cyberattacks. The use of AI in cybersecurity allows organisations to proactively respond to threats, reducing the risk of data breaches and financial losses. At the same time, it should be borne in mind that the introduction of AI can create problems that require additional attention to identify and resolve (Table 1).

Table 1. Areas of AI application and potential weaknesses

Areas of AI application	Execution	Possible weaknesses
Automation of risk identification	Big data analysis: AI processes large amounts of structured and unstructured data to identify potential risks. Machine learning: Algorithms are trained on historical data to predict possible future risks.	Data quality: It is necessary to ensure that the data is accurate, complete, and up-to-date. Confidentiality: Compliance with regulations on the protection of personal information.
Risk analysis	Predictive analytics: Modelling development scenarios and assessing the likelihood of risks. Natural language processing: Analysing text documents to identify potential risks missed by manual analysis.	Interpretability of models: It is important to understand how AI models make decisions. Algorithm biases: Checking models for biases that may affect the accuracy of the analysis.
Monitoring and early detection of risks	Real-time monitoring: Continuous tracking of indicators with alarms in case of deviations. Sentiment analysis: Tracking team or stakeholder sentiment through communication platforms.	False alarms: The possibility of an overabundance of alerts that may be ignored. False positives: AI systems produce a result with a percentage of probability, and may provide false positives or false negatives.

Table 1, Continued

Areas of AI application	Execution	Possible weaknesses
Decision support	Recommendation systems: Suggesting optimal risk response strategies. Resource optimisation: Algorithms help in the allocation of resources to minimise the impact of risks.	Dependence on technology: Avoiding over-reliance on AI, maintain critical thinking. Staff training: The team must understand the principles of AI systems.
Automation of routine tasks	Robotic process automation (RPA): Automation of repetitive tasks, such as updating risk registers or generating reports.	Resistance to change: Effective change management must be ensured to avoid resistance. Technical failures: Having backup plans in place in case of system failures.
Cybersecurity and information risk management	Anomaly detection: Detecting unusual activity on networks and systems. Attack prediction: Analysing cyber threat patterns to predict possible attacks.	Updating algorithms: Regularly updating AI models to keep up with new threats. Compliance: Compliance with regulatory requirements for cybersecurity and data protection.

Source: compiled by the author

The integration of AI into risk management contributes to the efficiency and resilience of organisations. It provides more accurate and timely analysis, allows for a better understanding of complex risk environments, and allows for a greater degree of confidence in responding to them. However, successful AI adoption requires consideration of technical, ethical and legal aspects, including data quality, privacy and regulatory compliance.

The use of AI in risk management in financial organisations

Banks of the 21st century are actively using mobile applications to reduce operating costs and provide convenient access to financial products. AI and machine learning help to increase the efficiency of operations and improve the customer experience. Technology also allows for the automation of risk management processes, especially in the area of credit scoring, and the use of machine learning algorithms to quickly analyse large amounts of data helps to reduce credit risks, detect fraudulent transactions and make informed financial decisions. Banks are focused on implementing technological innovations to improve the convenience and security of customer service. Among the most common AI tools are systems for analysing customer behavioural data, which allow for quick adaptation of products to the needs of users, and automated support services that provide advice and answers to customer questions in real time. Studies show that the use of such technologies has become a standard among leading financial institutions seeking to ensure the accuracy of assessments and efficiency of operations (Dunas & Bilokrynytska, 2019; Yanenkova *et al.*, 2021; Grabovets & Temelkov, 2024). As AI becomes an integral part of the banking sector, further development and implementation of innovative solutions aimed at improving the efficiency of financial services is expected.

The introduction of machine learning algorithms has significantly improved the speed and accuracy of credit decision-making: customers can receive a loan decision within a short time after applying through a mobile application, and the use of AI has improved the quality of the loan portfolio and reduced credit risks (Agarwal *et al.*, 2021; Edunjobi & Odejide, 2024). In other words, the use of AI in credit scoring and credit risk assessment has enabled financial institutions to increase process efficiency, reduce the risk of loan default, and improve customer service, which has a positive impact on the bank's financial stability.

Systems that use algorithms to detect anomalies and suspicious behaviour analyse customer transaction patterns, taking into account parameters such as transaction amounts, transaction frequency, geolocation and previous transaction history. When deviations from normal behaviour are detected, the system automatically generates alerts for further verification. The anomaly detection algorithms are based on machine learning techniques, including clustering models and deep neural networks. They are able to detect complex fraud schemes that may be invisible to traditional systems. For example, if a transaction is made from an unusual location for the customer or there is unusual activity at night, the system can temporarily block the transaction and send a confirmation request to the customer (Ali *et al.*, 2022).

As financial organisations such as JP Morgan and Gartner actively use AI to monitor transactions in real time to detect fraud and ensure cybersecurity, the technology allows them to analyse large amounts of transactional data, identify anomalies in user behaviour and respond quickly to potential threats (Gartner identifies..., 2022; How AI..., 2023). AI-based systems are constantly learning from new data, which helps to quickly identify fraudulent transactions, such as phishing, identity theft, or attempts to use stolen card data. This significantly increases the effectiveness of protection and reduces the risk of financial losses from cyber threats, which is also confirmed by many sources analysing current trends in the financial sector (Aschi *et al.*, 2022; Afriyie *et al.*, 2023; Al-hchaimi *et al.*, 2024). Fraud prevention measures include multifactor authentication and the use of biometrics to verify the customer's identity and a behavioural biometrics system that analyses unique patterns of customer interaction with a mobile application, such as typing speed and mouse movements. This is known to further increase the level of economic security at the micro level and reduce the risk of unauthorised access (Koba, 2021).

The results of the introduction of AI in cybersecurity are also positive: AI's rapid response to potential threats minimises operational risks and losses for banks, and its use in cybersecurity helps to comply with regulatory requirements for data protection and prevent money laundering. The introduction of AI for fraud detection and cybersecurity can increase the effectiveness of financial transaction protection, reduce the number of fraudulent transactions, and improve customer security, which has had a positive

impact on the reputation and financial stability of banks (Managing artificial…, 2024).

Financial institutions are actively using AI to analyse customer behaviour in order to provide personalised services and effectively manage customer risks. Machine learning algorithms analyse customer transaction history, financial activity, and other relevant data, allowing banks to create detailed customer profiles, identify their financial needs, and anticipate potential risks. Based on the collected data, they generate individual offers and recommendations that meet the unique needs of each client. For example, a bank may offer special loan products, favourable deposit terms or personalised loyalty programmes. Such an approach is known to increase customer satisfaction and strengthen long-term relationships with the bank (Jaiwant, 2022; Gigante & Zago, 2022). Credit limits are managed based on the client's risk profile generated by AI. By analysing payment discipline, income, and other financial indicators, banks can dynamically adjust credit limits, which helps reduce the risk of default and ensure more responsible lending.

The use of AI in know-your-customer and anti-money laundering procedures is gradually being seen as a standard for modern financial institutions (Ridzuan *et al.*, 2024). In know-your-customer procedures, financial institutions use automatic facial recognition and document analysis technologies to identify customers quickly and accurately: customers can upload photos of documents and selfies when registering via a mobile application, and AI checks the data and authenticity of documents, reducing the risk of fraud and errors in the verification process.

To combat money laundering, machine learning algorithms can also be used to analyse customer transactions in real time. Such algorithms identify suspicious behaviour patterns, atypical amounts or frequency of transactions, transfers to accounts in high-risk countries, etc. When anomalies are detected, the system generates alerts for the compliance department for further investigation. The use of AI in compliance processes helps to reduce operational risks, as automation of routine tasks reduces the likelihood of human error, increases the efficiency of the compliance department and allows employees to focus on more complex analytical tasks. This helps banks avoid fines and penalties from regulators, maintain financial stability and retain customer confidence.

It is important that AI risk management practices are in line with international standards and recommendations in the banking sector. Banks should use advanced machine learning and data analytics technologies in line with the recommendations of the Basel Committee on Banking Supervision to improve risk management through the use of modern technologies (Digitalisation of finance, 2024) and recommendations of scientists (Thach *et al.*, 2021). The use of AI should be based on ethical principles and compliance with regulatory requirements, in line with industry best practices. In the area of anti-money laundering and countering terrorist financing, the use of AI to automate anti-money laundering and countering terrorist financing processes should comply with the recommendations of the Financial Action Task Force and the requirements of the national bank of the country in which the bank operates, contributing to the effective detection and prevention of illegal financial transactions (FATF, 2021).

The use of AI has raised important ethical issues regarding the processing and protection of personal data. Collecting and analysing large amounts of data allows banks to improve their risk management, but at the same time requires high standards of confidentiality and ethics. As banks process significant amounts of their customers' information, including financial transactions, behavioural patterns and other personal data, this raises concerns about potential privacy breaches and the possibility of misuse. Ethical issues also relate to the transparency of AI algorithms used to make lending and risk management decisions. Lack of clarity on how algorithms make decisions can lead to discrimination or bias. For example, an algorithm may unknowingly favour certain groups of customers based on indirect indicators.

Aware of these risks, leading financial institutions are implementing measures to ensure the ethical use of data, including regular audits of algorithms for bias, ensuring transparency of processes, and providing customers with the opportunity to challenge decisions made by automated systems (Bias in algorithmic…, 2019). Banks should also inform customers about what data is collected, how it is used, and what rights customers have over their data. In addition, cybersecurity issues are critical, as a data breach or compromise could have serious consequences for customers. Institutions are required to invest in up-to-date data protection technologies, train staff on how to handle information securely, and respond to incidents in accordance with industry best practices. Ethical aspects also include responsibility for decisions made on the basis of AI, as automated systems should not violate the rights of customers, but rather act in their best interests. This requires a balance between the efficiency of technology and the ethical obligations of banks to their customers. Banks must comply not only with national laws but also with international standards, such as the Regulation of the European Parliament and of the Council No. 2016/679 (2016), if they serve EU customers.

Implementation of AI-based risk management in the financial sector

The introduction of AI in risk management opens up new opportunities to improve the efficiency of business processes. However, in order to maximise the benefits of these technologies, organisations need to follow specific strategic guidelines, including effective change management and optimisation of internal processes (Fig. 1).

Integrating AI into all stages of the risk management process requires organisations to consider data and data quality, as AI models require reliable and structured data to achieve accurate results. By implementing big data systems in conjunction with AI, financial institutions will be able to reduce operational risks, detect threats in advance, and minimise losses. Organisations that use real-time data significantly increase their ability to respond to potential threats. Another important aspect is the ongoing development and training of staff. As the introduction of AI is accompanied by significant technological changes, it is important to create training programmes for employees. They should not only understand the technological aspects of AI, but also be able to integrate new tools into their daily

work. As the introduction of AI often changes the structure of processes, making them more automated and faster, it is worth paying attention to process management. Reviewing existing business procedures and optimising them to take into account new technologies can be done, for example, by integrating automated risk management systems into existing banking reporting platforms to facilitate decision-making.

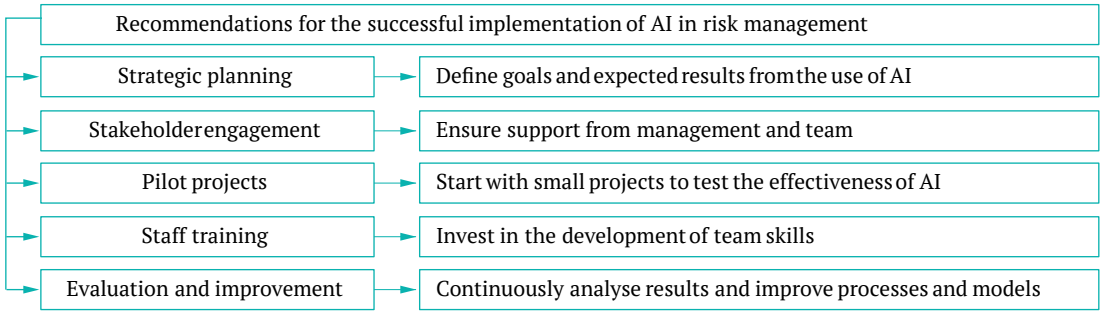

Figure 1. Recommendations for the successful implementation of AI in risk management
Source: compiled by the author

Cybersecurity is another area where AI is needed; machine learning technologies help monitor transactions and detect anomalies in user behaviour, allowing banks to identify potentially fraudulent activities in time and protect themselves from cyberattacks. In this context, the prospects for the development of threat detection technologies are becoming one of the key tasks for ensuring the stability of financial institutions in the future. The prospects for AI implementation also lie in the opportunities to use the technology not only for risk management, but also to improve customer experience and develop new products and services. For example, personalised financial offers based on user behaviour analysis will help institutions better understand customer needs and increase customer loyalty. In addition, AI can become a tool for building predictive models that will allow banks to adapt their strategy to changing market conditions.

DISCUSSION

The study analysed in detail the impact of AI on risk management processes, particularly in the financial sector. It was found that AI is an effective tool for predicting financial risks, monitoring transactions in real time, and automating routine tasks. Thanks to the introduction of machine learning and anomaly detection algorithms, modern financial institutions have significantly improved the quality of credit risk management, fraud detection, and cybersecurity. The personalisation of customer services and compliance procedures, which are an integral part of effective risk management using AI, were also discussed.

An analysis of how banks are using AI technologies to analyse large amounts of structured and unstructured data has shown that AI allows them to identify potential risks based on the analysis of financial indicators, market trends and internal operational data. Automating processes with AI has significantly improved the accuracy of risk forecasting and simplified data processing, enabling organisations to respond to risks more quickly and make informed decisions. However, the challenges of this approach include the need to ensure high data quality and confidentiality. The study by A.M.A. Musleh Al-Sartawi *et al*. (2022) also examined the role of AI in big data processing, but in the context of sustainable finance. AI's assistance in analysing big data related to environmental, social, and governance factors can improve environmental risk assessment and forecasting the sustainability impact of investments.

The study examined the impact of AI-assisted automation on banking consumers. The use of AI in credit scoring, fraud detection, and customer behaviour analysis has allowed banks to improve the efficiency of their processes and provide more accurate risk assessment and personalised services. Consumers have gained faster access to banking products and greater protection from cyber threats, which has had a positive impact on their experience and increased trust in the bank. F. Königstorfer & S. Thalmann (2020) found that AI in commercial banks opens up new opportunities to study the behavioural aspects of customers' financial decisions, meaning that the use of AI can allow banks to better understand customer needs, offer more personalised services, and improve service. However, the issue of using AI to predict customers' financial behaviour remains unresolved.

Innovative technologies, including AI, not only help to improve the efficiency of financial operations, but can also provide access to financial services to a wider range of users. With the help of AI, financial institutions can automate routine processes, reduce costs, and increase the speed of processing applications for loans and other financial services. In addition, AI can better analyse customer behaviour and offer personalised solutions, which greatly simplifies access to financial products, especially for customers who previously faced restrictions due to complexity of procedures or lack of credit history. These findings are consistent with the study by D. Mhlanga (2020), who discussed the interaction of AI with the Fourth Industrial Revolution to address the problems of unequal access to financial services. The scientist noted that process automation and improved customer analysis really help to reduce barriers for those who previously had limited access to financial resources. The study by S. Ahmed *et al*. (2022) also confirmed the effectiveness of AI in the financial sector by systematising scientific publications on operations' automation, risk management, and data analysis, which can contribute to more informed decision-making in financial institutions.

AI technologies help optimise management decisions, increase efficiency and minimise risks. The introduction of AI allows for the automation of routine processes such as updating registers and generating reports, which can increase the speed and accuracy of management decisions. AI has also had a significant impact on improving cybersecurity, as machine learning algorithms help detect anomalies in systems and prevent cyber threats. AI-based analytical tools can help predict potential risks, assess the impact of management decisions on various aspects of organisations, make informed decisions, and reduce potential financial losses. Research by H. Pallathadka *et al*. (2023) similarly showed that AI automates routine tasks, improves the quality of decisions, and contributes to more accurate forecasting of risks and market trends in business, e-commerce, and financial services. In the financial sector, AI helps to optimise risk management processes, as well as improve the accuracy of financial forecasts and asset management. L. Cao (2022), in turn, emphasised the challenges associated with ensuring data quality and transparency of algorithms, which coincides with the need to comply with ethical standards in the use of AI in the financial sector.

The study analysed the practices of using AI in various financial processes and highlighted their strengths and weaknesses. The introduction of AI has allowed for the automation of important business processes, such as risk management and credit scoring, which has reduced human error and accelerated decision-making. The strengths of these practices include AI's ability to work with large amounts of data, detect fraudulent transactions quickly, and improve customer security. At the same time, weaknesses include the need to ensure the transparency of algorithms, avoid bias, and comply with regulatory requirements. These findings are consistent with the study by A. Ashta & H. Herrmann (2021), which also analysed the impact of AI on financial processes. The authors identified significant opportunities for AI to transform banking, investment, and microfinance, while also highlighting the risks associated with cyberattacks, data protection, and regulatory challenges. The study by J.W. Goodell *et al.* (2021) further demonstrated that key research areas are focused on risk management and forecasting, but there is a need to address issues of algorithmic interpretation and data protection.

The study analysed the implementation of AI-assisted process automation, including robotic process automation, which automates repetitive tasks such as updating risk registers and generating reports. Machine learning algorithms used to predict risks and analyse large amounts of data were also discussed. As AI has increased the efficiency of real-time risk monitoring and enabled the detection of anomalies in user behaviour, it has facilitated timely response to threats. These findings are in line with the study by H.A. Javaid (2024), in which the author concluded that AI significantly improves the efficiency of financial services by reducing costs and increasing the accuracy of decision-making. Integration of AI allows financial institutions to adapt their operating models to changing market conditions, ensure flexibility and resilience of business models, and improve the quality of customer service in a changing market environment.

Among the main threats and weaknesses in the use of AI technologies is the quality of the data on which the algorithms operate. False or incomplete data can lead to erroneous decisions and increased risks. Another weakness is the transparency of AI models – the difficulty in explaining how an algorithm makes certain decisions can cause concern among customers and regulators. It also creates potential legal risks, as unclear decisions can cause distrust and conflicts. In their paper, N. Bussmann *et al*. (2021) confirmed the above weaknesses and emphasised the need for transparency in machine learning models, especially in the area of credit risk management. Complex and opaque models can lead to legal and ethical problems due to a lack of clarity in the decision-making process. The authors suggested the introduction of explanatory methods in AI models to increase trust in such systems and improve risk management.

The study revealed the process of how financial institutions collect and use customer data. This data may include information on customer behavioural patterns, financial transactions, and other personal data to improve customer service and mitigate risks. Further processing with AI algorithms allows banks to assess the risk profile of a customer, dynamically adjust credit limits and offer personalised products. However, the collection of large amounts of data also raises ethical questions about privacy and transparency of decision-making, requiring banks to ensure high standards of data processing, including compliance with international and national standards. V. Moscato *et al*. (2021) complemented this data by investigating different approaches to using machine learning to predict credit scores. The researchers compared several algorithms for assessing borrowers' creditworthiness and found that the use of different machine learning models allows financial institutions to choose the most effective approaches to reduce risks and improve decision-making. The studies reviewed highlighted the importance and prospects of using AI to increase the efficiency of financial transactions, mitigate risks, and improve customer interactions. At the same time, the need to increase the transparency of AI algorithms and implement ethical principles when working with large amounts of data remains a common problem.

CONCLUSIONS

The study demonstrated the significant impact of AI on risk management in various areas, especially in the financial sector. The analysis found that AI technologies significantly improve the processes of risk identification, assessment, and monitoring and help organisations achieve greater efficiency and resilience in a challenging market environment. It was found that the implementation of machine learning algorithms allows banks to predict risks faster and more accurately, which has a positive impact on management strategies. Real-time data analytics and machine learning have made it possible to automate labour-intensive processes, such as credit scoring and fraud detection. As a result, organisations can identify potential threats faster, respond to them and minimise potential losses.

AI technologies significantly improve the accuracy of risk analysis by being able to process large amounts of information. The use of deep learning and natural language analysis techniques allows financial institutions to identify market trends, assess reputational risks, and detect cyber threats faster. In areas such as cybersecurity, AI has become a key tool for detecting cyber threats by analysing

network traffic and user behaviour in real time, as well as for improving credit risk management and cybersecurity. Implemented machine learning algorithms have allowed banks not only to make faster credit decisions, but also to significantly reduce credit risks. The use of AI helps automate routine tasks such as updating risk registers and regulatory reporting. This is especially true for anti-money laundering and countering the financing of terrorism. By integrating AI into these processes, organisations can perform know-your-customer procedures faster and more accurately and prevent money laundering and terrorist financing risks. In addition, AI technologies significantly increase the ability of decision support systems to model various scenarios, allowing management to better allocate resources and improve overall risk management efficiency. In particular, in the area of anti-money laundering and countering the financing of terrorism, process automation allows organisations to meet regulatory requirements and reduce operational risks.

However, the study also identified certain challenges associated with AI integration, including ensuring data quality and compliance with legal regulations, especially in the context of personal data protection. The transparency of the algorithms used for decision-making remains an important issue, as they may affect the fairness and accuracy of risk assessment. For further research, it is recommended to pay attention to the analysis of specific technological solutions implemented in financial institutions that are willing to provide more open data on their functioning. This will allow obtaining expanded data on the impact of AI on risk management. In addition, further research is recommended to focus on ethical issues related to the use of AI, in particular, transparency of decision-making and avoidance of algorithmic bias. An in-depth analysis of these topics will allow for a better understanding of how AI can not only improve risk management efficiency, but also expand opportunities for the development of new products and services in the banking sector.

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CONFLICT OF INTEREST

None.

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Вплив штучного інтелекту на управління ризиками в операційній діяльності фінансових установ

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Анотація. Метою роботи було визначити вплив штучного інтелекту (ШІ) на якість управлінських рішень у процесі оцінки та прогнозування ризиків. Для цього було виконано аналіз ролі ШІ в управлінні ризиками, досліджено практики використання ШІ в управлінні ризиками. Результати дослідження підтвердили, що впровадження ШІ значно підвищує швидкість і якість прийняття рішень, пов'язаних з управлінням ризиками. Було виявлено, що за допомогою алгоритмів машинного навчання, які використовують велику кількість змінних для аналізу кредитоспроможності клієнтів, фінансові установи ефективніше здійснюють кредитний скоринг. Алгоритми дозволяють банкам знижувати рівень дефолтів і водночас покращувати якість кредитного портфеля, що робить оцінки більш обґрунтованими. Крім того, технології машинного навчання використовуються для оперативної ідентифікації підозрілих дій або аномальних моделей поведінки клієнтів, зменшення кількості шахрайських операцій, підвищення рівня безпеки клієнтів та скорочення витрат на виявлення й усунення таких загроз. Іншим результатом дослідження стало підтвердження ефективності автоматизації рутинних процесів, таких як оновлення реєстрів ризиків та генерування звітів, що дозволяє суттєво знизити операційні витрати й прискорити процеси прийняття управлінських рішень. Важливо, що використання ШІ не лише підвищує точність прогнозування ризиків і прийняття рішень, але й сприяє персоналізації послуг для клієнтів, що підвищує їхню лояльність та задоволеність. Разом із впровадженням систем комплаєнсу, технології ШІ забезпечують дотримання правових вимог і підвищують прозорість у фінансових операціях, що знижує ймовірність невідповідності регуляторним нормам та мінімізує відповідні ризики. Отримані результати вказали на те, що впровадження ШІ для управління ризиками, потребує не лише технологічної оптимізації, але й глибокого перегляду етичних стандартів, прозорості алгоритмів та адаптації регуляторних механізмів, що в комплексі забезпечить як підвищення ефективності, так і довіру до таких систем

Ключові слова: машинне навчання; кредитний скоринг; алгоритми; прозорість прийняття рішень; запобігання шахрайству

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Formulating state policy to support state corporations in strategic economic sectors

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Abstract. In the context of economic instability and global challenges, effective support for state corporations is a key element in ensuring the economic security and development of a country. The aim of this study was to analyse the processes of formulating state policy aimed at supporting state corporations in priority economic sectors and to propose a comprehensive approach to enhancing this support. Using methods of comparative analysis, descriptive methods, and statistical analysis, the main problems and barriers hindering the effective functioning of state corporations were identified. The peculiarities of forming state policy to support state corporations in Ukraine's strategic sectors were examined. Current challenges and policy principles were identified. Modern state approaches aim to provide a comprehensive analysis, backed by the latest scientific research, offering an understanding of effective policy formulation and implementation. Successful strategies were identified, including the implementation of best corporate governance practices, stimulating innovation, and ensuring financial stability through the diversification of funding sources. The results obtained indicate the need for a balanced approach to supporting state corporations, combining direct financial assistance with regulatory and institutional measures. In cases where state governance mechanisms are underdeveloped and the risks of state failure are high, the number of state enterprises should be limited. The concept integrates various components crucial for supporting state corporations, including regulatory mechanisms, financial incentives, and management structures. The necessity for flexibility and adaptability in policy development was emphasised, allowing state corporations to effectively respond to changing economic and technological conditions. The study proposed a comprehensive policy formation model consisting of such interrelated components as the selection of policy instruments, implementation structures, determination of sectoral priorities, and adaptive management. The study developed practical tools to enhance the efficiency of state corporations in key economic sectors

Keywords: public governance; enterprises; corporatisation; infrastructure; mechanism

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INTRODUCTION

State corporations often emerge as key drivers of economic growth, technological progress, and national competitiveness. During the era of neoliberal reforms, significant transformations occurred in the business and economic spheres. The relaxation of state control, rapid technological advancements, and the evolution of investment strategies created a favourable environment for the consolidation of corporate structures. This led to the concentration of capital and resources in certain economic sectors, altering the system of economic activity. State corporations in strategic sectors such as energy, defence, and transport are crucial for Ukraine's economic stability and national security. These sectors often require substantial investments, advanced technologies, and effective management methods. State policy plays a crucial role in providing the necessary support to state corporations, ensuring their effective contribution to the national economy. However, formulating effective state policy to support national corporations is a complex challenge that requires balancing the promotion of innovation with maintaining market efficiency.

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The relevance of this study is underscored by the growing debate on the optimal role of the state in the economy, particularly in light of global economic crises and technological disruptions. Researchers A. Musacchio & S. Lazzarini (2018) noted that state-owned enterprises (SOEs) play a crucial role in economic activities, significantly increasing market capitalisation worldwide over the past few decades. The strategic importance of these entities in sectors such as energy, transport, and advanced technologies necessitates careful consideration of support mechanisms. Key challenges faced by SOEs include ensuring autonomy from government interference and implementing transparent management methods. Ukrainian scholar S. Hromov (2024) highlighted the issue of state ownership policies being subordinated to political goals. Additionally, S. Hromov (2024) emphasised the low level of transparency in management and development processes, which reduces the stability and efficiency of SOEs. To overcome these obstacles, the optimal strategy appears to be the implementation of a comprehensive system of regulatory mechanisms. According to researchers L.E. Yeyati & J. Negri (2022), this system should encompass not only the SOEs themselves but also actively involve representatives of private business and various state institutions.

The role of state corporations in the economy has been the subject of extensive academic debate. Corporations are among the largest economic entities in the world, with their annual turnover exceeding the gross domestic product (GDP) of all national states except the largest. According to P. Matuszak & B. Kabaciński (2021), corporations and their extended value chains are a significant source of employment. States rely on corporations for tax revenues, expertise, and economic development. Citizens depend on corporations for everyday needs such as transportation, healthcare, and utilities. State enterprises are capable of optimising the provision of basic services to the population at moderate rates. According to scholars R. Andrews *et al*. (2020), the process of "corporatisation" (the creation of state enterprises) has significant and far-reaching implications for governance, the efficiency of public services, and is an example of systemic or corporate state entrepreneurship occurring in large, complex bureaucratic organisations. Researcher R. Miążek (2021) demonstrated that proper corporate governance ensures a positive contribution of state enterprises to the efficiency and competitiveness of the economy.

Researchers S. Meier *et al*. (2021) noted that if one of the causes of an economic crisis is inadequate regulation of the private sector, state enterprises can become a new alternative. In the works R. Cardinale *et al*. (2024), it is emphasised that in many countries, some state enterprises have chosen the path of corporatisation, avoiding privatisation. State enterprises become particularly useful in cases where there are significant market failures and no effective alternatives to state intervention, such as regulation, tax mechanisms, subsidies, or contracts with private companies. Furthermore, state ownership and management can reduce inefficiencies associated with agency costs, provided that the risks of state failure are minimal. However, in cases where state governance mechanisms are underdeveloped and the risks of rent-seeking and other state failures are high, the number of state enterprises should be limited.

Researchers M.J. Gill & D.J. Gill (2024) have identified the gradual nature of state mechanisms, which can significantly influence corporate processes and decisions, extending beyond state policy or regulations. Scholars K. Szarzec *et al*. (2021) emphasised that developing economies often view state enterprises as potential tools for accelerating economic growth. Before relying on such an approach, these countries must prioritise improving their institutional structures. In the absence of a strong institutional base, they may hinder the overall economic development of the country. The role of the state in the corporate sector is often underestimated. Its influence can be much broader and deeper than it appears at first glance. State instruments for supporting large corporations include providing financial assistance from the state budget, creating favourable tax conditions, introducing advantageous credit programs, and restricting competition in certain sectors. These measures allow state enterprises to operate without proper process optimisation and efficiency, as they are protected from the risks of financial insolvency and subsequent bankruptcy. Based on the analysis of these areas, the discussion on the role of state corporations in economic policy remains relevant and requires further in-depth research. The aim was to study the processes of forming state policy to support state corporations in strategic economic sectors and to propose a comprehensive approach to enhancing support.

MATERIALS AND METHODS

Based on the need to evaluate existing state policy and develop an approach to enhancing corporate support, an appropriate methodology was proposed. The study employed a mixed-methods approach to analyse the comprehensive formation of state policy regarding the support of state corporations in strategic economic sectors. The choice of methods was driven by the necessity to address complex and multifaceted issues involving various stakeholders and their interests. In accordance with the methodology, the content analysis method was applied to regulatory acts, strategic documents, and analytical reports concerning existing approaches to supporting state corporations (Draft recovery plan..., 2022; Analytical note..., 2024; Efficient state-owned..., 2024). The main sources of information for the study were data from the State Statistics Service of Ukraine, the Cabinet of Ministers of Ukraine, the State Property Fund of Ukraine, and sectoral ministries, particularly regarding the activities of economic entities and the structure of the national economy (Report on the work..., 2023; Efficient state-owned..., 2024; Analytical report..., 2024). Methods of systematisation and generalisation, along with a systematic approach, allowed for the consideration of state corporations as complex systems operating in interconnection with other elements of the economy and state governance.

The study included a comparative analysis of various strategic economic sectors to determine the effectiveness of existing approaches to supporting state corporations based on adapted policies (Shemaev *et al.*, 2022; Bondarenko, 2023). To develop sectoral approaches within the framework of the overall state policy for supporting corporations, the typology method was used, which allowed for the identification of specific needs and approaches for

sectors such as energy, defence industry, transport, and others. Quantitative statistical methods were used to analyse the indicators of the economic forms of state corporations (the number of state enterprises, their distribution by sectors and governing bodies), their role in strategic sectors, and the effectiveness of state support (Report on the work..., 2023; Analytical report..., 2024). This allowed for the identification of key trends and patterns in the sector of state corporations in Ukraine. The graphical method was used to visualise the research results (charts illustrating the structure of state corporate governance and the distribution of state enterprises by types of economic entities).

To develop an integrated model for formulating state policy to support corporations in strategic sectors, the modelling method was used. This allowed for the creation of a schematic representation of the complex policy formation process, considering the interconnections between different components, identifying key factors in the formation of state policy to promote innovation and competitiveness of state corporations, as well as sectoral approaches, development stages, flexibility, and adaptability. To develop recommendations for improving state policy to support corporations, the abstract-logical method was used, which allowed for the formulation of proposals to enhance financial stability, management, anti-corruption measures, and the reform of the regulatory framework. Particular attention was paid to analysing the impact of martial law on the activities of state corporations and the formation of state policy to support them. For this purpose, analytical materials from the National Council for the Recovery of Ukraine from the War were used, which allowed for the consideration of specific wartime challenges and needs (Draft recovery plan..., 2022). The comprehensive application of various scientific methods and approaches enabled a thorough analysis of the problem of forming state policy to support corporations in Ukraine's strategic economic sectors and the development of well-founded recommendations for its improvement.

RESULTS AND DISCUSSION

State corporations play a crucial role in sectors considered strategic due to their impact on national security, economic stability, and public welfare. According to the analysis by the Research Service of the Verkhovna Rada of Ukraine, strategic sectors include energy, defence, telecommunications, transport, and several others that are heavily regulated and receive significant state support (Analytical note..., 2024). It is asserted that state enterprises are generally less productive and profitable than private ones. While some state enterprises serve public policy goals (providing essential goods and services, addressing social issues, strategic importance), others operate in sectors that could be more efficiently served by the private sector (Gigineishvili *et al.*, 2023).

Privatisation, enterprise restructuring, and corporate governance reforms can increase the output of certain developing countries by 4-6% in the medium term. A key aspect is the development of a SOE ownership policy, which should establish the financial, economic, and social objectives of the state as a shareholder; the mandates of each SOE; and the main principles for the state's exercise of ownership rights to support public interests. This policy should determine which state sector enterprises should remain under state ownership (based on serving strategic and social goals), be privatised (commercially successful enterprises), and be restructured or liquidated (non-viable enterprises). For SOEs that will remain under state ownership, approaches to improving their financial performance can be proposed: ensuring the financial sustainability of commercial activities; providing transparent budget subsidies for non-commercial activities; timely publication of financial and audit reports; and creating a level playing field for competition between state and private enterprises, which will contribute to sustainable growth and development (Gigineishvili *et al.*, 2023).

State policy pertains to the actions taken by the state to achieve specific economic and social objectives. In the context of state corporations, state policy aims to enhance their efficiency, competitiveness, and contribution to national development. Effective policy boundaries ensure adequate funding, regulatory support, and governance structures for corporations. State corporations in Ukraine face numerous challenges, including financial constraints, unprofitability, outdated infrastructure, system opacity, and corruption (Efficient state-owned..., 2024). These issues hinder their ability to operate effectively and compete with private and international entities. As of 19.07.2024, the State Register of Corporate Rights recorded the presence of 452 economic entities (Fig. 1).

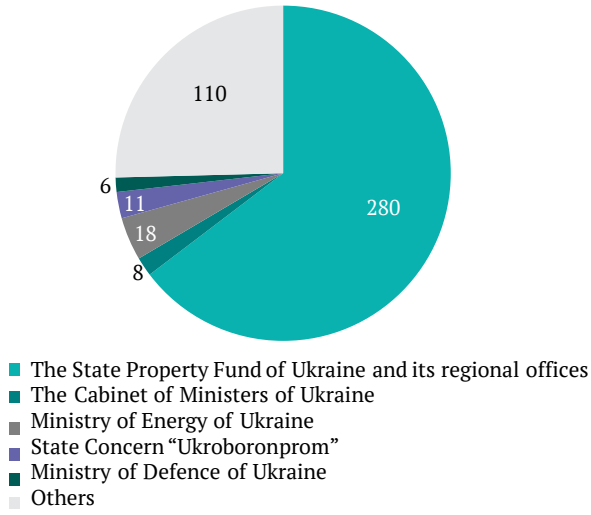

Figure 1. State corporate rights management bodies in the statutory capitals of business entities, Q1 2024

Source: created by the author based on Analytical report of the State Property Fund of Ukraine and the state property privatisation process in the 1st quarter of 2024 (2024)

Management of State Corporate Rights is carried out by various government bodies, including the Cabinet of Ministers of Ukraine (CMU), the State Property Fund of Ukraine (SPFU), ministries, and other central and local authorities. Under their supervision are: 320 joint-stock companies (JSC); 90 limited liability companies (LLC); 22 national joint-stock companies (NJSC) and a state holding company (SHC). It is worth noting that 124 JSCs, established by ministries, as well as 11 NJSCs and SHCs, registered in the state Register, are managed exclusively by the respective

ministries. According to the types of business entities, the state's shares are distributed as follows (Fig. 2).

Figure 2. Number and types of business entities with state-owned shares in statutory capitals, Q1 2024
Source: created by the author based on Analytical report of the State Property Fund of Ukraine and the state property privatisation process in the 1st quarter of 2024 (2024)

By the end of 2023, the State Property Fund of Ukraine managed 785 state enterprises. The management structure of these enterprises is distributed as follows: 7 enterprises under the supervision of regional branches of the SPFU; 6 enterprises designated as key companies; 177 enterprises included in the list of objects designated for privatisation; 148 enterprises are in the process of termination or liquidation; 317 enterprises are located in territories currently not controlled by the Ukrainian authorities (Autonomous Republic of Crimea, conflict zones, occupied territories) (Report on the work..., 2023). State corporations in Ukraine's strategic sectors exhibit mixed performance. For instance, the energy sector, dominated by the NJSC "Naftogaz of Ukraine", faces challenges related to pricing, debt, and regulatory uncertainty (Draft recovery plan..., 2022). Similarly, the defence sector, led by the State Concern "Ukroboronprom", struggles with corruption and inefficiency, affecting its ability to modernise and compete globally (Shemaev *et al.*, 2022; Bondarenko, 2023).

Despite these challenges, state corporations remain an integral part of Ukraine's economy, providing essential services and employing a significant workforce. However, their potential is often undermined by systemic issues that require comprehensive intervention. The authors have outlined several common problems faced by state corporations across various sectors. For example, state corporations struggle to balance commercial and public interests and align profit-making goals with broader state policy objectives. Individual state corporations face governance issues related to political interference, lack of transparency, and inefficient decision-making processes. A significant portion of state corporations operate under substantial debt, limiting their ability to invest in modernisation and expansion. Fiscal constraints of the state further exacerbate this issue, necessitating innovative financial solutions. The regulatory framework governing state corporations in Ukraine contains outdated and inconsistent provisions, creating uncertainty and inefficiency, hindering their operations and growth. In many cases, state corporations operate under specific regulatory constraints and normative rules that reduce their flexibility and ability to respond quickly to market changes. Based on the research issues, the key factors in developing support policies to promote innovation and competitiveness of state corporations are outlined in Table 1.

Table 1. Key factors in shaping state policy to promote innovation and competitiveness of state corporations

Factors	The essence of supportive measures
Sectoral approaches	The effectiveness of support policies varies significantly across different strategic sectors. For instance, the aerospace industry benefits more from long-term research partnerships, while the energy sector requires a combination of regulatory incentives and direct investments.
Development stage	Support policies need to be tailored to the development stage of both the corporation and the sector. Emerging technologies may require more direct support, while developed industries benefit from policies that promote restructuring and efficiency.
Position in the global value chain	The position of state corporations in the global value chain influences the type of support needed. Corporations aiming to move up the value chain require different support compared to those defending established positions.
Ecosystem development	Successful support policies often focus on developing entire innovative ecosystems rather than just individual corporations.
Flexibility and adaptability	Given the rapid pace of technological change, support policies must be flexible and adaptable. The most successful approaches include mechanisms for regular review and adjustment.

Source: created by the author

The current issues underscore the complexity of developing effective state policies to support corporations in strategic sectors. A range of accumulated complex questions indicates the necessity for an adaptive approach that balances the numerous goals and interests of stakeholders. Based on the analysis, it is possible to propose an integrated model for the development of state policies to support corporations in strategic sectors. The integrated model for the development of these state policies consists of interconnected components (Fig. 3).

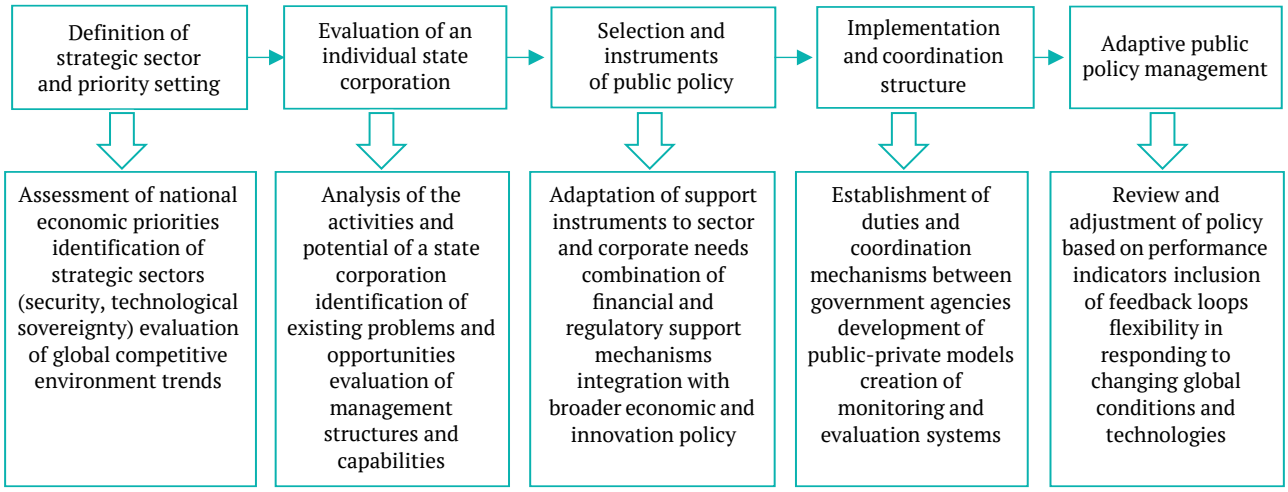

Figure 3. Integrated model for formulating public policy to support corporations in strategic sectors
Source: created by the author

The developed model emphasises the importance of a holistic approach to policy formulation, recognising the interconnections between various strategic sectors and the broader economic system. Several factors should be considered when implementing the model: public policy should provide state corporations with sufficient operational autonomy while ensuring robust accountability mechanisms; this balance is crucial for fostering innovation while maintaining public trust; it is advisable for public policy to focus on developing broader innovation systems, which may include supporting research institutions, startup incubators, and industrial clusters.

In the context of increasing economic globalisation, support policies must consider the international competitive environment, which will involve strategies for international cooperation, market access, and the development of skills and capabilities necessary for future competitiveness (Kruhlov, 2021), including investments in educational and training programs. Support for state corporations should align with broader economic, industrial, and innovation policies to ensure consistency and maximise impact. It is essential to encourage state corporations to contribute to addressing key societal issues (social inequality, post-war reconstruction), aligning their activities with sustainable development goals. Based on the research results, specific needs in sectoral approaches within the overall public policy framework for supporting corporations should be identified (Fig. 4).

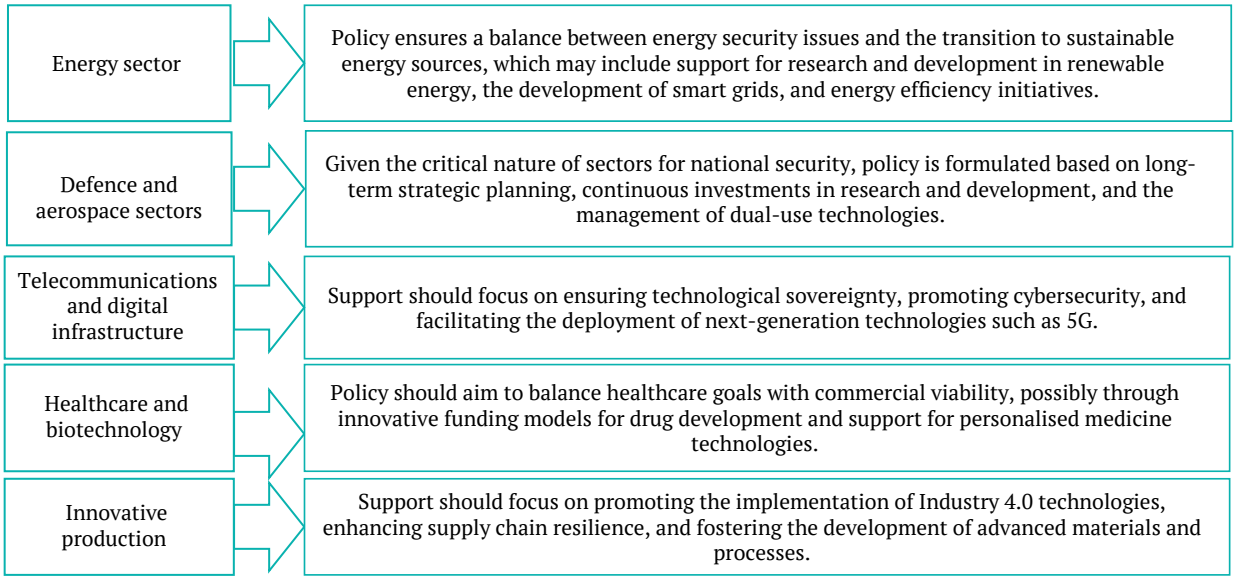

Figure 4. Sectoral approaches within the general public policy framework for supporting corporations
Source: created by the author

An integrated approach to public policy formulation acknowledges the complex, systemic nature of supporting state corporations in strategic sectors. Addressing various aspects, policy can be shaped towards a more effective,

sustainable, and socially beneficial support strategy, which should consider several key recommendations: the need to develop a strategic vision for state corporations, aligning their goals with national development objectives, supported by current policies, adequate funding, and proper governance with a focus on the post-war period; ensuring the financial sustainability of state corporations requires innovative financial solutions, including the implementation of public-private partnerships, attracting foreign investments, and engaging international financial institutions; improving the public administration system involves enhancing transparency, accountability, and efficiency, achievable through the adoption of best international practices, regular audits, and performance evaluations; combating corruption is crucial for the success of state corporations, necessitating a multifaceted approach, including strengthening internal controls, promoting transparency, and ensuring legal accountability; reforming the regulatory framework is essential to create a stable and predictable environment for state corporations, relying on updating regulations, simplifying compliance procedures, and ensuring sectoral consistency.

A comprehensive analysis of public policy formation for supporting corporations in strategic sectors allows for several key conclusions. There is no one-size-fits-all approach to supporting state corporations, as effective public policy must be tailored to the specific economic, political, and technological conditions of the country and sector, considering the state of war in the country. Successful support policy balances multiple objectives, including economic efficiency, technological progress, national security, and societal benefit. Given the rapid changes in the global economic environment, it is necessary to employ mechanisms for the regular review and adaptation of public policy. At the same time, the most effective support strategies extend beyond individual corporations to develop broader innovation ecosystems, including research institutions, supply chains, and human capital development. Effective support policies should prioritise innovation not only in terms of technological progress but also in business models and organisational structures.

The results of the study on the formation of state policy to support corporations in strategic sectors of Ukraine's economy demonstrate the necessity of a comprehensive and adaptive approach, especially under martial law conditions. Research dedicated to the formation of state policy to support state corporations pays significant attention to aspects such as governance, institutional reforms, and economic efficiency. The conclusions drawn align with a number of studies by scholars who have examined similar issues in various contexts. The analysis conducted in the study revealed that state corporations in Ukraine face issues such as financial constraints, inefficient management, and corruption. This is corroborated by the findings of scholars C. Park (2021), who studied state enterprises in developing countries (Malaysia, Pakistan, the Philippines, Vietnam, etc.), and M.C. Sánchez Carreira (2021), who examined Spanish state enterprises. These scholars have demonstrated the importance of professional management, transparency, and accountability in overcoming challenges (corruption, political influence, inadequate disclosure). Researchers note that corporate governance reforms aimed at enhancing transparency and reducing political influence can significantly improve enterprise efficiency. These conclusions fully align with the recommendations provided for improving the public management system of state corporations, particularly in the context of Ukraine, where corruption and political interference are major obstacles to the development of state corporations, especially under martial law conditions. The necessity of the integrated model for forming state policy to support corporations proposed in the article is confirmed by the approaches in the study by L. Gan (2023), which examined state enterprises in China. This work emphasises the need for a balance between autonomy and control, confirming the results regarding the importance of granting corporations' sufficient operational autonomy while maintaining accountability mechanisms to the state. Regarding the adaptation of policy to the specifics of different sectors, the results align with the data of researchers X. Zhao & S. Yu (2024), who analysed state enterprises in China and studied strategies in industries with varying competitiveness. The researchers emphasised the necessity of a differentiated approach to different sectors, where each strategic sector requires unique support methods that consider its characteristics. These results confirm the author's recommendations on the importance of developing specific sectoral strategies in the Ukrainian context.

The results of the conducted study emphasise the importance of combating corruption, which is supported by the work of scholars R. Anggriani *et al*. (2023) and A. Baum *et al*. (2024). These scholars demonstrated similar results, identifying corruption as one of the key obstacles to the efficiency of state corporations. Scholars C. Li *et al*. (2020) highlighted the importance of innovative capabilities and collaboration between the state and the private sector, which aligns with the findings on the necessity of developing mixed ownership forms and integrating state enterprises into broader innovation systems to enhance their competitiveness and innovative potential. The emphasis of the study's conclusions on the importance of aligning the goals of state corporations with national development goals is also confirmed by researcher M. Barnes (2019), whose work points to the necessity of strategic balancing to maximise public benefit and achieve sustainable development goals. It should be noted that most authors focus on ordinary economic conditions and do not refer to other additional factors (resource shortages, extremely volatile external environment, etc.).

At the same time, researchers P. Cheteni *et al*. (2024) provided evidence that state enterprises in developing countries are less efficient compared to private ones, due to weak management and lack of flexibility. The authors argue that the most effective solution to improve the productivity of state enterprises is full or partial privatisation. A similar view is held by scholars J. Park *et al*. (2021) in their study of state enterprises in the Republic of Korea, noting that as economic growth progresses, the need for state corporations decreases. This contrasts with the results of the presented study, which emphasise the significant role of state support and integrated approaches within public policy. This result indicates the necessity of implementing substantial social expenditures and projects and the importance of considering the specific conditions of Ukraine, where political instability and martial law may limit

privatisation opportunities. In the work of scholars S. Li & Y. Wu (2022), the impact of state subsidies on the efficiency of state enterprises in China was examined. The authors argue that while state subsidies can partially support the financial stability of such enterprises, in the long term, they lead to dependency on state support and reduce efficiency, which contradicts the conclusions of the article regarding the necessity of state support for corporations in Ukraine.

Overall, the study complements existing literature by proposing a comprehensive approach to forming state policy to support corporations in strategic sectors, with a particular focus on the Ukrainian context and martial law conditions. The work underscored the necessity of state policy capable of quickly adapting to the changing conditions of martial law. In times of instability, privatisation may be less effective than maintaining state support and developing innovative ecosystems, which partially contradicts traditional approaches to managing state enterprises but reflects the realities of modern Ukraine. The study emphasised the need for institutional reforms, a common feature with other analysed studies. However, unlike some mentioned, the conducted study considered the context of martial law, which creates additional challenges and limitations for forming support policies for state corporations (political instability and shifting priorities; supply chain disruptions; resource shortages, including human resources; changing regulatory conditions). The importance of an adaptive approach to state policy support for state corporations expands the boundaries of existing academic discussions, offering new perspectives for further research that will consider crisis and instability conditions.

CONCLUSIONS

State corporations in Ukraine's strategic sectors are crucial for the country's economic stability and national security, especially during martial law. However, they face numerous challenges, including financial constraints, governance issues, and corruption. Formulating effective state policy to support corporations requires a comprehensive approach that includes financial support, governance reforms, anti-corruption measures, and updates to regulatory acts. A well-structured state policy framework is essential for supporting state corporations in Ukraine's strategic sectors. By addressing key areas, Ukraine can enhance the efficiency and effectiveness of its state corporations, contributing to national development and economic resilience. The study of mechanisms for forming state strategy to support the corporate sector in key economic industries highlighted several key aspects. Developing effective state policy requires an individual approach that considers sector-specific characteristics in the country, especially during military conflict, while universal solutions for supporting state corporations prove ineffective. The optimal support strategy should balance various goals, such as enhancing economic efficiency, stimulating technological development, strengthening national security, and ensuring public welfare. Dynamic changes in the economic situation necessitate the implementation of mechanisms for systematic analysis and adjustment of state policy to maintain its relevance and effectiveness.

Effective strategies require a broad scope, focusing on the development of comprehensive innovation ecosystems, which includes supporting research institutions, optimising supply chains, and investing in human capital development. Support policies focus not only on technological innovations but also on the modernisation of business models and organisational structures, ensuring a holistic approach to innovation development. Formulating state policy to support corporations in strategic sectors remains a critical and complex challenge of modern economic management and requires a multidisciplinary approach. By applying integrated, adaptive, and context-dependent approaches, it is possible to enhance the effectiveness of state policy, promoting national economic development, technological progress, and societal well-being, which will be the direction of further research.

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CONFLICT OF INTEREST

None.

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Формування державної політики підтримки державних корпорацій у стратегічних галузях економіки

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Анотація. В умовах економічної нестабільності та глобальних викликів ефективна підтримка державних корпорацій є ключовим елементом забезпечення економічної безпеки та розвитку країни. Метою дослідження було проаналізувати процеси формування державної політики, спрямованої на підтримку державних корпорацій у пріоритетних секторах економіки, та запропонувати комплексний підхід до посилення зазначеної підтримки. Використовуючи методи порівняльного аналізу, описового методу та статистичного аналізу, визначено основні проблеми та бар'єри, що заважають ефективному функціонуванню державних корпорацій. Розглянуто особливості формування державної політики підтримки державних корпорацій у стратегічних секторах України. Визначено актуальні виклики та засади політики. Сучасні державні підходи мають на меті забезпечити всебічний аналіз, підкріплений останніми науковими дослідженнями, пропонуючи розуміння ефективного формулювання та реалізації політики. Виявлено успішні стратегії, що включають впровадження найкращих практик корпоративного управління, стимулювання інновацій та забезпечення фінансової стійкості за рахунок диверсифікації джерел фінансування. Отримані результати свідчать про необхідність виваженого підходу до підтримки державних корпорацій, поєднання прямої фінансової допомоги з регуляторними та інституційними заходами. У випадках, коли механізми державного управління є слабо розвинутими, а ризики неспроможності держави високі, кількість державних підприємств має бути обмеженою. Концепція інтегрує різні компоненти, що мають вирішальне значення для підтримки державних корпорацій, включаючи регуляторні механізми, фінансові стимули та управлінські структури. Підкреслено необхідність гнучкості та адаптивності при розробці державної політики, що дозволить державним корпораціям ефективно реагувати на мінливі економічні та технологічні умови. У дослідженні запропоновано комплексну модель формування політики, що складається з таких взаємопов'язаних компонентів, як вибір інструментів політики, структури реалізації, визначення галузевих пріоритетів та адаптивного управління. Дослідження сформувало практичні інструменти для підвищення ефективності державних корпорацій у ключових галузях економіки

Ключові слова: публічне урядування; підприємства; корпоратизація; інфраструктура; механізм

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Intellectual capital of IT companies in the development processes of innovative technologies and digital transformations: Historical and genetic analysis

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Abstract. In the context of digital transformation development, the role of IT companies, which contribute to the creation, implementation and development of innovative technologies, is growing. However, taking into account that innovation formation in the economy is a long-term process, it provides for a systematic study, particularly from a historical point of view, therefore the purpose of this article was to conduct a historical-genetic analysis of the IT sphere and the role of its intellectual capital in the processes of emergence and development of innovative technologies. A systematic and comparative analysis was used in the article to conduct a historical-genetic study of the intellectual capital of IT companies within the framework of the theory of technological structures and the innovation theory of the Austrian-American economist and historian of economic thought Joseph Schumpeter. The analysis was carried out to trace the emergence of the IT sphere. In the course of the study, the main achievements of the IT sphere have been analysed, the basic innovations in the IT sphere within the framework of innovation waves, their role and importance have been described, the role and influence of intellectual capital in these processes have been analysed. Starting with the fourth innovation wave, when the first developments in intellectual capital appeared, a parallel historical-genetic analysis of the IT sphere and intellectual capital has been conducted. The correlation of innovations emergence in the IT sphere with the stages of Joseph Schumpeter's innovation waves and the reason for the reduction of their duration has been revealed. It has been discovered that the implementation of digital transformations and related innovative technologies strongly depends on the quality of the intellectual capital of the IT sphere, which concentrates intellectual efforts when creating solutions aimed at accelerating various economic and management processes. The results of the conducted research provide a more systematic idea of the origin of the intellectual capital of IT companies and its connection with the development of innovative technologies and digital transformations, which has both theoretical and practical significance

Keywords: evolutionary-historical analysis; digitalisation; intangible assets; IT industry; Schumpeter's innovation theory

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INTRODUCTION

The issue of digital transformations and innovative technologies in the economy is receiving a lot of attention from both the authorities and the business, as digital technologies can stimulate economic growth, accelerate a number of business processes and increase their efficiency, as a result contributing to increasing the competitiveness of economies and businesses, as well as their development. It is also worth mentioning that digital transformations

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give access to large volumes of data that can be used to make more informed decisions. The use of digital technologies also contributes to increasing transparency, speed and efficiency of management processes. The introduction of digital technologies ensures new high-quality levels of interaction with customers, providing a more customised approach. Overall, digital transformations are a necessary prerequisite for a sustainable development and growth of organisations in the digital economy. However, favourable conditions must be created for the implementation and maintenance of all these transformations and the development of digital economy.

It concerns the IT sphere, which directly depends on the possibility of these transformations and their quality, which was studied by O. Andreichikov (2024). Infrastructure, science and education, which are engaged in fundamental research and provide training for IT specialists, require support and significant investments. As discovered by O. Starkova & O. Andreichikov (2024), IT companies largely depend on their intellectual capital (IC), the core of which is human capital, characterising IT services as intellectual, as the main part of their added value is produced by highly qualified labour. Requirements for candidates at the junior level position in IT companies around the world support this idea. Although, there used to be a single basic requirement for the first programmers – to pass a logic test – which is the first requirement for human capital in the IT field.

IC as a factor of development and innovation in 2024 is considered by scientists in various aspects and scopes. In particular, there are scientific works, which have established the connection of the intelligence quotient (IQ) of nations with economic growth, their cause-and-effect nature and the direct impact of the IQ of nations on the gross domestic product (GDP) of countries, which was particularly investigated by G. Francis & E.O.W. Kirkegaard (2022). It is worth paying attention to T. Shestakovska & T. Yarovoi (2020) work, in which a systematic analysis of IC management experience at the country level was carried out. At the current stage of the development of ideas about IC, the study of IC in terms of creating innovations given the digitalisation of the world's economies are of particular scientific and practical interest. Similar studies were partly carried out by T. Korytko & I. Bryl (2021), who substantially analysed the relationship of IC with the effectiveness of creating company value at the expense of human capital on the example of the Private Joint-Stock Company "Novokramatorsk Machine-Building Plant" and conducted a systematic analysis of IC measurement methods during digitisation. In addition to this work, the authors can mention a study of the nature of intellectual entrepreneurship in the conditions of digital economy, which is thoroughly covered by H. Ostrovska *et al.* (2021) and S. Revellino & J. Mouritsen (2023) in their papers. A few works concentrate on a specific study of IC of IT companies that have become centres of creation of innovative digital technologies and their suppliers. In particular, researchers S. Madhavaram *et al.* (2023) analysed data from 200 IT companies and concluded that IC contributes to competitiveness by creating opportunities for software development and innovation. Scholars P. Shaneeb & M. Sumathy (2021), investigating the impact of IC on the performance of 88 Indian IT companies, discovered that investment in staff training and development leads to increased profitability, while management structure and policies have a significant impact on return on assets of IT companies.

However, in order to fully ensure the effective management of IT companies on the basis of sustainable development, it was necessary to conduct more in-depth and fundamental systematic research, which aimed to conduct substantial, functional and historical analysis. This is the only way to get a complete and correct idea about the system, especially such a complex and poorly formalised one as IC of IT companies. The lack of scientific papers on a systematic historical and genetic analysis of IC of IT companies in the context of IT sphere defined the purpose of writing this article. During the historical and genetic research, the following methods were applied: a chronological method for determining the sequence of main innovations emergence in the IT sphere and their correlation with Schumpeter's innovation cycles; a comparative-historical analysis for identifying the impact of the IT sphere on innovation waves; a heuristic method for discovering new facts and establishing new relationships between IC of IT companies and the emergence of innovative technologies and digital transformations. Moreover, the methods of system analysis, synthesis, scientific abstraction and generalisation were also used to combine information from various sources to create a holistic view of historical events and processes in the context of IT industry development. It is also worth mentioning that, given the fact that the first significant findings and the emergence of the IT sphere itself took place at the beginning of the 20th century, historically, genetic research began from the third innovation wave.

JOSEPH SCHUMPETER'S INNOVATION WAVES

Historicism, as a dialectical principle of studying and evaluating objects and phenomena in their historical development, based on principles of a systemic approach, consists in the study of the past system, the identification of principles of its development, as well as regularities of its future behaviour, that is, in forecasting various aspects of its further functioning, which is part of a systematic historical research directed outwards. Only such systematic research can ensure the acquisition of knowledge necessary for making right decisions on the improvement of the system and the development of effective methods of its management, especially in the context of sustainable development and taking into account historical features of its formation.

In the context of the historical and genetic analysis of IC of IT companies' in the process of developing innovative technologies and innovations as such, it is appropriate to take the theory of technological structures and the innovation theory of the Austrian-American economist and historian of economic thought J. Schumpeter as a basis, who introduced such concepts as "innovation" and "creative destruction" based on M. Kondratiev's works on the theory of long waves (hereinafter K-waves) with a period of 50 ± 10 years (from 40 to 60 years), and also proved that the causes of cyclicality in the economy are the processes of innovation formation (Narkus, 2012). Cyclicality in the economy was considered by many scientists, who distinguished waves with different periods. In particular, the cycles with a period of 15 to 20 years were discovered by

the Laureate of the Nobel Prize in Economics S. Kuznets in 1971, medium-term cycles with a period of 7 to 11 years were discovered by the president of the French Society of Social Economy C. Juglar, which were later developed in the investment theories of crises by the Ukrainian economist M. Tugan-Baranovsky, and short-term cycles with a period of 3-4 years were substantiated by the British statistician J. Kitchin. The latter cycles are particularly interesting given that in the modern economic theory their mechanism is associated with a delay in the information flow (temporary lags), which affects management decision-making, therefore, as J. Kimani & M. Kibera (2023) pointed out, they are also referred to as The Kitchin Inventory Cycle. Moreover, as E.A. De Groot *et al*. (2021) argued in their paper, Schumpeter suggested that the given cycles with different periods are related and one large K-wave consists of six Juglar cycles, and one Juglar cycle encompasses three Kitchin cycles.

A characteristic feature of each new K-wave is the mass introduction of epoch-making scientific discoveries and inventions. As soon as there is a chance to make the production of brand-new products much cheaper, making them available to the majority of buyers, these new goods cause a stir, stimulating mass production and employment. As a result, the cost and prices of this product decrease, which increases consumer demand and the feedback mechanism accelerates the increasing K-wave, leading to a boom. In other words, innovations and large investments in these innovations must converge at one point. D. North, the winner of the 1993 Nobel Prize in Economics and one of the founders of cliometrics (the direction of new economic history) supports this idea, emphasising that new intellectual production is directly related to innovative activity, which, together with investments, is the basis of economic prosperity (Telles, 2024).

As I. Yehorov *et al*. (2020) pointed out, according to J. Schumpeter's innovation theory, each cycle of development (long wave) consists of two parts: innovative – the creation and introduction of new technologies, and imitative – their spread. The innovative part (basic innovations) is a shorter phase of the creation and introduction of innovative technologies (the increasing stage of the K-wave), and the imitative part (improving innovations) is a longer phase of the spread of new technologies (the decreasing stage of the K-wave). As L. Kovchuga (2021) highlighted, the German economist G. Mensch added the third part to them – short-term, caused by so-called pseudo-innovations: minor improvements in goods, technologies, management methods, etc. J. Schumpeter's innovation cycles do not have a clear time frame and depend on the perfection of the new technology, affecting the time spent in the complete cycle. Due to this, there is no clear established view on their duration, as well as their chronological correlation with technological structures among modern scientists. However, L. Hu *et al*. (2023) provided examples of a systematic approach to their systematisation and overview in their work. According to The World Economic Forum, innovation waves have the following time limits (Waves of change…, 2021) (Table 1).

Table 1. Periodisation of waves

Wave number	Years	Duration
First wave	1785-1845	60 years
Second wave	1845-1900	55 years
Third wave	1900-1950	50 years
Fourth wave	1950-1990	40 years
Fifth wave	1990-2020	30 years
Sixth wave	2020-2045	25 years

Source: developed by the authors based on Waves of change: Understanding the driving force of innovation cycles (2021)

Thus, the duration of innovation waves shortens with each subsequent cycle: in the first wave, the economy reached its "peak" and "bottom" in 60 years, and in the fifth wave, where software, the Internet and mobile communication became the most important innovations, these stages took about 30 years, and subsequent waves may be even shorter. Such modern researchers as A. Espinosa-Gracia & J. Sánchez-Chóliz (2023) have the similar opinion regarding the shortening of the wave duration, who concluded that the cycles are shortened due to the emergence and achievements in the field of information technology and computers. That is, the development of IT technologies acts as a catalyst and driver for new discoveries and solutions that change traditional business methods and management approaches. Summing up, it should be mentioned that the analysis of waves of all types is necessary for forecasting the prospects of long-term and medium-term technical and technological development and innovative transformations in order to choose appropriate strategies for the development of national economies, economic sectors and individual economic entities. In the course of the study, historical periods of J. Schumpeter's innovation waves and related innovative transformations were considered in the context of the emergence and development of the IT industry, as well as its contribution to scientific and technical progress, which creates new opportunities for economic growth and increased competitiveness.

JOSEPH SCHUMPETER'S THIRD INNOVATION WAVE (1900-1950)

Before considering J. Schumpeter's third innovation wave, it should be mentioned that historians consider the appearance of the first machine in 1725, which was controlled by a perforated paper tape and was invented by a Lyon inventor B. Bouchon, as an early prototype of software. Later in 1804 (during the first wave of innovation, 1785-1845), another French inventor, loom adjuster J.M. Jacquard improved B. Bouchon's work and for the first time used punched cards instead of ribbons to create a patterned fabric and invented a way to automatically control the thread during the operation of the loom, which was later named the Jacquard loom in his honour. J.M. Jacquard's important achievement was

that his machine used a universal binary code according to the principle "there is a hole" – "there is no hole". This machine was ahead of its time and became a prototype of the first computer devices. The idea of using punched cards was adopted by C. Babbage in 1830 for his analytical machine, which final development was completed by his son H.P. Babbage, who in 1906 together with Munro's workshop built a working model of C. Babbage's analytical machine (Schaffer, 2019). The programming profession itself appeared two years before the end of Schumpeter's first wave in 1843, when the British mathematician A. Lovelace described an algorithm for calculating Bernoulli numbers for an early version of C. Babbage's analytical machine, which was never built during her life. However, A. Lovelace was later recognised as the world's first programmer and her description was recognised as the first program designed for a computer. Also, it was A. Lovelace who first used the terms "cycle", "working cell", "memory cell" and others (Story of the Jacquard invention, n.d.).

Consideration of J. Schumpeter's third innovation wave can be started with an event that took place 10 years before its beginning in 1890 and determined the basic innovation for the entire wave, namely with the first machine census of the US population, during which a static tabulator of the founder of modern automatic calculations H. Hollerith was used to calculate data. As G. Strawn (2023) pointed out, H. Hollerith's invention was supplemented by a high-ranking official from the Census Bureau, J. Billings, who suggested producing tabulation using punched cards. It inspired H. Hollerith to start his own business, The Hollerith Electric Tabulating System, and after a successful census in 1896, he founded the Tabulation Machine Company, which became one of four businesses that merged into Computing Tabulation Recording Corporation (CTR) in 1911. The new company called CTR existed during 13 years and afterwards in 1924 was renamed International Business Machines (IBM) – one of the techno-giants, which during the Second World War contributed to designing several high-speed electromechanical calculators that were the forerunners of electronic computers. Moreover, throughout the 20th century IBM employees developed a number of innovative technologies, being their pioneers and some of them even became Nobel laureates (Edgar F. Codd. The inventor…, n.d.; IBMers, n.d.).

In 1918, the German electrical engineer, Doctor of Technical Sciences A. Scherbius patented the most complex encryption machine in the history of mankind Enigma with 159 quintillion different combinations of symbols and numbers, making a significant contribution to the development of cryptography for military and civilian intelligence (100 years…, 2024). According to Schumpeter's theory of innovation, the beginning of the 1920s marks the peak of the third wave. With the help of tabulators, a prototype of a local computer network was created in the Kaufmann's department store in Pittsburgh during 1932-1933. A system consisting of 250 terminals connected by telephone lines with 20 tabulators was created there. Terminals were used to read data punched in the form of holes on product labels then these data were processed by tabulators (accounting machines) and an invoice was issued for the purchase (Heide, 2009). In 1936, the outstanding English mathematician and cryptographer A. Turing proposed an abstract computing device "Turing Machine", which can be considered as a model of a general-purpose computer, which made it possible to formalise the concept of an algorithm and is still used in many theoretical and practical studies (Da Silva *et al*., 2024). With his scientific works, A. Turing made a generally recognised contribution to the foundations of computer science, as well as to the theory of artificial intelligence (AI) and cybernetics.

In 1938, the German engineer and one of the pioneers of computer engineering, K. Zuse, created the first limited-programmable binary computing machine Z1 at home with data input, using the keyboard in the decimal numbering system in the form of floating-point numbers (Konrad Ernst Otto Zuse, n.d.). In 1939, with the support of the German Research Institute of Aerodynamics, the improved Z2 was released, which was already put into operation, and in 1941 Z3 was released – the first fully functional program-controlled and freely programmable computing machine, which was able to calculate in binary floating-point code and all features of a modern computer. A little later, K. Zuse also created Plankalkül – the world's first high-level procedural programming language.

In 1943, the Colossus computer was created at the Bletchley Park estate (Milton Keynes, England) to decipher cipher texts of the German Enigma mechanical encryption machine. During 1943-1945, the US Army Ballistic Research Laboratory commissioned scientists from the University of Pennsylvania E.J. Presper and J.W. Mauchly to create the first universal 30-ton Electronic Numerical Integrator and Computer, which became the prototype of most modern Turing-complete computers (ENIAC…, n.d.). In 1944, the US Navy commissioned IBM to create a 5-ton relay-mechanical machine "Mark I" or Automatic Sequence Controlled Calculator (ASCC) – an automatic computer controlled by a program. In 1948, the Manchester Small-Scale Experimental Machine (SSEM) was also launched – the world's first stored-program computer built on the basis of Von Neumann architecture, created by scientists from the University of Manchester F.C. Williams, T. Kilburn and G. Tootill on commission of the British Ministry of Supply, responsible for military research (including guided nuclear weapons) (Tindsley, 2023). In 1950, at the end of Schumpeter's third innovation wave, the National Physical Laboratory (Great Britain) completed the development of the Pilot Automatic Computing Engine (ACE) – a small-scale programmable computer with a stored program based on the Turing machine model.

Summarising the overview of Schumpeter's third innovation wave in the context of innovations that took place in the IT field, it can be said that this period of fundamental research was possible due to the intelligence of such scientists as A.M. Turing, J. Presper, J. Mauchly and others (ENIAC…, n.d.). The main results of the wave include the formalisation of the concept of algorithm – one of the key concepts in informatics and computer sciences, the development of the first high-level procedural programming language, the emergence of working samples of computer technology (basic innovations), which are improved several times (simulation innovations). All these achievements significantly accelerate the development of science and technology. The research results obtained during this wave, which were financed from public funds through

various ministries, were not yet widely commercialised and were mainly used in the public sector in such areas as encryption and cryptography (military and defence industry), various computing (space, nuclear industries etc).

JOSEPH SCHUMPETER'S FOURTH INNOVATION WAVE (1950-1990)

Semiconductors, the growth of the number of electronic computers, industrial robots and personal computers, as well as the emergence and development of the global Internet, the prototype of which was the computer network Advanced Research Projects Agency Network (ARPANET), created in 1969 in the USA by the US Defence Advanced Research Projects Agency (DARPA) – are the defining innovations during this wave. It should be mentioned that the beginning of this wave almost exactly coincides with the beginning of the third industrial revolution (beginning of 1960) or the third post-industrial wave of A. Toffler. As I. Petrunenko *et al*. (2022) pointed out, according to E. Toffler's estimates, the third wave should completely replace the second at the end of 2025. Moreover, during Toffler's third wave in the conditions of a post-industrial society, knowledge and information became the main drivers of economic development and transformed into a new type of intangible assets – information capital. As a basic innovation within the framework of Schumpeter's fourth innovation wave, software can be singled out, the market of which as an independent industry began to shape just at the beginning of this wave and determined the main vector of development for this period.

The term "software" in 1958, as well as the term "bit" (binary digit) in 1946, was first used by a mathematician from Princeton University, a member of the US National Academy of Sciences J. Tukey (John Tukey, unsung man..., 2024). In the same 1958, the term "information technology" appeared, which was applied by H.J. Leavitt & T.L. Whisler (1958) in the Harvard Business Review magazine, and IBM natives E. Kubie and J. Sheldon registered the first private IT company in this market in 1955. Computer Usage Company, which independently developed software for modelling oil flow for the California Research Corporation, became a pioneer in the field of programming services. Until then, software was developed either by computer users or by a few commercial computer vendors, such as IBM, which in the 1950s also developed the high-level programming language FORTRAN (n.d.) (FORmula TRANslator) that was widely used primarily for scientific and engineering calculations, contributing to the creation of a large number of programs and subroutine libraries written in it.

In 1952, the British computer scientist A. Glennie, working together with A. Turing, created Autocode, which is considered the world's first compiler. The same year, mathematician G. Hopper developed the theory of machine-independent programming languages and the A 0 System compiler, which translated mathematical code into binary machine code. Moreover, in the same year FLOW MATIC was developed under her leadership – the first data processing language, using English words instead of numbers (Barfield, 2021). In 1953, the world's first computer science training program appeared in the computer laboratory of the University of Cambridge (Goddard, 2019) and later in 1962, the first computer science faculty appeared in the USA at Purdue University (Department of computer science..., 2023).

In 1956, IBM introduced the first hard disk, the IBM 305 RAMAC (n.d.) (Random Access Method of Accounting and Control), which weighed almost a ton and had 5 MB of memory. A little later, in 1961, D. Gregg invented the optical disc and in 1963, D. Engelbart invented the computer mouse (History of IT, 2024). The world's first fully automated electronic machine for processing checks and keeping current accounts, the Electronic Recording Machine Accounting (ERMA) began its operation in one of the departments of Bank of America in 1959 (Spicer, 2023). In 1968, IBM in collaboration with Rockwell and Caterpillar created the Information Management System (IMS) for the Apollo space program – a hierarchical database (BD) and information management system that enabled transaction processing (Introduction to IMS, n.d.). This IBM development was a significant improvement after the Integrated Data Store database management system (DBMS), based on the data navigation model, which was developed in 1963 by the American computer scientist and Turing Prize winner Charles William Bachman, who later also developed a new version of DBMS with a network model called Integrated Database Management System (IDMS), which supported IBM mainframes.

Despite the fact that in the 1970s, a period of stagflation began in the USA, which was primarily caused by a sharp increase in oil prices, leading to a slowdown in the pace of technological development and innovation, the IT sector continued to develop actively. In 1970, IBM employee E. Codd first described the principles of creating relational databases in the work "Relational Model of Data for Large Shared Data Banks" (Edgar F. Codd. The inventor..., n.d.). The first database was developed by a group of students and scientists at The University of California in Berkeley, who created the INGRES relational database, which used the QUEL query language. In 1973, IBM started to develop its own relational database System R, which used the Structured Query Language (SQL) for the first time, developed by IBM scientists D. Chamberlin and R. Boyce and which still remains the main language for working with databases (Mucci, 2024).

In 1971, R. Tomlinson developed a program for exchanging messages between computers, Send Message (SNDMSG), which is considered the prototype of e-mail, D. Noble invented the floppy disk, the Intel company created the first commercially available microprocessor Intel 4004 (The history of IT, 2024). In addition, in the same year, the first computer virus called "Creeper" was created by B. Thomas. The IT sphere received a more significant shift in 1981 after the agreement between IBM and Microsoft, when the era of operating systems for personal computers and the first software for them began (Miller, 2021). In the conditions of capitalist relations and increasing globalisation, as well as due to the development of the Internet, it contributed to the formation of the market of personal gadgets and significantly revived the development of software, attracting the attention of businesses and investors. In this way the IT sphere gradually went beyond state funding and began a new stage of development. In the same 1981, a new economic course called Reaganomics began in the USA, the main features of which were the stimulation of demand, investment and innovation, being the main prerequisite for the appearance of the K-wave, which in this case contributed to the development of Schumpeter's fifth innovation wave.

Then in 1985, the NASDAQ-100 index of technology companies (NASD Automated Quotations) appears on the NASDAQ exchange, which was created back in 1971 and was the first in the world to provide automated stock quotations, allowing investors to trade quickly and transparently electronic securities of 100 technology companies such as Apple, Microsoft, Intel, Oracle, Cisco Systems and others, and in 1998 NASDAQ was the first in the world to provide online trading (NASDAQ, n.d.). The emergence of the C++ and Objective-C programming languages, the creation of the Berkeley Internet Name Domain (BIND) – the first Domain Name System server (DNS server) at the University of California at Berkeley, where a Unix-like operating system Berkeley Software Distribution (BSD) was developed, which was used by various commercial startups in the 1980s, were significant events of the 1980s in the IT field (The history of BIND, n.d.). In 1985, the first domain names darpa.mil, darpa.edu, darpa.net, darpa.gov, darpa.arpa, symbolics.com were registered (Baltes, 2024) and in 1989 the first private commercial Internet provider The World appeared, which provided access to the global Internet (Who invented the Internet, 2023). During the 1980s, decision support systems, expert systems and databases were also actively developing, the widespread use of AI on personal computers began due to the development of the method of backward propagation of errors, the direction of computer games was developing, MS Word (1983) and Windows 1.0 (1985) appeared, the first notebook from Apple (1989), and such companies as Microsoft, MicroPro and Lotus Development already had annual software sales of tens of millions of US dollars in the 1980s.

Summarising the overview of Schumpeter's fourth innovation wave, it can be said that even in unfavourable conditions and crisis phenomena in the economy, the IT sphere has proven itself as a powerful factor of innovative development and a driver of the development of economy as a whole. The most important challenge of this period was information and its rapid accumulation, which required software for its storage and processing, in particular various databases, the existence of which, in turn, would be impossible without the appropriate hardware, in particular hard and laser disks. During this innovation wave, the term "intellectual capital" was used for the first time. E.A. Aduna-Lira (2022) pointed out that it was used in 1969 by the famous American Keynesian economist and the author of the theory of technical determinism and convergence J. Galbraith in his letter to the Polish economist M. Kaleckiego, to emphasise workers' intellectual activity among. It is worth mentioning that a little earlier in 1962, the Austrian-American economist F. Machlup introduced the concept of "knowledge industry", meaning five sectors of economy: education, scientific research and development, means of communication, information machines and information services. It was stipulated by the fact that the sphere of services, science and education during the fourth innovation wave gradually began to prevail over industry and agriculture, where scientific knowledge also began to be actively used, contributing to the formation process of a post-industrial society. The term "post-industrial society" itself appeared in 1958 in the works of professor of social sciences at the University of Chicago D. Riesman, and already in 1973 the concept of post-industrial society was most fully and comprehensively substantiated by the outstanding American professor of sociology at Harvard University D. Bell, who thoroughly analysed main trends in changing relations of social production sectors, the formation of service economy, the formation of scientific knowledge as an independent element of production forces, and the concentration of society around the axis of knowledge production.

In particular, after the appearance of the world's first computer science program, the training of specialists in this area began. Since 1966, the number of Computer Science graduates with bachelor's degree in the United States was steadily increasing until 1986, when it reached 40,000 graduates per year (National Science Board, 2000). For comparison: in Ukraine, 47,100 applications were submitted for the computer science degree during the admission campaign in 2021 (Admission campaign…, 2021). Thus, due to the growth of education prestige, the knowledge industry gradually gained a new sense, leading to the emergence of a whole layer of qualified specialists, including programmers, managers, intellectual workers, which contributed to the increase of intellectual potential in the process of "processing" the biosphere into the noosphere, the main generator of which, according to V.I. Vernadsky's doctrine about the noosphere, is human thought, which is a part of human capital. Moreover, the overview of the fourth wave suggested that the number of different IT solutions increased significantly during this period, which correlates with the increase in the number of trained specialists in the field of computer science. This once again proves that human capital is the core of the IT sphere.

Therefore, when conducting a parallel analysis, it becomes evident that the initial phase of the IT sphere development (1950 – the appearance of FORTRAN, 1953 – the first educational program in computer sciences, 1955 – the first private IT company, etc.) and the emergence of the terms "post-industrial society" (1958), "knowledge industry" (1962) and "intellectual capital" (1969) have a logical sequence and a chronological connection. This period (1950-1970) was the rising stage of the K-wave, during which the role of intellectual activity, information technology and computerisation significantly increased in science, scientific and technical progress and economy (trade, banking, railway transport, etc.). This trend attracted attention of such economists as J. Galbraith and F. Machlup, who initiated the research of IC and intangible assets.

JOSEPH SCHUMPETER'S FIFTH INNOVATION WAVE (1990-2020)

The Internet was the basic innovation for this wave: web1 (1991-2005) is a read-only network, web2 (2006-2020) is a social participation network and the internet economy, related to it. At the very beginning of the wave in 1991 the development of the Internet was facilitated by the HyperText Markup Language (HTML) technology and the first WorldWideWeb browser (later renamed Nexus), developed by the British physicist T. Berners Lee from the Swiss research institute Conseil Européen pour la Recherche Nucléaire (CERN), who in 1994 founded the World Wide Web Consortium (W3C) – the main international organisation that still develops and implements technological standards for the Internet (A short history…, n.d.). Also in the 1990s, a number of programming languages such as Python, PHP,

Java, JavaScript, AppleScript, Visual Basic, etc. emerged and in 1997, Wireless Fidelity (Wi-Fi) appeared.

According to the World Bank Group, 40 million people had access to the Internet in 1995, this number increased to 400 million in 2000 and it exceeded one billion people in 2005 (Individuals using the Internet..., n.d.). Such spread of the Internet and PCs attracted the attention of business, whose owners began to massively create websites for their companies and transfer their business processes to the Internet in order to promote their services, with subsequent entry into the NASDAQ stock exchange, where just mentioning the word "internet" in the company's profile would increase its value by dozens of percent. However, such business models were ineffective as the funds that should have been spent on supporting operational business processes were spent mainly on marketing campaigns and advertising on television and in the press. According to the data of the World Bank Group, the number of registered shares on American platforms increased to a record 8.09 thousand in 1996 (to compare: in 2019, there were 3.9 thousand, i.e. half as much) (Listed domestic companies..., n.d.). In addition, in the 1990s, 2,300 alliances or 44% of all alliances created during that time in the world, were technological and related to such information technologies as computer software and hardware, telecommunications, industrial automation, and microelectronics (National Science Board, 2000).

This trend led to the "dotcom crisis" in 2000, studied by S. Barber (2022). According to Schumpeter's theory, the recession started after the peak of the fifth wave and the NASDAQ index began to drop on the market, losing about 80% of its capitalisation due to the bankruptcies of more than 800 companies, resulting from the information economy of Silicon Valley. The main causes of this crisis were stipulated by excessive investment and speculation around the internet economy rather than rapidly developing innovative IT technologies. Investors invested in these "tech" companies with a website, disregarding the fact that they were mostly unprofitable. M. Meeker's portfolio from the Morgan Stanley bank can serve as an example of a risky investment policy, which included about two hundred internet companies with a total market value of 450 billion US dollars, whereas, their total profitability was negative and amounted to minus 6 billion US dollars at the end of 1999, just before the crisis began (New horizons..., n.d.). Individuals, lacking knowledge and being influenced by the aggressive advertising, actively invested about 150 billion US dollars in this field in 1998, 180 billion in 1999, and 260 billion in 2000, when the collapse had already begun. Finally, according to analysts' estimates, 100 million private investors lost 5 trillion US dollars in stocks by 2002 (Venture capital..., 2024). To overcome the recession in the 2000s, it took companies such as NASDAQ, Microsoft, Amazon and other technology leaders about 15-17 years (that is, until 2015-2017) to restore results achieved in 2000 before the collapse during the "dotcom crisis". However, it should mention that the innovative component of this Schumpeter's wave gave rise to the imitative component, i.e. the basic innovation contributed to the emergence and improvement of innovations in dozens of industries related to the internet industry: software, network equipment, internet search services (1994 Yahoo! search and 1998 Google), online advertising, AI, semiconductors, cloud services, delivery services and many others, still working for the internet industry.

The beginning of the 2000s was also a period of the social network boom as a new version of the Internet web2. The term "social networks" was suggested by the English sociologist J. Barnes in 1954 and was widely used later in various fields of science (Bessarab *et al.*, 2021). The first prototype of a social network was the electronic bulletin board Computerised Bulletin Board System (CBBS) – a computer program for file transfer and communication via the early Internet, which was created in four weeks by members of the Chicago Area Computer Hobbyists' Exchange (CACHE) W. Christensen and R. Suess in 1978 (Metz, 2019). In 1983, there were already about 800 such boards around the world. However, social networks began to gain popularity on the Internet in 1995, when a successful American portal "classmates.com" emerged, aimed at finding former classmates, army comrades and colleagues. The site quickly gained popularity and dozens of its analogues appeared soon. However, 2003-2004 are considered the official beginning of the social network boom with LinkedIn, MySpace and Facebook being launched in the USA and the emergence of video hosting YouTube in 2005. In 2008, the Bitcoin cryptocurrency protocol appeared, which was created by an unknown author or a group of authors under the name S. Nakamoto (What is bitcoin, n.d.). It gave a start to the entire industry of cryptocurrencies, which changed the paradigm of the economy as a whole and contributed to the development of a new version of the Internet, web3.

Summarising the results of the fifth innovation wave, it can be said that it was quite a dynamic and productive wave, during which a fundamental basic innovation was created – the Internet with a number of related directions (imitation innovations), which changed the IT sphere itself and determined its priorities, as well as influenced the general landscape of the world economy, even changing value orientations from physical to immaterial ones, which was studied by O. Starkova & O. Andreichikov (2024) on the example of the Apple company. Owing to the achievements of the IT sphere during the fifth innovation wave, in particular due to the main innovation of this wave – the Internet, the ways of conducting business and economic activity began to change fundamentally. The Internet has become a major driver of globalisation, allowing companies to easily enter international markets and exchange information in real time. E-commerce has revolutionised retail, enabling consumers to purchase goods and services from anywhere in the world. The implementation of information systems into business processes has led to the automation of many operations, increased management efficiency and reduced costs. New business models have also emerged, such as platform economies and financial technologies, which enabled small and medium-sized enterprises to compete with large corporations. Information technologies have also contributed to the development of analytics and big data processing, which has made it possible to make more informed decisions and forecast market trends with high accuracy.

JOSEPH SCHUMPETER'S SIXTH INNOVATION WAVE (2020-2045)

According to the World Economic Forum, such innovative technologies as AI, blockchain, Internet of Things (IoT)

and big data have been playing an important role in digital transformation since the beginning of the 2020s (Waves of change…, 2021). Although, AI and blockchain with huge investments can be considered the main basic innovation for the current sixth innovation wave. In particular, 2020 was crucial for AI, when the ChatGPT was released, developed by the OpenAI company, which started raising 7 trillion US dollars for the development of this project in 2024 (Hagey & Fitch, 2024). Attention to AI is stipulated by its capacity to innovate quickly. For example, computer modelling using AI, made it possible to create new antibiotics (Duboust, 2023) and substitutes for lithium-ion batteries (Conover, 2024) in a very short time. Such achievements and digitalisation in general have become possible due to the development of the IT sphere, which in turn is very dependent on its own IC. According to Attainix Consulting, a leading company for the study and assessment of IC, at the beginning of March 2024, Microsoft's IC was valued at more than 1.38 trillion US dollars or 46% of the total capitalisation of 3 trillion US dollars, Apple's IC was valued at more than $1.31 US dollars or 48% of the total capitalisation of more than 2.7 trillion US dollars, and Nvidia's IC was valued at more than 380 billion US dollars or 19% of the total capitalisation of more than 2 trillion US dollars, which is stipulated by the fact that IC, in contrast to physical one, provides for the creation of a much greater added value (IcTracker valuation…, n.d.).

The given examples suggest that IC is an important component of modern technological companies and its application makes it possible to create innovative products with higher added value, for example, software, the development of which brings significant revenue to both private IT companies and budgets of many countries in the form of taxes and investments. In particular, in Ukraine, in 2023, the share of IT in the country's GDP was 4.9%, the contribution of the IT industry to the gross added value made up 5.5 billion US dollars, the volume of export of IT services amounted to 6.7 billion US dollars (a reduction of 8.4% compared to 2022), and the amount of involved investments accounted for 111 million US dollars (in 2022 – 631.5 million USD) (Oliinyk, 2024). Moreover, in Ukraine, 21.7% of enterprises have full-time IT specialists and another 14.6% of enterprises engage freelancers to perform information and communication technology functions (IT Ukraine Association, 2022). Such indicators are not accidental, given the modernisation and development of enterprises and entire industries in the modern world is directly connected with the development and implementation of information technologies, as they provide for production processes automatisation, productivity increase, cost reduction and overall improvement of business efficiency.

There are many examples of the implementation of modern IT solutions developed in Ukraine, which have changed the approaches and standards of doing business, as well as affected the life of every Ukrainian: the nationwide Diia system, Privat24 and Monobank banking products, services of NOVA companies (before Nova Poshta rebranding), which has gone beyond providing solely postal services and already provides digital financial services (NovaPay), produces software and web applications (Nova Digital), engages in e-commerce (Nova Global) and provides services to other well-known Ukrainian technology marketplaces such as ROZETKA, OLX, etc. This list can be enlarged with powerful world-known and popular services such as Grammarly (an AI service for checking English spelling), GitLab (a DevOps life cycle web tool), Prometheus (an online course platform) and many others.

A special attention should be paid to IT-Enterprise company, Ukrainian innovator in the field of Industry 4.0, which offers a number of high-tech solutions for industry and has many successful examples of their implementation in Ukrainian and foreign markets. In particular, such an example is the implementation of digital twins for Kharkiv manufacturer of air and space aircraft JSC FED, which implemented the Advanced Planning and Scheduling (APS) – Smart.Factory solution, designed to calculate the optimal location of production facilities to maximise production productivity (Shchehlov & Morozova, 2022). The services of IT companies are already actively used in the agricultural sector, where 10% of Ukrainian farmers already implement IT technologies in their work, using AI, IoT, drones, GPS technologies, geographic information systems, analytical systems for yield assessment and variable rationing, remote earth sensing and others (IT Ukraine Association, 2022).

Understanding the importance of human capital, IT companies actively create their own training centres and finance educational projects. In particular, during the annual conference on IT education "Synergy. IT Business & IT Education" in December 2023 with the participation of Ukrainian leading IT companies and high-ranking government officials, it was put forward that education is the first global direction that will have a long-term impact on the country's development, and innovations and development of the latest technologies is impossible without the development of science (Synergy of education…, 2023). That is, investing in the development of IC of the IT industry leads, in fact, to an increase in profit (self-growth) of capital as such, suggesting that IC has the function of capital self-growth. The above mentioned proves that IC is a very important type of capital for IT companies and its management is a priority task, since IC is now perceived as a certain internal force of modern business, which supports the necessary level of competences and gives impetus to innovation. In turn, according to CoinMarketCap, in March 2024 the crypto-economy based on blockchain technologies had a total capitalisation of about 2.4 trillion US dollars and the capitalisation of AI-related tokens had a growing trend (Top AI…, n.d.).

There are also many similar examples of developments in this direction in Ukraine (Results of digital…, 2024). In particular, the National Bank of Ukraine will have conducted an open testing of the e-hryvnia blockchain by the end of 2024, encouraging everyone to participate (Interview of Andriy Poddyerogin…, 2024). The Draft Law of Ukraine No. 10225-1 (2023) aimed at creating favourable conditions for the web3 sector in Ukraine was included in the agenda of the Verkhovna Rada of Ukraine on February 6, 2024. Kitsoft company as a part of the Public Union "Virtual Assets of Ukraine" acted as a technical partner and developed a prototype of a new generation real estate and land registry based on web3 technologies, which was presented to the Ministry of Digital Transformation of Ukraine on January 19, 2024 (Kitsoft developed…, 2024).

In addition, the Government of Ukraine has already developed and adopted a number of strategies and programs

aimed at stimulating the development of digital economy. The development of electronic government is one of the key directions of digital transformation in Ukraine. It provides for transferring public services to the online mode, which makes them more available and convenient for citizens, as the example of the nationwide digital system Diia suggests. In particular, the Ministry of Digital Affairs together with the Swiss Agency for Development and Cooperation (SDC) held an event dedicated to the development of digital Ukraine in Ukraine House Davos on January 17, 2024. The domestic experience of the digital state development was presented there, in particular: the WIN-WIN innovation development strategy (Diia, Mriya..., 2024) on the creation of benefits for all involved parties. Also, electronic identification and electronic signature technology has already been widely introduced, the "paperless" operation of the state is being implemented, the penetration rates of basic electronic services and industry digital transformation are increasing. Significant work was also carried out in the direction of digital education, within which the innovative educational application "Dream" was presented on February 16, 2024 (Scaling educational opportunities..., 2024).

Taking into account the above mentioned, it can be argued that the IT sphere plays a primary role in Schumpeter's innovation waves, concentrating intellectual efforts upon creating solutions aimed at accelerating various economic processes for various industries. The study suggests that the more the IT sphere develops and the more IT solutions appear in it, the shorter Schumpeter's innovation waves become. Moreover, it is difficult to imagine the innovative economy and digital transformations without computers, the Internet, mobile banking, e-mail, various messengers, databases, etc., which resulted from the IT sphere that put an end to paper-based calculations and records. In the course of the study, it was also discovered that when imposing the stages of IT development on J. Schumpeter's innovation waves, one can see a correlation with the genesis of the innovation cycle as a process of transferring innovations into the field of application, namely: J. Schumpeter's first innovation wave – innovation or invention (application of perforated paper tapes for automating the Bouchon machine and punched cards for the Jacquard machine); the second innovation wave – innovation or a developed invention (C. Babbage's early analytical machine and A. Lovelace's first program before it); the third innovation wave – innovation (appearance of ENIAC and serial computers); the fourth innovation wave – assimilation (software development); the fifth innovation wave – diffusion or distribution (development of the Internet); the sixth innovation wave – routinisation or stable implementation of innovations (wide introduction of IT technologies, based on AI and blockchain in all spheres of life: AI-powered personal assistants, cryptocurrencies, blockchain registries, digital twins, etc.).

CONCLUSIONS

The IT sphere was shaped as an industry as a result of the emergence, further improvement and dissemination of innovations in the field of computing. Due to the emergence of the IT sphere and the solutions that were developed within it, significant progress and development was achieved in many spheres and branches of the economy (defence, space, energy, medical, banking and trade spheres, education and science, etc.). The study has discovered that the IT sphere is highly dependent on IC, the development of which is primarily related to human capital, as well as the development of education and science. As it has been discovered in the course of historical and genetic analysis, the first scientific mentions and works on IC appeared, when the IT sphere acquired systemic features with a scientific, educational and business background. A direct correlation between the number of trained personnel in the field of computer science and the number of created IT solutions was also revealed, which laid the foundation for further digital transformations and the development of innovative technologies.

The influence of the IT sphere on the economy and public administration has already reached such a level that high-ranking government officials have become engaged in the development of the IT sphere. In turn, business representatives in various industries and spheres of the economy around the world also pay significant attention and invest significant funds in the creation and development of information technologies, receiving significant improvements in business efficiency as a result. On the example of the world's largest IT companies (Microsoft, Apple, Nvidia), it was shown that IC occupies a fairly significant part – from 19 to 48% in the structure of their capital, which proves its importance in the creation of innovative technologies and digital transformations, which are created and introduced by IT companies. Thus, the importance and primary role of IC in the processes of digital transformation and related innovative technologies have been revealed in the course of the historical and genetic analysis. The obtained results are of both practical and theoretical significance for further research of IT companies' IC, its modelling, construction of application models and its management, taking into account the historical component of its development.

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CONFLICT OF INTEREST

None.

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Інтелектуальний капітал IT-компаній у процесах розвитку інноваційних технологій та цифрових трансформацій: історико-генетичний аналіз

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Анотація. У контексті розвитку цифрових трансформацій роль IT компаній, завдяки яким створюються, впроваджуються та розвиваються інноваційні технології, зростає. Однак через те, що процес формування інновацій в економіці є тривалим, він потребує системного вивчення зокрема й з історичного погляду, тому метою статті було проведення історико-генетичного аналізу IT-сфери та ролі її інтелектуального капіталу в процесах появи та розвитку інноваційних технологій. Завдяки системному та порівняльному аналізу в статті проведено історико-генетичне дослідження інтелектуального капіталу IT компаній у рамках теорії технологічних укладів та інноваційної теорії австрійсько-американського економіста та історика економічної думки Йозефа Шумпетера. Аналіз проведено від початку появи IT сфери. У ході дослідження були проаналізовані основні досягнення IT сфери, описані базисні інновації в IT сфері в рамках інноваційних хвиль, їх роль та значення, а також проведено аналіз ролі та впливу інтелектуального капіталу в даних процесах. Починаючи з четвертої інноваційної хвилі, коли почали з'являтись перші наробки в напрямку дослідження інтелектуального капіталу, проведено паралельний історико-генетичний аналіз IT-сфери та інтелектуального капіталу. Виявлено кореляцію появи інновацій в IT-сфері з етапами протікання інноваційних хвиль Йозефа Шумпетера та причиною скорочення їхньої тривалості. Виявлено, що імплементація цифрових трансформацій та пов'язаних із ними інноваційних технологій сильно залежить від якості інтелектуального капіталу IT сфери, в якій концентруються інтелектуальні зусилля при створенні рішень спрямованих на прискорення різноманітних економічних та управлінських процесів. Результати проведеного дослідження дають більш системне уявлення про причини виникнення інтелектуального капіталу IT компаній і його зв'язку з розвитком інноваційних технологій та цифрових трансформацій, що має як теоретичне, так і практичне значення

Ключові слова: еволюційно-історичний аналіз; інноваційна теорія Шумпетера; нематеріальні активи; IT індустрія; діджиталізація

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Public debt, debt servicing and economic growth in Nigeria

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Abstract. Public debt is a vital tool that governments use to finance public spending, especially in situations where it is challenging to raise taxes and cut spending. Nigeria is currently bedevilled with high debt servicing amounting to $1.12 billion by the end of quarter one of 2024. This study investigated the effect of government debt on economic growth in Nigeria. The study employed auto regressive distributed lag model to analyse the secondary data that was obtained from statistical bulletin of Central Bank of Nigeria from 1992 to 2023 and World Development Indicator. The study revealed that there is an existence of significant but negative relationship between domestic debt and economic growth on the long run with a coefficient value of −0.008394 and at 5% level of significance. There also exist a significant and positive impact of foreign debt on economic growth in long run with value of coefficient of 0.360653 and at 5% level of significance. Debt servicing was reported to have negative relationship with economic growth in Nigeria with value of coefficient of −0.120965 and at 1% level of significance. The study also reported a bi-directional effect of domestic debt on growth of economy in Nigeria while a unidirectional causality was reported between economic growth and debt

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servicing. The study concluded that public debt has significant impact on the growth of economy in Nigeria. Government of Nigeria should make effort in reducing the debt-revenue ratio by paying some affordable debt as soon as possible and seeks for ways of enjoying debt forgiveness by multinational banks. The study recommends that Nigerian government should make more use of external debt than domestic debt because of the low interest of external debt to domestic debt which will help in reducing the debt burden

Keywords: government debt; growth rate of gross domestic product; exchange rate; auto regressive distributed lag model; statistical significance

INTRODUCTION

Achieving economic growth is an issue across countries of the world especially countries with low capital formation thereby making government of this struggling nations to source for debts in order to embark on infrastructural development. According to International Monetary Fund (2024), government debt in Nigeria has risen significantly in recent decades, raising worries about its sustainability and possible effect on growth of the economy. This rapid debt accumulation is partly due to a combination of factors, including shortfalls in government revenue collection, increased funding of infrastructure and societal programs, and the need to respond to economic shocks like the COVID-19 pandemic (Onafowora & Owoye, 2019). As noted by S.C. Alagoa *et al*. (2023), challenge that many developing nations have been confronting from the onset of 21st century is the pace of national debt. Thus, if public debt is not managed effectively, rising national debt levels can be detrimental to economic growth worldwide (Ogbonna, 2019). Every level of government will be willing to evade on its debt to institutions like International Monetary Fund, along other entities like the World Bank and regional development banks. However, these institutions are empowered by the international community to prevent such defaults. As noted by I. Ajayi & D. Edewusi (2020), these institutions are equipped to monitor countries and intervene in financial matters to prevent defaults and maintain stability in global finance.

On the other hand, the nation would cover the debt if state or local governments defaulted on their obligations. According to A.A. Rafindadi & A. Musa (2019), public debt may be divided into two categories: short-term debt, which is intended to be paid off in one or two years, and long-term debt, which is projected to persist for a longer length of time. A. Yusuf & S. Mohd (2021) asserted that a country's economy will greatly impact when employing aggressively domestic borrowing, for the fact local interest rates are greater than international ones, paying off domestic debt accounts for sizeable portion of revenue of the government. When the amount of outstanding debt rises, the cost of borrowing domestically and can also grow rapidly, particularly in undeveloped financial sector. S.C. Alagoa *et al*. (2023) opined that lower investment eventually results in lower output levels and a smaller steady-state capital stock. Thus, a longer period of debt would result in poorer overall output, which would then lead to decreased spending and worse economic wellbeing. Á. Dombi & I. Dedák (2018) opined that the burden of public debt is another name for this, which decreases with each generation and leaves behind a lower total stock of capital.

Despite massive endowed resources and possible ability of attaining economic growth, the country has faced challenges in achieving consistent and inclusive growth patterns. Factors such as debt servicing costs, debt management strategies, and revenue mobilisation efforts have implications for key indicators of economy like that of gross domestic product (GDP), employment, and income distribution. Concerns have been expressed over the likely impacts of Nigerian growing public debt on the nation's growth (Adebiyi & Musliudeen, 2023), and also concerns about the capacity of government to set off its debt and the sustainability of its finances have been raised by the mounting debt load. According to A. O'Neill (2023), the national budget's heavy reliance on debt payment places further pressure on government coffers and restricts financing for vital areas like social services and infrastructure development. Moreover, the volatility of global financial markets and variations in oil prices, a significant source of government income, heighten the dangers associated with large levels of debt, potentially destabilising Nigeria economy.

Several studies, such as G.O. Ugwuanyi *et al*. (2021) argued a positive impact existed between public debt and growth of the economy especially the impact of foreign debt to growth of the economy. K.O. Onyele & E.O. Nwadike (2021) reported significant but negative correlation existed between public debt and growth of the economy. Furthermore, the previous studies concentrated on external debts on growth of the economy while neglecting domestic debt on growth of the economy. The previous studies also neglected debt servicing and growth rate of economy in Nigeria. Hence, their works on debt burden variables could be difficult not to be biased which was caused from these ignored variables and therefore, reliance on these works should be carefully done. Moreso, the previous studies neglected the direction of Granger causality that existed between debt burden and growth rate of economy in Nigeria. Therefore, the purpose of this study was to examine how domestic debt, foreign debt and debt servicing will impact economic growth in Nigeria.

MATERIALS AND METHODS

This study adopted *ex post facto* research design which is appropriate because it analyse fact before the commencement of the study. The study utilised secondary data which was sourced from the Central Bank of Nigeria Annual Statistical Bulletin (n.d.) ranging over 1992 to 2023, Nigeria Bureau of Statistics (TAX-to-GDP..., 2022; Nigerian domestic..., 2024) and World Development Indicators (n.d.). The data was analysed using auto regressive distributed lag (ARDL) model. In a single-equation model, ARDL models are employed in investigating the dynamic associations with data that are time series in nature. The autoregressive side of the dependent variable's gives a value that may depend on prior realisations of the variable itself, as well as the current and historical values of other explanatory variables (the distributed lag part). The variables can

as well be classified as nonstationary, stationary, or a combination of the two.

The ARDL model is effective when distinguishing between the long- and short-term impacts and to examine cointegration – or, more broadly, as well as to determine whether the variables of interest have a long-term relationship – in its equilibrium correction representation. Cumulative sum of recursive residuals (CUSUM) tests was also employed in the study so as to check the stability or otherwise of the data. The study considered 1992 to 2023 because the data for 2024 is yet to be published. Model specification – the modified model is stated as follows:

$$EG = f(DD, FD, DS, INT, EXR, INF). \quad (1)$$

Econometrically, the model is stated as:

$$EG_t = \beta_0 + \beta_1 DD_t + \beta_2 FD_t + \beta_3 DS_t + \beta_4 INT_t + \beta_5 EXR_t + \beta_6 INF_t + \varepsilon_t, \quad (2)$$

where EG_t – economic growth (proxy with growth rate of gross domestic product) at time t; DD_t – domestic debt; FD_t – foreign debt; DS_t – debt servicing; INT_t – interest rate; EXR_t – exchange rate; INF_t – inflation rate; β_0 – constant term; β_1, β_2, β_3, … – coefficients to be estimated; ε_t – error term. Using, the Granger causality model, one can analyse the association between both dependent and independent variables. For this analysis, the two primary Granger causality models are shown:

$$Y_{it} = \sum_{i=1}^{n} \alpha_{11i} X_{t-i} + \sum_{j=1}^{n} \beta_{11i} Y_{t-j} + \mu_{11t}; \quad (3)$$

$$X_{it} = \sum_{i=1}^{n} \alpha_{21i} Y_{t-i} + \sum_{j=1}^{n} \beta_{21i} X_{t-j} + \mu_{21t}, \quad (4)$$

where Y stands for economic growth; X stands for external debt, debt servicing, interest rate, capital, labour and technology. The measurements of variables are shown in Table 1.

Table 1. Measurement of Variables

Variables	Proxy Measurements	Symbol	Expected sign
Economic growth	This serves as dependent variable that measures economic growth	EG	EG_t
Domestic debt	% of GDP	DD	$\beta_1 > 0$
Foreign debt	% of GDP	FD	$\beta_2 > 0$
Debt servicing	% of total revenue	DS	$\beta_3 < 0$
Interest rate	Monetary policy rate (MPR)	INT	$\beta_4 < 0$
Exchange rate	Official exchange rate (NGN/USD)	EXR	$\beta_5 > 0$
Inflation rate	Consumer price index (CPI)	INF	$\beta_6 < 0$

Source: created by the authors

Economic growth is the dependent variable while domestic debt, foreign debt, debt servicing, interest rate, exchange rate and inflation are the independent variables. Economic growth is the continuous increase in the level of output of a country's goods and services produced for a given time period as compared to a preceding era. The portion of a nation's overall government debt that is owing to domestic lenders is known as domestic debt while that of the one owned to foreign lenders are known as foreign debt. Debt servicing is the cost charged on debt. Interest rate is the price tag by Central Bank of Nigeria on loans. Exchange rate which is one of the control variables is the rate at which a country's currency is changed for a foreign currency. Finally, inflation rate is the persistent increase in the prices of goods and servicing of a country. The Philip Peron (PP) test, the augmented Dickey-Fuller (ADF) test and Granger-causal effect test were used.

RESULTS AND DISCUSSION

To ascertain whether the variables are stationary, the unit root test is considered and the sequence of integration can be inferred from their stationarity. The cointegration test requires knowledge of the variables' integration sequence. Table 2 indicates that while economic growth, inflation, interest rates, and exchange rates were stagnant following the initial differencing, domestic product and foreign debt remained at the same level.

Table 2. Test results of unit root

Variable	ADF test		PP test		Order of integration, ADF	Order of integration, PP
	Test statistic	*p* value	Test statistic	*p* value		
Economic growth	−4.235292	−3.568379	−4.173127	−3.568379	I(1)	I(1)
Domestic debt	−4.453421	−3.568379	−4.483427	−3.568379	I(0)	I(0)
Foreign debt	−4.151845	−3.568379	−3.981778	−3.568379	I(0)	I(0)
Debt servicing	−5.724267	−3.574244	−12.629551	−3.568379	I(1)	I(1)
Inflation	−76.42913	−3.568379	−67.595591	−3.568379	I(1)	I(1)
Interest rate	−4.178832	−3.580623	−11.83347	−3.568379	I(1)	I(1)
Exchange rate	−3.825221	−3.568379	−3.825221	−3.568379	I(1)	I(1)

Source: created by the authors

A combination of the I(0) and I(1) series was given as shown by the unit root test. This suggests that the ARDL limits test is appropriate method in determining the long-run relationship (cointegration). Table 3 demonstrates the bound F statistic 10.312347 is higher to the upper critical value with 4.01 at the level of significance of 5%.

Table 3. ARDL bound test for economic growth

Test statistic	Value	*K*
F statistic	10.312347	6
Critical value bounds		
Significance	I0	I1
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Source: created by the authors

Implying a long-term link among the selected variables, with this result, authors could move forward to estimate the ARDL model. The R^2 of 0.896048 indicates to have good fit to the data (Table 4). This indicates that 89.6% of *EG* changes can be attributed to variations in interest rates, inflation, exchange rates, domestic and foreign debt, and debt payments. *F* statistic with 5.070470 and its *p* value of 0.006289 demonstrate the model's statistical significance. This suggests that the model is suitable for forecast.

Table 4. Long-run results for economic growth

Regressor	Coefficient	Standard error	*t* statistics	*p* value
Dependent variable: *EG*				
Domestic debt	−0.008394	0.003376	−2.486163	0.0322
Foreign debt	0.360653	0.018996	2.582642	0.0022
Debt servicing	−0.120965	0.011716	−10.324620	0.0000
Interest rate	−0.000135	0.001889	−0.071292	0.9455
Exchange rate	0.331152	0.002122	4.369829	0.0014
Inflation	−0.000431	0.001102	−0.390995	0.7040
C	15.471930	6.244072	2.477859	0.0327
R^2			0.896048	
Adjusted R^2			0.719329	
S.E of regression			38.30385	
F statistic			5.070470	
Prob (*F* statistic)			0.006289	
Durbin Watson			2.115241	

Source: created by the authors

Table 4 showed the domestic debt's coefficient value to be −0.008394, while the *p* value is 0.0322, revealing negative significant influence of domestic debt on growth of GDP. Conversely, foreign debt shows positive and significant impact on *EG* with the coefficient value of 0.360653 as well as the *p* value of 0.0022, of which servicing of debt has a negative and influence with the coefficient value of −0.120965 and *p* value of 0.0000. Interest rates as well as inflation have negative and insignificant contemporaneous influence on GDP (*p* values of 0.9455 and 0.7040, respectively), as can be observed from their coefficient values of −0.000135 and −0.000431. It is clear from the exchange rate coefficient value of 0.331152 and the *p* value with 0.0014 that exchange rates significantly and negatively lagged impact on Nigeria's economic growth. The outcome of this model's brief dynamics is shown in Table 5.

Table 5. Short run and diagnostics tests results

Growth rate of GDP				
Regressor	**Coefficient**	**Standard error**	***t* statistics**	***p* value**
D(EG(−1))	−0.145868	0.150792	−0.967348	0.3562
D(Domestic debt)	−0.282159	0.138237	−2.041128	0.0685
D(Foreign debt)	0.015633	0.004235	3.691479	0.0042
D(Debt servicing)	−0.003388	0.000833	−4.067095	0.0023
D(Interest rate)	0.002922	0.001023	2.857311	0.0170
D(Exchange rate)	0.001536	0.001032	1.488356	0.1675
D(Inflation)	−0.001405	0.000692	−2.029828	0.0698
CointEq(−1)	−1.384582	0.073964	−5.199605	0.0004
Diagnostic tests				
Test		*F* statistic	Prob. Value	
Breusch-Pagan Godfrey serial		1.917899	0.2270	
Breusch-Pagan-Godfrey heteroskedasticity		0.437217	0.9384	

Source: created by the authors

The established long-term link of the model's variables is validated by it negative but significant estimate of CointEq(−1). The it shows the CointEq(−1) to be −1.384582, with significant at 1 percent. Implying the next quarter period should account for approximately 1.38 percent of the long run equilibrium deviations. The diagnostic test also showed that there is no mis-specification mistake and that no issue with serial correlations existed. For the fact that the statistics are not significant and the test's null hypothesis of equal variance cannot be rejected, therefore the Breusch-Pagan heteroskedasticity statistics of 0.437217 with *p* values of 0.9384 imply that there is no heteroskedasticity in the models. The investigation's next stage involved determining whether long-run coefficient stability could be achieved using the CUSUM tests (Fig. 1).

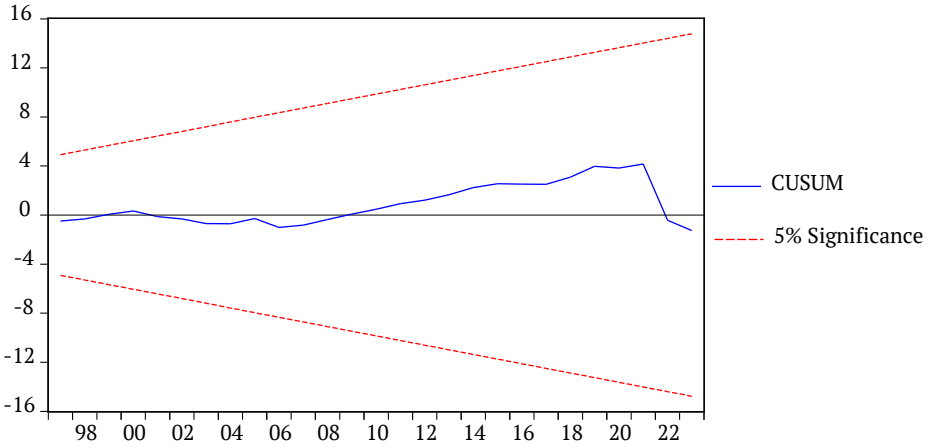

Figure 1. CUSUM test

Source: created by the authors

To ensure stability, the cumulative is expected to remain between the two crucial lines at the 5% significance level. If not, there is a problem with instability. Figure 1 showed that the CUSUM plot is located in between the two important borders, implying the model are stable. The study examined the causal relationship of public debt and growth of economy using the Granger-causal effect test (Table 6).

Table 6. Causality for public debt and economic growth

Null hypothesis	Obs	*F* statistic	Prob.
DD does not Granger cause *EG*	33	6.46700	0.0032
EG does not Granger cause *DD*		6.11860	0.0057
EXD does not Granger cause *EG*	33	0.04913	0.9522
EG does not Granger cause *EXD*		1.08380	0.3537
DS does not Granger cause *EG*	33	2.19830	0.1320
EG does not Granger cause *DS*		5.96567	0.0341
INF does not Granger cause *EG*	33	0.87528	0.4291
EG does not Granger cause *INF*		1.69403	0.2042
INT does not Granger cause *EG*	33	1.48435	0.2459
EG does not Granger cause *INT*		5.86484	0.0082
EXTE does not Granger cause *EG*	33	0.02884	0.9716
EG does not Granger cause *EXTE*		1.63620	0.2149

Source: created by the authors

The findings demonstrated that domestic debt and *EG* have a reciprocal relationship. The findings indicated that there is only one direction of causal relationship between of growth of economy and servicing of debt. The study therefore recommends that Nigerian government should make more use of foreign debt to internal debt because of the low interest of foreign debt to domestic debt which will help in reducing the debt burden. This study also recommends that government of Nigeria should make effort in reducing the debt-revenue ratio by paying some affordable debt as soon as possible and seeks for ways of enjoying debt forgiveness by multinational banks. To improve production performance of Nigeria, the government in the country and pertinent monetary authorities should implement an appropriate exchange rate policy that will permit a realistic and stable exchange rate. Interest rate impact negatively on the economic growth in Nigeria therefore policy makers in Nigeria should try to manage the interest rate in such a way that will enhance the economic growth. The government ought to persist in executing broader reforms and suitable measures that guarantee the efficient transfer of all debt inflows into the real sector, so fostering

transformed enduring growth rate of the economy. Debt of a nation should be decided by the present macroeconomic parameters/indicators based on the tolerance limitations set by the national assembly, debt management office and the economic team for the benefit of the nation. Sovereign nations that are concerned with sustainable economic growth, especially the less developed countries, which are characterised with poor capital formation as a result of low levels of domestic savings and investment should turn to borrowing from outside sources in order to augment domestic saving whenever they are faced with a lack of capital.

The study aligns with theory of Keynesian economics (Kur *et al*., 2021). According to Keynesian economics, government action, including borrowing to finance deficit spending can be used to boost economic growth, especially when the economy is experiencing a downturn or recession. Keynesians contend that deficit spending can assist in igniting the economy's productive capacity and fostering growth at times of underutilised resources, such as high unemployment and idle capacity. There is a multiplier impact, which argues of an initial increase in spending of government can leads to a bigger rise in overall activities of the economy, is a key idea in Keynesian economics (Eichner, 2023). Fiscal policy deficit spending in particular is viewed as a vital instrument for increasing demand and restarting the economy in such circumstances.

ARDL model was employed to consider debt of government and growth of economy. The dependent variable used is growth rate of GDP of which the independent variables are domestic debt, foreign debt, debt servicing, interest rate and inflation as well as exchange rate. However, it was revealed domestic debt to be negative but significant determinant of growth of the economy which is consistent with the results of D. Didia & P. Ayokunle (2020) and C.K. Eke & N.E. Akujuobi (2021) that shows domestic debt are detrimental to growth of the economy. Therefore, null hypothesis of domestic debt does not significantly affect growth of the economy should not be accepted. This is consistent with neo-classical growth theory. Neoclassical economics places a strong emphasis on how effectively market processes distribute resources and foster economic expansion (Eke & Akujuobi, 2021). It makes the case that interference from the government, particularly deficit spending, can skew signals from the market and cause resources to be misallocated, which will eventually hurt chances for long-term growth, as noted by I. Ajayi & D. Edewusi (2020). The idea of rational expectations, which postulates that economic agents' base decisions on their reasonable expectations of future outcomes, is a concept that neoclassical economists frequently include into their analyses (Yusuf & Mohd, 2021). According to this concept, consumers and businesses may modify their behavior to decrease consumption and investment if they anticipate future tax rises or inflation brought on by rising levels of government debt (Eke & Akujuobi, 2021).

The result of the study further revealed that all foreign debts are significant determinants of economic growth which is consistent with the result of M. Matandare & J. Tito (2018) and I. Ajayi & D. Edewusi (2020). Based on these, the null hypothesis of foreign debts does not affect significantly the growth of the economy in Nigeria should be rejected. The result of the study also showed that all exchange rates are significant determinants of growth rate of the economy which is consistent to the result of G. Ani & S. Nwannebuike (2021) and E. Nyeche (2024). This is consistent with the theory of purchasing power parity. The purchasing power of nations' currencies, which is substantially influenced by inflation, plays a vital role in shaping the course of foreign exchange rate swings. Policymakers and other economic stakeholders can effectively manage the subtleties of exchange rate swings by understanding the dynamics of buying power and how it interacts with. As a result, well-informed choices can be taken to use exchange rate dynamics to improve national economies and promote long-term, sustainable growth and development. In summary, the trajectory of variations in foreign exchange rates is mostly determined by the purchasing power of a country's currency, which is heavily impacted by inflation.

To examine the causal effect of public debt on growth of economy in Nigeria, we employed granger causality test and it was shown a bi-directional granger-causal effect of domestic debt and growth of the economy while a one-way causal relationship existed between economic growth and debt servicing. Hence, the hypothesis of no causal effect of public debt on growth of the economy should be rejected. This is consistent with the studies of K.O. Onyele & E.O. Nwadike (2021) and S.C. Alago *et al*. (2023), which assumed that when government source for loans in the domestic economy affects the availability of loans for other productive activities by private sector while external debt serves as extra financial inflows which developing economy like Nigeria lacks which can help to augment the financial resources in the country. The study revealed that domestic debt is a negative but significant determinant of economic growth. The result of the study further revealed that all foreign debts are significant determinants of economic growth which. The study revealed further that there is bi-directional causality between domestic debt and gross domestic product while a one-way causal relationship existed between gross domestic product and debt servicing.

CONCLUSIONS

Considering the findings from the tests and regressions of this study, the study concluded a negative relationship between domestic debt and economic growth. The study concluded that foreign debts are significant determinants of economic growth which. Servicing of debt often result to burden on the country revenue thereby affecting the available funds for developmental projects that can enhance the economic growth. The study thereby concluded that public debt affects economic growth in Nigeria. Therefore, when faced with a lack of capital, less developed nations should look to borrowing from outside sources to augment domestic saving. Moreover, the volatility of global financial markets and variations in oil prices, a significant source of government income to Nigeria has necessitated the need to turn on foreign debt in financing public facilities as government expenditure stimulates the economy by providing cash to consumers and businesses, which then raise spending and spark other cycles of investment and consumption.

The initial effect of government expenditure on economic output is increased by this multiplier effect. Concerns about the Nigerian government's capacity to pay off its debt and the sustainability of its finances have been

raised by the mounting debt servicing load therefore efforts should be made to reduce the debt servicing through seeking for debt forgiveness or debt restructuring thereby giving the economy ample opportunity to invest in developmental projects. To enhance Nigeria's production performance, the government and relevant monetary authorities must develop an appropriate exchange rate policy. Given the lack of data for 2024 at the time of the study, taking it into account in analysis may be an area for further research.

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CONFLICT OF INTEREST

None.

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Державний борг, погашення боргу та економічне зростання в Нігерії

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Анотація. Державний борг є важливим інструментом, який уряди використовують для фінансування державних витрат, особливо в ситуаціях, коли складно підвищувати податки та скорочувати видатки. Наразі Нігерія страждає від високих витрат на обслуговування боргу, який до кінця першого кварталу 2024 року становитиме 1,12 мільярда доларів США. У цій роботі досліджено вплив державного боргу на економічне зростання в Нігерії. Для аналізу вторинних даних, отриманих зі статистичного бюлетеня Центрального банку Нігерії з 1992 по 2023 роки та Індексу світового розвитку, було використано авторегресійну модель із розподіленим лагом. Дослідження показало, що існує значний, але негативний зв'язок між внутрішнім боргом та економічним зростанням у довгостроковій перспективі зі значенням коефіцієнта −0,008394 на 5 % рівні значущості. Існує також значний і позитивний вплив зовнішнього боргу на економічне зростання в довгостроковому періоді зі значенням коефіцієнта 0,360653 на 5 % рівні значущості. Погашення боргу має негативний зв'язок з економічним зростанням в Нігерії з коефіцієнтом −0,120965 на 1 % рівні значущості. Дослідження також показало двосторонній вплив внутрішнього боргу на зростання економіки Нігерії, тоді, як між економічним зростанням та обслуговуванням боргу був виявлений односторонній причинно-наслідковий зв'язок. У дослідженні зроблено висновок, що державний борг має значний вплив на зростання економіки Нігерії. Уряд Нігерії повинен докласти зусиль для зменшення співвідношення боргу до доходів шляхом якнайшвидшого погашення доступного боргу, а також шукати шляхи списання боргу міжнародними банками. Дослідження рекомендує уряду Нігерії більше використовувати зовнішній борг, ніж внутрішній, через низький відсоток зовнішнього боргу по відношенню до внутрішнього, що допоможе зменшити борговий тягар

Ключові слова: державний борг; темпи зростання валового внутрішнього продукту; обмінний курс; авторегресійна модель з розподіленим лагом; статистична значущість

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