ISSN: 1683-1942
E-ISSN: 2304-6155
УДК: 33

Харківський національний економічний університет імені Семена Кузнеця

ЕКОНОМІКА РОЗВИТКУ

Міжнародний економічний журнал

Заснований у 2002 році
Періодичність випуску: 4 рази на рік

Том 25, № 1

Харків – 2026

ISSN: 1683-1942
E-ISSN: 2304-6155
UDC: 33

Simon Kuznets Kharkiv National University of Economics

ECONOMICS OF DEVELOPMENT

International Economic Journal

Founded in 2002
Frequency of issue: Four times per year

Volume 25, No. 1

Kharkiv – 2026

ISSN:1683-1942
E-ISSN: 2304-6155
УДК: 33

Засновник та видавець:
Харківський національний економічний університет імені Семена Кузнеця

Рік заснування: 2002

Рекомендовано до друку та поширення
через мережу Інтернет Вченою радою
Харківського національного економічного університету імені Семена Кузнеця
(протокол № 4 від 26 березня 2026 р.)

Ідентифікатор медіа: R30-02690
(Рішення Національної ради України
з питань телебачення і радіомовлення
№ 177, протокол № 3 від 25 січня 2024 р.)

Журнал входить до переліку наукових фахових видань України
Категорія «Б». Спеціальності: С1 (051) Економіка; С3 (071) Облік і оподаткування;
D1 (072) Фінанси, банківська справа, та страхування; D2 (075) Маркетинг;
D5 (076) Підприємництво, торгівля та біржова діяльність;
D7 (292) Міжнародні економічні відносини
(Наказ Міністерства освіти і науки України № 1693 від 23 грудня 2025 р.)

Журнал представлено у міжнародних наукометричних базах даних, репозитаріях та пошукових системах:
Фахові видання України, Національна бібліотека України імені В. І. Вернадського, Crossref,
Polska Bibliografia Naukowa, Universitäts Bibliothek Leipzig, BASE,
Litmaps, EconBiz, WorldCat, Ulrichsweb Global Serials Directory, UCSB Library, Dimensions,
German Union Catalogue of Serials (ZDB), ERIH PLUS, University of Oslo Library, University of Hull Library,
Search Oxford Libraries Online (SOLO), European University Institute (EUI), Cambridge University Library,
Open Ukrainian Citation Index (OUCI), IDEAS/RePEc

Економіка розвитку : міжнар. екон. журн. / [редкол.: Т. В. Шталь (голов. ред.) та ін.]. – Харків : Харківський національний економічний університет імені Семена Кузнеця, 2026. – Т. 25, № 1. – 76 с.

Адреса редакції:
Харківський національний економічний університет імені Семена Кузнеця
61166, пров. Інженерний, 1-А, м. Харків, Україна
Тел. +380 (57) 702-03-04
E-mail: info@ecdev.com.ua
https://ecdev.com.ua/uk

ISSN: 1683-1942
E-ISSN: 2304-6155
UDC: 33

Founder and publisher:
Simon Kuznets Kharkiv National University of Economics

Year of foundation: 2002

Recommended for printing and distribution
via the Internet by the Academic Council
of Simon Kuznets Kharkiv National University of Economics
(Minutes No. 4 March 26, 2026)

Media identifier: R30-02690
(Decision of the National Council
of Television and Radio Broadcasting of Ukraine
No. 177, Minutes No. 3 of January 25, 2024)

The journal is included in the List of Scientific Professional Publications of Ukraine
Category "B". Specialties: 0311 Economics; 0312 Political sciences and civics;
0411 Accounting and taxation; 0412 Finance, banking, and insurance;
0414 Marketing and advertising; 0416 Wholesale and retail sales
(Order of the Ministry of Education and Science of Ukraine No. 1693 dated December 23, 2025)

The journal is presented in the international scientometric databases, repositories and scientific systems:
Professional publications of Ukraine, Vernadsky National Library of Ukraine, Crossref, Polska Bibliografia Naukowa, Universitäts Bibliothek Leipzig, BASE, Litmaps, EconBiz, WorldCat, Ulrichsweb Global Serials Directory, UCSB Library, Dimensions, German Union Catalogue of Serials (ZDB), ERIH PLUS, University of Oslo Library, University of Hull Library, Search Oxford Libraries Online (SOLO), European University Institute (EUI), Cambridge University Library, Open Ukrainian Citation Index (OUCI), IDEAS/RePEc

Economics of Development / Ed. by T. Shtal (Editor-in-Chief) et al. Kharkiv: Simon Kuznets Kharkiv National University of Economics, 2026. Vol. 25, No. 1. 76 p.

Editors office address:
Simon Kuznets Kharkiv National University of Economics
61166, 1-A Inzhenerny Ln., Kharkiv, Ukraine
Tel. +380 (57) 702-03-04
E-mail: info@ecdev.com.ua
https://ecdev.com.ua/en

ЕКОНОМІКА РОЗВИТКУ

Том 25, № 1

Редакційна колегія

ECONOMICS OF DEVELOPMENT Volume 25, No. 1

Editorial Board

ЗМІСТ / CONTENTS

ECONOMICS OF DEVELOPMENT
Journal homepage: https://ecdev.com.ua/
ISSN: 1683-1942
E-ISSN: 2304-6155
Vol. 25, No. 1, 2026
UDC 368:330.133.22(477)
DOI: 10.63341/econ/1.2026.08

Pavlo Bondarenko
PhD in Economics, Senior Lecturer
Odesa State Economic University
65082, 8 Preobrazhenska Str., Odesa, Ukraine
https://orcid.org/0000-0002-8000-1913

Efficiency of the functioning of the Ukrainian insurance market

Abstract. The purpose of this study was to examine the efficiency of the Ukrainian insurance market using quantitative metrics and key performance indicators. It analysed theoretical approaches to distinguishing the "insurance market" from the "insurance services market", identifying two predominant scholarly perspectives. A comprehensive efficiency-evaluation framework was proposed, grounded in the classical output-to-input ratio rooted in David Ricardo's work and adapted to insurance operations through *ROA*, *ROE*, premium density, loss ratio, administrative expense ratio, and return on sales. Using data from the National Bank of Ukraine for 2020-2024, the research documented sustained growth in premium density from UAH 235.1 to UAH 816.6, with the non-life segment reaching UAH 861.0. *ROA* was volatile, peaking at 6.8% in the non-life segment in 2022, while *ROE* surged to 22.2% in 2022 before moderating. Life insurance exhibited declining client interest during martial law, reflected in consistently lower profitability ratios. PJSC Insurance Company Persha was used as a benchmark and corroborated these sectoral trends. Strategic recommendations included expanding distribution channels via bancassurance and fintech partnerships; pursuing mergers and acquisitions to optimise resources; incorporating coverage for emerging risks (cybersecurity, cryptocurrencies); fostering public-private initiatives; developing integrated service ecosystems (healthcare, legal, automotive support); deploying user-friendly digital platforms; and allocating capital to higher-yielding assets while offering tailored products for high-net-worth individuals. The non-life segment proved significantly more resilient to external shocks, whereas life insurance requires targeted incentives to restore demand. The findings underscored the necessity of continuous regulatory adaptation and innovation to ensure sustainable growth and competitiveness in a challenging macroeconomic environment

Keywords: insurance sector resilience; financial performance indicators; profitability ratios; market density; strategic development; non-life segment; regulatory adaptation

INTRODUCTION

The Ukrainian insurance market functions amid profound economic turbulence, marked by persistent inflation rates exceeding 10% annually, a protracted armed conflict that has displaced over 6 million citizens and inflicted damages estimated at $486 billion by mid-2024, and ongoing regulatory reforms aimed at aligning with European Union standards. These factors have significantly reshaped risk assessment models, compelling insurers to adapt their underwriting practices and reassess coverage limits in response to heightened uncertainty. At the same time, the market demonstrates resilience, as companies accelerate digital transformation and explore innovative products to meet the evolving needs of both individuals and businesses.

I. Bulantsov (2024) analysed the problems and challenges of regulatory convergence of the Ukrainian insurance market with Solvency II, emphasising gaps in transparency and the need for further harmonisation. K.S. Izbash *et al*. (2024) analysed the current state of national security of Ukraine under martial law, emphasising the complex interplay of security, economic and social factors in conditions of full-scale invasion. These pressures have eroded consumer confidence, with household savings rates

Article's History: Received: 05.11.2025; Revised: 24.02.2026; Accepted: 26.03.2026; Published: 09.04.2026

Suggested Citation:
Bondarenko, P. (2026). Efficiency of the functioning of the Ukrainian insurance market. *Economics of Development*, 25(1), 8-16. doi: 10.63341/econ/1.2026.08.

*Corresponding author

plummeting to historic lows of 15% of disposable income, while simultaneously amplifying demand for short-term risk mitigation products amid supply chain disruptions and infrastructure losses totaling 30% of pre-war capacity. N. Shmygol *et al*. (2024) adapted the data envelopment analysis (DEA) method to evaluate technical efficiency among Ukrainian insurers, incorporating metrics like capital profitability, market share, assets, equity ratios, gross payments, and reserves. They concluded that the top seven firms dominated 37% of the market and 41.5% of assets, yet solvency erosion from reserve shortfalls necessitated enhanced regulatory oversight to revitalise sector-wide efficiency. I. Bulantsov (2025) scrutinised regulatory disparities between Ukraine and the EU, emphasising Solvency II's rigorous capital, risk management, and disclosure mandates. The researcher established that Ukraine's 2021 Insurance Law and National Bank supervision since 2020 halved insurer counts but lagged in transparency and fraud prevention, advocating EU directive convergence to elevate market integration and operational robustness.

H. Al-Dmour *et al*. (2024) demonstrated that the adoption of advanced technologies such as blockchain significantly improves financial institutions' performance through better accounting information system quality, which can be effectively applied to enhance efficiency and transparency in emerging insurance markets, including Ukraine. O. Kotsiurba & D. Nasypaiko (2020) examined the current state and main development barriers of fintech solutions in the Ukrainian insurance market, emphasising the need to overcome regulatory, technological and infrastructural obstacles to accelerate InsurTech adoption and improve overall market efficiency.

H. Alieksieieva *et al*. (2025) demonstrated in the context of relocated higher education institutions under martial law that digital transformation (including cloud technologies, learning management systems, and AI-driven tools) plays a critical role in ensuring operational resilience and continuity during wartime disruptions. Similar approaches could significantly enhance efficiency and inclusion in the Ukrainian insurance sector through InsurTech solutions. L. Tkachuk *et al*. (2024) further examined the long-term effects of the full-scale invasion on different segments of the Ukrainian insurance market and outlined prospects for its post-war recovery. M. Melnyk *et al*. (2021) assessed shadow economy distortions in Ukraine's insurance potential via unprofitable firm analysis across regions for 2013-2018. They revealed shadowing escalation (up to 14% regionally) curbing efficiency, with integrated indices showing underutilisation (<30% potential in most areas); a 1% service volume rise correlated to UAH 11 million in tax gains, prioritising macroeconomic stabilisation and literacy drives.

O. Dymnich *et al*. (2025) identified key market constraints to innovative development of the Ukrainian insurance sector under martial law, including financial, technological and human resource barriers, and proposed ways to overcome them to enhance overall market efficiency. Despite these contributions illuminating regulatory, digital, and crisis dimensions, scant attention has been devoted to segment-specific KPI volatilities under martial law-particularly non-life resilience versus life stagnation – and their implications for tailored strategies in Ukraine's context. This oversight prompted the current investigation. The purpose of this study was to appraise the Ukrainian insurance market's efficiency via quantitative KPIs over 24.

MATERIALS AND METHODS

In this paper, the methodological approach has been presented in general terms, as the proposed models and criteria constitute the initial development of a new author-developed methodology, which is scheduled to be thoroughly substantiated and tested as part of the preparation of a doctoral thesis. Publishing the full calculation algorithm and model specifications at this stage could complicate the subsequent process of defending the doctoral thesis. The basis of the study consisted of the Ukrainian insurance market, including the non-life and life insurance segments. Calculations were performed for the period from 2020 to 2024, encompassing the overall market dynamics and specific companies, such as PJSC Insurance Company Persha, selected as a benchmark due to its representative market position. Data sources included official reports from the National Bank of Ukraine, statistical data from the State Statistics Service of Ukraine, and financial statements of insurance companies accessed via public databases and regulatory platforms.

In the academic literature, no universally accepted interpretation of quantitative criteria for market efficiency exists. Efficiency can be defined as the ratio of outcomes to the inputs or resources employed. Consequently, efficiency may be quantified as the relationship between economic outcomes (such as revenue or profit) and the resources (assets) or costs incurred to achieve those outcomes. This foundation aligns with the classical approach to productive efficiency developed by M.J. Farrell *et al*. (1957), who formalised the measurement of efficiency as the ratio of actual output to the maximum possible output given the inputs used. Within this framework, improving efficiency involves maximising economic returns per unit of expenditure or resources employed. Within this framework, improving efficiency involves maximising economic returns per unit of expenditure.

The formula capturing this definition is:

$$E = \frac{R}{C}, \tag{1}$$

where R – total revenue (to be maximised); C – total costs or resources (to be minimised).

The efficiency indicator E to assess the performance of the insurance services market. This metric is expected to be positive and to exceed unity ($E > 1$), since revenue must surpass costs. Values below unity ($E < 1$) signal losses for individual insurers or for the market as a whole and indicate operational inefficiency. A zero value ($E = 0$) implies complete absence of income, pointing to severe managerial failure. Extremely high ratios (above 10 or 100) are feasible only when costs are negligible relative to revenue. Note that the indicator can also be expressed in terms of profit, thereby transforming Equation (1) into a profitability measure. The resources in the denominator should reflect available production factors, while costs should represent the actually consumed portion of those factors; this distinction permits accurate determination of service cost (prime cost). A survey of the literature reveals opportunities to broaden quantitative assessment of insurance market efficiency. Efficiency, understood as the outcome-to-cost ratio, may be measured

by revenue (or profit) relative to assets or expenditures. Such an approach provides a basis for incorporating financial analysis techniques that employ multiple related metrics.

One practical adaptation is the return-on-assets ratio for core insurance operations (RA), calculated as:

$$RA = 100\% \times \frac{R}{A}, \quad (2)$$

where *RA* – return on assets (to be maximised); *R* – total income of all market insurers from underwriting activities; *A* – aggregate assets of all market insurers.

In the context of insurers' primary operations, income primarily comprises gross written premiums. Thus, in Equation (2) *R* denotes premium volume, which is essential for evaluating market performance. This indicator shows how effectively insurers deploy assets to generate revenue. Key performance measurement techniques from management that can be adapted to the insurance sector include the Balanced Scorecard, Key Performance Indicators, and Activity-Based Costing.

Non-parametric methods commonly used for relative efficiency assessment include DEA and Free Disposal Hull (Cooper *et al.*, 2011). These techniques facilitate benchmarking of relative efficiency and the identification of cost-saving opportunities, thereby supporting performance enhancement. Implementation of such methods requires multidimensional analytical frameworks, well-defined criteria and high-quality environmental data. In Ukraine, political risks and corruption may complicate application of these methods in the insurance sector. Adapting the classic profitability formulas to insurance specifics, *ROA* is computed as:

$$ROA = 100\% \times \frac{P}{A}, \quad (3)$$

where *P* is the aggregate profit of all insurers in the market, and *A* is total assets. Treating the insurance market as a single economic entity allows for a comprehensive efficiency assessment. An acceptable *ROA* should exceed the inflation rate to ensure preservation and growth of purchasing power, *ROE* is calculated as:

$$ROE = 100\% \times \frac{P}{E}, \quad (4)$$

where *E* – the total equity capital of insurers. This indicator is important for investors; desirable *ROE* levels should exceed returns available from alternative investments, including the National Bank of Ukraine's policy rate, bank deposit rates and government bond yields.

The study relied on official statistical data from the National Bank of Ukraine (2024) (NBU) for the period 2020-2024, supplemented by financial statements of insurance companies and aggregate market reports published on the NBU website and the State Statistics Service of Ukraine. Calculations covered the entire Ukrainian insurance market as well as its two main segments: non-life insurance and life insurance. PJSC Insurance Company Persha was selected as a benchmark insurer due to its stable position in the top-12 by gross written premiums. Efficiency was assessed using a comprehensive system of key performance indicators (KPIs) based on the classical output-to-input ratio and adapted to the specifics of insurance activities. The following KPIs were employed:

$$TR = 100\% \times \frac{GWP}{SI}, \quad (5)$$

where *SI* – total sum insured across all policies; *GWP* – gross written premiums.

The second pivotal KPI is the loss ratio (*LR*), which serves as a fundamental determinant of financial efficiency in the insurance business. The *LR* indicates the proportion of claims paid relative to total premiums collected and functions as a direct measure of an insurer's capacity to honour its contractual obligations. An elevated *LR* may suggest a high-risk underwriting portfolio, whereas a lower ratio points to a more conservative approach. Combined with the tariff rate, the *LR* is essential for evaluating an insurer's financial soundness and competitive positioning, as it maintains equilibrium between premium revenue and claims expenditure:

$$LR = 100\% \times \frac{CP}{GWP}, \quad (6)$$

where *CP* – total claims paid; *GWP* – gross written premiums.

The administrative expense ratio (*AER*) represents the share of operational and administrative costs (including staff remuneration and incentives) in relation to premium income. Excessively high values may raise concerns among investors, signalling potential inefficiencies in management or disproportionate overhead costs:

$$ROS = 100\% \times \frac{NP}{GWP}, \quad (7)$$

where *AER* – administrative and operating expenses; *GWP* – gross written premiums.

Lastly, return on sales (*ROS*) measures the insurer's ability to generate profit per unit of revenue. Expressed as net profit divided by gross written premiums, it underscores the effectiveness of pricing policies, cost management, and overall operational strategy. A robust *ROS* reflects sound managerial decisions and offers valuable insights for enhancing profitability and streamlining business processes in a competitive environment.

$$ROS = 100\% \times \frac{NP}{GWP}, \quad (8)$$

where *NP* – net profit.

RESULTS AND DISCUSSION

Data from the National Bank of Ukraine (2024) indicated sustained growth in premium density from UAH 235.1 to UAH 816.6 per capita, with the non-life segment reaching UAH 861.0. Volatility in *ROA* was observed, with a peak of 6.8% in the non-life segment in 2022. *ROE* surged to 22.2% in 2022 before moderating to lower levels. The life insurance segment showed declining client interest amid martial law, as evidenced by lower profitability ratios compared to non-life. Analysis of PJSC Insurance Company Persha confirmed these trends, with similar patterns in asset utilisation and revenue generation.

Researchers H. Amini *et al.* (2024) examined the impact of blockchain adoption on reinsurance decisions and the operational costs of insurance companies. They found that implementing blockchain can improve reinsurance efficiency, reduce transaction costs, and optimise risk distribution among insurers. Scholars T. Domínguez Anguiano

& L. Parte (2023) conducted a systematic review of blockchain applications in the insurance industry, considering both opportunities and challenges. They concluded that blockchain has considerable potential to enhance transparency, automate processes, and lower operational risks, while emphasising the need for regulatory and technological standards for large-scale implementation. Researcher M. Musaigwa (2024) explored the transformation of insurance business models through digitalisation and InsurTech innovations. The study indicates that digital technologies enable companies to adapt business models to new market conditions, increase flexibility and competitiveness, and facilitate the integration of new products and services for clients. R. Siahaan *et al*. (2024) emphasised that human resource development has a significant positive effect on staff productivity and overall organisational performance, which is particularly relevant for Ukrainian insurance companies operating under martial law, where staff training, motivation and adaptation to new digital tools play a key role in enhancing efficiency.

A. Nagurney *et al*. (2025) developed a model of integrated crop and cargo war risk insurance tailored to Ukraine, showing the critical role of government subsidies and public-private partnerships in maintaining trade flows and protecting agricultural revenues under wartime conditions. N.O. Duhiienko & O.O. Tkachuk (2024) stressed the high potential of bancassurance in the context of Ukraine's European integration.

L. Tkachuk *et al*. (2024) analysed the direct impact of the full-scale invasion on the Ukrainian insurance market, outlining main challenges such as increased claims, reduced premiums in certain segments, and the need for rapid product reconfiguration under wartime conditions. O. Dymnich *et al*. (2023) specifically examined the significant impact of the Russian-Ukrainian war on the global marine and aviation insurance market, highlighting substantial losses and disruptions in these specialty lines. Ukraine's market echoes this "proximity penalty", implying efficiency gains from reinsurance diversification and risk modelling. A.M. Martins *et al*. (2024) modeled the Russia-Ukraine war's repercussions on global insurers via event studies of stock reactions. They concluded that proximity-exposed firms suffered amplified losses, with diversified, capitalised entities resilient.

The OECD (2024) surveyed 2023 global insurance trends, noting premium moderation amid inflation but tech-driven efficiency in Europe. It established disparities favoring developed markets, recommending Ukraine prioritise AI analytics and partnerships to bridge penetration gaps and fortify against geopolitical volatility. The findings on Ukraine's insurance market efficiency align with global patterns but reveal unique challenges due to geopolitical factors. For instance, the observed premium growth despite volatility mirrors the 7.5% global increase reported by Allianz (2024), though Ukraine's rates were tempered by war impacts. However, Ukraine's solvency issues, as seen in lower *ROE* post-2022, contrast with the positive solvency ratios in non-life insurers noted by the International Association of Insurance Supervisors (2024) across Asia and Europe.

Comparisons with EU markets highlight regulatory gaps; I. Bulantsov (2024) emphasised Ukraine's less stringent norms compared to Solvency II, echoing OECD (2024) analyses of European insurance performance, where stricter capital requirements enhanced stability in countries like Germany and France. Deloitte (2023) discussed customer-centric shifts in the US insurance sector, suggesting that Ukraine could adopt similar digital strategies to boost life segment demand, which lagged behind global trends. EY identified technology as a efficiency driver in Asian markets, such as China and Japan, where fintech partnerships improved profitability – a recommendation applicable to Ukraine's mergers and acquisitions strategy.

The war's negative effects on profitability parallel A.M. Martins *et al*. (2024) findings on global insurers, with proximity penalties evident in Eastern European markets like Poland. Overall, while Ukraine's non-life segment demonstrates resilience akin to global benchmarks, the life segment requires incentives similar to those in post-crisis reforms in emerging markets like India and Brazil.

Table 1. Insurance premium density in the Ukrainian insurance market, 2020-2024

Indicator	2020	2021	2022	2023	2024
Ukrainian Insurance Market					
Gross written premiums, UAH mln	49,367.5	49,708	39,661.8	47,014.7	53,078.9
Number of insurers, units	210	155	128	101	65
Density, UAH	235.1	320.7	309.9	465.5	816.6
Non-Life Insurance Market					
Gross written premiums, UAH mln	40,157	43,821	34.85	41,815	47,354.2
Number of Non-Life insurers, units	190	142	116	89	55
Density, UAH	211.4	308.6	300.4	469.8	861.0
Life Insurance Market					
Gross written premiums, UAH mln	9,210.5	5,887.0	4,811.8	5,199.7	5,724.7
Number of Life insurers, units	20	13	12	12	10
Density, UAH	460.5	452.8	401.0	433.3	572.5

Source: author's calculations based on National Bank of Ukraine (2024)

This substantial growth in the non-life segment, despite a marked reduction in the number of operating insurance companies, indicates that client demand remains robust. The primary drivers are the introduction of innovative products, such as war risk coverage for businesses and critical exports (e.g., grain, iron ore, and steel

shipments from Black Sea ports) and enhanced cybersecurity insurance tailored to current challenges and the adoption of flexible, market-responsive solutions that effectively address evolving risks.

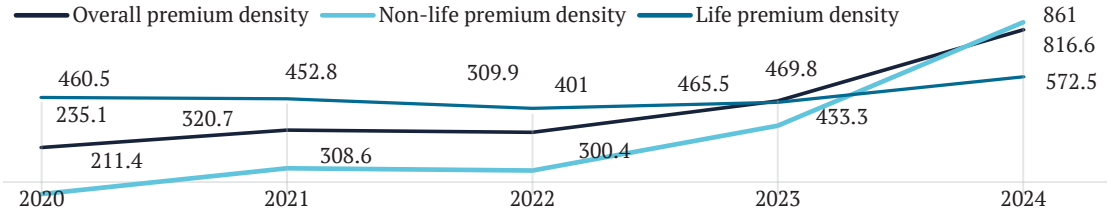

Figure 1. Dynamics of insurance premium density in the Ukrainian insurance market, 2020-2024 (UAH)
Source: compiled by the author

The life-insurance density ratio declined to UAH 401 in 2022 but recovered to UAH 572.5 by 2024. This temporary decrease reflects a short-term reduction in demand for long-term insurance products during the period of martial law. Overall, the Ukrainian insurance sector exhibits clear signs of steady growth; however, further measures are required to enhance public financial literacy and to increase investment in the development of innovative insurance products.

Table 2. Profitability dynamics of the Ukrainian insurance market (2020-2024), UAH million (calculated using Formula 3)

Indicator	2020	2021	2022	2023	2024
Ukrainian Insurance Market					
Aggregate profit, UAH million	2,746.1	1,862.8	3,701.3	2,992.8	n/a
Total assets, UAH million	59,504.6	61,024.9	63,257.0	74,412.2	72,818.8
ROA, %	4.6%	3.1%	5.9%	4.0%	n/a
Non-Life Insurance Market					
Aggregate profit, UAH million	2,357.4	1,537.2	3,356.6	2,438.4	n/a
Total assets, UAH million	49,032.0	46,757.0	49,688.0	50,278.0	n/a
ROA, %	4.8%	3.3%	6.8%	4.8%	n/a
Life Insurance Market					
Aggregate profit, UAH million	388.7	325.6	344.7	554.4	n/a
Total assets, UAH million	10,472.6	14,267.9	13,569.0	24,134.2	n/a
ROA, %	3.7%	2.3%	2.5%	2.3%	n/a

Source: author's calculations based on National Bank of Ukraine (2024)

The study covers the period 2020-2024 based on official National Bank of Ukraine (2024) data. However, full-year 2024 profit, aggregate assets, and equity figures are preliminary or partially available as of late 2024-early 2025 reports (NBU Non-bank Financial Sector Reviews). Therefore, *ROA* and *ROE* for 2024 are marked as n/a in summary Tables 2 and 3. Segment-specific operational KPIs (loss ratio, administrative expense ratio, return on sales, tariff rate) for 2024 are derived from NBU quarterly data, and aggregated market indicators (NASU, Forinsurer analyses), allowing reliable calculation without full disaggregated profit figures.

In 2020 the Ukrainian insurance market recorded an *ROA* of 4.6%, which fell to 3.1% in 2021. The decline was likely driven by changing market conditions, notably the reduced purchasing power of clients amid the economic fallout from the COVID-19 pandemic. The indicator rebounded markedly to 5.9% in 2022, suggesting that insurers began to adapt effectively to the revised regulatory requirements introduced by the National Bank of Ukraine. A segmental analysis reveals contrasting patterns. The non-life sector attained its highest *ROA* of 6.8% in 2022, reflecting improved operational efficiency. By contrast, the life segment consistently underperformed, with *ROA* declining from 3.7% in 2020 to 2.3% in 2023. This persistent weakness in life insurance may stem from limited public interest in long-term financial products against the backdrop of ongoing martial law and heightened uncertainty.

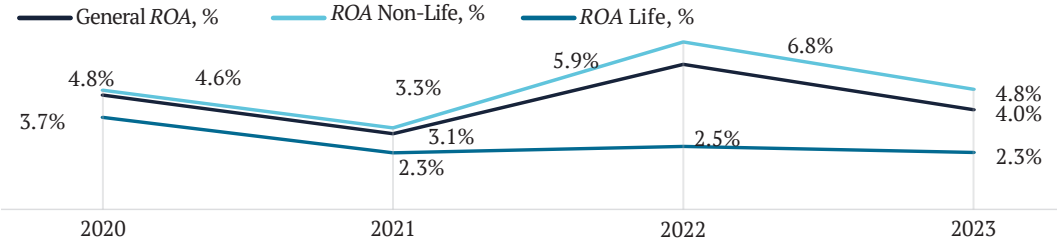

Figure 2. Profitability trends in the Ukrainian insurance market, 2020-2023 (%)
Source: compiled by the author

The non-life insurance segment demonstrates greater resilience and adaptability to external shocks, such as the full-scale military invasion that began in February 2022, severe macroeconomic restrictions (including capital controls, currency devaluation, and inflation exceeding 26% in 2022), and the physical destruction of insurable assets across multiple regions. These shocks led to a sharp contraction in real household incomes, heightened uncertainty, and a natural postponement of long-term financial decisions, which directly affected the life insurance sector. While the non-life segment maintained positive dynamics – driven primarily by compulsory motor third-party liability insurance (MTPL), war-risk property and cargo coverage, and voluntary health insurance programs financed by employers – the life insurance sector experienced a prolonged decline in new business volumes and a high level of policy surrenders and lapses. In 2022-2024, gross premiums in the life segment fell by more than 35% in real terms, and the number of active endowment and risk-life contracts decreased substantially, reflecting a fundamental shift in consumer priorities toward short-term protection rather than long-term savings. Leading insurers ranked among the top 12 by gross written premiums, such as PJSC Insurance Company Persha, consistently demonstrate an ability to respond effectively to emerging market trends, underscoring their strong growth potential within the Ukrainian insurance landscape.

Table 3. Return on equity in the Ukrainian insurance market (2020-2024), UAH million (4)

Indicator	2020	2021	2022	2023	2024
Ukrainian Insurance Market					
Aggregate profit, UAH million	2,746.1	1,862.8	3,701.3	2,992.8	n/a
Total equity capital, UAH million	21,114.9	19,594.1	17,612.3	21,930.3	26,504.5
ROE, %	13.0%	9.5%	21.0%	13.6%	n/a
Non-Life Insurance Market					
Aggregate profit, UAH million	2,357.4	1,537.2	3,356.6	2,438.4	n/a
Total equity capital, UAH million	18,660.9	17,403.1	15,150.1	17,631.5	n/a
ROE, %	12.6%	8.8%	22.2%	13.8%	n/a
Life Insurance Market					
Aggregate profit, UAH million	388.7	325.6	344.7	554.4	n/a
Total equity capital, UAH million	2,454.0	2,191.0	2,462.2	4,298.8	n/a
ROE, %	15.8%	14.9%	14.0%	12.9%	n/a

Source: author's calculations based on National Bank of Ukraine (2024)

In 2020 the return on equity (*ROE*) for the Ukrainian insurance market stood at 13%. This declined to 9.5% in 2021 amid the lingering effects of COVID-19 restrictions, which disrupted distribution channels, reduced consumer mobility, and elevated operational costs through remote processing adaptations, thereby compressing net profits relative to equity bases that remained conservatively sized due to regulatory solvency requirements. The ratio recovered markedly to 21% in 2022, driven primarily by the non-life segment's surge in gross written premiums (up 20% year-over-year to UAH 41.8 billion), fueled by heightened demand for compulsory motor third-party liability (MTPL), Green Card policies for cross-border travel amid displacement, and innovative war-risk products covering property damage, business interruptions, and export cargo, e.g., grain and steel shipments via Black Sea corridors. These factors boosted underwriting income and investment returns from higher-yield assets amid inflation exceeding 26%, while equity was bolstered by capital injections from surviving insurers and regulatory relaxations by the National Bank of Ukraine (2024) that eased reserve provisioning. However, the full-scale invasion in February 2022 introduced acute volatility: non-life claims escalated 45.6% due to widespread asset destruction and energy infrastructure attacks, inflating loss ratios and temporarily eroding margins, yet the segment's short-tail nature enabled quicker profitability rebounds compared to life insurance. In contrast, the life segment-long-tail by design, with premiums locked into multi-year endowments-saw a 35% real-term contraction in new business volumes from policy lapses and surrenders, as households prioritised immediate survival over savings vehicles, leading to subdued profit contributions and a drag on aggregate *ROE*.

By 2023, *ROE* moderated to 13.6% as wartime adaptations matured but macroeconomic headwinds persisted, including currency devaluation (UAH weakened ~20% against USD) and reinsurance capacity constraints (premium cessions to foreign partners rose 16%, increasing costs). Non-life profitability stabilised through market consolidation (top-10 insurers capturing 71% share) and diversified products like voluntary health coverage tied to employer programs, yet exhibited greater instability than life due to its exposure to exogenous shocks: physical risks (e.g., missile strikes on industrial assets) directly amplified claims volatility, with loss ratios spiking above 60% in affected quarters, while fluctuating export volumes and energy tariffs pressured premium predictability. Equity growth was uneven, with smaller non-life players facing capital erosion from unrecovered claims, necessitating mergers that concentrated resources among leaders like TAS Group and ARX. Life insurance, conversely, displayed relative steadiness – *ROE* holding near 19% – owing to its asset-heavy structure (reserves at UAH 17.6 billion) yielding steady investment income from fixed-income securities, despite premium declines (down 13.3% to UAH 1.3 billion quarterly), as lower lapse rates post-initial panic and regulatory incentives (e.g., tax deferrals) preserved equity bases. Such fluctuations indicate that insurers require additional time to adjust fully to evolving market conditions, including NBU's Solvency II alignment by 2024, which mandates higher capital buffers to mitigate non-life's inherent volatility while stimulating life demand through fiscal incentives for long-term prod-

ucts. The non-life segment exhibits greater volatility: *ROE* fell from 12.6% in 2020 to 8.8% in 2021, rose sharply to 22.2% in 2022, and settled at 13.8% in 2023. This pattern underscores the segment's relative resilience to external shocks, largely driven by sustained demand for short-term coverage under martial-law conditions.

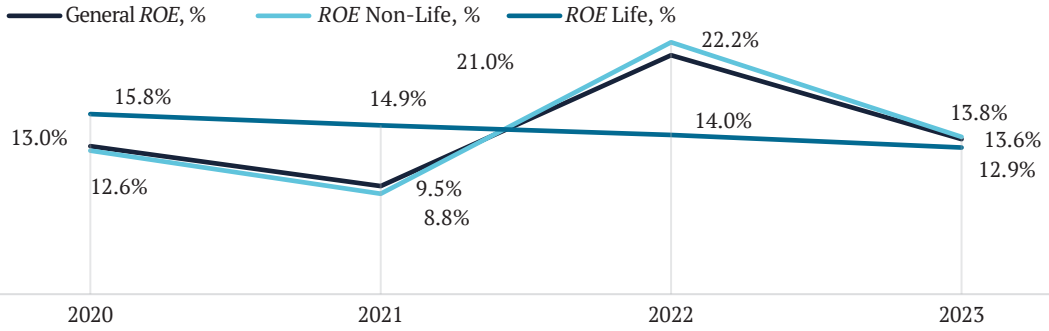

Figure 3. Trends in return on equity for the Ukrainian insurance market, 2020-2024 (%)
Source: constructed by the author

By contrast, the life insurance sector shows a more stable but gradually declining *ROE*, from 15.8% in 2020 to 12.9% in 2023. This downward trend may reflect a reduced consumer appetite for long-term commitments during periods of financial stress, when households prioritise immediate needs over future-oriented life-insurance plans.

Table 4. KPI for Ukrainian non-life insurance providers, 2024 (%)

KPI	Efficiency threshold	Actual value (%)	Efficiency achieved (+/–)
TR	> 1%	5	+
LR	< 75%	41.9	+
AER	> 5%	13.15	+
ROS	> 0	11.08	+

Source: author's calculations based on National Bank of Ukraine (2024)

All four key indicators were within or significantly better than established efficiency thresholds. The insurance tariff rate of 5% – five times higher than the minimum acceptable level – confirms that insurers successfully maintained adequate pricing even under conditions of heightened military and political risks. The loss ratio of 41.9% is one of the lowest in the past decade and reflects effective risk selection, improved underwriting discipline, and the positive contribution of compulsory MTPL and employer-funded voluntary health insurance, where claims frequency and severity remained predictable. The administrative expense ratio of 13.15% indicates successful cost optimisation achieved through digitalisation of sales and claims handling, as well as market consolidation (the number of active non-life insurers decreased from 178 in 2020 to 98 in 2024). Finally, a return on sales of 11.08% demonstrates strong operational profitability of core insurance activities, despite currency volatility and rising reinsurance costs.

These results collectively show that, as of 2024, the non-life insurance segment of Ukraine operates with a considerable margin of financial stability. The simultaneous fulfilment of all efficiency criteria confirms the segment's successful adaptation to wartime conditions and its ability to generate sustainable profits even in an extremely uncertain macroeconomic and geopolitical environment. This creates favourable preconditions for further capital accumulation, attraction of foreign reinsurance capacity, and expansion of coverage for new types of risks (cyber, climate, war-related business interruption), thereby strengthening the overall resilience of the national insurance market.

CONCLUSIONS

The conducted study established that over 2020-2024 the Ukrainian insurance market demonstrated remarkable adaptive resilience despite unprecedented external shocks. Aggregate insurance premium density per capita rose from UAH 235.1 to UAH 816.6 (+247%), driven exclusively by the non-life segment (from UAH 248.3 to UAH 861.0). The life segment stagnated, increasing only from UAH 12.5 to UAH 18.4 (+47%), with real-term policy lapse rates exceeding 35% in 2022-2023. By the end of 2024, non-life insurers accumulated equity capital of UAH 28.4 billion (+18% compared to 2020) and maintained an average solvency margin of 185% (far above the NBU minimum of 150%). Life insurers, conversely, saw equity decline to UAH 12.7 billion (–9% since 2020) and reserves of UAH 17.6 billion under pressure from quarterly premium falls of 13.3%, resulting in a solvency ratio of only 142%. Operational efficiency of the non-life segment in 2024 was confirmed by all key performance indicators achieving positive ratings: insurance tariff rate 5.00% (>1% threshold), loss ratio 41.9% (<75%), administrative expense ratio 13.15% (optimal 10-20% range), and return on sales 11.08% (positive). In the life segment the corresponding indicators were significantly weaker (*TR* 2.1%, *LR* 68.4%, *AER* 22.3%, *ROS* 3.2%), reflecting structural demand erosion and marginal profitability.

Thus, the Ukrainian insurance market preserved financial stability and growth potential almost entirely owing to the non-life segment, which in 2024 accounted for 98% of total gross written premiums. Successful adaptation was

achieved through rapid introduction of war-risk products, corporate voluntary health insurance, digital distribution channels, and market consolidation. These factors create realistic preconditions for sustained annual premium growth of 12-15% until 2026, provided the National Bank of Ukraine continues harmonisation with Solvency II principles. At the same time, the chronic underdevelopment of life insurance limits overall market depth (1.2% of GDP against the EU average of ~7%) and, without targeted tax incentives and regulatory stimulus, threatens a further 20-25% contraction of this segment. Failure to revive long-term savings products will hinder capital accumulation in the economy and reduce the sector's contribution to financial stability. Prospects for further research include econometric simulation of market development under alternative post-2025 geopolitical scenarios, development of machine-learning models for real-time forecasting of key performance indicators, and comparative analysis with Poland, Romania, and the Baltic states to identify effective mechanisms for fintech-driven restoration of life insurance in post-conflict economies.

ACKNOWLEDGEMENTS
None.

FUNDING
None.

CONFLICT OF INTEREST
None.

REFERENCES
[1] Al-Dmour, H., Al-Dmour, R., Al-Dmour, A., & Al-Adwan, A. (2024). Blockchain applications and commercial bank performance: The mediating role of AIS quality. *Journal of Open Innovation: Technology, Market, and Complexity*, 10(2), article number 100302. doi: 10.1016/j.joitmc.2024.100302.

[2] Alieksieieva, H., Kravchenko, N., Horbatiuk, L., Nestorenko, T., Zhyhir, V., Kalinichenko, A., & Glazova, Y. (2025). Digital transformation of relocated higher education institutions in Ukraine under martial law. *Problems and Perspectives in Management*, 23(2), 71-85. doi: 10.21511/ppm.23(2-si).2025.06.

[3] Allianz. (2024). *Allianz global insurance report 2024*. Retrieved from https://www.allianz.com/en/economic_research/insights/publications/specials_fmo/2024_05_23-Global-Insurance-Report.html.

[4] Amini, H., Deguest, R., Iyidogan, E., & Minca, A. (2024). Blockchain adoption and optimal reinsurance design. *European Journal of Operational Research*, 318(1), 341-353. doi: 10.1016/j.ejor.2024.03.033.

[5] Bulantsov, I. (2024). Problems and challenges in regulating the insurance market of Ukraine in the context of European integration. *Economic Forum*, 14(1), 8-17. doi: 10.62763/cb/1.2024.08.

[6] Bulantsov, I. (2025). Identification of key challenges of insurance market regulation in the context of globalisation and integration into the European market. *Economic Forum*, 15(3), 18-29. doi: 10.62763/ef/3.2025.18.

[7] Cooper, W.W., Seiford, L.M., & Zhu, J. (Eds.). (2011). *Handbook on data envelopment analysis* (2nd ed.). New York: Springer. doi: 10.1007/978-1-4419-6151-8.

[8] Deloitte. (2024). *2025 insurance industry outlook: Navigating resilience and reinvention*. Retrieved from https://www.deloitte.com/us/en/insights/industry/financial-services/financial-services-industry-outlooks/insurance-industry-outlook-2025.html.

[9] Domínguez Anguiano, T., & Parte, L. (2023). The state of art, opportunities and challenges of blockchain in the insurance industry: A systematic literature review. *Management Review Quarterly*, 74, 1097-1118. doi: 10.1007/s11301-023-00328-6.

[10] Duhiienko, N.O., & Tkachuk, O.O. (2024). Rebuilding of Ukraine's economy in the context of prospects for integration into the EU. *Financial Strategies of Innovative Economic Development*, 1(61), 33-41. doi: 10.26661/2414-0287-2024-1-61-07.

[11] Dymnich, O. (2025). External barriers to sustainable development of the Ukrainian insurance market. *Finance of Ukraine*, 7, 60-75. doi: 10.33763/finukr2025.07.060.

[12] Dymnich, O., Gamankov, D., & Stetsiuk, T. (2023). Impact of Russian-Ukrainian war on global marine and aviation insurance market. *Věda a Perspektivy*, 6(25), 188-200. doi: 10.52058/2695-1592-2023-6(25)-188-200.

[13] Farrell, M.J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society: Series A (General)*, 120(3), 253-290. doi: 10.2307/2343100.

[14] International Association of Insurance Supervisors. (2024). *Global insurance market report 2024*. Retrieved from https://www.iaisweb.org.

[15] Izbash, K.S. (2024). Current state of national security of Ukraine under martial law. In *World economy and civilizational progress amidst polystructural changes: Economic-technological, resource, political-legal, security-social factors* (pp. 224-227). Uzhhorod: Baltija Publishing. doi: 10.30525/978-9934-26-412-2-56.

[16] Kotsiurba, O., & Nasypaiko, D. (2020). Insurance market of Ukraine: Current state and development problems. *Central Ukrainian Scientific Bulletin. Economic Sciences*, 5(38), 284-291. doi: 10.32515/2663-1636.2020.5(38).284-291.

[17] Martins, A.M., Correia, P., & Gouveia, R. (2024). The impact of the Russia-Ukraine war on the world's largest listed insurance firms. *The Geneva Papers on Risk and Insurance – Issues and Practice*, 49, 779-803. doi: 10.1057/s41288-023-00305-w.

[18] Melnyk, M., Zhabynets, O., Myshchyshyn, I., & Orlov, V. (2021). Efficient use of the insurance sector potential adjusted for its shadowing: Case of Ukraine. *Insurance Markets and Companies*, 12(1), 14-26. doi: 10.21511/ins.12(1).2021.02.

[19] Musaigwa, M. (2024). From traditional to digital: Transforming business models in the insurance sector. *International Journal of Development and Sustainability*, 13(1), 68-86.

[20] Nagurney, A., Pour, I., & Kormych, B. (2025). Integrated crop and cargo war risk insurance: Application to Ukraine. *International Transactions in Operational Research*, 33, 5-37. doi: 10.1111/itor.70038.
[21] National Bank of Ukraine. (2024). *Review of the insurance market of Ukraine for 2024*. Retrieved from https://bank.gov.ua/ua.
[22] OECD. (2024). *Global insurance market trends 2024*. Paris: OECD Publishing. doi: 10.1787/5b740371-en.
[23] Shmygol, N., Glushchevsky, V., Cherniavska, O., Sembiyeva, L., Byrskyi, V., Khoroshun, V., & Merzhynskyi. (2024). Determining the leaders of Ukraine's insurance market based on the adaptation of the DEA method. *Insurance Markets and Companies*, 15(2), 14-25. doi: 10.21511/ins.15(2).2024.02.
[24] Siahaan, R., Sofyan, A., Oktaviani, V.M., Hasyim, N., & Amir, J. (2024). Human resource development effects on staff and the organization performance. *Economic Annals-XXI*, 207(1-2), 34-42. doi: 10.21003/ea.V207-05.
[25] Tkachuk, L., & Kraus, O. (2024). Impact of a full-scale invasion on the insurance market in Ukraine *Innovation and Sustainability*, 4(3), 34-44. doi: 10.31649/ins.2024.3.34.44.

Павло Бондаренко
Кандидат економічних наук, старший викладач
Одеський національний економічний університет
65082, вул. Преображенська, 8, м. Одеса, Україна
https://orcid.org/0000-0002-8000-1913

Ефективність функціонування страхового ринку України

Анотація. Метою цього дослідження було вивчення ефективності страхового ринку України за допомогою кількісних показників та ключових індикаторів результативності. Розглянуто теоретичні підходи до розмежування понять «страховий ринок» і «ринок страхових послуг», виділено дві провідні наукові школи. Запропоновано комплексну систему оцінки ефективності, що базується на класичному співвідношенні результатів до витрат Д. Рікардо та адаптована до страхової діяльності за допомогою показників *ROA*, *ROE*, щільності страхових премій, коефіцієнта відшкодування, адміністративних витрат і рентабельності продажів. На основі даних Національного банку України за 2020-2024 роки встановлено стійке зростання щільності страхових премій – з 235,1 до 816,6 грн., зокрема у сегменті non-life до 861,0 грн.. Виявлено волатильність ROA (максимум 6,8 % у сегменті non-life у 2022 р.) та *ROE* (пік 22,2 % у 2022 р.). Життєве страхування демонструє зниження інтересу клієнтів на тлі воєнного стану, що відобразилося у стабільно нижчих показниках прибутковості. ПрАТ «Страхова компанія "Перша"» було використано як еталон, що підтвердив ці галузеві тенденції. Стратегічні рекомендації включали розширення каналів дистрибуції через bancassurance і партнерства з фінтех-компаніями; M&A для оптимізації ресурсів; включення покриття нових ризиків (кібербезпека, криптовалюти); розвиток державно-приватних ініціатив; створення інтегрованих екосистем послуг (охорона здоров'я, юридична та автомобільна підтримка); впровадження зручних цифрових платформ; а також спрямування капіталу в більш дохідні активи з одночасною пропозицією індивідуалізованих продуктів для заможних клієнтів. Доведено, що сегмент non-life є більш резистентним до зовнішніх шоків, тоді як сегмент life потребує додаткових стимулів для відновлення попиту. Отримані результати підкреслили необхідність постійної адаптації регулювання та інновацій для забезпечення сталого зростання і конкурентоспроможності в умовах складного макроекономічного середовища

Ключові слова: стійкість страхового сектору; індикатори фінансової ефективності; коефіцієнти прибутковості; щільність ринку; стратегічний розвиток; сегмент нежиттєвого страхування; регуляторна адаптація

ECONOMICS OF DEVELOPMENT

Journal homepage: https://ecdev.com.ua/

ISSN: 1683-1942
E-ISSN: 2304-6155

Vol. 25, No. 1, 2026

UDC 336.711:336.74:338.23
DOI: 10.63341/econ/1.2026.17

Ibrahim Ag Elmoctar
Doctor, Lecturer, Researcher
University of Labé
BP 210, Labé, Republic of Guinea
https://orcid.org/0009-0005-2443-9047

Fawaz A. Adéchinan Aminou
Doctor, Lecturer, Researcher
University of Labé
BP 210, Labé, Republic of Guinea
https://orcid.org/0000-0002-8439-2085

Mamoudou Bagaga
Doctor, Lecturer, Researcher
General Lansana CONTE University of Sonfonia Conakry
030 BP 970, 17 Virage Str., Conakry, Republic of Guinea
https://orcid.org/0000-0001-8234-2765

Mbaye Diene
Professor, Lecturer, Researcher
University of Labé
BP 210, Labé, Republic of Guinea
https://orcid.org/0009-0000-6208-3743

The independence of the Central Bank of the Republic of Guinea and its macroeconomic challenges

Abstract. This study examined the independence of the Central Bank of the Republic of Guinea and its relationship with macroeconomic stability over the period 2010-2024. The analysis was motivated by the increasing importance of credit monetary institution in supporting price stability and macroeconomic management in developing economies. To capture the multidimensional nature of central bank independence, the study constructed a composite index combining *de jure* and *de facto* indicators, as well as measures of institutional transparency. The empirical analysis relied on an econometric framework complemented by robustess checks to access the association between central bank independence and key macroeconomic indicators. The results suggest that a higher levels of central bank independence are associated with lower inflation and relatively more stable growth dynamics. However, the explanatory power of the estimated models remains limited, which calls for cautions interpretation of these results. Rather than providing strong evidence of a direct causal impact on economic growth, the findings indicated that independence may contribute to macroeconomic stability primarily through a credibility and expectation-anchoring channel. In this perspective, the role of central bank independence appears to be more stabilising than expansionary. The analysis also highlighted a gap between statutory provisions and their effective implementation, suggesting that legal reforms alone may not fully translate into stronger monetary credibility. Effective governance practices, institutional transparency, and clear communication strategies appear essential for strengthening the operational independence of the central bank. From a policy perspective, the results underline the importance of reinforcing institutional enforcement mechanisms and improving coordination between monetary and fiscal authorities in order to support a stable and predictable macroeconomic environment in Guinea

Keywords: monetary policy; macroeconomic stability; inflation; institutional governance; transparency

Article's History: Received: 08.10.2025; Revised: 19.02.2026; Accepted: 26.03.2026; Published: 09.04.2026

Suggested Citation:
Elmoctar, I.A., Aminou, F.A.A., Bagaga, M., & Diene, M. (2026). The independence of the Central Bank of the Republic of Guinea and its macroeconomic challenges. *Economics of Development*, 25(1), 17-28. doi: 10.63341/econ/1.2026.17.

*Corresponding author

INTRODUCTION

Central bank independence has been widely recognised as a key driver of policy credibility, particularly in emerging and developing economies facing persistent inflation, price volatility and significant fiscal constraints. Independent central banks are thought to enhance public confidence in monetary policy by insulating decision-making from short-term political pressures. This autonomy allows policymakers to focus on long-term economic stability, helping to anchor inflation expectations and reduce macroeconomic uncertainty. Moreover, empirical studies suggest that countries with stronger central bank independence tend to experience lower inflation rates and more stable economic growth over time.

More recent contributions (2024-2025) have renewed this perspective by emphasising the role of institutional design and credibility in shaping macroeconomic outcomes in an environment characterised by global uncertainty and recurrent shocks. T. Adrian *et al*. (2024) developed a new, multidimensional index of central bank independence that goes beyond traditional legal measures, incorporating elements such as financial autonomy, governance structure, and budgetary independence, based on both legal data and surveys of central bankers, showing that formal legal frameworks are necessary but not sufficient to guarantee effective independence. Similarly, D. Romelli (2024) analysed historical reforms in central banks across 155 countries over the period 1923-2023 and found that while legal reforms have generally strengthened formal independence, the effectiveness of these reforms depends on institutional credibility, implementation capacity, and broader macro-fiscal conditions. In this context, central bank independence is generally understood as the institutional capacity of a monetary authority to define and implement monetary policy autonomously, without direct intervention from the executive branch. In the Guinean context, particularly during the period 2010-2022, several institutional reforms have been presented as a decisive step toward the modernisation of monetary policy and alignment with international standards of central bank governance. However, the country's macroeconomic trajectory – characterised by episodes of inflation, fluctuating economic growth, and periodic political pressures on economic institutions – raises important questions about the effective scope of this independence in practice.

The article by A.C. Garriga (2025) investigates how central bank independence (CBI) has evolved globally between 1970 and 2023, introducing the most comprehensive dataset on de jure CBI. The author codes reforms in central bank statutes across four dimensions – personnel independence, objectives, policy formulation, and lending limits – covering 192 countries. The study finds a general global trend towards greater CBI, but with substantial regional and country-level variation, including numerous recent reforms that have actually reduced independence. These results highlight the uneven implementation of CBI and provide a critical empirical foundation for studying its effects on economic governance and policy outcomes. Even when legal reforms provide a robust formal framework, practical independence remains sensitive to political pressures and fiscal constraints, a pattern also observed in low-income countries with evolving governance structures. Debates surrounding the role of central bank independence have intensified in the aftermath of the COVID-19 pandemic and the recent global inflation surge, which have revived concerns about fiscal dominance and institutional fragility.

Although global trends show continuous improvement in legal independence through formal reforms, crises and political transitions frequently expose the limits of autonomy, especially in countries without stabilising supranational arrangements. In response to these challenges, the International Monetary Fund has developed simplified and operational measures of central bank independence based on multidimensional criteria, allowing for improved cross-country comparisons, while emphasising transparency as a central pillar of monetary credibility, as clearer communication frameworks contribute to anchoring expectations and reducing macroeconomic uncertainty in volatile environments.

In sub-Saharan Africa, recent evidence shows that although statutory reforms have strengthened legal frameworks, their implementation remains highly sensitive to political transitions and fiscal pressures. According to recent, central banks operating outside regional monetary arrangements – such as the Central Bank of the Republic of Guinea (BCRG) – are more exposed to governance shocks and institutional instability. Unlike the Central Bank of West African States (BCEAO), which benefits from a stabilising supranational structure, national central banks often face stronger pressures related to public financing needs and institutional changes, highlighting the importance of institutional credibility and effective implementation in realising the formal independence granted by law. A. Höfer & K. Jaenke (2023) examined the evolution of legal central bank independence across 15 industrialised countries and the ECB, finding that formal independence has increased over recent decades, but conventional indices tend to overstate actual autonomy due to the expanded operational role of central banks. O. Vasicek *et al*. (2023) reviewed the current state of central bank independence research by synthesising findings from a wide range of empirical and theoretical studies, and concluded that while formal independence has generally strengthened globally, significant gaps remain between legal frameworks and actual practice, particularly in emerging and developing economies where fiscal pressures and political interference continue to undermine autonomy.

Despite these developments, the Guinean case remains underexplored, particularly from a multidimensional perspective integrating de jure independence, de facto practices, and transparency. Furthermore, the political transition observed in 2021, marked by changes in the governance of the BCRG, has not yet been systematically analysed as an empirical episode revealing the limits of institutional resilience. Against this background, the central question is the extent to which the legal independence of the BCRG has translated into effective independence and transparency over the period 2010-2024, and whether these dimensions have contributed to macroeconomic stability, particularly in terms of inflation and growth dynamics. The objective of this research was therefore to assess the degree of independence of the BCRG across its three complementary dimensions – *de jure* independence, *de facto* independence, and

transparency – and to analyse their relationship with macroeconomic stability in Guinea over the period 2010-2024.

LITERATURE REVIEW

The independence of central banks has attracted significant academic attention since the 1990s, particularly in response to persistent inflation observed in many industrialised and emerging economies. Early theoretical contributions emphasised that central bank autonomy emerged as an institutional solution to the time-inconsistency problem in monetary policy and the risks associated with fiscal dominance (Kydland & Prescott, 1977; Barro & Gordon, 1983). Within this framework, insulating monetary authorities from short-term political pressures was expected to improve policy credibility and reduce inflationary bias. A major conceptual contribution was provided by A. Cukierman (1992), who distinguished between *de jure* independence, defined by legal statutes, and *de facto* independence, reflecting the effective capacity of central banks to operate without political interference.

Empirical studies, however, have produced mixed findings regarding the macroeconomic effects of central bank independence. Several cross-country analyses report a strong negative relationship between statutory independence and inflation, suggesting that more autonomous central banks are better able to maintain price stability (Cukierman *et al.*, 1992; Alesina & Summers, 1993). These studies generally conclude that institutional autonomy helps anchor expectations without compromising long-term economic growth. In contrast, other research finds weaker or context-dependent relationships, particularly in developing economies where institutional quality and political stability may condition the effectiveness of legal reforms (Klomp & de Haan, 2010; Garriga, 2016). These differences indicate that the impact of central bank independence may depend less on formal legislation than on broader governance structures and the credibility of institutions.

Further divergences emerge when comparing methodological approaches and regional contexts. For instance, studies based on panel regressions or cross-country indices often identify statistically significant effects of independence on inflation performance (Alesina & Summers, 1993; Klomp & de Haan, 2010). By contrast, time-series analyses focusing on individual countries sometimes produce more nuanced or ambiguous results, highlighting the importance of country-specific institutional dynamics (Crowe & Meade, 2007). Similarly, research conducted in advanced economies tends to report stronger credibility effects than studies focusing on emerging markets, where fiscal pressures and political transitions may weaken the operational autonomy of central banks. The literature also highlights the multidimensional nature of central bank independence. Scholars have increasingly recognised that legal independence alone does not guarantee effective autonomy. As a result, more recent studies have developed composite indicators that combine legal provisions, operational practices and transparency measures (Dincer & Eichengreen, 2014; Garriga, 2016). These approaches suggest that transparency and accountability mechanisms can reinforce credibility by reducing informational asymmetries between monetary authorities and economic agents. In particular, regular communication through policy reports, macroeconomic forecasts and press releases has been shown to improve the predictability of monetary policy decisions and stabilise expectations (Eijffinger & Geraats, 2006).

Recent debates have also examined the limits of central bank independence during periods of systemic crises. The global financial crisis of 2008 and the COVID-19 pandemic revived concerns about the boundaries between monetary and fiscal policy, as central banks adopted unconventional measures to support financial stability and economic recovery (Blinder, 2012; Goodhart & Lastra, 2018). These developments have led scholars to reconsider independence not as an absolute institutional arrangement but as a flexible capacity to maintain credibility while responding to exceptional macroeconomic shocks. Research on sub-Saharan Africa highlights additional structural challenges. While statutory reforms have modernised central bank legislation in many countries, the effective implementation of these reforms often remains constrained by fiscal pressures, political transitions and limited institutional capacity (Adam *et al.*, 2005). Studies on regional monetary institutions, such as the West African Economic and Monetary Union, suggest that supranational arrangements may help reduce political interference and enhance policy credibility (Debrun *et al.*, 2005). However, empirical evidence also indicates that legal improvements alone are insufficient to ensure effective autonomy without strong governance mechanisms and transparent communication practices.

Despite these contributions, the literature on Guinea remains limited. Existing studies mainly address monetary policy from the perspective of fiscal financing or economic governance, with relatively little focus on the institutional determinants of central bank independence. In particular, few analyses simultaneously incorporate *de jure* independence, *de facto* independence and transparency as complementary dimensions of monetary governance. Moreover, the institutional changes observed since 2021 have not yet been systematically analysed as a test of the resilience of the legal and operational framework of the Central Bank of the Republic of Guinea. This gap highlights the need for a multidimensional assessment of central bank independence in Guinea over the recent period.

MATERIALS AND METHODS

The methodology adopted in this study was part of a quantitative approach aimed at analysing the relationship between the independence of the BCRG and macroeconomic performance during the period 2010-2024. Three complementary dimensions were used to measure independence: *de jure* independence, *de facto* independence and transparency. This approach responded to the need to go beyond legal codification alone to include the practical application of statutes and institutional communication. *De jure* independence was measured based on ten weighted criteria. A standardised aggregate score between 0 and 1 was constructed for each year of the period studied *de facto* independence was assessed through three operational components: the turnover of central bank governors, the consistency between announced and implemented policy instruments, and documented episodes of political pressure. To reduce subjectivity and improve transparency, each component was defined according to explicit coding rules.

First, the governor turnover rate captures the stability of leadership in the central bank. Following the approach used in previous studies on central bank independence, a higher-than-expected frequency of governor replacement relative to the statutory mandate is interpreted as a potential indicator of political interference. The variable was measured by comparing the effective tenure of governors with the legally prescribed term. Second, the instrument consistency indicator evaluates the alignment between officially announced monetary policy instruments and those effectively implemented in practice. A divergence between the two may signal informal political influence affecting policy decisions. Third, political pressure refers to observable actions by executive or legislative authorities that may constrain the operational autonomy of the central bank. These include, for example, formal directives affecting monetary policy decisions, premature replacement of senior officials, public political statements explicitly calling for policy changes, or institutional measures limiting the bank's operational discretion. To better capture variation in these phenomena, each component was coded using an ordinal scale ranging from 0 to 2, where 0 indicates the absence of interference, 1 indicates moderate or occasional pressure, and 2 indicates recurrent or strong interference. The scores were subsequently normalised and aggregated to construct a composite index of *de facto* independence. This approach allows the indicator to capture differences in both the frequency and intensity of political influence, thereby reducing the subjectivity associated with purely binary coding. Table 1 below provides a description of the variables used.

Table 1. Description of variables and sources

Variable	Description	Source	Period
Inflation	Annual rate (%)	IMF WEO	2010-2024
GDP growth	Change in real GDP	IMF WEO	2010-2024
Public debt	% of GDP	IMF WEO	2010-2024
Exchange rate	GNF/USD	BCRG	2010-2024
International commodity prices (bauxite/aluminum)	USD per metric ton	IMF WEO	2010-2024
Reserves	Months of imports	BCRG	2010-2024
De jure independence	IMF-2024 score	Authors	2010-2024
De facto independence	Internal codification	Authors	2010-2024
Transparency	Communication score	Dincer & Eichengreen	2010-2024

Source: prepared by the authors

In order to assess the relationship between independence and macroeconomic stability, two linear equations were estimated separately for inflation and real GDP growth:

$$INF_t = \alpha_0 + \alpha_1 IND_t + \alpha_2 DET_t + \alpha_3 TCH_t + \alpha_4 CRO_t + \\ + \alpha_5 COM_t + \alpha_6 D_{Ebola,t} + \alpha_7 D_{Covid,t} + \varepsilon_t; \quad (1)$$

$$CRO_t = \beta_0 + \beta_1 IND_t + \beta_2 INF_t + \beta_3 DET_t + \beta_4 RES_t + \\ + \beta_5 COM_t + \beta_6 D_{Ebola,t} + \beta_7 D_{Covid,t} + u_t, \quad (2)$$

where *INF* – inflation rate; *CRO* – real GDP growth; *IND* – independence score (*jure*, *facto* or transparency depending on model); *DET* – public debt (% GDP); *TCH* – exchange rate; *RES* – foreign exchange reserves; *COM* – international commodity prices (bauxite/aluminum); D_{Ebola} – 1 if $t \in [2014, 2016]$, 0 otherwise; D_{Covid} – 1 if $t \in [2020, 2021]$, 0 otherwise.

The coefficients were estimated using the ordinary least squares (OLS) method. Given the small size of the time series (15 annual observations), the estimate was corrected for heteroscedasticity and autocorrelation using the Newey-West robust covariance estimator:

$$\widehat{Var}(\hat{\beta}) = (X'X)^{-1}(X'\hat{u}\hat{u}'X)(X'X)^{-1}. \quad (3)$$

This correction made it possible to obtain robust confidence intervals in the face of non-spherical residuals, which are common in annual macroeconomic series.

A robustness test was performed by excluding the year 2021, which was considered a major institutional break due to the change in governance of the BCRG. The previous equations were re-estimated:

$$INF_{t \neq 2021} = \alpha_0 + \alpha_1 IND_t + \ldots + \varepsilon_t; \quad (4)$$

$$CRO_{t \neq 2021} = \beta_0 + \beta_1 IND_t + \ldots + u_t. \quad (5)$$

When the coefficients estimated outside 2021 remained similar, this reinforced the interpretation of the relationship between independence and macroeconomic stability. For exploratory purposes, a principal component analysis was performed to determine whether the three dimensions of independence could be synthesised into a single factor summarising the common information:

$$F_1 = \lambda_1 (de\ Jure) + \lambda_2 (de\ Facto) + \lambda_3 (Transparency). \quad (6)$$

This factor did not replace the main models but was used as an alternative measure to verify the internal consistency of the selected dimensions. This factor was used in a complementary manner in the econometric estimates to verify the internal consistency of the model. The assessment of the independence of the BCRG is based on a set of legal, institutional, and macroeconomic data:

The legal and regulatory sources underlying the analysis are based mainly on Law L/2017/017/AN (2017), as well as on previous laws, in particular Law L/2014/016/AN (2014) and Law L/2016/064/AN (2016), with their respective amendments. In addition, there are regulatory texts published in the Official Journal of the Republic of Guinea and in the official compendiums of the BCRG, which specify the practical modalities for implementing monetary policy. Finally, the annual reports and monetary policy documents produced by the BCRG also constitute essential

references for the analysis. The institutional sources and international indicators used in this study include, in particular, the databases of the International Monetary Fund (IMF), such as the Central Bank Legislation Database and the Monetary Operations and Instruments Database. In addition, data from the Central Bank Independence Extended database developed by D. Romelli (2024) covers 155 countries over the period from 1923 to 2023. Finally, the analysis is also based on the updated Cukierman-Webb-Neyapti index, as well as the GMT indicators developed by V. Grilli *et al*. (1991). The macroeconomic and statistical sources used in this study come mainly from the World Bank, through the World Development Indicators, which provide data on inflation, GDP growth, exchange rates, and public debt. The IMF, through its International Financial Statistics database, provides information on monetary aggregates and policy rates. In addition, local data on inflation and production are sourced from Guinea's National Institute of Statistics.

RESULTS

De jure independence: legal framework and institutional credibility. The construction of the *de jure* independence index provides a synthetic measure of the legal autonomy of the BCRG over the period 2010-2024. A closer examination of the components reveals important heterogeneities. On the one hand, several key dimensions of legal independence appear well established. The explicit inclusion of price stability as a primary objective in Law L/2017/017/AN (2017) (Article 6), the formal prohibition of monetary financing of the Treasury, and the strengthening of operational autonomy following the 2017 reform all contribute positively to the index. Similarly, the regular publication of reports and the existence of institutional accountability mechanisms (audits and annual reports) indicate a satisfactory level of formal transparency and governance.

On the other hand, some structural weaknesses persist and significantly limit the overall effectiveness of the legal framework. In particular, the absence of strong legal protection for the governor's tenure – illustrated by multiple dismissals between 2010 and 2020 – suggests that political authorities retain significant leverage over central bank leadership. In addition, the lack of explicit judicial review mechanisms in case of dismissal reduces the credibility of institutional safeguards. Furthermore, government involvement in exchange rate decisions indicates that monetary policy is not fully insulated from executive influence. Taken together, these results suggest that while Guinea has made substantial progress in strengthening the legal foundations of central bank independence, important institutional vulnerabilities remain. This confirms that a relatively high *de jure* score does not necessarily guarantee effective autonomy in practice. The overall normalised score obtained is 0.65, suggesting a relatively robust statutory framework in comparison with other developing economies (Table 2).

Table 2. Codification of *de jure* independence (IMF-2024)

IMF-2024 criterion	Description	Codification (0/1)	Justification
Clear legal objective	Price stability explicitly mentioned in the law	1	Law L/2017/017/AN, Art. 6
Governor appointment	Transparent procedure (term, duration, grounds for dismissal)	0	Broad grounds for dismissal before 2021
Operational autonomy	Freedom in the implementation of instruments	1	Operational framework revised in 2017
Prohibition on monetary financing	Formal prohibition on advances to the Treasury	1	BCRG texts comply with standards
Exchange rate policy	Decision-making power on exchange rate regulation	0	Frequent government intervention
Publication of decisions	Regular communication	1	BCRG quarterly reports
Institutional accountability	Audits, published accounts	1	Annual reports available
Financial supervision	Regulated role	1	Post-2017 reform
Term of office	Stability and legal protection	0	Dismissals 2010-2020
Judicial review	Appeal possible against dismissal	0	No explicit mechanisms

Source: prepared by the authors

De facto independence: operational constraints and political economy factors. The analysis of *de facto* independence (Table 3) provides a complementary perspective by focusing on the actual functioning of monetary policy. The synthetic score obtained (0.40) is significantly lower than the *de jure* index, highlighting a clear gap between formal rules and their practical implementation. This discrepancy is mainly explained by several factors. First, the instability in central bank leadership – reflected in three unscheduled changes of governor between 2010 and 2020 – indicates a limited degree of institutional continuity. Such instability can weaken policy credibility and disrupt the consistency of monetary strategies. Second, documented episodes of political and budgetary pressure suggest that monetary policy decisions may be influenced by short-term fiscal considerations. However, some positive developments are also observed. The improvement in the consistency between announced and implemented instruments since the 2017 reform indicates progress in the operational framework of monetary policy. This suggests that recent institutional reforms have contributed to strengthening technical capacity, even if political constraints persist. Overall, the relatively low *de facto* independence score confirms that operational autonomy remains constrained by political and fiscal dynamics, reinforcing the importance of analysing central bank independence as a multidimensional concept.

Table 3. Codification of *de facto* independence

Dimension	Indicator	Codification	Justification
Governor rotation	Number of unscheduled changes	0 = unstable / 1 = stable	Three changes 2010-2020
Political pressures	Documented episodes	0	Identified budgetary pressures
Instruments announced vs applied	Operational consistency	1	Modernisation since 2017
Decision autonomy	Monetary decisions not influenced	0	Partial budgetary dominance

Source: prepared by the authors

The transparency index (Table 4), constructed following the approach of N. Dincer & B. Eichengreen (2014), yields an aggregate score of 0.60, indicating a moderate level of communication and information disclosure by the central bank. Disaggregated results show that the communication of objectives (0.8) and the publication of statistical data (0.7) are relatively well developed. This reflects an effort by the BCRG to align with international standards in terms of monetary policy communication. However, other dimensions remain weaker. In particular, the absence of published macroeconomic models (0.4) and the limited dissemination of forecasts (0.5) suggest that transparency is still incomplete. These findings imply that while transparency contributes to improving the predictability of monetary policy, it remains insufficient to fully anchor expectations in the absence of strong institutional independence. In other words, transparency acts as a reinforcing mechanism rather than a substitute for autonomy.

Table 4. Institutional transparency grid

Dimension	Description	Score (0-1)
Objectives	Communicated price stability objective	0.8
Data	Regularly published statistics	0.7
Decisions	Post-Monetary Policy Committee announcements	0.6
Models	No publication of models	0.4
Forecasts	Published macroeconomic forecasts	0.5

Source: prepared by the authors

The results reported in Table 5 provide robust evidence that Central Bank independence is associated with lower inflation in Guinea over the period 2010-2024. Across all specifications, the coefficient of independence remains negative and statistically significant, confirming the disciplining role of menetary institutions. The magnitude of the effect is strongest for *de jure* independence (-0.78, significant at the 1% level), suggesting that the legal and statutory framework of the BCRG constitutes a key anchor for price stability. This finding indicates that reforms strengthening the formal mandate, autonomy, and policy objectives of the central bank are closely associated with improved inflation outcomes. This finding is consistent with the theoretical literature on monetary credibility, which argues that clearly defined institutional rules limit discretionary political intervention in monetary policy and reduce inflationary bias. In the Guinean context, the strengthening of legal provisions defining the mandate of the BCRG appears to have contributed to anchoring inflation expectations by signalling the commitment of monetary authorities to price stability. However, the slightly smaller coefficients associated with *de facto* independence (-0.69) and transparency (-0.64) highlight that legal provisions alone are insufficient. The effectiveness of central bank independence depends critically on its operational implementation and on the credibility of policy communication. This suggests that institutional reforms must be complemented by consistent practices and transparent policy frameworks to fully anchor inflation expectations.

Beyond institutional variables, the results underscore the importance of fiscal dynamics. The positive and statistically significant coefficient of public debt (around 0.20-0.23) indicates that higher levels of indebtedness are associated with increased inflationary pressures. This finding supports the fiscal dominance hypothesis, whereby monetary policy becomes constrained by government financing needs. In such contexts, the central bank may face implicit or explicit pressure to accommodate fiscal imbalances, thereby weakening its capacity to maintain price stability. The Guinean case illustrates how macro-fiscal conditions can limit the effective independence of the central bank, even when formal autonomy is strengthened. External sector dynamics also play a critical role. The exchange rate exhibits a positive and significant effect on inflation (0.13-0.15), confirming the presence of exchange rate pass-through. Given Guinea's high dependence on imported goods – particularly fuel, capital equipment, and food products – currency depreciation translates rapidly into higher domestic prices. This structural vulnerability reinforces the importance of exchange rate stability as a complementary channel for inflation control.

Importantly, the inclusion of international commodity prices (COM) significantly enriches the analysis. The negative and statistically significant coefficient (-0.17 to -0.20) suggests that increases in global aluminium prices – used as a proxy for bauxite – are associated with lower inflation. This result reflects Guinea's position as a resource-dependent economy: higher commodity prices improve export revenues, strengthen the external balance, and alleviate exchange rate pressures, thereby contributing to lower inflation. This finding highlights the central role of external terms-of-trade shocks in shaping

domestic price dynamics, often beyond the direct control of monetary authorities. Furthermore, the explicit incorporation of structural shocks through dummy variables provides additional insights. The Ebola epidemic (2014-2016) and the COVID-19 pandemic (2020-2021) both exhibit positive and statistically significant effects on inflation, with coefficients ranging from 0.34 to 0.45. These results confirm that major health crises generate inflationary pressures, likely through supply chain disruptions, reduced domestic production, increased public spending, and logistical constraints. Notably, the effect of COVID-19 appears stronger, reflecting its global scale and broader economic impact. Taken together, these findings suggest that central bank independence should not be viewed in isolation, but rather as part of a broader macroeconomic framework. In resource-dependent economies such as Guinea, price stability depends not only on institutional design but also on the management of fiscal policy, exposure to external shocks, and the volatility of global commodity markets (Table 5).

Table 5. Effects of independence on inflation (2010-2024)

Variables	Jure	Facto	Transparence	ACP factor
Independance	-0.78***	-0.69**	-0.64**	-0.58**
Public debt	0.20**	0.23**	0.21**	0.22**
Exchange rate	0.13*	0.15*	0.14*	0.15*
GDP growth	-0.09	-0.11	-0.10	-0.08
Commodity prices (COM)	-0.18**	-0.20**	-0.19**	-0.17**
Ebola dummy (2014-2016)	0.35*	0.38*	0.36*	0.34*
COVID-19 dummy (2020-2021)	0.42**	0.45**	0.43**	0.40**
Constant	3.10***	3.02***	3.18***	2.95***
Adjusted R^2	0.61	0.59	0.58	0.60
N	14	14	14	14

Note: *** p < 0.01; ** p < 0.05; * p < 0.1
Source: prepared by the authors

The relatively modest size of the coefficients supports the view that the effect of central bank independence on economic growth operates primarily through indirect channels. Rather than acting as a direct engine of growth, institutional autonomy enhances macroeconomic stability, reduces uncertainty, and fosters a more predictable economic environment. In this context, central bank independence promotes growth by anchoring expectations, lowering inflation volatility, and improving the credibility of monetary policy, thereby encouraging long-term investment and productive economic activity. This interpretation is reinforced by the negative and statistically significant relationship between inflation and growth, with coefficients ranging from -0.17 to -0.20 across specifications. These results confirm that inflation constitutes a key transmission channel through which monetary institutions affect real economic outcomes. Higher inflation is associated with reduced growth, reflecting its adverse effects on investment decisions, resource allocation, and overall economic efficiency. By contributing to price stability, central bank independence indirectly supports growth through the stabilisation of macroeconomic conditions.

Fiscal dynamics also play a significant role in shaping growth outcomes. The negative and statistically significant coefficient associated with public debt (-0.14 to -0.17) indicates that rising indebtedness constrains economic expansion. This finding suggests that high levels of public debt may crowd out productive investment, limit fiscal space, and generate uncertainty regarding future macroeconomic policies. In such a context, fiscal imbalances may undermine the positive effects of monetary stability by weakening overall economic confidence. Conversely, foreign exchange reserves exert a positive and significant influence on growth (0.10-0.12), highlighting the importance of external buffers in a small open economy. Higher reserve levels enhance the capacity of monetary authorities to manage exchange rate volatility, absorb external shocks, and maintain investor confidence. This stabilising role is particularly relevant for Guinea, given its exposure to global commodity markets and external financial conditions.

Importantly, the inclusion of international commodity prices (COM) provides additional insight into the structural drivers of growth. The positive and statistically significant coefficient (0.26-0.29) indicates that increases in global aluminium prices – used as a proxy for bauxite – are associated with higher economic growth. This result reflects Guinea's dependence on the extractive sector, where favourable terms-of-trade shocks translate into increased export revenues, higher fiscal resources, and stronger aggregate demand. It underscores the dominant role of external commodity cycles in shaping growth dynamics. The model also explicitly accounts for major structural shocks through the inclusion of epidemic-related dummy variables. Both the Ebola crisis (2014-2016) and the COVID-19 pandemic (2020-2021) exhibit negative and statistically significant effects on growth, with coefficients ranging from -0.43 to -0.55. These findings confirm that health crises constitute substantial negative shocks to economic activity, likely operating through disruptions in production, trade, labour markets, and investment. The stronger effect observed for COVID-19 reflects its global scope and the severity of its economic consequences. Overall, the results highlight that economic growth in Guinea is driven by a combination of institutional, macroeconomic, and external factors. While central bank independence contributes positively to growth, its effect remains indirect and conditional on broader macroeconomic conditions, including inflation dynamics, fiscal sustainability, external buffers, and commodity price fluctuations (Table 6).

Table 6. Effects of independence on real GDP growth

Variables	Jure	Facto	Transparence	ACP factor
Independance	0.39**	0.35*	0.33*	0.29*
Inflation	-0.19**	-0.18**	-0.20**	-0.17**
Public debt	-0.16*	-0.15*	-0.17*	-0.14*
Foreign exchange reserves	0.11*	0.12*	0.10*	0.11*
Commodity prices (COM)	0.27**	0.29**	0.28**	0.26**
Ebola dummy (2014-2016)	-0.45**	-0.48**	-0.46**	-0.43**
COVID-19 dummy (2020-2021)	-0.52***	-0.55***	-0.53***	-0.50***
Constant	4.30***	4.25***	4.40***	4.18***
Adjusted R^2	0.62	0.60	0.59	0.61
N	14	14	14	14

Note: *** p < 0.01; ** p < 0.05; * p < 0.1
Source: prepared by the authors

The results presented in Table 6 indicate that central bank independence is positively associated with real GDP growth in Guinea over the period 2010-2024, although the magnitude of the effect remains moderate. Across all specifications, the coefficient of independence is positive and statistically significant, with the strongest effect observed for *de jure* independence (0.39, significant at the 5% level). This finding suggests that a stronger legal and institutional framework governing the central bank contributes to improved macroeconomic performance, albeit to a lesser extent than its impact on inflation. The exclusion of the year 2021 in the robustness tests provides additional insight into the relationship between institutional stability and central bank independence.

The reduction observed in the coefficient associated with *de facto* independence after excluding 2021 suggests that political disruptions can have measurable effects on the operational credibility of monetary institutions. In this sense, the events of 2021 can be interpreted as an empirical test of the resilience of the statutory framework governing the BCRG. While legal provisions defining central bank autonomy remained formally unchanged, their practical implementation was temporarily affected by the broader political environment. Nevertheless, the persistence of statistically significant relationships in the robustness tests indicates that the link between central bank independence and macroeconomic stability is not purely circumstantial. Even in the presence of political shocks, institutional arrangements appear to exert a stabilising influence on monetary policy outcomes (Table 7).

The results reported in Table 7 show that the coefficients remain broadly consistent with the main estimates, although their magnitude decreases slightly. The year 2021 represents a significant institutional break in Guinea's recent political history. The political transition that occurred during this period led to changes in government structures and increased uncertainty regarding economic governance. For the central bank, this institutional shock created conditions in which *de facto* independence temporarily weakened, particularly through unplanned changes in leadership and increased fiscal pressures.

Table 7. Ranking of countries by E-Government Index

Variables	Jure	Facto	Transparence	ACP factor
Independance	-0.82**	-0.61*	0.39*	0.31*
Public debt	0.21**	0.23**	-0.17*	-0.15*
Exchange rate	0.14*	0.15*	–	–
Inflation (growth model)	–	–	-0.19**	-0.18**
Foreign exchange reserves	–	–	0.12*	0.11*
Constant	3.31***	3.12***	4.70***	4.60***
Adjusted R^2	0.45	0.41	0.42	0.40
N	13	13	13	13

Note: *** p < 0.01; ** p < 0.05; * p < 0.1
Source: prepared by the authors

In particular, the negative relationship between central bank independence and inflation persists, with coefficients of -0.82 (*de jure*) and -0.61 (*de facto*), both statistically significant. Similarly, the positive effect of independence on economic growth remains moderate but significant. The role of public debt as an inflationary factor and a constraint on growth is also confirmed. These findings suggest that the estimated relationships are structurally robust and not driven by short-term shocks. At the same time, the slight reduction in the magnitude of coefficients highlights the sensitivity of *de facto* independence to political instability (Table 8).

Table 8. Robustness test: exclusion of 2021

Variable	Coefficient (inflation)	Coefficient (growth)
Jure independence	−0.82**	0.39*
Facto independence	−0.61*	0.31*
Inflation (growth model)	–	−0.19**
Public debt	+0.21**	−0.17*

Source: prepared by the authors

Overall, the empirical results support the three hypotheses formulated in this study. First, *de jure* independence exerts a stronger influence than *de facto* independence, highlighting the importance of a clear and credible legal framework for monetary governance. Second, *de facto* indicators provide a more sensitive picture of institutional disruptions, particularly during periods of political instability such as the events observed in 2021. Third, central bank independence is associated with lower inflation and more stable growth dynamics, although its direct impact on economic growth remains moderate. Taken together, these findings suggest that central bank independence in Guinea functions primarily as a macroeconomic stabilisation mechanism. Its effectiveness depends not only on statutory provisions but also on fiscal discipline, institutional transparency and the broader political environment in which monetary policy operates.

DISCUSSION

The empirical results obtained in this study broadly confirm the conclusions of a large body of literature suggesting that central bank independence contributes to lower inflation. Seminal empirical contributions by A. Cukierman *et al.* (1992) and A. Alesina & L.H. Summers (1993) demonstrated that countries with more independent monetary authorities tend to experience significantly lower and more stable inflation rates. The negative and statistically significant relationship between central bank independence and inflation observed in the Guinean case is therefore consistent with these early findings.

From a theoretical perspective, the link between institutional autonomy and price stability is generally explained by the time-inconsistency problem in monetary policy (Kydland & Prescott, 1977). When monetary authorities are subject to political pressure, governments may have incentives to pursue expansionary policies that temporarily stimulate economic activity but ultimately generate higher inflation. Granting operational autonomy to the central bank reduces these incentives by insulating monetary decisions from short-term political objectives.

In the Guinean context, the results suggest that strengthening the legal framework governing the Central BCRG contributed to improving monetary credibility and limiting inflationary pressures. However, the volatility of inflation observed between 2010 and 2016 indicates that the relationship between legal independence and price stability is not always immediate. Despite the relatively high score of *de jure* independence according to the IMF evaluation grid, inflation remained unstable during this period. This observation suggests that statutory provisions alone may not fully capture the complexity of institutional credibility in economies undergoing structural and political transitions. The discrepancy observed between *de jure* independence and macroeconomic outcomes highlights an important methodological issue widely discussed in the literature. While legal indices provide a useful framework for comparing institutional arrangements across countries, they may fail to capture the effective operational autonomy of central banks. A. Cukierman *et al*. (1992) was among the first scholars to emphasise the distinction between formal statutory independence and the practical ability of central banks to resist political pressures.

More recent empirical studies confirm this limitation. For example, A.C. Garriga (2016) shows that although legal reforms have spread widely across developing countries since the 1990s, their effectiveness depends strongly on political institutions and governance quality. Similarly, J. Klomp & J. de Haan (2010) demonstrate through a meta-analysis that the inflation-reducing effect of central bank independence is significantly stronger in advanced economies than in developing countries, where institutional enforcement mechanisms may be weaker. The results of this study appear to support these arguments. The gap observed between *de jure* and *de facto* independence suggests that formal legal reforms do not automatically translate into consistent operational implementation. In practice, monetary policy credibility depends on a range of factors including leadership stability, institutional routines and the broader political environment. In the Guinean case, periods of political uncertainty or institutional transition may have temporarily weakened the operational autonomy of the central bank, even though the legal framework remained formally unchanged.

Another key mechanism highlighted by the empirical results concerns the role of fiscal policy in shaping the effectiveness of central bank independence. The positive and statistically significant coefficient associated with public debt suggests that higher levels of government indebtedness are correlated with increased inflationary pressures. This relationship reflects the phenomenon commonly referred to in the literature as fiscal dominance. The concept of fiscal dominance was formally developed by T.J. Sargent & N. Wallace (1984), who argued that when public debt becomes excessive, monetary authorities may be forced to accommodate government financing needs. In such circumstances, the central bank's capacity to pursue price stability becomes constrained by fiscal requirements. As a result, even legally independent central banks may find it difficult to resist political pressures to adopt expansionary policies. In many developing economies, including Guinea, the relationship between fiscal and monetary authorities is particularly important because government budgets often rely heavily on domestic financing sources. When fiscal deficits increase, the central bank may face pressure to provide liquidity or indirectly support government borrowing. This situation

can weaken monetary credibility and undermine anti-inflationary policy efforts.

The empirical significance of the public debt variable in this study therefore provides evidence that the effectiveness of central bank independence cannot be analysed in isolation from fiscal policy dynamics. Rather, monetary autonomy should be viewed as part of a broader institutional framework in which fiscal discipline plays a critical role. In addition to legal and operational independence, the results of this study highlight the importance of transparency as a complementary mechanism for strengthening monetary credibility. Although the estimated coefficients indicate that transparency has a smaller effect than statutory independence, its impact remains statistically significant. This finding is consistent with the literature on central bank communication. S.C. Eijffinger & P.M. Geraats (2006) argue that transparent communication improves the effectiveness of monetary policy by reducing information asymmetries between policymakers and economic agents. When central banks regularly publish macroeconomic forecasts, policy reports and explanations of their decisions, economic actors are better able to anticipate future policy actions and adjust their behaviour accordingly.

Similarly, N. Dincer & B. Eichengreen (2014) show that higher levels of transparency are associated with improved policy credibility and more stable inflation expectations. In emerging economies where institutional credibility may still be evolving, transparent communication can therefore play an important role in reinforcing public confidence in monetary institutions. Nevertheless, the results of this study suggest that transparency alone cannot substitute for a strong institutional framework. While communication mechanisms can enhance the credibility of monetary policy, they remain most effective when supported by clear legal mandates and stable governance arrangements. In environments where fiscal pressures or political interference remain significant, transparency may improve expectations but cannot fully offset weaknesses in institutional autonomy. Overall, the discussion highlights several important insights regarding the relationship between central bank independence and macroeconomic stability in Guinea. First, the results confirm the widely documented association between institutional autonomy and improved inflation control. Second, the analysis reveals that legal indicators of independence may overestimate the actual operational autonomy of central banks in countries with evolving political and institutional systems. Third, fiscal dynamics – particularly public debt accumulation – play a critical role in shaping the effectiveness of monetary policy independence. Finally, transparency contributes to strengthening policy credibility by anchoring expectations, although it functions primarily as a complementary mechanism rather than a substitute for institutional autonomy. Taken together, these findings suggest that central bank independence should be understood as a multidimensional and evolving institutional process rather than a purely legal condition. Its effectiveness depends on the interaction between statutory frameworks, operational practices, fiscal discipline and communication strategies. Strengthening these elements simultaneously may therefore be essential for consolidating macroeconomic stability in Guinea. This discussion provides the basis for the conclusions presented in the following section.

CONCLUSIONS

The multidimensional assessment of the independence of the Central Bank of the Republic of Guinea during the period 2010-2024 highlighted the decisive role that institutional autonomy plays in macroeconomic stability. The results confirmed that strengthening the legal framework helped to reduce inflation and stabilise the economic environment, while effective independence remained more sensitive to institutional disruptions and political constraints. Transparency emerged as an additional channel for improving monetary credibility, although its effects remained dependent on consistency between announcements, decisions and macroeconomic conditions. This study suggested that central bank independence is a lever for stabilisation, but that it cannot be considered in isolation from interactions with fiscal policy, the quality of governance and the institutional context. The results indicated that reducing inflation and uncertainty creates an environment conducive to economic development, but that the impact on growth remains indirect and dependent on complementary factors, notably public debt management and external resilience. The gap between statutory codification and macroeconomic outcomes suggests that institutional scores do not fully capture informal decision-making mechanisms or the perceptions of economic agents. The price volatility observed despite a high regulatory rating confirms that monetary credibility is built over time through the consistent application of rules, the consistency of announcements and the institution's ability to absorb political and fiscal shocks.

In light of the lessons learned, two areas appear to be crucial. First, the consolidation of the effective application of the legal framework should benefit from a strengthened governance mechanism, including transparent mechanisms for appointing and dismissing senior officials, as well as explicit rules on public funding. Second, the development of transparency and institutional communication should help anchor the expectations of economic agents and enhance the predictability of monetary policy. These recommendations are in line with the reforms already undertaken, but highlight the need to gradually consolidate the institutional mechanisms that support monetary credibility in an economic environment exposed to internal and external shocks. This study remains limited by the small size of the time series and the absence of variables quantifying certain aspects of institutional governance. Future research could incorporate additional indicators of perception and credibility, or compare Guinea's experience with that of other African countries facing similar constraints. The analysis of non-linear models or long-term relationships could also be an interesting avenue for enriching the assessment of the mechanisms through which independence influences macroeconomic stability.

ACKNOWLEDGEMENTS

None.

FUNDING

None.

CONFLICT OF INTEREST

None.

REFERENCES

[1] Adam, C., Cobham, D., & Girardin, E. (2005). Monetary frameworks and institutional constraints: UK monetary policy reaction functions, 1985-2003. *Oxford Bulletin of Economics and Statistics*, 67(4), 497-516. doi: 10.1111/j.1468-0084.2005.00129.x.

[2] Adrian, T., Khan, M., & Menand, L. (2024). *A new measure of central bank independence*. Washington: IMF.

[3] Alesina, A., & Summers, L.H. (1993). Central bank independence and macroeconomic performance: Some comparative evidence. *Journal of Money, Credit and Banking*, 25(2), 151-162. doi: 10.2307/2077833.

[4] Barro, R., & Gordon, D. (1983). Rules, discretion and reputation in a model of monetary policy. *Journal of Monetary Economics*, 12(1), 101-121. doi: 10.1016/0304-3932(83)90051-X.

[5] Blinder, A. (2012). *Central bank independence and credibility during and after a crisis*. Princenton: Griswold Center for Economic Policy Studies.

[6] Crowe, C., & Meade, E.E. (2007). The evolution of central bank governance around the world. *Journal of Economic Perspectives*, 21(4), 69-90. doi: 10.1257/jep.21.4.69.

[7] Cukierman, A. (1992). *Central bank strategy, credibility, and independence: Theory and evidence*. Cambidge: MIT Press.

[8] Cukierman, A., Web, S.B., & Neyapti, B. (1992). Measuring the independence of central banks and its effect on policy outcomes. *The World Bank Economic Review*, 6(3), 353-398. doi: 10.1093/wber/6.3.353.

[9] Debrun, X., Masson, P., & Pattillo, C. (2005). Monetary union in West Africa: Who might gain, who might lose, and why? *Canadian Journal of Economics*, 38(2), 454-481. doi: 10.1111/j.0008-4085.2005.00288.x.

[10] Dincer, N., & Eichengreen, B. (2014). Central bank transparency and independence: Updates and new measures. *International Journal of Central Banking*, 10(1), 189-253.

[11] Eijffinger, S.C., & Geraats, P.M. (2006). How transparent are central banks? *European Journal of Political Economy*, 22(1), 1-21. doi: 10.1016/j.ejpoleco.2005.09.013.

[12] Garriga, A.C. (2016). Central bank independence in the world: A new data set. *International Interactions*, 42(5), 849-868. doi: 10.1080/03050629.2016.1188813.

[13] Garriga, A.C. (2025). Revisiting central bank independence in the world: An extended dataset. *International Studies Quarterly*, 69(2), article number sqaf024. doi: 10.1093/isq/sqaf024.

[14] Goodhart, C., & Lastra, R. (2018). Populism and central bank independence. *Open Economies Review*, 29(1), 49-68. doi: 10.1007/s11079-017-9447-y.

[15] Grilli, V., Masciandaro, D., & Tabellini, G. (1991). Political and monetary institutions and public financial policies in the industrial countries. *Economic Policy*, 6(13), 341-392. doi: 10.2307/1344630.

[16] Höfer, A., & Jaenke, K. (2023). The development of central bank independence: Empirical evidence. *Credit and Capital Market*, 56(2), 123-144. doi: 10.3790/ccm.56.2.123.

[17] Klomp, J., & De Haan, J. (2010). Inflation and central bank independence: A meta regression analysis. *Journal of Economic Surveys*, 24(4), 593-621. doi: 10.1111/j.1467-6419.2009.00597.x.

[18] Kydland, F.E., & Prescott, E. (1977). Rules rather than discretion: The inconsistency of optimal plans. *Journal of Political Economy*, 85(3), 473-492. doi: 10.1086/260580.

[19] Law L/2014/016/AN "On the Organization and Functioning of the Central Bank of the Republic of Guinea". (2014, July). Retrieved from https://www.droit-afrique.com/uploads/Guinee-Loi-2014-016-banque-centrale.pdf.

[20] Law L/2016/064/AN "Amending Certain Provisions Relating to the Central Bank of the Republic of Guinea". (2016, November). Retrieved from https://www.droit-afrique.com/uploads/Guinee-Loi-2016-064-banque-centrale.pdf.

[21] Law L/2017/017/AN "Statutes of the Central Bank of the Republic of Guinea (BCRG)". (2017, June). Retrieved from https://www.bcrg-guinee.org/wp-content/uploads/2020/02/Statut-de-la-banque-centrale-de-la-Republique-de-la-Guinee.pdf.

[22] Romelli, D. (2024). The political economy of central bank independence reforms: A century-long global perspective. *Journal of Monetary Economics*, 141, 121-126. doi: 10.1016/j.jmoneco.2023.11.004.

[23] Sargent, T.J., & Wallace, N. (1984). Some unpleasant monetarist arithmetic. In *Monetarism in the united kingdom* (pp. 15-41). London: Palgrave Macmillan UK. doi: 10.1007/978-1-349-06284-3_2.

[24] Vasicek, O., Uhrova, N., Dimitriou Janickova, L., Wroblowsky, T., & Navratil, B. (2023). Central bank independence: Where do we stand? *Economies*, 11(4), article number 109. doi: 10.3390/economies11040109.

Ібрагім Аг Ельмоктар
Доктор, викладач, дослідник
Університет Лабе
BP 210, м. Лабе, Республіка Гвінея
https://orcid.org/0009-0005-2443-9047

Фаваз А. Адечінан Аміну
Доктор, викладач, дослідник
Університет Лабе
BP 210, м. Лабе, Республіка Гвінея
https://orcid.org/0000-0002-8439-2085

Мамуду Багага
Доктор, викладач, дослідник
Університет імені генерала Лансани Конте в Сонфонії, Конакрі
030 BP 970, вул. 17 Virage, м. Конакрі, Республіка Гвінея
https://orcid.org/0000-0001-8234-2765

Мбає Дієне
Професор, викладач, дослідник
Університет Лабе
BP 210, м. Лабе, Республіка Гвінея
https://orcid.org/0009-0000-6208-3743

Незалежність Центрального банку Республіки Гвінея та його макроекономічні виклики

Анотація. У цьому дослідженні розглянуто незалежність Центрального банку Республіки Гвінея та його зв'язок із макроекономічною стабільністю в період 2010-2024 років. Аналіз зумовлений зростаючою роллю кредитно-грошових установ у забезпеченні стабільності цін і макроекономічного управління в країнах, що розвиваються. Для врахування багатовимірної природи незалежності центрального банку у дослідженні сформовано композитний індекс, що поєднує показники *de jure* та *de facto*, а також показники інституційної прозорості. Емпіричний аналіз ґрунтувався на економетричній моделі, доповненій перевірками на стійкість результатів для оцінки зв'язку між незалежністю центрального банку та ключовими макроекономічними індикаторами. Результати засвідчили, що вищий рівень незалежності центрального банку пов'язаний із нижчою інфляцією та відносно більш стабільною динамікою економічного зростання. Однак пояснювальна здатність оцінених моделей залишається обмеженою, що вимагає обережної інтерпретації цих результатів. Замість надання переконливих доказів прямого причинно-наслідкового впливу на економічне зростання, отримані висновки показали, що незалежність може сприяти макроекономічній стабільності переважно через канал довіри та закріплення очікувань. У цьому контексті роль незалежності центрального банку видається радше стабілізуючою, ніж стимулюючою. Аналіз також виявив розрив між законодавчими положеннями та їх фактичною реалізацією, що свідчить про те, що лише правові реформи не завжди призводять до підвищення довіри до монетарної політики. Ефективні практики управління, інституційна прозорість і чіткі комунікаційні стратегії є ключовими для зміцнення операційної незалежності центрального банку. З точки зору економічної політики результати підкреслили важливість посилення механізмів інституційного впровадження та покращення координації між монетарними і фіскальними органами з метою забезпечення стабільного та передбачуваного макроекономічного середовища в Гвінеї

Ключові слова: монетарна політика; макроекономічна стабільність; інфляція; інституційне управління; прозорість

ECONOMICS OF DEVELOPMENT

Journal homepage: https://ecdev.com.ua/

ISSN: 1683-1942
E-ISSN: 2304-6155

Vol. 25, No. 1, 2026

UDC 658.7:005.334:502.131.1
DOI: 10.63341/econ/1.2026.29

Serhiy Shevchenko*

PhD in Economics, Associate Professor
Lviv Polytechnic National University
79013, 12 Stepana Bandery Str., Lviv, Ukraine
https://orcid.org/0000-0002-5522-3258

Supply chain security within the sustainable development framework: Global practices and the Ukrainian context

Abstract. The relevance of the study was determined by the growing vulnerability of global supply chains under conditions of armed conflict, geopolitical instability, and increasing risks to sustainable development. The purpose of the research was to systematise approaches to supply chain security and to substantiate its role as a key determinant of sustainable development, taking into account international practices and the Ukrainian context. The methodological framework was based on a systematic analysis of scientific literature, comparative analysis of international security programmes, and synthesis and generalisation methods, which made it possible to identify key patterns, risk factors, and institutional mechanisms of supply chain protection. The study established that supply chain vulnerability was driven not only by external shocks, such as military aggression and infrastructure destruction, but also by internal structural characteristics of modern logistics systems, including extended network configurations and lean inventory strategies. It was determined that effective security was achieved through integrated, risk-oriented and partnership-based models, combining public-private cooperation, advance information exchange, and differentiated control mechanisms. The analysis of international programmes (C-TPAT, FAST, CSI, AMR) demonstrated their effectiveness in enhancing supply chain resilience while maintaining trade efficiency. The Ukrainian case confirmed that large-scale disruptions of transport infrastructure generated systemic economic, social, and environmental consequences, thereby directly affecting sustainable development. It was substantiated that supply chain security functioned as a cross-cutting factor linking economic continuity, social stability, and environmental responsibility. The practical significance of the results lies in their applicability for policymakers, logistics managers, and enterprises in developing adaptive, resilient, and security-oriented supply chain management models in conditions of crisis and post-war recovery

Keywords: transport infrastructure; logistics resilience; risk management; public-private cooperation; infrastructure disruption; international trade; post-war recovery

INTRODUCTION

Contemporary global instability, driven by armed conflicts, geopolitical tensions, and increasing threats to transport infrastructure, has significantly transformed the functioning of supply chains, making them more vulnerable and less predictable. Under such conditions, logistics systems were no longer limited to their traditional operational role but increasingly perform strategic functions related to economic resilience, social stability, and environmental responsibility. The vulnerability of modern supply chains was determined not only by external shocks, such as military aggression and disruptions of transport routes, but also by internal structural characteristics, including extended network configurations, limited inventory buffers, and dependence on critical infrastructure.

Recent studies (2020-2026) indicate a clear shift in supply chain management from efficiency-oriented models toward resilience- and security-oriented approaches. O. Aigbogun *et al*. (2022) conceptualise supply chain resilience as a dynamic organisational capability that allows firms to anticipate, absorb, and recover from disruptions,

Article's History: Received: 13.11.2025; Revised: 27.02.2026; Accepted: 26.03.2026; Published: 09.04.2026

Suggested Citation:

Shevchenko, S. (2026). Supply chain security within the sustainable development framework: Global practices and the Ukrainian context. *Economics of Development*, 25(1), 29-40. doi: 10.63341/econ/1.2026.29.

*Corresponding author

thereby maintaining operational continuity. P.E. Mora Lozano & J.R. Montoya-Torres (2024), using modelling and optimisation methods, demonstrate that incorporating resilience considerations into supply chain design improves adaptability and system performance under uncertainty. Similarly, X. Ren *et al*. (2024) provided empirical and analytical evidence that resilience-oriented strategies enhance robustness and reduce vulnerability to disruption. Within this paradigm, supply chain security is increasingly understood not only as a protective function but also as a strategic element of sustainable development. At the same time, contemporary research emphasises the systemic and interconnected nature of supply chain disruptions. M. Herburger *et al*. (2024) showed that disruptions can propagate across interconnected logistics networks, producing cascading effects that amplify risks across sectors. T. Rahman *et al*. (2022), drawing on evidence from the COVID-19 pandemic, demonstrate that global supply chains are highly sensitive to external shocks due to their interdependence and limited redundancy. These findings highlight the need for integrated approaches that combine risk management, institutional coordination, and digital technologies to strengthen supply chain security. These challenges are particularly evident in Ukraine, where the full-scale war has caused extensive damage to transport infrastructure, disrupted logistics routes, and reduced international trade capacity. According to D. Andrienko *et al*. (2024), analytical assessments indicate significant losses in infrastructure and a decline in export potential, necessitating rapid adaptation of logistics systems. UNCTAD (2024) similarly reports substantial disruptions in trade flows and supply chain stability, emphasising the importance of flexible and adaptive logistics strategies under extreme conditions. The disruption of logistics systems in Ukraine is further exacerbated by inconsistencies between national regulatory frameworks and international supply chain management standards. D. Bugayko & V. Reznik (2025), based on institutional analysis, identify regulatory gaps that hinder effective integration into global supply chains and complicate the implementation of modern logistics practices. International experience suggests that effective supply chain security depends on the integration of institutional trust mechanisms and resilience-oriented logistics systems. T. Karavayev *et al*. (2022) find that cooperation between customs authorities and businesses improves transparency and reduces risks in cross-border supply chains. L. Lebedeva & D. Shkuropadska (2024) show that the development of resilient transport and logistics systems, combined with coordinated governance, is essential for maintaining supply chain stability in both developed and transition economies.

Despite the growing body of research, insufficient attention is still paid to the complex analysis supply chain security as a component of sustainable development, particularly in the context of armed conflicts. This creates a research gap that necessitates a systematic examination of supply chain security integrating international experience with the specific challenges faced by Ukraine. The purpose of this article was to systematise approaches to supply chain security under conditions of global instability and to substantiate its role as a key determinant of sustainable development, taking into account international practices and the Ukrainian context.

MATERIALS AND METHODS

The research was based on a comprehensive methodological framework that combines general scientific and specialised methods aimed at analysing supply chain security within the sustainable development framework, with particular attention to global practices and the Ukrainian context. The applied methodology ensures a systematic and reproducible examination of the research problem and allows for the integration of theoretical, analytical, and contextual approaches.

The primary method employed in the study was a systematic analysis of scientific literature, which served as the foundation for examining existing theoretical approaches to supply chain security, logistics resilience, risk management, and sustainable development. Academic publications were selected based on the following criteria: relevance to supply chain security, logistics resilience, and sustainable development; publication within the period 2020-2026; inclusion in recognised scientific databases (Scopus, Web of Science, and peer-reviewed journals); and a focus on risk management, resilience, and security in both global and conflict-affected contexts. In addition, policy reports, and analytical studies by international organisations were reviewed to identify dominant concepts, methodological approaches, and research gaps. The information base of the study was also formed by analytical reports of international organisations (in particular, UNCTAD) and statistical data on infrastructure losses and economic damage provided by the KSE Institute, which were used for empirical validation of theoretical findings. The literature analysis enabled the formulation of the conceptual framework of the study and ensured the consistency of the research with contemporary academic discourse.

Methods of synthesis and generalisation were applied to integrate and systematise findings from diverse sources. Through synthesis, individual elements related to supply chain security, sustainability, and resilience were combined into a coherent analytical model, while generalisation allowed for the identification of common patterns, principles, and trends across different geographical and institutional contexts. These methods facilitated the development of a holistic understanding of supply chain security as a multidimensional phenomenon embedded in economic, social, and environmental dimensions of sustainable development. The abstraction method was used to highlight the essential characteristics and key determinants of supply chain security, enabling the isolation of critical factors influencing logistics stability under conditions of global instability and armed conflict. Accordingly, specific security tools (such as satellite tracking systems, CCTV, or access control mechanisms) were considered as functional categories of monitoring, control, and risk mitigation rather than analysed as isolated technical instruments.

A comparative analysis was employed to examine international practices in supply chain security and to assess their applicability to the Ukrainian context. This method enabled the identification of similarities and differences in institutional arrangements, risk management approaches, and resilience-building strategies across countries, as well as the evaluation of their potential adaptation to national conditions affected by war-related disruptions. The United States was selected as a reference case due to its advanced

institutionalised supply chain security frameworks (including C-TPAT, FAST, CSI, and AMR), long-term implementation experience, and global influence on trade security standards. This case is considered representative of risk-oriented and partnership-based logistics governance models and therefore relevant for adaptation in high-risk environments such as Ukraine.

In addition, elements of the case study method were applied, focusing on Ukraine as a country experiencing large-scale disruptions of supply chains due to armed conflict. This approach enabled an in-depth analysis of real-world processes, including infrastructure damage, transformation of logistics routes, and changes in transport modalities. In addition, contextual and empirical analysis was applied to assess the impact of armed conflict on Ukraine's transport and logistics systems. Secondary data from official statistics, analytical reports, and sectoral assessments were used to evaluate infrastructure losses, changes in transport modalities, and disruptions in supply chain functioning. This included the analysis of statistical and analytical reports of the KSE Institute and UNCTAD, which provided quantitative evidence of infrastructure losses and global logistics trends. This approach allowed for the validation of theoretical assumptions through real-world observations without relying on primary data collection. Overall, the combination of the above methods ensured a comprehensive assessment of supply chain security within the sustainable development framework. The applied methodology provides transparency regarding the research process and offers sufficient detail to enable replication or extension of the study by other researchers using similar materials and analytical approaches.

RESULTS AND DISCUSSION

Contemporary threats to global security have a profound impact on the movement and functioning of logistics systems, particularly in high-risk regions. Armed conflicts lead to the destruction of infrastructure, restrictions on transport routes, and rising operational costs, which significantly complicate the distribution of goods and resources. In areas of active hostilities, supply chains become unstable, requiring continuous adaptation and the use of alternative routes and supply mechanisms. As a result, delivery speed declines, the risk of losses increases, and the regularity of supply is disrupted. These disruptions were reflected in measurable operational consequences, including increased delivery lead times, higher transportation costs, reduced reliability of supply schedules, and the necessity to redesign logistics routes. In particular, the shift towards alternative transport corridors and multimodal solutions led to longer logistics chains and additional coordination costs, thereby increasing overall system complexity and reducing efficiency.

Terrorist attacks and crimes against transport assets and property have become a recurrent phenomenon in the modern world. Although the costs associated with disruptions caused by such events are difficult to quantify precisely, they are highly tangible for affected enterprises. The main consequences include managerial time losses, the need to replace damaged assets, interruptions in service provision, increased insurance premiums, legal expenses, and overall organisational destabilisation. The scale and systemic nature of these consequences became particularly evident following the terrorist attacks on the World Trade Centre in New York and the Pentagon in Washington on September 11, 2001. Since then, logistics security has attracted heightened attention from national governments. One of the immediate responses by the United States government was the introduction of a number of specialised initiatives, including the Customs-Trade Partnership Against Terrorism (C-TPAT), the Free and Secure Trade (FAST) program, the Container Security Initiative (CSI), and the Advanced Manifest Regulations (AMR), commonly known as the "24-hour rule". These measures were aimed at reducing the likelihood of similar attacks in the future.

The analysis indicates that the practical effectiveness of these programmes is manifested through a reduction in customs clearance time, improved predictability of cross-border operations, and lower inspection rates for certified participants. At the same time, their implementation contributes to enhanced transparency and traceability within supply chains, which is critical for reducing security risks and improving coordination among logistics actors. Enhancing supply chain security requires the integration of advanced verification mechanisms and technologies that improve transparency, trust, and coordination among participants (Curado Silveirinha *et al.*, 2025).

Previous studies indicated that terrorist threats are not confined to the territory of a single country, which in turn intensifies concerns regarding the vulnerability of supply chains at the global level. Consequently, it is essential to study and adopt international best practices, as well as to improve and develop new risk management instruments within the distribution systems of Ukrainian enterprises. Given that the United States of America is the world's largest economy and was directly affected by the terrorist attacks of September 11, 2001, it is appropriate to examine in greater detail the measures implemented by this country to prevent subsequent threats and to consider this market as a reference point for the development of general security frameworks. The analysis showed that regulatory requirements in the field of security are subject to continuous improvement and refinement. In contemporary conditions, partnership between customs authorities and the business sector represents a key factor in ensuring efficient logistics, as it enables the optimisation of customs procedures, reduction of cargo transit time, and mitigation of disruptions within supply chains. Through information sharing and coordinated actions, the reliability of logistics processes and the stability of international trade are significantly enhanced.

Cooperation between customs authorities and business entities is also one of the critical factors in preventing terrorist threats and strengthening the security of international trade. Joint efforts by public institutions and the private sector facilitate the timely identification of potential risks, the exchange of relevant information, and the implementation of coordinated preventive measures. Businesses, as active participants in logistics processes, contribute to greater supply chain transparency, while customs authorities ensure control, risk analysis, and border protection. This approach forms a comprehensive security system that reduces the likelihood of trade channels being exploited for terrorist purposes. C-TPAT is a voluntary international supply chain security program initiated

by the U.S. Customs and Border Protection in the aftermath of the 2001 terrorist attacks. Its primary objective is to strengthen border security and international trade through structured cooperation between government authorities and the private sector. Program participants commit to implementing security standards and conducting risk assessments within their supply chains, which enables the identification of vulnerabilities and the prevention of their misuse for illicit activities.

The main goal of the program is to establish a framework for close and systematic cooperation among U.S. importers, carriers, and international exporters supplying goods to the United States. Participants are required to conduct comprehensive assessments of supply chain security, submit a supply chain security profile questionnaire to the competent authority, develop and implement security enhancement programs, and communicate C-TPAT requirements to other companies within their respective supply chains. C-TPAT operates according to the principle of "trust but verify". Companies undergo risk assessments, submit applications, develop security profiles, and implement requirements related to the protection of cargo, equipment, and personnel. Following certification, participants receive tangible benefits in customs clearance procedures, including accelerated cargo processing and a reduced number of inspections (U.S. Customs and Border Protection [CBP], n.d.).

C-TPAT participants are granted a range of significant advantages, such as expedited customs clearance, fewer inspections, assignment of a dedicated supply chain security specialist, access to the C-TPAT partner list, the possibility of using simplified accounting procedures, an emphasis on self-regulation, and access to designated FAST lanes at the borders with Canada and Mexico. The examination of international supply chain security initiatives demonstrates that their effectiveness is primarily determined not by individual control measures but by the integration of risk-based management, advance information exchange, and partnership mechanisms (Mora Lozano & Montoya-Torres, 2024). Programs such as C-TPAT and FAST illustrate that differentiated treatment of low-risk operators allows security objectives to be achieved without creating excessive barriers to trade. The results suggest that security-oriented partnership models simultaneously enhance control, reduce transaction costs, and increase the reliability of logistics flows, thereby strengthening overall supply chain resilience. These programmes also contribute to environmental sustainability by reducing idle time at borders, optimising transport routes, and lowering fuel consumption and emissions. However, under wartime conditions, forced rerouting of logistics flows may offset these benefits, increasing environmental pressure.

In Ukraine, C-TPAT does not operate as a national government program. However, Ukrainian companies that conduct business in the United States or participate in global supply chains may become C-TPAT participants by meeting the relevant requirements of U.S. Customs and Border Protection and successfully completing the certification process. Participation enables such companies to obtain tangible logistical benefits, including expedited customs clearance in the United States, provided that they comply with the established criteria and security standards. Furthermore, C-TPAT is linked to other international supply chain security standards, such as the European Authorised Economic Operator (AEO) system, through mutual recognition mechanisms. These arrangements contribute to strengthening partnerships between customs authorities and the business sector across different countries, including Ukraine, and facilitate greater interoperability of security regimes in international trade. Under conditions of full-scale war and heightened security risks, modern international mechanisms for protecting supply chains acquire particular significance for Ukraine. Over more than a decade of implementation, C-TPAT has demonstrated an effective partnership-based model of cooperation between public authorities and the private sector, contributing to enhanced logistics resilience, reduced risks of illicit activities, and increased trust among participants in international trade. For Ukrainian companies, participation in C-TPAT represents not only a tool for gaining practical logistical advantages but also an important step toward integration into global security and trade standards. In the longer term, the experience of this program may serve as a valuable foundation for the development of national initiatives in the field of logistics security, which is critically important for economic recovery and the strengthening of Ukraine's position in global markets.

With reference to Ukraine, the results indicated that the absence of nationally embedded supply chain security frameworks comparable to international partnership-based models increases exposure to systemic logistics risks. While Ukrainian companies may individually participate in international security programs, the lack of coordinated national mechanisms limits the scalability of security benefits across supply chains. This finding highlights a structural gap between international logistics security practices and national institutional capacity, which directly affects the resilience and sustainability of Ukraine's supply chains under wartime conditions. A comparative analysis revealed significant structural differences between international supply chain security models and the Ukrainian logistics system. In particular, advanced economies such as the United States rely on institutionalised public-private partnership frameworks, risk-based customs procedures, and certified trusted operator programmes, which ensure both high security and operational efficiency. In contrast, the Ukrainian system remains characterised by fragmented institutional coordination, limited implementation of risk-based approaches, and the absence of fully developed national security programmes. These differences indicate a structural gap that constrains the scalability of security mechanisms and reduces the overall resilience of supply chains under wartime conditions.

To better understand the structural differences in supply chain security approaches, a comparative analysis of institutional, procedural, and technological dimensions was conducted. The comparison focuses on established international practices, particularly the United States model based on public-private partnerships and risk-based management systems, and contrasts them with the current Ukrainian context. This analytical framework allows for the identification of systemic gaps and potential directions for improving supply chain resilience and security (World Customs Organisation, 2021; Mora Lozano & Montoya-Torres, 2024).

A comparative analysis of institutional models of supply chain security in the United States and Ukraine, including differences in risk management, customs procedures, and trust mechanisms, is presented in Table 1.

Table 1. Comparative analysis of supply chain security models

Dimension	USA (C-TPAT / FAST)	Ukraine
Institutional model	Public-private partnership	Fragmented
Risk management	Risk-based	Reactive
Customs procedures	Simplified	Complex
Trust mechanisms	Certified operators	Limited
Digitalisation	High	Partial

Source: compiled by the author based on World Customs Organisation (2021), P.E. Mora Lozano & J.R. Montoya-Torres (2024), H. Zheng *et al*. (2024)

As shown in Table 1, the U.S. model demonstrates a high level of institutional integration, relying on structured public-private partnerships, certified operator programmes, and advanced digital systems. International studies indicate that supply chain security is closely associated with the integration of institutional trust mechanisms and resilience-oriented logistics systems. In particular, the Authorised Economic Operator (AEO) programme enhances cooperation between customs authorities and businesses, while the resilience of transport logistics systems has become a key factor in ensuring the stability of supply chains in the EU and Ukraine (Karavayev *et al.*, 2022; Lebedeva & Shkuropadska, 2024). In contrast, Ukraine's supply chain security framework remains fragmented, with limited coordination between stakeholders and a predominance of reactive risk management approaches. Supply chain decision-making under uncertainty requires the application of structured risk assessment models capable of capturing complex interdependencies between system components (Rahman *et al.*, 2022).

At the same time, the effectiveness of supply chains is often constrained by structural barriers. Maritime supply chains are significantly affected by a wide range of barriers, particularly infrastructural and regulatory constraints, which play a critical role in determining their efficiency and performance (Kashav *et al.*, 2022). The most significant differences are observed in the areas of risk management and trust-based mechanisms. Recent research highlights that resilience and sustainability in supply chains are closely interconnected and should be addressed simultaneously within risk management frameworks (Meng *et al.*, 2025). While the U.S. system is built on proactive risk assessment and the recognition of trusted economic operators, Ukraine still lacks a fully institutionalised system of certification and mutual trust between business and regulatory authorities (World Customs Organisation, 2022; Zheng *et al.*, 2024).

Furthermore, the level of digitalisation plays a critical role in enhancing transparency and predictability in supply chain operations. The partial implementation of digital tools in Ukraine limits the effectiveness of security controls and increases operational uncertainty, particularly under crisis conditions (Ren *et al.*, 2024). Cybersecurity has become a critical component of supply chain resilience, as increasing digitalisation expands the range and complexity of potential disruptions. These structural differences indicate that strengthening supply chain security in Ukraine requires not only technological modernisation but also institutional transformation, including the development of trust-based frameworks and the integration of international best practices.

In the logistics context, free and secure trade is regarded as a key condition for the effective functioning of global supply chains, where cross-border material flows occur with minimal regulatory barriers while maintaining strict security requirements. Trade liberalisation contributes to the optimisation of logistics processes by reducing customs delays, simplifying border-crossing procedures, harmonising transport and accompanying documentation, and lowering transaction costs in international transportation. At the same time, the security dimension of logistics entails the implementation of standards and technologies aimed at protecting cargo, infrastructure, and information systems, controlling the origin and quality of goods, and preventing smuggling, terrorist threats, and the spread of hazardous materials. Consequently, within logistics systems, free and secure trade emerges as an integrated concept that combines faster and more cost-efficient cargo movement with the assurance of physical, economic, and regulatory protection at all stages of the supply chain.

Under conditions of escalating global challenges, military threats, and the destabilisation of logistics routes, supply chain security has become a critical issue not only for trade stability but also for national economies as a whole. This is particularly relevant for Ukraine, which operates in a high-risk environment and requires the adoption of effective international approaches to protecting logistics processes. One of the most effective instruments that reconciles the interests of the state and the business sector in the context of secure trade is the Free and Secure Trade (FAST) program. Its experience deserves special attention as a reference point for the modernisation of Ukraine's logistics system. FAST is a joint initiative of the customs authorities of the United States, Canada, and Mexico, designed to simplify and accelerate cross-border cargo movements through the prior verification of trusted international trade participants. The program targets businesses that adhere to high security standards within their supply chains, granting participants benefits such as streamlined customs procedures, reduced inspection times, and access to dedicated border lanes.

The practical effectiveness of the FAST initiative is most clearly demonstrated through the analysis of specific cross-border transportation cases, where the combination of advance participant verification and risk-based control mechanisms leads to shorter border clearance times and enhanced predictability of logistics operations. Experience

with FAST in real-world supply chains shows that security requirements, including driver identification, verification of carrier reliability, and compliance with procedural standards, can be integrated into day-to-day operational activities without increasing administrative burdens. Instead, these requirements are transformed into a competitive advantage by reducing idle time, optimising delivery schedules, and stabilising service levels. In this context, illustrative cases provide evidence of FAST's impact on transit times, costs, and the organisation of interactions among logistics stakeholders.

The FAST initiative applies to border crossings between the United States and Canada and Mexico. Its primary objective is to ensure faster and more efficient clearance of cargo for C-TPAT-certified participants at these borders. Certified commercial vehicle drivers participating in C-TPAT are entitled to use designated FAST lanes, which significantly accelerate border-crossing procedures. Overall, the program is aimed at enhancing supply chain security while avoiding unjustified barriers to international trade. Beyond the use of designated lanes, the FAST mechanism is based on the principle of prior selection of "trusted" supply chain participants and the application of risk-oriented control. To benefit from the program, the key parties involved in transportation must typically be approved, including the importer (through participation in C-TPAT), the carrier, and the driver, all of whom undergo reliability checks and comply with established requirements for physical and procedural security. In practical terms, this approach implies strengthened control at the stages of shipment preparation and planning, including standards for cargo protection, facility access, documentation, and traceability, followed by a reduction in border delays due to fewer inspections and faster routine procedures for low-risk shipments.

Within logistics systems, the application of FAST enhances the predictability of cross-border operations and reduces time-related and financial losses associated with vehicle downtime, congestion, and additional administrative costs. This is particularly important for time-sensitive supply chains, such as those operating under just-in-time production models, where the stability of border crossings directly affects inventory levels, fulfilment of contractual obligations, and overall competitiveness. At the same time, the program strengthens the integration of security procedures into logistics management, shaping a model of "secure speed," in which the acceleration of cargo flows is achieved not by reducing control, but by more precisely targeting high-risk movements.

For Ukraine, which is currently operating under wartime conditions, sustained pressure on transport infrastructure, and a critical dependence on foreign economic relations, the principles underlying the FAST program may have strategic significance. Its implementation or adaptation to Ukrainian realities, even in the form of a pilot partnership initiative, could become an important instrument for restoring trust in Ukrainian logistics operators, improving customs administration, and ensuring the security of international cargo flows. Participation in such initiatives also opens additional opportunities for Ukrainian exporters, including faster customs clearance, cost reductions, and simplified cooperation with partners in the United States, Canada, Mexico, and other countries that recognise comparable security standards. In a broader perspective, the development of secure and efficient logistics channels constitutes an integral component of a sustainable development strategy. It encompasses not only economic performance but also environmental responsibility, social resilience, and sound governance. Reliable logistics systems form the foundation of functioning markets, support for small and medium-sised enterprises, humanitarian supply, and investment attraction. Consequently, the integration of FAST principles into Ukraine's logistics management system may serve not only as a mechanism for crisis response but also as a cornerstone for sustainable recovery and long-term growth.

It is also important to highlight other initiatives that contribute to strengthening supply chain security at the international level. Among them, a key role is played by the Container Security Initiative (CSI), which provides the advance screening of potentially high-risk cargo at ports of departure before their arrival in the United States (U.S. Customs and Border Protection, n.d.). This model is based on the use of intelligence data, advanced scanning technologies, and containers equipped with built-in protection mechanisms against unauthorised interference. The CSI framework is complemented by the Secure Freight Initiative (SFI), which expands the technical capabilities of cargo inspection and covers a broad range of major international ports (U.S. Customs and Border Protection, n.d.). Another important instrument is the Advanced Manifest Rule (AMR), which requires carriers and exporters to submit detailed cargo information in advance. This mechanism enables the identification of risks prior to border crossing and helps prevent the unauthorised importation of dangerous or illicit goods.

Such programs not only enhance security in global logistics systems but also contribute to the establishment of new standards of sustainable development, particularly by minimising delays, reducing costs, and ensuring transparency in supply chains. They also promote higher levels of environmental and social responsibility among businesses, as sustainable development encompasses not only economic efficiency but also the safety of logistics processes for people and the environment. As Ukraine continues its integration into global markets, it has strong grounds for adopting best international practices in logistics security and adapting them to national conditions. The implementation of similar approaches or participation in programs such as CSI or AMR, even in the form of pilot initiatives, would enable Ukrainian companies not only to reduce risks but also to enhance their competitiveness and credibility at the global level.

Transport infrastructure has become one of the sectors that has suffered the most significant losses as a result of Russia's full-scale military aggression against Ukraine. In the first weeks of the war, Russian forces carried out massive strikes on aviation infrastructure facilities, primarily airfields that were used not only for military purposes but also for civilian and dual-use (civil-military) operations. Subsequently, railway infrastructure, which plays a system-forming role in the national logistics system, became a major target of sustained attacks. The total losses of Ukraine's transport sector are estimated at approximately USD 38.8 billion in terms of revenue losses, or nearly

USD 19 billion in terms of value-added losses (Andrienko *et al.*, 2024). This figure includes lost revenues of enterprises within the sector, costs associated with the dismantling of destroyed facilities, economic losses resulting from reduced road construction activity, as well as expenditures related to the performance of both civilian and military tasks under martial law.

Since the onset of the full-scale war, rail transport has demonstrated its critical importance in ensuring the economic and humanitarian security of the state. The railway system assumed the primary responsibility for the free evacuation of millions of Ukrainian citizens, as well as a significant number of enterprises from areas of active hostilities. In addition, railway infrastructure ensured the delivery of critically important materials and equipment to frontline regions. In response to this strategic role, railway facilities became priority targets of missile and artillery attacks, resulting in substantial losses, primarily in the form of foregone revenues for JSC Ukrzaliznytsia. The aviation sector began to incur economic losses even before the actual outbreak of active hostilities. On February 12, 2022, leading international insurance companies notified Ukrainian air carriers of the suspension of aircraft insurance due to the high risk of a military invasion. This development posed a serious threat of flight cancellations by international airlines operating to and from Ukraine, prompting the state to declare its readiness to provide additional financial guarantees to support the functioning of the aviation market. Following the escalation of hostilities, Ukraine's airspace was fully closed and air traffic suspended. Simultaneously, Russian forces carried out a series of missile strikes on key airfields with the objective of undermining Ukraine's air defence capabilities. As a result, 19 out of 35 airfields were damaged, including 12 civilians and 7 dual-use (civil-military) facilities, excluding purely military airfields. Some of these sites were subjected to repeated shelling (Andrienko *et al.*, 2024).

After the beginning of the full-scale invasion, all maritime trade routes of Ukraine became inaccessible for both exports and imports, causing significant losses to the national economy. In March 2022 alone, export volumes declined by approximately 50%. In August 2022, following agreements reached between Ukraine, Türkiye, the United Nations, and Russia, the operations of three Ukrainian ports – Odesa, Pivdennyi, and Chornomorsk – were partially unblocked. In 2021, these ports accounted for nearly 70% of Ukraine's foreign trade turnover. Within the framework of the so-called "grain initiative," a total of 19 million tonnes of agricultural products were exported through maritime ports between August 2022 and June 2023. Nevertheless, even during the implementation of this initiative, maritime trade capacity remained constrained, and Russia subsequently began to systematically sabotage the agreements and refused to extend them further. Despite these challenges, Ukraine managed to partially restore maritime navigation unilaterally through the actions of its Defence Forces (UNCTAD, 2024).

Municipal transport infrastructure in regions of active hostilities also suffered extensive destruction. As a result of large-scale attacks on civilian infrastructure, residents of many cities were left without access to public transportation and private vehicles. The most severe losses of municipal assets occurred in the Luhansk and Donetsk regions, as well as in the city of Kharkiv. Estimates indicate that approximately 60% of public transport assets were lost in Donetsk region and more than 70% in Luhansk region, effectively leading to the collapse of passenger transport systems in these areas. A substantial share of privately owned vehicles was also destroyed or damaged (Andrienko *et al.*, 2024). A comparative analysis of institutional approaches to supply chain security in the United States and Ukraine, including differences in risk management, customs procedures, trust mechanisms, and the level of digitalisation, is presented in Table 2.

Table 2. Assessment of losses in Ukraine's transport sector

Types of losses	Revenue losses, USD bn	Value added losses, USD bn
Decline in revenues (road transport)	7.130	3.257
Decline in revenues (rail transport)	6.442	2.943
Decline in revenues (warehousing and storage)	5.666	2.588
Decline in revenues (water transport)	4.313	1.970
Decline in revenues (postal and courier activities)	3.849	1.758
Decline in revenues (urban transport)	1.332	0.608
Decline in revenues (other activities)	0.985	0.450
Costs of dismantling and removal of construction debris	6.763	3.090
Total sector losses	38.814	18.664

Source: D. Andrienko *et al.* (2024)

As shown in Table 2, the US model is characterised by a high level of institutional integration, risk-based management, and active public-private cooperation, whereas the Ukrainian system remains fragmented, with limited implementation of trust mechanisms and a lower level of digitalisation. These differences highlight the need to adapt international best practices to the Ukrainian context, taking into account institutional and operational constraints. The concentration of losses in system-forming logistics segments demonstrates the high level of structural dependence of supply chains on centralised infrastructure. This finding confirmed that insufficient diversification of transport routes and logistics nodes significantly increases systemic vulnerability under crisis conditions. The results indicate that the most significant losses within Ukraine's transport sector are concentrated in segments that perform system-forming logistics functions, particularly rail transport, road freight transport, and warehousing activities. These segments ensured the continuity of material flows between production, distribution, and consumption nodes,

and their disruption generated cascading effects across entire supply chains. The concentration of losses in these areas confirms the high structural vulnerability of logistics systems that rely on centralised infrastructure and limited route diversification. As a result, supply chain security risks increase not only at the operational level but also at the systemic level, undermining predictability, controllability, and resilience of logistics networks.

International experience demonstrates that resilient supply chains are built on the combination of risk-based governance, public-private cooperation, and advanced digital systems (World Customs Organisation, 2022; UNCTAD, 2023). The full-scale war in Ukraine has become an unprecedented example of the systemic destruction of logistics infrastructure. Massive attacks on aviation, rail, and maritime facilities, the blockade of trade routes, and the destruction of urban transport networks have significantly undermined the country's economic security. As noted above, despite extensive damage, rail transport has performed a critical humanitarian and economic function by ensuring the evacuation of millions of citizens and maintaining the supply of essential goods and materials. At the same time, the aviation sector has virtually ceased operations due to the closure of national airspace and the destruction of aerodrome infrastructure. Maritime logistics has faced severe constraints as a result of port blockades, leading to a sharp decline in exports and substantial losses in foreign currency revenues.

The destruction of municipal transport infrastructure in eastern regions of Ukraine has generated not only economic but also profound social consequences, limiting population mobility and access to basic services. In this regard, the war has clearly demonstrated that logistics security is a fundamental prerequisite for social stability and the economic viability of territories. The analysis further reveals that disruptions in transport and logistics infrastructure produce cascading effects across supply chains, undermining their predictability, controllability, and overall security. Losses in core transport and distribution segments indicate structural vulnerability and insufficient diversification of logistics routes, thereby increasing exposure to systemic risks. The classification of supply chain vulnerabilities into infrastructural, organisational, and institutional categories was developed through analytical generalisation and comparative synthesis of findings from the reviewed literature and empirical observations. The analysis revealed that wartime disruptions exposed three interrelated categories of supply chain vulnerabilities: infrastructural, organisational, and institutional. Infrastructural vulnerabilities stem from the physical destruction of transport corridors, logistics hubs, and storage facilities. Organisational vulnerabilities arise from the reduced buffer capacities of supply chains, limited inventory reserves, and dependence on time-sensitive delivery models. Institutional vulnerabilities are reflected in regulatory fragmentation, restricted border access, and limited interoperability between national and international security regimes. Together, these vulnerabilities amplify security risks and constrain the adaptive capacity of supply chains under prolonged crisis conditions.

The destruction of logistics hubs and transport corridors weakens buffer capacities, constrains the redistribution of material flows, and reduces the ability of supply chains to absorb shocks. These dynamics pose direct challenges to supply chain security and hinder sustainable development by amplifying economic uncertainty, social vulnerability, and environmental pressures. Alongside strategic challenges, tactical security measures gain particular importance. Vehicles, distribution centres, and warehousing facilities become potential targets of criminal activity, especially under conditions of weakened control and heightened demand for critical resources. The application of satellite tracking systems, closed-circuit television (CCTV), intrusion alarm systems, and access control mechanisms enhances the transparency and controllability of logistics flows. At the same time, the effectiveness of these measures depends on appropriate organisational arrangements, continuous monitoring, and the professional training of personnel (Ren *et al*., 2024).

Particular attention should be paid to the human factor. Personnel selection, screening, and training procedures constitute a critical component of the security system, as a substantial share of incidents is associated with internal risks rather than external threats. International experience indicates that improving supply chain security is impossible without integrating risk management into the overall corporate governance framework (Herburger *et al*., 2024). A decisive role is played by risk awareness at the senior management level and by the understanding that changes in business strategy directly transform organisational risk profiles. Supply chain vulnerability has increased significantly as a result of the extension and so-called "thinning" of logistics networks between specialised facilities (Rahman *et al*., 2022). Business strategies focused on inventory minimisation, relocation of production to lower-cost countries, and the globalisation of material flows have reduced safety stock levels and heightened system sensitivity to external disruptions.

The findings confirm that post-war recovery cannot be limited to physical reconstruction alone. Instead, it requires the development of integrated supply chain security models that combine resilience, institutional coordination, environmental responsibility, and risk-oriented governance. Research conducted by the Centre for Logistics and Supply Chain Management at Cranfield University (United Kingdom) as early as 2003 demonstrated that the very structure of modern supply chains constitutes an independent source of risk. The study identified four levels of vulnerability, including value creation processes and flows, dependence on assets and infrastructure, organisational and inter-organisational networks, and the external environment. These conclusions have become particularly relevant in the context of pandemics, climate change, and, above all, armed conflicts. Disruptions of supply chains caused by political instability, epidemics, or military aggression are capable of generating catastrophic consequences for individual firms, entire industries, and national economies as a whole (Christopher & Peck, 2004).

In the European Union and North America, logistics security is increasingly interpreted through the lens of sustainable development (Li *et al*., 2026). The economic dimension is reflected in ensuring supply continuity and reducing losses; the social dimension concerns the protection of workers and consumers; while the environmental dimension relates to minimising the negative impacts of

accidents, delays, and inefficient routing on the natural environment. For Ukraine, the application of global best practices and the findings of international research is critically important in the context of post-war recovery. The formation of resilient, diversified, and secure logistics systems should become a priority of both public policy and corporate strategy. The results confirm that supply chain security functions as a cross-cutting determinant of sustainable development under crisis conditions. Disruptions in logistics infrastructure and governance generate economic losses, restrict social mobility and access to essential goods, and increase environmental risks associated with inefficient routing and emergency logistics solutions. Consequently, the security of supply chains emerges not as a secondary operational concern but as a foundational condition for economic resilience, social stability, and environmental responsibility.

Thus, logistics security in wartime conditions extends beyond a purely operational task and transforms into a strategic determinant of sustainable development. The military challenges faced by Ukraine have clearly demonstrated the interdependence between supply chain security, economic resilience, social stability, and environmental responsibility. The integration of international experience, scientific approaches to risk management, and the principles of sustainable development provides the foundation for shaping a new logistics model – resilient, secure, and adaptable to crises. Such a model is capable of supporting long-term recovery and strengthening the competitiveness of Ukraine's economy in the post-war period. In addition, disruptions in logistics systems contribute to increased environmental pressure. The forced extension of transport routes, the use of less efficient alternative modes, and the intensification of emergency logistics operations lead to higher fuel consumption and greenhouse gas emissions. This demonstrated that supply chain security is directly linked not only to economic and social stability but also to environmental sustainability under crisis conditions.

The findings of this study confirm that supply chain security has evolved from an operational concern into a multidimensional strategic function, which is consistent with recent research in the field of logistics and supply chain management. In particular, the results aligned with the conclusions of A. Gurtu & J. Johny (2021), who emphasised that supply chain risk management constitutes a systemic and strategic activity aimed at ensuring the continuity and stability of global logistics networks. The present study extends this perspective by demonstrating that, under conditions of armed conflict, security considerations become central to the functioning of supply chains rather than supplementary.

The identified structural vulnerabilities of supply chains are also consistent with the findings of M. Christopher & H. Peck (2004), who argued that the architecture of supply chains itself represents a significant source of risk. While their research focused primarily on disruptions in relatively stable economic environments, this study confirms that these vulnerabilities are significantly amplified under conditions of war, where infrastructure destruction and institutional constraints intensify systemic instability. The results further support the conclusions of T. Rahman *et al*. (2022), who highlighted the importance of resilience-oriented strategies in mitigating supply chain disruptions. However, unlike previous studies that emphasised resilience primarily in the context of natural disasters or pandemics, the present research demonstrates that wartime conditions require a more integrated approach, combining resilience with security, institutional coordination, and strategic governance.

A significant contribution of this study lies in the integration of supply chain security into the sustainable development framework. This finding is consistent with the research of Y. Borbon-Galvez *et al*. (2025), who demonstrated the complementary relationship between sustainability and resilience. The present study confirms that this relationship becomes particularly pronounced under crisis conditions, where disruptions in logistics systems generate not only economic losses but also social instability and environmental pressures. In addition, the findings correspond with the work of J. Liu *et al*. (2023), who emphasised the importance of adaptability and flexibility in ensuring maritime supply chain resilience. The Ukrainian case analysed in this study illustrates that the ability to rapidly reconfigure logistics routes and utilise alternative transport modes is a critical determinant of supply chain survival under extreme conditions.

At the same time, the results highlight certain differences compared to existing literature. While many studies focus on technological solutions and digitalisation as key drivers of supply chain security (Ren *et al*., 2024), this research demonstrates that under wartime conditions, institutional capacity, infrastructure availability, and international cooperation play a more decisive role than technological advancement alone. Furthermore, the study supports the conclusions of N. Antoniiuk *et al*. (2023), who emphasised the role of financial support and strategic planning in ensuring logistics security. However, the present research expands this perspective by showing that financial mechanisms must be complemented by institutional coordination and international integration in order to be effective in high-risk environments. The comparative analysis of international security programmes (C-TPAT, FAST, CSI, and AMR) confirms the effectiveness of partnership-based models of governance, which is consistent with the SAFE Framework of Standards (World Customs Organisation, 2022). These findings indicate that the integration of public-private cooperation mechanisms significantly enhances both security and efficiency of supply chains. Overall, the results of this study confirm that supply chain security should be considered a core component of sustainable development strategies. The findings demonstrate that economic resilience, social stability, and environmental sustainability are interdependent and cannot be achieved without secure and adaptive logistics systems. This reinforces the need for further research focused on developing integrated models of supply chain security tailored to high-risk and conflict-affected environments.

CONCLUSIONS

The study demonstrated that under conditions of global instability and armed conflict, supply chain security extends beyond its traditional operational role and becomes a strategic determinant of sustainable development. The findings confirmed that supply chain vulnerability is driven

not only by external shocks, such as military aggression and infrastructure destruction, but also by internal structural characteristics, including extended logistics networks, limited diversification of transport routes, and dependence on centralised infrastructure. The analysis showed that disruptions in transport and logistics systems generate cascading effects across supply chains, undermining their predictability, controllability, and resilience. The Ukrainian case provided empirical evidence that large-scale infrastructure damage leads to significant economic losses, reduced social stability, and increased environmental pressure, thereby directly affecting the foundations of sustainable development. The study further established that effective supply chain security is achieved through integrated, risk-oriented, and partnership-based approaches. International practices, including C-TPAT, FAST, CSI, and AMR, demonstrated that public-private cooperation, advance information exchange, and differentiated control mechanisms enhance both security and trade efficiency. From a practical perspective, the results highlight the need to develop national supply chain security frameworks adapted to wartime conditions and aligned with international standards. The formation of resilient, diversified, and risk-aware logistics systems should become a priority of both public policy and corporate strategy in Ukraine's post-war recovery. Future research should focus on the development of integrated models of supply chain security tailored to conflict-affected environments, including the quantitative assessment of resilience and sustainability indicators, the role of digital technologies in logistics risk management, and the evaluation of policy instruments for strengthening institutional coordination and international integration.

ACKNOWLEDGEMENTS
None.

FUNDING
None.

CONFLICT OF INTEREST
None.

REFERENCES
[1] Agricultural Research Centre. (2024). *How Azerbaijan adapts to new technologies in agriculture?* Retrieved from https://atm.gov.az/en/news/1440/how-azerbaijan-adapts-to-new-technologies-in-agric/.
[2] Ahmetoglu, S., Cob, Z.C., & Ali, N.A. (2023). Internet of things adoption in the manufacturing sector: A conceptual model from a multi-theoretical perspective. *Applied Sciences*, 13(6), article number 3856. doi: 10.3390/app13063856.
[3] Albreem, M.A., Sheikh, A.M., Bashir, M.J., & El-Saleh, A.A. (2023). Towards green Internet of Things (IoT) for a sustainable future in Gulf Cooperation Council countries: Current practices, challenges and future prospective. *Wireless Networks*, 29(2), 539-567. doi: 10.1007/s11276-022-03133-3.
[4] Alkhateeb, A., Catal, C., Kar, G., & Mishra, A. (2022). Hybrid blockchain platforms for the internet of things (IoT): A systematic literature review. *Sensors*, 22(4), article number 1304. doi: 10.3390/s22041304.
[5] Al-Okaily, M., Younis, H., & Al-Okaily, A. (2024). The impact of management practices and industry 4.0 technologies on supply chain sustainability: A systematic review. *Heliyon*, 10(17), article number e36421. doi: 10.1016/j.heliyon.2024.e36421.
[6] Bag, S., & Pretorius, J. (2022). Relationships between industry 4.0, sustainable manufacturing and circular economy: Proposal of a research framework. *International Journal of Organizational Analysis*, 30(4), 864-898. doi: 10.1108/IJOA-04-2020-2120.
[7] Baghirova, N. (2023). *Smart farming for sustainable agriculture in Karabakh*. Baku: ADA University.
[8] Billah, M., Alam, S., Masukujjaman, M., Ali, M., Makhbul, Z., & Salleh, M. (2023). Effects of Internet of Things, supply chain collaboration and ethical sensitivity on sustainable performance: Moderating effect of supply chain dynamism. *Journal of Enterprise Information Management*, 36(5), 1270-1295. doi: 10.1108/JEIM-06-2022-0213.
[9] Caldwell, E. (2023). *Smart villages in Azerbaijan.* Retrieved from https://www.smartrural21.eu/wp-content/uploads/World-Bank-Smart-Villages-Presentation_Erik-Caldwell.pdf.
[10] Cavalieri, A., Reis, J., & Amorim, M. (2022). A conceptual model proposal to assess the effectiveness of IoT in sustainability orientation in manufacturing industry: An environmental and social focus. *Applied Sciences*, 12(11), article number 5661. doi: 10.3390/app12115661.
[11] Cisco. (2024). *Global networking trends report*. Retrieved from https://www.cisco.com/c/dam/global/en_uk/solutions/enterprise-networks/2024-global-networking-trends.pdf.
[12] Ding, S., Tukker, A., & Ward, H. (2023). Opportunities and risks of internet of things (IoT) technologies for circular business models: A literature review. *Journal of Environmental Management*, 336, article number 117662. doi: 10.1016/j.jenvman.2023.117662.
[13] Edquist, H., Goodridge, P., & Haskel, J. (2021). The Internet of Things and economic growth in a panel of countries. *Economics of Innovation and New Technology*, 30(3), 262-283. doi: 10.1080/10438599.2019.1695941.
[14] European Commission. (2024a). *How to master Europe's digital infrastructure needs?* Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52024DC0081.
[15] European Commission. (2024b). *Internet of Things (rolling plan for ICT standardisation 2024)*. Retrieved from https://interoperable-europe.ec.europa.eu/collection/rolling-plan-ict-standardisation/internet-things-rp2024.
[16] Foltean, F.S., & Glovaţchi, B. (2021). Business model innovation for IoT solutions: An exploratory study of strategic factors and expected outcomes. *Amfiteatru Economic*, 23(57), 392-411. doi: 10.24818/EA/2021/57/392.
[17] Fortune Business Insights. (2025). Retrieved from https://surl.li/jkwykk.

[18] Goudarzi, M., Ilager, S., & Buyya, R. (2022). Cloud computing and internet of things: Recent trends and directions. In R. Buyya, L. Garg, G. Fortino & S. Misra (Eds.), *New frontiers in cloud computing and internet of things* (pp. 3-29). Cham: Springer. doi: 10.1007/978-3-031-05528-7_1.
[19] Harikannan, N., Vinodh, S., & Antony, J. (2025). Analysis of the relationship among Industry 4.0 technologies, sustainable manufacturing practices and organizational sustainable performance using structural equation modelling. *The TQM Journal*, 37(1), 42-72. doi: 10.1108/TQM-02-2023-0044.
[20] Huma, Z.E., Latif, S., Ahmad, J., Idrees, Z., Ibrar, A., Zou, Z., Alqahtani, F., & Baothman, F. (2021). A hybrid deep random neural network for cyberattack detection in the industrial internet of things. *IEEE Access*, 9, 55595-55605. doi: 10.1109/ACCESS.2021.3071766.
[21] Huseynova, A., & Mazanova, O. (2023). *The leading role of digital technologies in the development of the smart city concept in Azerbaijan*. doi: 10.2139/ssrn.4800562.
[22] Imamguluyev, R., Hasanova, P., Imanova, T., Poladova, U., Amrahova, A., & Hajibayli, A. (2024). The role of edge computing in 6G-enabled IoT applications. *International Journal of Research Publication and Reviews*, 5(12), 2007-2013. doi: 10.55248/gengpi.5.1224.3523.
[23] International Renewable Energy Agency. (2024). Retrieved from https://www.iea.org/reports/renewables-2024.
[24] ISO/IEC 30141:2024. (2024). *Internet of things (IoT) reference architecture*. Retrieved from https://www.iso.org/standard/88800.html.
[25] Javadpour, A., Sangaiah, A.K., Zhang, W., Vidyarthi, A., & Ahmadi, H. (2024). Decentralized AI-based task distribution on blockchain for cloud industrial internet of things. *Journal of Grid Computing*, 22(1), article number 33. doi: 10.1007/s10723-024-09751-9.
[26] Kemp, S. (2025). *Digital 2025: Azerbaijan*. Retrieved from https://datareportal.com/reports/digital-2025-azerbaijan.
[27] McKinsey & Company. (2024). *Technology trends outlook 2024*. Retrieved from https://surl.li/irmzke.
[28] Mesquita, L.L., Lizarelli, F.L., Duarte, S., & Oprime, P.C. (2022). Exploring relationships for integrating lean, environmental sustainability and Industry 4.0. *International Journal of Lean Six Sigma*, 13(4), 863-896. doi: 10.1108/IJLSS-09-2020-0145.
[29] Mitra, A., Seetharaman, A., & Maddulety, K. (2024). A structural equation model study for adoption of Internet of Things for the growth of manufacturing industries in Australia. *Journal of Comprehensive Business Administration Research*, 1(2), 93-104. doi: 10.47852/bonviewJCBAR42022482.
[30] Nasser, A.A., Al-Ashwal, M.M., Al-Khulaidi, A.A., Al-Naqeep, A.N., & Al-Jober, M. (2023). A hybrid business-technical model for evaluating iot platforms' functionality, reliability, and usability. *International Journal of Engineering Trends and Technology*, 71(10), 39-59. doi: 10.14445/22315381/IJETT-V71I10P205.
[31] Nozari, H., Fallah, M., & Szmelter-Jarosz, A. (2021). A conceptual framework of green smart IoT-based supply chain management. *International Journal of Research in Industrial Engineering*, 10(1), 22-34. doi: 10.22105/riej.2021.274859.1189.
[32] Organisation for Economic Co-operation and Development. (2022). *Promoting enterprise digitalisation in Azerbaijan*. Retrieved from https://www.oecd.org/content/dam/oecd/en/publications/reports/2022/04/promoting-enterprise-digitalisation-in-azerbaijan_6187d4fa/6a612a2a-en.pdf.
[33] Organisation for Economic Co-operation and Development. (2024). *OECD digital economy outlook 2024 (Volume 2)*. Retrieved from https://www.oecd.org/en/publications/oecd-digital-economy-outlook-2024-volume-2_3adf705b-en.html.
[34] Paiola, M., Schiavone, F., Grandinetti, R., & Chen, J. (2021). Digital servitization and sustainability through networking: Some evidences from IoT-based business models. *Journal of Business Research*, 132, 507-516. doi: 10.1016/j.jbusres.2021.04.047.
[35] Rahimov, E.R., & Rahimov, J.R. (2025). *Nano internet of things*. New York: "Vector" International Publishing House.
[36] Rajabzadeh, M., & Fatorachian, H. (2023). Modelling factors influencing IoT adoption: With a focus on agricultural logistics operations. *Smart Cities*, 6(6), 3266-3296. doi: 10.3390/smartcities6060145.
[37] Salamzadeh, A., Hadizadeh, M., Rastgoo, N., Rahman, M.M., & Radfard, S. (2022). Sustainability-oriented innovation foresight in international new technology based firms. *Sustainability*, 14(20), article number 13501. doi: 10.3390/su142013501.
[38] Saleem, M.U., Shakir, M., Usman, M.R., Bajwa, M.H., Shabbir, N., Shams Ghahfarokhi, P., & Daniel, K. (2023). Integrating smart energy management system with internet of things and cloud computing for efficient demand side management in smart grids. *Energies*, 16(12), article number 4835. doi: 10.3390/en16124835.
[39] Sevak, K.Y., & George, B. (2024). The evolution of Internet of Things (IoT) research in business management: A systematic review of the literature. *Journal of Internet and Digital Economics*, 4(3), 242-265. doi: 10.1108/JIDE-12-2023-0026.
[40] Song, T., Cai, J., Chahine, T., & Li, L. (2021). Towards smart cities by internet of things (IoT) – a silent revolution in China. *Journal of the Knowledge Economy*, 12(2), 1-17. doi: 10.1007/s13132-017-0493-x.
[41] Ullah, A., Anwar, S.M., Li, J., Nadeem, L., Mahmood, T., Rehman, A., & Saba, T. (2024). Smart cities: The role of Internet of Things and machine learning in realizing a data-centric smart environment. *Complex & Intelligent Systems*, 10(1), 1607-1637. doi: 10.1007/s40747-023-01175-4.
[42] Valiyev, A., Akhundov, B., Mukhtarova, G., & Ismayilova, N. (2022). *Localizing smart urban development in Azerbaijan*. doi: 10.3929/ethz-b-000525828.

[43] Van Hoang, T. (2024). Impact of integrated artificial intelligence and internet of things technologies on smart city transformation. *Journal of Technical Education Science*, 19(1), 64-73. doi: 10.54644/jte.2024.1532.
[44] Wang, K., Zhao, Y., Gangadhari, R.K., & Li, Z. (2021). Analyzing the adoption challenges of the Internet of things (IoT) and artificial intelligence (AI) for smart cities in China. *Sustainability*, 13(19), article number 10983. doi: 10.3390/su131910983.
[45] World Bank. (2024). *World development report 2024: Data for better lives*. Retrieved from https://www.worldbank.org/en/publication/wdr2024.
[46] World Economic Forum. (2024). *IDEA: Investing in the digital economy of Azerbaijan*. Retrieved from https://www3.weforum.org/docs/WEF_IDEA_Investing_in_the_Digital_Economy_of_Azerbaijan_2024.pdf.
[47] Xing, L. (2024). Evaluation of the impact of artificial intelligence and intelligent Internet of Things on population mobility on regional economic differences. *Soft Computing*, 28, 13977-13988. doi: 10.1007/s00500-023-08351-1.
[48] Yavuz, O., Uner, M.M., Okumus, F., & Karatepe, O.M. (2023). Industry 4.0 technologies, sustainable operations practices and their impacts on sustainable performance. *Journal of Cleaner Production*, 387, article number 135951. doi: 10.1016/j.jclepro.2023.135951.

Сергій Шевченко
Кандидат економічних наук, доцент
Національний університет «Львівська політехніка»
79013, вул. Степана Бандери, 12, м. Львів, Україна
https://orcid.org/0000-0002-5522-3258

Безпека ланцюгів постачання в контексті сталого розвитку: світові практики та український контекст

Анотація. Актуальність дослідження зумовлена зростаючою вразливістю глобальних ланцюгів постачання в умовах збройних конфліктів, геополітичної нестабільності та посилення ризиків для сталого розвитку. Метою дослідження була систематизація підходів до забезпечення безпеки ланцюгів постачання та обґрунтування її ролі як ключового чинника сталого розвитку з урахуванням міжнародного досвіду та українського контексту. Методологічна основа базована на системному аналізі наукової літератури, порівняльному аналізі міжнародних програм безпеки, а також методах синтезу й узагальнення, що дозволило виявити ключові закономірності, фактори ризику та інституційні механізми захисту ланцюгів постачання. Встановлено, що вразливість ланцюгів постачання зумовлюється не лише зовнішніми шоками, такими як військова агресія та руйнування інфраструктури, але й внутрішніми структурними характеристиками сучасних логістичних систем, зокрема розгалуженими мережевими конфігураціями та стратегіями мінімізації запасів. Визначено, що ефективна безпека досягається через інтегровані, ризик-орієнтовані та партнерські моделі, які поєднують державно-приватну взаємодію, попередній обмін інформацією та диференційовані механізми контролю. Аналіз міжнародних програм (C-TPAT, FAST, CSI, AMR) продемонстрував їхню ефективність у підвищенні стійкості ланцюгів постачання при збереженні ефективності торгівлі. Український кейс підтвердив, що масштабні порушення транспортної інфраструктури спричиняють системні економічні, соціальні та екологічні наслідки, безпосередньо впливаючи на сталий розвиток. Обґрунтовано, що безпека ланцюгів постачання виступає наскрізним чинником, який поєднує економічну безперервність, соціальну стабільність та екологічну відповідальність. Практичне значення результатів полягає в можливості їх використання органами державної влади, менеджерами з логістики та підприємствами для розроблення адаптивних, стійких і безпеково орієнтованих моделей управління ланцюгами постачання в умовах кризи та післявоєнного відновлення

Ключові слова: транспортна інфраструктура; логістична стійкість; управління ризиками; державно-приватне партнерство; порушення інфраструктури; міжнародна торгівля; післявоєнне відновлення

ECONOMICS OF DEVELOPMENT
Journal homepage: https://ecdev.com.ua/
ISSN: 1683-1942
E-ISSN: 2304-6155
Vol. 25, No. 1, 2026
UDC 338.48(477.87):004.89
DOI: 10.63341/econ/1.2026.41

Roman Slavik*
PhD in Economics, Associate Professor
State Higher Educational Institution "Uzhhorod National University"
88000, 14 Universytetska Str., Uzhhorod, Ukraine
https://orcid.org/0000-0002-6198-3202

Evaluation of the recreational and tourist potential of municipalities using the fuzzy set method

Abstract. The study is relevant due to the need to improve the evaluation of the recreational and tourist attractiveness of municipalities within Ukraine's new administrative-territorial system, particularly in the communities of Zakarpattia region. The objective was to determine the level of their tourism attractiveness using fuzzy set theory to quantitatively reflect the uncertainty of multifactorial decisions. Fuzzy modeling with trapezoidal membership functions and statistical methods were used to analyse the relationship between resources and revenue from the tourism fee. The results confirmed significant heterogeneity in the spatial distribution of recreational and tourism resources: the coefficient of variation for the composite index was 105%, indicating sharp differences between communities. The group with the highest attractiveness included the Berehove, Yasinya, Uzhhorod, Koson, Mukacheve, and Irshava communities; the Mizhhirya, Pylypets, Khust, and Rakhiv communities also had significant potential. More than half of Zakarpatia's communities were among the least attractive; four of them did not have any cultural heritage sites or nature reserves. A gap had been identified between resource potential and financial results: seven communities generated 68% of the tourism fee, while the least attractive ones accounted for 22% of the potential and generated 24% of the fee, indicated the possibility of a synergistic effect through logistics, marketing, infrastructure, and human resources. In contrast, communities with 23% of the potential accounted for less than 1% of revenue, indicated "reverse synergy." Statistical analysis showed that only 1.5% of the variation in revenue was explained by the type of resources. The key factor was not the type of resource, but the ability of communities to made integrated use of their collective resource potential in cooperation with neighboring communities. The practical value of the study lied in proposition of a fuzzy model as an analytical tool for strategic planning, branding, and enhancing the competitiveness of municipalities

Keywords: territorial communities of the Zakarpattia region; fuzzy logic; territorial attractiveness index; tourist fee; sustainable tourism development; spatial and statistical analysis

INTRODUCTION

The development of any sector of the national economy requires the government to determine its priority and provide adequate investment support. Tourism is regarded as a priority area of the country's economic and cultural development, which requires the creation of favourable conditions for the sector's functioning. In this context, the state encourages investment, promotes the development of tourism as a competitive and profitable sector of the economy, and ensures the creation of new jobs. The Zakarpattia region is characterised by significant recreational and tourism potential, the effective use of which requires a scientifically grounded analysis of demand, supply, and the market positioning of tourism products. As a result of administrative reform, local communities play a leading role in the development of the tourism sector, possessing the resource, managerial, and marketing potential necessary for the implementation of regional tourism development programs.

The war has triggered a severe crisis in Ukraine's tourism industry: a sharp decline in revenue, the destruction of infrastructure, an outflow of investment, and a drop in tourist numbers that has exceeded the impact of the pandemic. As researchers V. Yermachenko *et al*. (2024) argued,

Article's History: Received: 21.08.2025; Revised: 30.01.2026; Accepted: 26.03.2026; Published: 09.04.2026

Suggested Citation:
Slavik, R. (2026). Evaluation of the recreational and tourist potential of municipalities using the fuzzy set method . *Economics of Development*, 25(1), 41-55. doi: 10.63341/econ/1.2026.41.

*Corresponding author

sustainable tourism development can become a key tool for the post-war recovery of local communities, provided that the interests of business and local communities are harmonised and a "win-win" approach is applied. They propose a cluster-based approach to tourism development that takes into account the extent of the impact of hostilities in the region, allowing for more effective planning of recovery and stimulation of economic growth. A number of scientific publications have been devoted to the study of the recreational and tourist complex of the Zakarpattia region and the assessment of the recreational and tourist potential of the municipalities in other regions.

The authors L. Hutsal & I. Shorobura (2023) conceptually investigated the features of the formation of the tourist attractiveness of territorial communities of Ukraine from the standpoint of a practical approach in the conditions of decentralisation. They substantiated the goals, objectives, key problems and areas of development (infrastructure development, new routes, green, cognitive, eco- and youth tourism), which should transform communities into tourist centres. Increasing the tourist attractiveness of communities ensures sustainable economic development, activation of entrepreneurship, preservation of historical and cultural heritage and requires state support and strategic planning at the local level. The authors A. Melnyk *et al*. (2023) substantiated that decentralisation has created new opportunities and resources for the development of tourism as a cross-sectoral driver of the local economy for the territorial communities. The factors of the tourist attractiveness of rural and settlement communities are studied: historical and cultural heritage, the state of tourist infrastructure (accommodation, catering, leisure, everyday life, transport) and human potential. Based on the identified problems of infrastructure, the authors propose priority measures for its modernisation and develop a "road map" of the touristification of the community space to increase their competitiveness, investment attractiveness and employment of the population.

The author N. Barvinok (2023) argue that the tourism potential of local communities is held back by inadequate infrastructure: a limited network of lodging and dining establishments, poor roads, and insufficient information services. The authors propose measures to address these issues – road reconstruction, attracting investment, marketing, and creating new attractions – to encourage socioeconomic growth. The global academic community pays due attention to research on the recreational and tourism appeal of municipalities. In particular, Z. Song (2025) proposes an approach to assessing the comprehensive competitiveness of tourist destinations within cities, combining Bourdieu's field theory and Porter's theory of competitiveness, as well as utilising geospatial big data and machine learning for analysis. The study found that competitiveness is based on four factors (quality, popularity, spatial attractiveness, and emotional perception) and demonstrates a spatial pattern that gradually weakens from the center of Nanjing to its outskirts. M. Hou *et al*. (2023) show green tourism inspiration, environmental engagement, and green revisit intentions, while fuzzy AHP revealed that tourism engagement has the highest fuzzy-weighted score in developing the revisit intentions of Chinese tourists. Moreover, they indicated that green tourism inspiration and environmental wellness matter most in reshaping tourists' revisit intentions. F. Liu (2024) evaluated the tourism attractiveness in the perspective of culture and tourism integration based on the TOPSIS model. The results showed that the model can effectively assess the attractiveness of tourism destinations and provide a scientific basis for tourism development, and the results of the evaluation of tourism attractiveness through the perspective of culture and natural tourism integration show that the integration of culture and tourism resources plays an important role in enhancing the attractiveness of tourism destinations. Such studies are valuable for Zakarpattia in the context of sustainable regional development, as more than 50% of the region is covered by forests and 80% of its territory is mountainous.

The assessment of the recreational and tourist attractiveness of territories developed mainly in the direction of "tourism destination attractiveness/competitiveness" models with an emphasis on index, multi-criteria and behavioural approaches. Four large groups of works can be conditionally distinguished: spatial-behavioural models, integral indices of destination attractiveness, multi-criteria/expert models of sustainable tourism and "niche" types of mobility. The author R. Slavik *et al*. (2020) expanded and improved regional research on the assessment of investment and recreational and tourist attractiveness of territories in terms of administrative districts that existed until 2020. The new administrative system of Ukraine, the formation of territorial communities, requires improving the methods and approaches to such assessments, which determines the relevance of this study.

The purpose of this article was to study the prerequisites for the development of the recreational and tourist sphere of the Zakarpattia region in the context of territorial communities using the methodological tools of the theory of fuzzy sets, which was improved and highlighted by the author R. Slavik *et al*. (2020), based on fuzzy logic and the theory of fuzzy sets. This study was operationalised through a set of interrelated tasks. First, a database of natural and historical-cultural resources of the Zakarpattia region was compiled and spatially allocated to territorial communities, after which the communities were grouped according to the availability of recreational and tourism resources using fuzzy logic methods. The next step involved establishing the relationship between the presence of natural and historical-cultural resources and the financial revenues of communities in the form of the tourist fee. Finally, the study sought to identify territorial communities that are undervalued in the tourism market of the Zakarpattia region and to develop proposals aimed at increasing tourist attendance in the least popular communities.

MATERIALS AND METHODS

The existence of various constraints and risks in planning the development of the recreational sector in general, and of local communities in particular, creates an atmosphere of uncertainty for managers. Attracting additional resources (material, financial) to recreational areas requires assessing them for recreational value, infrastructure development, investment attractiveness, and so on. In other words, managers must possess the necessary tools for a comprehensive analysis of recreational areas to effectively manage them and explore opportunities for investment

development. Such a toolkit can be created, in particular, through mathematical modelling of the recreational and tourism attractiveness of local communities, which will make it possible to determine their level of competitiveness in the recreational investment market. This model provided answers to a potential manager (investor) regarding factors influencing the riskiness of investments in a given community, and to the community's local government – opportunities to improve the investment environment and regulate the number of tourists.

A specific set of recreational areas $R_i\,(i = \overline{1,m})$, that are of interest to the investor, or that are subject to management and evaluation, was selected for analysis F_j; $(j = \overline{(1,n)}$. The various factors used to evaluate territories were standardised according to the following rule:

$$k_{ij} = \frac{F_{ij}}{F_{ijmax}}, \quad (1)$$

where k_{ij} – the standardised index of the j-th evaluation factor for the i-th territory; F_{ij} – the indicator for i-th territory regarding evaluation factor j, expressed in physical units (UAH, people, units, km, etc.); F_{ijmax} – the maximum value of the j-th factor of the evaluation in natural units.

A matrix of standardised indices with dimensions $m \times n$ is constructed, where n – the number of territories under study and m – the number of evaluation factors (criteria). The most and least significant factors influencing the level of recreational and tourist attractiveness of communities are identified by maximising and minimising the standardised indices of each row in the matrix. The symbolic representation of this algorithm can be expressed as: $c_i = max_i\ k_{ij}$; $b_i = min_i\ k_{ij}$; where c_i and b_i – respectively, the maximum and minimum values in row i. A ranking of the recreational and tourist attractiveness of the municipalities under study was compiled by summing the standardised indices for each row of the matrix and assigning a rank to each territory. That is:

$$S_i = \sum_{j=1}^{n} k_{ij} \rightarrow r_n. \quad (2)$$

A schematic representation of the matrix is shown in Table 1.

Table 1. Matrix of standardised indices for evaluating local communities based on specified criteria

	F_1	F_2	F_3	....	F_j	$max_i\ k_{ij}$	$min_i\ k_{ij}$	$sum_i\ k_{ij}$	rank
R_1	k_{11}	k_{12}	k_{13}	...	k_{1j}	c_{1j}	b_{1j}	S_1	r_1
R_2	k_{21}	k_{22}	k_{23}	...	k_{2j}	c_{2j}	b_{2j}	S_2	r_2
....	....	...	....	....	....	....	....	....	....
R_i	k_{i1}	k_{i2}	k_{i3}	....	k_{ij}	c_{ij}	b_{ij}	S_i	r_n

Source: developed by the author

This ranking of the investment attractiveness of recreational areas was generalised using the methodology of fuzzy logic. Fuzzy logic is a starting point that operates with imprecise, undefined, and even incompletely understood concepts. According to this concept, the results of complex and critical situations should mostly be estimated approximately, rather than precisely. For convenience, the set of values S_1; S_2... S_i were converted to the range of values from 0 to 1 such that $S_i\ min = 0$ and $S_i\ max = 1$. The remaining values of the sum of standardised indices lie in the range from 0 to 1 ($S_i \in [0;1]$) and are determined by the rule:

$$S_i[0:1] = \frac{S_i - S_i\,min}{S_i\,max - S_i\,min}. \quad (3)$$

Next, linguistic variables $B = \{b_j,\ j = \overline{1,n}\}$ are introduced, which are defined on the quantitative scale [0;1] and take on values in the form of words and phrases from ordinary language. Linguistic variables and their values serve to provide a qualitative verbal description of a certain quantitative value. Any linguistic variable and all its values are associated with a specific quantitative scale. Additionally, within the range of numerical values of the terms, subsets of 100% membership of a specific community in the corresponding linguistic variable are introduced (Table 2).

Table 2. Correspondence between the names of linguistic variables and their meanings

The value of linguistic variable B – the level of recreational and tourist attractiveness of the territorial communities		A brief linguistic analysis of the terms	Range of numerical values of terms	Subsets of 100% membership
b_1	the least attractive local communities	**LA**	**[0; 0.25)**	A_1 **[0; 0.1]**
b_2	attractiveness level below average	**BA**	**(0.1; 0.45)**	A_2 **[0.25; 0.3]**
b_3	average attractiveness	**AA**	**(0.3; 0.7)**	A_3 **[0.45; 0.55]**
b_4	above average attractiveness level	**AAA**	**(0.55; 0.9)**	A_4 **[0.7; 0.75]**
b_5	the greatest recreational and tourist attractiveness	**GA**	**(0.75; 1]**	A_4 **[0.9; 1]**

Source: developed by the author

Thus, territories that do not belong to the 100% membership subsets belong to one of the neighbouring linguistic terms with a certain degree of membership, which varies in the range from 0 to 1. The membership function $\mu(B)$ is a function whose domain is the carrier S_i and whose range is the unit interval [0, 1]. The larger the value of the function $\mu(B)$, the higher the degree of membership of the element S_i in b_j is estimated. If $S_i \in A_1; A_2; A_3; A_4; A_5$, then $\mu(S_i) = 1$. After determining the possible range of variation for the parameters S_i, $i = \overline{1,n}$, and the output variable B, the form of the membership functions for the fuzzy terms was specified. A membership function reflects elements from the set S onto a set

of numbers in the interval [0;1], which indicate the degree of membership of each element in various qualitative terms. To construct the membership functions of the five fuzzy terms of the input variable {GA, AAA, AA, BA, LA}, the ranges of variation of the parameter S_i, $i = \overline{1.64}$ (since there are 64 territorial communities under analysis) were mapped onto a single universal set *S*. Five fuzzy subsets were defined, whose membership functions are shown in Figure 1.

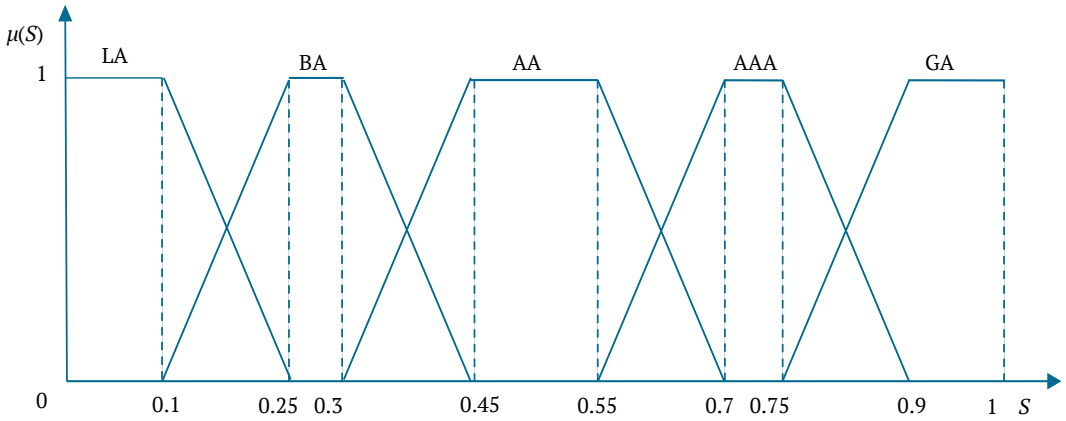

Figure 1. Fuzzy variable S_i with trapezoidal membership function
Source: developed by the author

The selection of correspondences between linguistic variables and numerical values is determined by the use of a fuzzy model for assessing the recreational and tourist attractiveness of territorial communities. The interval [0, 1] was divided into five partially overlapping intervals, ensuring a smooth transition between levels of recreational and tourist attractiveness and reflecting the uncertainty at the boundary values. The central sub-ranges of each term are defined as zones of full membership, since it is within these zones that the corresponding qualitative characteristic is most distinct and unambiguous. The range of 0-0.25 represents the low-value zone, corresponding to weak recreational and tourist attractiveness. 0.25-0.45 marks the transition to a below-average level. 0.45-0.55 is the centre of the scale, which is logically interpreted as the average level. 0.55-0.9 – a zone of gradually increasing attractiveness. 0.9-1 – the upper part of the scale, where communities have the highest recreational and tourist attractiveness. Thus, the extreme values represent communities that are either strongly or weakly attractive. The intermediate zones reflect a gradual transition. The cores of the terms define the most typical values for each category. The trapezoidal membership functions of all fuzzy terms of the input variable, showed in Figure 1, take the following analytical form:

$$\mu^{LA}(Si)=\begin{cases}1, & 0 \le S_i \le 0.1;\\ \frac{S_i-0.25}{0.1-0.25}, & 0.1 \lhd S_i \lhd 0.25;\end{cases} \quad (4)$$

$$\mu^{BA}(Si)=\begin{cases}\frac{S_i-0.45}{0.3-0.45}, & 0.3 \lhd S_i \lhd 0.45;\\ 1, & 0.25 \le S_i \le 0.3;\\ \frac{S_i-0.1}{0.25-0.1}, & 0.1 \lhd S_i \lhd 0.25;\end{cases} \quad (5)$$

$$\mu^{AA}(S_i)=\begin{cases}\frac{S_i-0.7}{0.55-0.7}, & 0.55 \lhd S_i \lhd 0.7;\\ 1, & 0.45 \le S_i \le 0.55;\\ \frac{S_i-0.3}{0.45-0.3}, & 0.3 \lhd S_i \lhd 0.45;\end{cases} \quad (6)$$

$$\mu^{AAA}(S_i)=\begin{cases}\frac{S_i-0.9}{0.75-0.9}, & 0.75 \lhd S_i \lhd 0.9;\\ 1, & 0.7 \le S_i \le 0.75;\\ \frac{S_i-0.55}{0.7-0.55}, & 0.55 \lhd S_i \lhd 0.7;\end{cases} \quad (7)$$

$$\mu^{GA}(Si)=\begin{cases}\frac{S_i-0.75}{0.9-0.75}, & 0.75 \lhd S_i \lhd 0.9;\\ 1, & 0.9 \le S_i \le 1.\end{cases} \quad (8)$$

The main reason for choosing trapezoidal membership functions was to harmonise the idea of "clear-cut" intervals of full membership with fuzzy transition zones between subsets, while keeping the model's geometry and interpretation as simple as possible. A trapezoidal function differs from a triangular one by having a plateau with $\mu(S_i) = 1$ on the interval, rather than just at a single point. Trapezoidal (as well as triangular) functions provide linear interpolation between 0 and 1, so the calculation of membership degrees remains computationally simple and stable and does not complicate the implementation of the model (Khairuddin *et al.*, 2021). In applied problems (including spatial analysis of the tourist attractiveness of territories), trapezoidal/triangular functions are recommended as the "standard" due to the balance between accuracy and computational efficiency (Nuriyev, 2022). This form allows for flexible adjustment of the width of transition zones (how "blurred" the transition between classes of tourist attractiveness is) without changing the intervals of full membership themselves. Equipped with the tools of this methodology, a manager (investor) can also identify the competitive advantages of a given territory over others if it is selected as a priority for investment development. It is also possible to rank territories not based on all factors, but selectively based on those that are decisive for the development of a specific type of recreation (landscapes, geological landmarks, thermal springs, etc.). To determine the degree of influence of natural or historical and cultural resources on the amount of the tourist fee of the territory, a statistical method was used to determine the influence

of grouping features on the total variation of the feature, using the following values (Roshchyk, 2010).

Total variance:

$$\sigma^2 = \frac{\sum(x_i - \bar{x})^2 f_i}{\sum f_i}. \quad (9)$$

Within-group variance:

$$\frac{\sum(x_i - \bar{x})^2 f_{ij}}{\sum f_{ij}}. \quad (10)$$

Average of intragroup variances:

$$\bar{\sigma}^2 = \frac{\sum \sigma_j^2 f_i}{\sum f_i}. \quad (11)$$

Intergroup variance:

$$\delta^2 = \frac{\sum(\bar{x}_j - \bar{x})^2 f_i}{\sum f_i}. \quad (12)$$

Coefficient of determination:

$$\frac{\delta^2}{\sigma^2}. \quad (13)$$

Correlation coefficient:

$$\sqrt{\frac{\delta^2}{\sigma^2}} = \sqrt{\eta^2} = \eta, \quad (14)$$

where x_i – is the median value of the tourist fee in the i-th interval; $\bar{x}$ – average of a variable characteristic; $\bar{x}_j$ – the average for the j-th group; f_i – the number of local communities with the x_i attribute in the total set; $f_j = \sum f_{ij}$ – the total number of local communities in the j-th group; f_{ij} – number of local communities with the x_i attribute i-th group. To determine the uniformity of the distribution of recreational and tourism resources, or of revenue from the tourism fee, among local communities, this study uses the quadratic coefficient of variation:

$$V_\sigma = \frac{\sigma}{\bar{x}} \times 100\%, \quad (15)$$

where σ – the standard deviation of the standardised indices of communities' recreational and tourism resources, or the amounts of the tourism tax in the general population; $\bar{x}$ – the average arithmetic mean of standardised indices of communities' recreational and tourism resources, or the rates of the tourism fee. To determine the relationship between the availability of resources and revenue from the tourism fee in communities, Pearson's correlation coefficient was used:

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{(n\sum x^2 - (\sum x^2)(n\sum y^2 - (\sum y)^2)}}, \quad (16)$$

where $n = 64$ – number of territorial communities in Zakarpattia region; x – the value of the standardised index of recreational and tourism resources in a specific community; y – the amount of the tourist fee in a specific community.

There is no universal scale for interpreting Pearson's correlation coefficient in studies examining the relationship between recreational and tourism resources and tourism revenue. Given that tourism is a multifaceted phenomenon and that the communities in Zakarpattia region are highly heterogeneous, it is advisable to use moderately strict (medium) intervals that accurately reflect the actual complex relationships. Therefore, to assess the strength of the relationship between the resource endowment of local communities and the amount of the tourism fee, it is advisable to use Pearson's correlation coefficient, interpreted as follows: weak correlation – up to 0.30, moderate – 0.30-0.49, strong – 0.50-0.69, very strong – 0.70 and above. The empirical data for this study were compiled through an analysis of databases on the nature reserve sites in Zakarpattia (The Nature Reserve Fund of Zakarpattia..., n.d.), immovable cultural heritage (Ministry of Culture of Ukraine, n.d.). Data on the tourist fee in the Zakarpattia region in terms of territorial communities is not published for public access and is considered an internal document of Department of Tourism and Resorts of Zakarpattia Regional State Administration (2025). At the request of the author of the publication, the most recent data for 2025 was provided. The accuracy of the data regarding the amount of the tourist fee can be verified on the website of the Ministry of Finance of Ukraine (n.d.).

RESULTS

The 2020 administrative reform introduced significant changes to the administrative-territorial division of the Zakarpattia region: 64 territorial communities and 6 enlarged districts were formed: Rakhiv, Khust, Tyachiv, Mukachevo, Uzhhorod, Berehove (Resolution of Verkhovna Rada of Ukraine No. 33, 2020). To the latter were transferred control over resources from the former district administrations. On the one hand, this opened up new opportunities for local communities, on the other hand, it increased responsibility for the control and use of resources. One of the factors of socio-economic development can be the availability of recreational and tourist resources, which are one of the most important means of positioning in the tourism market. The use of the latter on the principles of the concept of sustainable development is the task of local communities. A set of recreational and tourist resources was highlighted as indicators for evaluating the attractiveness of territorial communities, after which they were combined and an integral indicator for each of them was derived. Thus, territorial communities were examined in quantitative aspects. Summary information on recreational and tourist resources of the Zakarpattia region, which are proposed for analysis in terms of territorial communities, is presented in Table 3.

The Zakarpattia region also has UNESCO heritage sites, such as the Church of the Ascension of the Lord (Strukivska) in the village of Yasinya and the Church of St. Michael the Archangel in the village of Uzhok (Stavne territorial community), but they have the status of cultural heritage sites of national significance. Natural UNESCO heritage sites include the "Primeval Beech Forests of the Carpathians and Other Regions of Europe," which are part of the primeval forests within the Carpathian Biosphere Reserve and adjacent protected areas of Zakarpattia.In accordance with the model described in the "Materials and Methods" section, a 64×17 matrix of grouped data is generated, since there are 64 communities in Zakarpattia region that are analysed according to 17 criteria for evaluating recreational and tourism resources. Moreover, criteria $F1$ ... $F3$ refer to historical

and cultural resources, while *F*4 ... *F*17 refer to natural recreational and tourism resources. The numerical values of the *F* parameters in this model are presented in Table 4 as the number of resource units available in a specific territorial community. The exception is the numerical parameters of factors *F*4 and *F*5, which are expressed in m^3/day.

Table 3. Classification of recreational and tourist resources in Zakarpattia region

Resource classification			Designation of the evaluation factor	Number of units or debit (m^3/day) for balneological resources.
Historical, architectural and intangible cultural heritage sites		Objects of historical and architectural heritage of national significance	F_1	84
		Objects of historical and architectural heritage of local significance	F_2	59
		Intangible cultural heritage objects	F_3	36
Natural	Balneological	Thermal waters	F_4	11,488 m^3/day
		Mineral waters	F_5	7,483 m^3/day
	Objects of the nature reserve fund	Botanical gardens of national significance	F_6	1
		Dendrological parks of local significance	F_7	2
		Monuments of landscape gardening art of national significance	F_8	1
		Monuments of landscape gardening art of local significance	F_9	32
		Local nature reserves	F_{10}	44
		Nature reserves of national significance	F_{11}	21
		Protected tracts	F_{12}	12
		Regional landscape parks	F_{13}	2
		National natural parks	F_{14}	3
		Biosphere reserves	F_{15}	1
		Natural landmarks of national significance	F_{16}	9
		Natural monuments of local significance	F_{17}	316

Source: prepared by the author based on data of The nature reserve fund of Zakarpattia oblast by territorial community (n.d.), Ministry of Culture of Ukraine (n.d.) and Department of Tourism and Resorts of Zakarpattia Regional State Administration (n.d.)

Table 4. Numerical values of the assessment factors for local communities in Zakarpattia region

Evaluation factor / Community	F_1	F_2	F_3	F_4 (m^3/day)	F_5 (m^3/day)	F_6	F_7	F_8	F_9	F_{10}	F_{11}	F_{12}	F_{13}	F_{14}	F_{15}	F_{16}	F_{17}
Baranyntsi				50					1								5
Velyky Berezny					58				2					1			3
Velyka Dobron											1		1				
Dubrynychy-Maly Berezhny	2				121												6
Kostryno	3	1			135					2				1		1	3
Onokivtsi	1															1	4
Perechyn					152												4
Serednje	1								1	1							3
Stavne	4				50					2	1			1			6
Surte	4		1						1				1				
Turya-Remeta	1				37					1	2	1					8
Uzhhorod	7	15		179	1,263	1			10								2
Chop			1										1				
Kholmok	2		1	150													1
Mukachevo	5	13		388	12		1		4	2		1					4
Svaljava	1																3
Volovets	3		1		9						2						3
Zhdenijevo	2		1		3					3						1	4
Kolchyno				200													2

Table 4. Continued

Evaluation factor / Community	F_1	F_2	F_3	F_4 (m³/day)	F_5 (m³/day)	F_6	F_7	F_8	F_9	F_{10}	F_{11}	F_{12}	F_{13}	F_{14}	F_{15}	F_{16}	F_{17}
Chynadiyevo	3	1		375				1				1	1				4
Velyky Luchky													1				
Verkhny Koropets					29		1										1
Horonda																	
Ivanivtsi												1					1
Nelipyno																	
Nyzhny Vorota	3	1	1							2							2
Poliana					600					3							9
Batjove			1		480												1
Berehove	8	15	2	2,880	369				3	1		1					3
Velyky Berehy	1		1									1	1			1	
Velyka Biyhan	1		1	80	81					4							5
Vylok	2		1										1				1
Vinogradiv	4	4	1	160					4	2	1		1		1		4
Korolevo	3		1		36								1				
Kamjanske	1				3												
Pyterfolvo	1	2	1	525						2	1		1				2
Koson	1		1	6,000								1					
Bilky	1																2
Vyshkovo		1		205	34												6
Horinchovo																	3
Dovhe		3									1						2
Drahove														1	1		2
Zarichcha																	
Irshava	4			296	100					1	1			1		1	4
Kolochava	2		1		174									1			1
Keretsky					69				1			2					4
Mizhhirya	4		1		1,015						1					2	27
Pylypets	9		1		571												14
Synevir	1		1							2	1			1			4
Khust	8	2	1		95										1		19
Bedevlja																	
Bushtyno					184				2			2					6
Vilchivtci					75												2
Dubove					8					1							1
Neresnytsa					64										1		11
Solotvyno	4																3
Teresva																	1
Tjachiv	1								1								4
Uglja	2				15										1		15
Ust-Chorna					66					5	6	1					8
Rakhiv	1	1	4		220				1	1					1	1	24
Bohdan			3		2					4					1		9
Velyky Bychkiv			3		244					2	1				1		16
Yasinya	3		5		1,109				1	3	2				1	1	34

Source: prepared by the author based on data of The nature reserve fund of Zakarpattia oblast by territorial community (n.d.), Ministry of Culture of Ukraine (n.d.) and Department of Tourism and Resorts of Zakarpattia Regional State Administration (n.d.)

The existence of various restrictions and risks in planning the development of the recreational sector in general, and local communities in particular, creates an environment of uncertainty for regional management. Attracting additional resources (material, financial) to local communities requires studying them in terms of their recreational and tourist value, infrastructure development, investment attractiveness, etc. In other words, managers must have the necessary tools for comprehensive analysis of recreational areas for effective management and study of socio-economic development opportunities. Such tools can be created, in particular, with the help of the fuzzy set theory mentioned above, through mathematical modelling of the recreational and tourist attractiveness of territories, which will make it possible to determine their level of competitiveness in the recreational investment market. Using Formula (1), the absolute values of the *F* criteria are converted into standardised indices for local communities ranging from 0 to 1. In this context, the evaluation factors are grouped into historical and cultural resources and

natural recreational and tourism resources. The trapezoidal membership functions $\mu(S_i)$ of all fuzzy terms of the output variable shown in Figure 1 will take the analytical form shown in Table 5.

Table 5. Affiliation of territorial communities of Zakarpattia region to a specific linguistic term as a result of the assessment of recreational and tourist resources

Linguistic terms	Sum of historical and cultural resource indices S_i [0;1]	Sum of natural resource indices S_i [0;1]	Territorial communities	Degree of belonging (%)	Sum of indices for all resources S_i [0;1]
The greatest recreational and tourist attractiveness (GA)	1	0.62	Berehove	100	1
	0.32	1	Yasinya	78	0.867
	0.88	0.46	Uzhhorod	47	0.821
Above average attractiveness level (AAA)			Yasinya	22	0.867
			Uzhhorod	53	0.821
	0.08	0.86	Koson	57	0.636
	0.72	0.305	Mukachevo	49	0.624
	0.16	0.72	Irshava	23	0.584
Average attractiveness (AA)			Koson	43	0.636
			Mukachevo	51	0.624
			Irshava	77	0.584
	0.44	0.42	Khust	100	0.541
	0.2	0.62	Mizhhirya	100	0.536
	0.24	0.58	Rakhiv	100	0.532
	0.4	0.36	Pylypets	100	0.478
	0.36	0.29	Vinogradiv	70	0.405
	0.12	0.44	Velyky Bychkiv	47	0.37
	0.12	0.38	Kholmok	19	0.329
Attractiveness level below average (BA)			Vinogradiv	30	0.405
			Velyky Bychkiv	53	0.37
			Kholmok	81	0.329
	0	0.42	Ust-Chorna	100	0.284
	0.08	0.32	Uglja	100	0.267
	0.12	0.28	Bohdan	100	0.26
	0.08	0.29	Dubrynychy-Maly Berezhny	95	0.243
	0.16	0.197	Chynadiyevo	85	0.227
	0	0.33	Poliana	83	0.225
	0.16	0.19	Pyterfolvo	83	0.225
	0.16	0.185	Stavne	79	0.219
	0.16	0.164	Kostryno	69	0.204
	0.04	0.25	Turya-Remeta	63	0.194
	0.08	0.2	Velyka Biyhan	57	0.185
	0.12	0.16	Zhdenijevo	53	0.179
	0.2	0.085	Nyzhni Vorota	49	0.173
	0	0.25	Neresnytsa	49	0.173
	0.16	0.103	Volovets	42	0.163
	0	0.23	Bushtyno	37	0.156
	0.08	0.144	Synevir	30	0.145
	0.2	0.04	Surte	30	0.145
	0.16	0.059	Solotvyno	22	0.133
	0.04	0.15	Vyshkovo	18	0.127
	0.12	0.067	Kolochava	10	0.115
	0.16	0.22	Korolevo	5	0.108
	0	0.15	Keretsky	3	0.105

Table 5. Continued

Linguistic terms	Sum of historical and cultural resource indices S_i [0;1]	Sum of natural resource indices S_i [0;1]	Territorial communities	Degree of belonging (%)	Sum of indices for all resources S_i [0;1]
Least attractive territorial communities (LA)			Dubrynychy-Maly Berezhny	5	0.243
			Chynadiyevo	15	0.227
			Poliana	17	0.225
			Pyterfolvo	17	0.225
			Stavne	21	0.219
			Kostryno	31	0.204
			Turya-Remeta	37	0.194
			Velyka Biyhan	43	0.185
			Zhdenijevo	47	0.179
			Nyzhny Vorota	51	0.173
			Neresnytsa	51	0.173
			Volovets	58	0.163
			Bushtyno	63	0.156
			Surte	70	0.145
			Synevyr	70	0.145
			Solotvyno	78	0.133
			Vyshkovo	82	0.127
			Kolochava	90	0.115
			Korolevo	95	0.108
			Keretsky	97	0.105
	0.12	0.04	Dovhe	100	0.098
	0.12	0.04	Vylok	100	0.098
	0.04	0.1	Serednje	100	0.093
	0.04	0.1	Onokivtsi	100	0.093
	0.04	0.1	Tjachiv	100	0.093
	0.08	0.06	Velyky Berehy	100	0.087
	0	0.13	Velyky Berezny	100	0.0867
	0	0.123	Baranyntsi	100	0.0857
	0.04	0.085	Batjove	100	0.08
	0	0.11	Perechyn	100	0.072
	0.04	0.6	Svaljava	100	0.064
	0	0.085	Drahove	100	0.059
	0.04	0.0339	Bilky	100	0.052
	0	0.068	Kolchyno	100	0.046
	0	0.06	Horinchovo	100	0.041
	0	0.053	Vilchivtci	100	0.036
	0.04	0.017	Chop	100	0.035
	0	0.47	Verkhny Koropets	100	0.032
	0	0.043	Dubove	100	0.03
	0	0.04	Ivanivtsi	100	0.029
	0	0.04	Velyka Dobron	100	0.0289
	0.04	0.0004	Kamjanske	100	0.023
	0	0.017	Velyky Luchky	100	0.017
	0	0.02	Teresva	100	0.014
	0	0	Nelipyno	100	0
	0	0	Horonda	100	0
	0	0	Bedevlja	100	0
	0	0	Zarichcha	100	0

Source: prepared by the author based on data of The nature reserve fund of Zakarpattia oblast by territorial community (n.d.), Ministry of Culture of Ukraine (n.d.) and Department of Tourism and Resorts of Zakarpattia Regional State Administration (n.d.)

The data in the table allows the following preliminary conclusions to be drawn. There is an uneven distribution of recreational and tourism resources among communities (the quadratic coefficient of variation is 1.05, or 105%). The communities of Berehove, Yasinya, Uzhhorod, Koson, Mukachevo, and Irshava have the greatest recreational and tourist appeal in terms of resource potential. Mizhhirya, Pylypets, Khust, and Rakhiv can also be considered

significant. More than half of the territorial communities are included in the subset of the least recreationally and touristically attractive communities. Four communities have no recorded tangible or intangible historical and cultural heritage sites or protected natural areas of local or national significance (Nelipyno, Horonda, Zarichcha, Bedevlja).

The most significant resources that act as tourist magnets in the Berehove, Koson, and Khust territorial communities are the significant thermal water resources with developed infrastructure for balneological recreation, historical and architectural resources, in particular, Khust Castle, architectural ensembles in the centres of Khust and Berehove, as well as rural green tourism and ethno-tourism in Hungarian villages. The basis for the development of recreation and tourism in the Uzhhorod and Mukachevo territorial communities is the concentration of the most valuable historical and architectural monuments (Mukachevo Castle "Palanok", Uzhhorod Castle, Holy Cross Cathedral with the Bishop's Residence, etc.) combined with the presence of thermal and mineral waters, as well as a developed logistics and tourism infrastructure. The prerequisite for the development of tourism and recreation in the Irshava, Mizhhirya, Pylypets, and Rakhiv territorial communities is the landscape resources based on protected natural areas, such as the Synevyr National Nature Park, the Carpathian Biosphere Reserve, Zacharovany Krai National Nature Park, Shipit Waterfall, Lake Synevyr, etc. It should also be noted that belonging to the category of the least tourist-attractive communities does not mean that there are no prospects for the development of the recreation and tourism sector in them. It only reflects the resource potential in relation to other communities. Communities in the above category accumulate 22% of the recreational and tourism resource potential of the Zakarpattia region, while generating 24% of the region's tourism fee. Figure 2 shows the territorial communities whose share in tourism revenue is incomparably greater than their resource potential.

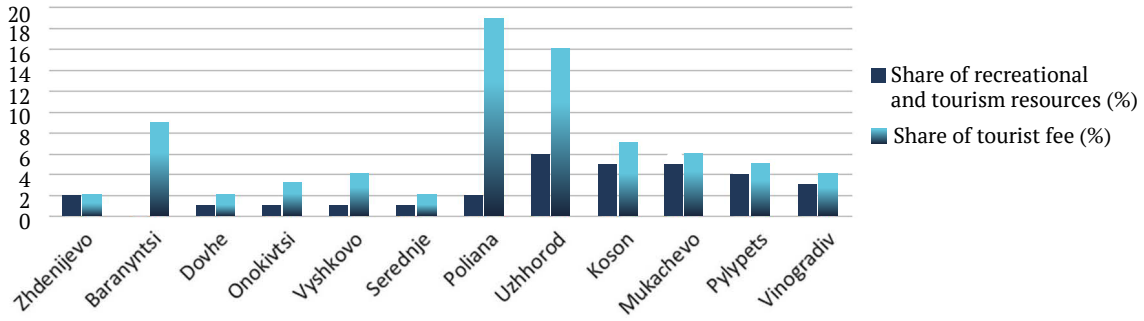

Figure 2. Ratio of local community revenues to their recreational and resource potential as a percentage of the regional total

Source: prepared by the author based on data of The nature reserve fund of Zakarpattia oblast by territorial community (n.d.), Ministry of Culture of Ukraine (n.d.) and Department of Tourism and Resorts of Zakarpattia Regional State Administration (n.d.)

As can be seen from the figure, even communities with the smallest share of resource potential can have a significantly greater financial impact by using socio-economic levers: logistics, marketing, infrastructure, human resources, etc. There is a certain synergistic effect that can serve as an example for communities with relatively poorer resource potential. The communities of Poliana, Uzhhorod, Baranyntsi, Vyshkovo, and Onokivtsi are leaders in this regard. A number of communities also exhibit reverse synergy. Despite their significant resource potential, these communities generate relatively lower financial returns (Fig. 3). Communities such as Irshava, Rakhiv, Velyky Bychkiv, Kholmok, Ust-Chorna, Bohdan, Dubrynychi-Maly Berezhny, Stavne and Kostryna, which control over 23% of the region's recreational and tourism potential, together generate less than 1% of tourism fee.

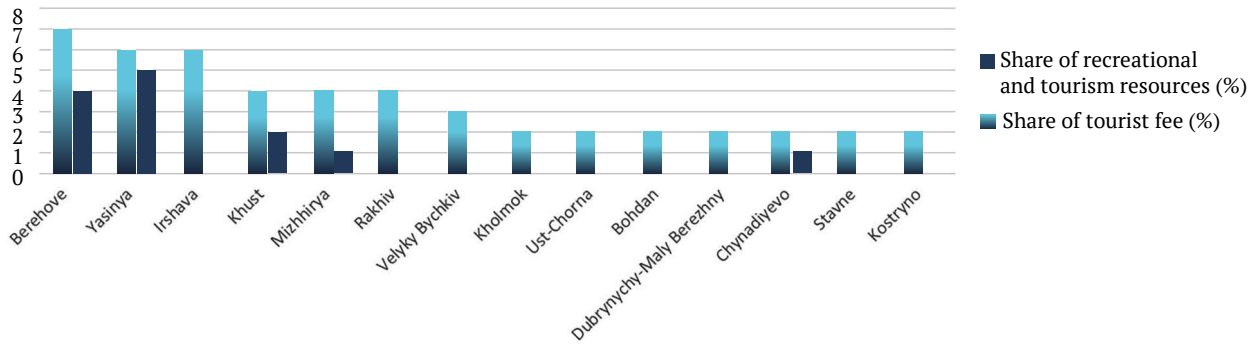

Figure 3. Ratio of local community revenues to their recreational and resource potential as a percentage of the regional total

Source: prepared by the author based on data of The nature reserve fund of Zakarpattia oblast by territorial community (n.d.), Ministry of Culture of Ukraine (n.d.) and Department of Tourism and Resorts of Zakarpattia Regional State Administration (n.d.)

Using the methodology of compiling and grouping statistical data, and analysing variations and correlations between dispersions, the degree of correlation between the availability of natural or historical and cultural resources in local communities and the amount of tourist revenue generated was determined. To do this using Sturges method for selecting the number of groups (intervals) in a variation series (Roshchyk, 2010), 64 territorial communities in Zakarpattia Oblast were classified into one of seven groups based on the criterion of income from the tourism fee. Using the data of Table 5, communities were divided into those for which natural or historical and cultural resources play a dominant role. The summary data are presented in Table 6.

Table 6. Distribution of territorial communities by natural and historical-architectural resources depending on the amount of tourist fee (thousand UAH)

Amount of tourist fee (thousand UAH)	Total number of communities,	Number of communities with a predominance in natural resources,	Number of communities with a predominance of historical and cultural resources,
Up to 500	49	36	13
500 – 1,000	5	3	2
1,000 – 1,500	3	1	2
1,500 – 2,000	3	1	2
2,000 – 2,500	1	1	-
2,500 – 3,000	1	1	-
3,000 or more	2	1	1
In total	64	44	20
The dispersion	General $\sigma^2 = 513{,}431$	$\sigma_1^2 = 460{,}098$	$\sigma_2^2 = 597{,}500$
Intergroup dispersion	$\delta^2 = 7{,}645$		
Coefficient of determination $\frac{\delta^2}{\sigma^2} = 0.15$; Correlation coefficient $\sqrt{\frac{\delta^2}{\sigma^2}} = \sqrt{\eta^2} = \eta = 0.12$			

Source: developed by the author

Thus, assessing the strength of the relationship between the size of the tourist fee and the presence of one of the types of recreational and tourist resources (natural or historical and cultural), it was found that the level of income is only 1.5% influenced by the presence of one of them. Since the correlation coefficient corresponds to the range [0-0.3], we concluded that there is a weak connection between the level of income and the type of recreational and tourist resources. After calculating Pearson's correlation coefficient using Equation 16 and the data from Table 5, it was found that the presence of recreational and tourism resources generally has a moderate effect on the amount of the tourism fee ($r = 0.46$). The presence of either historical and cultural resources ($r = 0.43$) or natural recreational and tourism resources ($r = 0.33$) also has a moderate impact on the amount of tourism fees collected by local communities and falls within the same range of values [0.3-0.49]. Calculation of the coefficient of variation of tourist fee for 64 territorial communities based on the general set established its value at 2.23, or 223%, which indicates its heterogeneity. A total of 7 communities generate 68% of the tourist fee in Zakarpattia region. The median value of the tourist fee is estimated at UAH 47.3 thousand (the maximum is UAH 6,177.3 million in the Poliana territorial community).

DISCUSSION

The results confirmed the very high spatial heterogeneity of the recreational and tourism potential of communities in Zakarpattia, as well as even greater variation in tourism fee. It was found that only 7 communities account for 68% of tourism fee, while four communities have no cultural heritage sites or nature reserves at all. A weak correlation was found between the type of resources (natural or historical and cultural) and the size of the tourist fee, which is interpreted as the importance of the dominance of the "integral management factor" (logistics, infrastructure, marketing, and community cooperation). Methodologically, a combination of the classical index model with subsequent fuzzy classification (trapezoidal membership functions for five linguistic levels of recreational and tourist attractiveness) and spatial statistical analysis of Pearson's correlation coefficient, variation and dispersion was proposed. This allowed not only for the development of a rating but also for its interpretation in terms of "lowest / below average / average / above average / highest attractiveness", with the possibility of partial membership of communities in adjacent subsets. These conclusions are then superimposed on financial results (tourism fee) to identify synergistic and "anti-synergistic" effects within communities.

A number of foreign studies also use fuzzy logic to assess tourism attractiveness, but the emphasis is placed on other aspects. For example, the authors X. Gu *et al*. (2022), in their assessment of the attractiveness of natural destinations based on the fuzzy-AHP approach, focused primarily on the structure of the criteria (landscape aesthetics, ecological sensitivity, accessibility, infrastructure), while fuzziness was introduced primarily into the weights and expert judgments. Unlike this study, where fuzzy logic is applied to an integrated index at the municipal level, the study by the above-mentioned authors works with more detailed spatial units (local nature-oriented destinations) and emphasises the ecological dimension of sustainability. At the same time, both approaches agree that a strict "clear" division of evaluation criteria (for example, based solely on the number of protected natural areas) does not reflect actual attractiveness, and flexible fuzzy gradations based on the analysis of multiple criteria are necessary. A group of researchers led by A. Nguyen *et al*. (2026), who, using a hybrid method combining Fuzzy AHP and Fuzzy

TOPSIS, identified the transportation system as the most influential criterion for the sustainable development of agritourism in one of Vietnam's regions, followed by the attractiveness of tourism resources and the diversity of landscape resources. The authors recommend priority policy directions at the national and local levels to improve infrastructure, engage communities, and promote digital transformation for the purpose of sustainable agritourism. Such conclusions demonstrate the importance of multi-criteria analysis specifically of recreational and tourism resources, as conducted in this study, as an important (but not sufficient) condition for regional development.

The model of regional tourism competitiveness based on the Fuzzy Delphi-Fuzzy AHP-PROMETHEE method, developed for the counties of the West Pomeranian Voivodeship in Poland, is also based on the multifactorial nature of attractiveness (natural and man-made attractions, location, and recreational infrastructure). Researchers A. Stecyk *et al*. (2021) use numerical values to formalise experts' linguistic assessments and obtain a stable competitiveness ranking of tourist destinations. The approach to ranking territorial communities in the Zakarpattia region in this study is fundamentally similar in the logic of fuzzy index modelling, but the difference lies in the fact that in this work, the fuzziness is based not on subjective expert opinions, but on standardised objective indicators (number of sites, water discharge, area of protected natural areas), which reduces the risk of prejudice and increases the model's reproducibility in new territories. The relevance of such approaches was also demonstrated by researcher A. Nuriyev (2022), who argued that for selecting tourist destinations in countries with limited statistical data, it is advisable to use multi-criteria models based on Z-scores, which account for both the fuzziness and reliability of information. The proposed Z-TOPSIS and Z-PROMETHEE methods with direct calculations allow for the correct ranking of alternatives without loss of information, showing consistent results for the regions of Azerbaijan.

Researchers B. Gavurova & V. Polishchuk (2025) developed a new hybrid model of sustainable tourism in the Visegrad Group countries (a matrix of normalised scores by criteria groups + an expert assessment of the sustainability level based on a survey of 2,343 respondents). Authors B. Gavurova *et al*. (2025) also applied multi-criteria approach to assess the tourist attractiveness of regions. Although there is no "classical" fuzzy logic there, the authors effectively work with linguistic variables (perception of sustainability, satisfaction, etc.), the conversion of which into numerical indices is similar to the methodology of this study regarding the transition from linguistic levels to trapezoidal membership functions. This confirmed the validity of the thesis in the proposed study regarding the advisability of hybrid models that combine statistical (variation, correlation) and fuzzy tools to support managerial decisions in tourism. A separate body of research shifts the focus from resources to the actual behaviour of tourists. Author K. Kondo (2025) proposed a regional attractiveness index derived from a model of trip choice and inter-municipal flows, which is scale-independent and based on actual trip destination choices. The author demonstrates that destinations with relatively limited resource potential but unique attractions (theme parks, events) can have a high attractiveness index, while resource-rich areas remain "underutilised" in tourist flows. These findings fully correlate with the idea of the proposed study regarding "synergistic" and "reverse-synergistic" communities. Some communities with low resource potential exceed the expected level of tourist revenue thanks to infrastructure, marketing, and logistics, while others, resource-rich communities, fail to transform their potential into financial results.

Global city attractiveness indices based on "digital footprints" (such as the Yanolja Attractiveness Index) generally model attractiveness as a function of reputation and information "noise" on social media and in search queries, combining sentiment analysis with flow statistics. In this approach, the authors S. Jang *et al*. (2025) argued that natural and cultural resources indirectly influence rankings through tourists' perceptions and experiences. In contrast, this study demonstrates a "resource-oriented" approach in the first stage, but the conclusions highlight the importance of the behavioural level, affirming that the ability of communities to integrate resources, develop logistics, marketing, and cooperation is decisive. Thus, the empirical results of this study confirm the current trend away from purely resource-based models toward models where tourist behaviour and managerial decisions modulate realised attractiveness. A similar conclusion was reached by M.J. Ibáñez *et al*. (2024), who argued that the attributes of tourist destination attractiveness do not operate in isolation but in configurations that differently stimulate the volume of leisure travel in the pre- and post-COVID periods. In the pre-pandemic period, two types of configurations were identified-"safety-oriented" (focused on safety and hygiene) and "eco-systemic" (emphasising tourism priorities, sustainable development, and infrastructure), whereas post-pandemic, priorities regarding public health, high-quality tourism infrastructure, and cultural resources have become key, with a relative decline in the role of safety and security. Similar studies on changes in the recreational and tourism appeal of regions under the influence of external factors are relevant to this work, where the subject is the Zakarpattia region, which borders four European Union countries and, following the external factor of Russia's full-scale invasion, became a place of rest and recovery for the rest of Ukraine, as the safest region without a curfew.

Another trend is the emergence of niche attractiveness indices focused on specific groups of mobile users, such as the Digital Nomad Friendliness (DNF) Index. According to the authors M. Zhang *et al*. (2026), the attractiveness of cities for digital nomads is assessed using a requirements tree and the multi-criteria MIVES (Integrated Value Model for Sustainable Evaluation) model, where the weights of the criteria (landscape aesthetics, quality of public spaces, community, safety) are determined by stakeholders. The authors emphasise that landscape aesthetics and the presence of an active local community, rather than just economic parameters, proved to be the decisive drivers. This aligns with the thesis of this study that resources without corresponding local interaction, infrastructure, and event practices do not guarantee high revenues. This study derives general indices of recreational tourism attractiveness, indicating the possibility of ranking territories based on specific subsets of factors for particular types of recreation. This idea conceptually resonates with niche DNF indices

and similar models (for sports, event, and gastronomic tourism), where criteria are selected for a specific segment and the implementation of fuzzy membership functions can be adapted. Given international examples, such segmentation of the model proposed in this study can be considered a promising direction for further research.

In a study on the multi-criteria assessment of the recreational potential of a post-industrial region, author I. Merylova (2025) also examined comprehensive indices of a territory's suitability for various types of recreation, combining natural, historical-cultural, and socio-economic criteria. As in the present study, strong spatial heterogeneity was identified, and territories were classified by potential level, highlighting the cores of recreational development. However, the multi-criteria evaluation method in the aforementioned author's work operates on a "clear" scoring scale, whereas the fuzzy model proposed in this study allows for the formalisation of transitional states and uncertainty when assigning communities to classes. Thus, the approach of this study is consistent with international practice in multi-criteria territorial assessment but complements it with a more flexible fuzzy toolkit.

CONCLUSIONS

The study's findings revealed significant disparities in the distribution of recreational and tourism resources and tourism fee revenues among the local communities of Zakarpattia region. Four communities have neither cultural heritage sites nor nature reserves, and in eleven, no payment of the tourism fee has been recorded at all; all of them belong to the group with the lowest tourism appeal. At the same time, the analysis showed that even such communities possess alternative resources capable of stimulating tourism development. These include logistical resources (border location, proximity to transportation hubs), industrial resources (manufacturing facilities, farms, industrial heritage sites), as well as gastronomic and event-based resources. In particular, the use of Vylok's border location and the "Maly Berezny-Ublia" border crossing, as well as the transport hub in Batyovo, looks promising. Tyachiv and the Teresva community also have significant potential due to their proximity to Ukrainian villages in Romania. The Borzhava narrow-gauge railway, the chocolate factory in Bushtyno, the buffalo farms in Horinchevo and Oleshnyk, as well as the traditions of greenhouse vegetable farming in a number of villages, could become important tourist attractions. Statistical analysis has shown that community revenues depend not so much on individual types of resources as on the ability to use them comprehensively in cooperation with other communities. This underscores the need for spatial planning of territorial development, the formulation of effective strategies, and the consolidation of efforts by academia, business, government, and the public. A perspective for further research is the development of integrated indices that take into account not only natural and cultural resources but also alternative factors – logistical, industrial, gastronomic, and event-related. This will allow for a more objective identification of the "hidden" tourism potential of communities with low traditional attractiveness scores. Efforts should focus on modeling various forms of cooperation among local communities (clusters, tourist routes, joint brands) and assessing their impact on revenue, tourist flows, and local development. The use of GIS technologies and economic-mathematical models will make it possible to determine optimal directions for the development of transport, border, and service infrastructure, as well as to identify "bottlenecks" in the territorial organisation of tourism.

ACKNOWLEDGEMENTS

None.

FUNDING

None.

CONFLICT OF INTEREST

None.

REFERENCES

[1] Barvinok, N. (2023). Assessment of tourist and recreational potential and tourist infrastructure in individual united territorial communities of Kirovograd region. *Economies' Horizons*, 2(24), 4-20. doi: 10.31499/2616-5236.2(24).2023.281149.

[2] Department of Tourism and Resorts of Zakarpattia Regional State Administration. (2025). *Tourist tax monitoring data by communities*. Retrieved from https://zaktour.gov.ua/u-2025-rotsi-na-zakarpatti-splatyly-majzhe-32-mln-hrn-turystychnoho-zboru/.

[3] Gavurova, B., & Polishchuk, V. (2025). Knowledge management in tourism: Leveraging fuzzy modelling to understand and predict tourist behaviour in the V4 countries. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 20(3), 1165-1208. doi: 10.24136/eq.3819.

[4] Gavurova, B., Polishchuk, I., & Polishchuk, V. (2025). Multi-criteria hybrid model of region assessment in the context of sustainable tourism. *Journal of Business Economics and Management*, 26(4), 880-900. doi: 10.3846/jbem.2025.24601.

[5] Gu, X., Hunt, C.A., Jia, X., & Niu, L. (2022). Evaluating nature-based tourism destination attractiveness with a fuzzy-AHP approach. *Sustainability*, 14(13), article number 7584. doi: 10.3390/su14137584.

[6] Hou, M., Zhang, M., & Sun, Y. (2023). Greening tourism with environmental wellness: Importance of environmental engagement, green tourist intentions, and tourists' environmental stimulus. *Environmental Science and Pollution Research International*, 30(33), 79846-79860. doi: 10.1007/s11356-023-28052-4.

[7] Hutsal, L., & Shorobura, I. (2023). Formation of tourist attractiveness of territorial communities in Ukraine. *Economy and Society*, 49. doi: 10.32782/2524-0072/2023-49-47.

[8] Ibáñez, M.J., Ponce Oliva, R.D., & Diaz Avendaño, J. (2024). Tourism metamorphosis: Reshaping destination attractiveness in a post-pandemic world. *Journal of Infrastructure, Policy and Development*, 8(7), article number 4806. doi: 10.24294/jipd.v8i7.4806.

[9] Jang, S., Choi, K., & Yoon, H.W. (2025). Yanolja attractiveness index: Understanding a metric for measuring the attractiveness of global tourism cities. *Yanolja Research Insights*, 30.
[10] Khairuddin, S.H., Hasan, M.H., Akashah, E.P., & Hashmani, M.A. (2021). Generating type 2 trapezoidal fuzzy membership function using genetic tuning. *Computers, Materials & Continua*, 71(1), 717-734. doi: 10.32604/cmc.2022.020666.
[11] Kondo, K. (2025). Measuring the attractiveness of trip destinations based on human mobility data. *Scientific Reports*, 15, article number 45485. doi: 10.1038/s41598-025-29023-0.
[12] Liu, F. (2024). Design and application of a TOPSIS-based fuzzy algorithm: A case study from tourism attraction evaluation. *International Journal of Advanced Computer Science and Applications*, 15(12), 427-434. doi: 10.14569/IJACSA.2024.0151245.
[13] Melnyk, A.V., Melnyk, N.V., Kacharovskyi, R.Ye., & Selezniova, O.V. (2023). Determinants of forming the tourist attractiveness of amalgamated territorial communities. *Agrosvit*, 2, 35-41. doi: 10.32702/2306-6792.2023.2.35.
[14] Merylova, I. (2025). Multi-criteria evaluation of recreational potential in post-industrial landscapes: A case study of the Prydniprovsk region. *Civil Engineering and Architecture*, 13(6), 4179-4193. doi: 10.13189/cea.2025.130607.
[15] Ministry of Culture of Ukraine. (n.d.). *State register of immovable monuments of Ukraine*. Retrieved from https://mcsc.gov.ua/kulturna-spadshchyna/derzhavnyy-reiestr-nerukhomykh-pam-iatok-ukrainy/.
[16] Ministry of Finance of Ukraine. (n.d.). *Execution of local budget revenues*. Retrieved from https://www.mof.gov.ua/uk/vykonannia-dokhodiv-mistsevykh-biudzhetiv.
[17] Nguyen, A.T., Nguyen, T.L., Le, N.A., Phuong, N.T., Do, T.T., Thi, T.T., & Le, H.T. (2026). A hybrid approach combining Fuzzy AHP and Fuzzy TOPSIS to rank agritourism destinations in Tan Cuong green tea region, Thai Nguyen, Vietnam. *Environmental and Sustainability Indicators*, 29, article number 101039. doi: 10.1016/j.indic.2025.101039.
[18] Nuriyev, A.M. (2022). Fuzzy MCDM models for selection of the tourism development site: The case of Azerbaijan. *F1000Research*, 11, article number 310. doi: 10.12688/f1000research.109709.1.
[19] Resolution of Verkhovna Rada of Ukraine No. 33 "On the Formation and Liquidation of Districts". (2020, July). Retrieved from https://zakon.rada.gov.ua/laws/show/807-20#Text.
[20] Roshchyk, I.A. (2010). *Socio-economic statistics*. Rivne: National University of Water and Environmental Engineering.
[21] Slavik, R., Saliuk, M., & Mykyta, M. (2020). Assessment of socio-economic indicators of administrative districts of Zakarpattia region in the context of recreation and tourism infrastructure development. *Journal of Socio-Economic Geography*, 28, 78-88. doi: 10.26565/2076-1333-2020-28-09.
[22] Song, Z. (2025). Research on assessing comprehensive competitiveness of tourist destinations within cities, based on field theory and competitiveness theory. *Sustainability*, 17(1), article number 90. doi: 10.3390/su17010090.
[23] Stecyk, A., Sidorkiewicz, M., & Orfin-Tomaszewska, K. (2021). Model of regional tourism competitiveness: Fuzzy multiple-criteria approach (FDM-FAHP-PROMETHEE II framework). *European Research Studies Journal*, 24(3), 638-663. doi: 10.35808/ersj/2376.
[24] The nature reserve fund of Zakarpattia oblast by territorial community. (n.d.). Retrieved from https://pzf.land.kiev.ua/pzf-obl-7.html.
[25] Yermachenko, V., Melnychenko, S., Sidak, M., Dupliak, T., & Losytka, T. (2024). Sustainable tourism in the post-war reconstruction of territorial communities in Ukraine. *Access Journal*, 5(1), 34-57. doi: 10.46656/access.2024.5.1(3).
[26] Zhang, M., Zhong, Y., Tan, L., Shi, H., Liu, J., Jiang, Y., & Wang, M. (2026). Mapping the attractiveness of globally important agricultural heritages to digital nomads: A stakeholder-driven, multi-criteria evaluation framework. *Heritage Science*, 14, article number 21. doi: 10.1038/s40494-025-02240-6.

Роман Славік
Кандидат економічних наук, доцент
Державний вищий навчальний заклад «Ужгородський національний університет»
88000, вул. Університетська, 14, м. Ужгород, Україна
https://orcid.org/0000-0002-6198-3202

Оцінка рекреаційного та туристичного потенціалу муніципалітетів з використанням методу нечітких множин

Анотація. Дослідження є актуальним у зв'язку з необхідністю вдосконалення оцінювання рекреаційно-туристичної привабливості муніципалітетів у межах нової адміністративно-територіальної системи України, зокрема громад Закарпатської області. Метою роботи було визначення рівня їх туристичної привабливості з використанням теорії нечітких множин для кількісного відображення невизначеності багатофакторних рішень. Для аналізу взаємозв'язку між ресурсами та надходженнями від туристичного збору застосовано нечітке моделювання з трапецієподібними функціями належності та статистичні методи. Отримані результати підтвердили значну неоднорідність просторового розподілу рекреаційно-туристичних ресурсів: коефіцієнт варіації інтегрального індексу становив 105 %, що свідчить про різкі відмінності між громадами. До групи з найвищою привабливістю увійшли Берегівська, Ясінянська, Ужгородська, Косоньська, Мукачівська та Іршавська громади; значний потенціал також мають Міжгірська, Пилипецька, Хустська та Рахівська громади. Понад половина громад Закарпаття належить до найменш привабливих; чотири з них не мають жодних об'єктів культурної спадщини або природно-заповідного фонду. Виявлено розрив між ресурсним потенціалом і фінансовими результатами: сім громад забезпечують 68 % надходжень від туристичного збору, тоді як найменш привабливі акумулюють 22 % потенціалу та генерують 24 % надходжень, що вказує на можливість синергетичного ефекту завдяки логістиці, маркетингу, інфраструктурі та людським ресурсам. Натомість громади з 23 % потенціалу формують менше 1 % доходів, що свідчить про «зворотну синергію». Статистичний аналіз показав, що лише 1,5 % варіації доходів пояснюється типом ресурсів. Ключовим чинником є не тип ресурсу, а здатність громад інтегровано використовувати сукупний ресурсний потенціал у співпраці з сусідніми громадами. Практична цінність дослідження полягає у запропонуванні нечіткої моделі як аналітичного інструменту для стратегічного планування, брендингу та підвищення конкурентоспроможності муніципалітетів

Ключові слова: територіальні громади Закарпатської області; нечітка логіка; індекс територіальної привабливості; туристичний збір; сталий розвиток туризму; просторовий і статистичний аналіз

ECONOMICS OF DEVELOPMENT

Journal homepage: https://ecdev.com.ua/

ISSN: 1683-1942
E-ISSN: 2304-6155

Vol. 25, No. 1, 2026

UDC 336.71:330.59
DOI: 10.63341/econ/1.2026.56

Dina Mohyee
PhD in Economics, Assistant Professor
Ain Shams University
11566, El-Khalyfa El-Mamoun Str., Cairo, Egypt
https://orcid.org/0000-0002-7044-0998

Noura Anwar Abdel-Fatah*
PhD in Biostatistics, Associate Professor
Cairo University
12613, 1 Gamaa Str., Giza, Egypt
Associate Professor
Badr University in Cairo
11829, Badr City, Cairo, Egypt
https://orcid.org/0000-0002-0339-2252

Noha Yahya
PhD in Economics, Assistant Professor
Ain Shams University
11566, El-Khalyfa El-Mamoun Str., Cairo, Egypt
https://orcid.org/0009-0006-9589-1679

Investigating financial exclusion through the lens of socio-economic inequalities: Implications for financial well-being

Abstract. The aim of the study was to measure the level of socio-economic inequalities appeared due to financial exclusion and then to measure their effect on financial well-being of people according to the different socioeconomic characteristics. This research used the 2021 version of Global Findex Survey and was disseminated in 2023 with a sample of 1,003 respondents. The inequality in financial exclusion is measured using the concentration index and the concentration curves. For studying the effect of financial exclusion on financial well-being, binary logistic regression model is used. The results of this research revealed that socio-economic inequalities represented drivers for financial exclusion exemplified in poor, females, rural, unemployed, least educated and young population. With respect to access exclusion, results revealed that 76.7% of the poorest 20%, 70% of the females, 70% of the rural, 68.5% of the unemployed, 65.7% of the uneducated and 85.3% of the young respondents were unbanked. On the other hand, with respect to usage exclusion, results revealed that 88.7% of the poorest 20%, 78.8% of the females. 80% of the rural, 77.7% of the unemployed, 76.8% of the uneducated and 90.8% of the young respondents had inactive accounts. Additionally, results of the regression analysis showed that income, age, and usage exclusion for the purpose of saving have significant effect on financial resilience. While usage exclusion for the purpose of saving, age, working status, and gender have significant effect on financial worry. This research adds significant value to the current knowledge through filling the gap in understanding socio-economic inequalities associated with financial exclusion since it succeeded in identifying those who are financially excluded. The study proposes an action plan that outlines concrete steps aiming at reducing financial exclusion at one hand and promoting financial well-being in Egypt on the other hand

Keywords: marginalisation from formal financial institutions; financial resilience; financial worry; demographic characteristics concentration index; binary logistic regression

Article's History: Received: 29.09.2025; Revised: 01.02.2026; Accepted: 26.03.2026; Published: 09.04.2026

Suggested Citation:
Mohyee, D., Abdel-Fatah, N.A., & Yahya, N. (2026). Investigating financial exclusion through the lens of socio-economic inequalities: Implications for financial well-being. *Economics of Development*, 25(1), 56-74. doi: 10.63341/econ/1.2026.56.

*Corresponding author

INTRODUCTION

The research problem that motivated this study is the growing socioeconomic inequalities in financial exclusion, despite the progress achieved worldwide with respect to account ownership. At the same time, financial exclusion negatively affects people's financial resilience and increase their financial worry. Thus, people who exhibit diminished financial resilience and elevated financial worry are inclined to possess lower levels of financial well-being (FWB). Literature on financial exclusion within social classes is scarce. However, it's important to investigate the extent to which the marginalised groups inside each class are financially excluded. Hence, this research focuses on the other side financial exclusion rather than financial inclusion. In addition, it measures socioeconomic inequality within each social class in various socioeconomic characteristics such as income groups, gender, place of residence, working status, and education.

For this, the research highlights some studies that discussed financial inclusion, and it deducted the alternative perspective-financial exclusion. With respect to gender, some studies, like S. Kaur & C. Kapuria (2020), showed that financial inclusion indicators demonstrated inequality between males and females in developing and emerging market economies. M. Fahmy & H. Ghoneim (2023) tested whether being financially included differs according to gender using three different models. They found mixed results whereby this relationship is insignificant in two out of the three models. Regarding income inequality, H.M. el Baz (2020) argued that the gap between the richest and poorest income groups has increased between 2014 and 2017 with higher exclusion in favour of the poorest. In addition, high income groups are considered the preferred target group for formal financial institutions because of their higher credit ratings, lower probability of defaults, and more stable and well-recognised income. Furthermore, C. Milana & A. Ashta (2020) found improvement in financial inclusion indicators between 2011 and 2017 but documented many divides among various socioeconomic classes particularly geographical location, age, gender, and education.

Pertaining to the studies that have considered aspects of financial wellbeing. Several studies have presented the theoretical foundations of FWB. M. Sinani (2021) used a qualitative descriptive method in addressing FWB and agreed on setting up a theory that aims at defining, measuring and analysing FWB. In addition, Consumer Financial Protection Bureau (CFPB) suggested a "Financial Well-Being" scale in a technical report whereby the study started by presenting a definition of FWB, then offered an overview of a typical approach to a scale development and then developed a reliable CFPB financial well-being scale. J. Coats & V. Bajtelsmit (2024) discussed measures and drivers of FWB and showed that there are various alternative techniques in assessing it and that financial literacy and personal traits are influencing FWB. Hence, considerable studies have discussed theoretical framework for FWB. Furthermore, some studies aimed at testing the level of FWB concept in some countries whereby each study selected a certain method. K. Sehrawat *et al*. (2021) used the partial least squares structural equation modeling (PLS-SEM) approach in identifying which determinants of the financial literacy and financial behavior are influencing FWB and carried out a survey on 349 respondents and concluded that 12 out of 17 factors are affecting FWB. In addition, V. Mathew *et al*. (2022) performed a cross-sectional causal investigation study using a web-based survey and indicated that there is a positive impact on financial self-efficacy and negative impact on risk tolerance whereby it was presented from the Indian perspective. Finally, there are some studies that have applied FWB on specific countries.

Additionally, A. Tinta *et al*. (2022) studied the microeconomic determinants of financial inclusion focusing on individual characteristics of financial inclusion and financial resilience in 40 African countries. They found that younger individuals and rural residents prefer using mobile accounts while elder, more educated, employed, and richer people prefer financial institution accounts. Furthermore, F. Hamid *et al*. (2023) studied the impact of socio-demographic characteristics, financial inclusion and financial knowledge on the financial resilience across Malaysia and it resulted that the financially resilience differs according to socio-economic characteristics and that it is associated with higher financial knowledge. To this end, this research differs from existing literature in 3 respects. This research aimed at analysing financial exclusion through measuring disparities among income groups, gender, education, place of residence, working status, and age along with determining financial exclusion effect on financial well-being.

LITERATURE REVIEW

Financial Exclusion was defined by the European Commission as a process whereby people encounter difficulties in accessing and/or using financial products and services. Financially excluded individuals and groups are classified into two main dimensions: barriers to access and barriers to usage, as explained by A. Csiszárik-Kocsir & C. Lentner (2023). Despite the progress achieved worldwide with respect to account ownership, financial exclusion in terms of barriers to access is still evident. In this respect, R. Saini *et al*. (2019) report that almost 3 billion people globally were facing barriers to access formal financial goods and services in 2018. However, worldwide in 2021, according to the Global Findex Database, 26% of people lacked access to financial services through a financial institution or mobile money provider, and by 2025 this percentage declined to 21%, as documented by L. Klapper *et al*. (2025).

This decline in the number of financially excluded people could be attributed to adopting financial inclusion strategies as an enabler for achieving Sustainable Development Goals (SDGs). Interestingly, A. Demirgüç-Kunt *et al*. (2018) highlight that more than half of the global unbanked population is concentrated in only seven countries, among which is Egypt. It is worth noting that financial exclusion hinders the achievement of Sustainable Development Strategy (SDS) in Egypt and Egypt's Vision 2030. In addition to the importance of barriers to access to financial services, barriers to the use of these services constitute another important dimension of financial exclusion, as emphasised by R. Saini *et al*. (2019). In this respect, the Global Findex 2021 survey shows that financial exclusion in terms of usage persists, with 13% of account owners having inactive accounts in developing countries in 2021 compared to 17% in 2017, according to A. Demirgüç-Kunt *et al*. (2018).

Another area of concern relates to socioeconomic gaps associated with financial exclusion among various socioeconomic classes such as gender, income, age, education, and workforce. Although some progress has been achieved in closing these gaps, more efforts are still required, as noted by S. Kaur & C. Kapuria (2020). Furthermore, due to socioeconomic inequalities, these vulnerable groups are more likely to suffer from higher financial exclusion with lower ability to access and use financial services. Consequently, being financially excluded hinders people's ability to obtain sufficient funds to meet unexpected financial shocks – known as financial resilience – and increases their anxiety about their financial lives – known as financial worry. In this context, financial well-being has two dimensions, namely financial resilience and financial worry. For this, the research argues that the higher the socioeconomic inequalities, the higher the financial exclusion, and the lower the financial well-being in Egypt. Therefore, the contribution of this research lies in measuring the extent of socio-economic inequalities associated with financial exclusion and their effect on financial wellbeing. Hence, it aims to firstly measure the level of socio-economic inequalities that appear due to financial exclusion and then to assess their effect on financial well-being across different socioeconomic characteristics.

The term "Financial Exclusion" originated when attention shifted towards inclusion, leaving some groups behind. It was first mentioned in 1993 to describe those with limited physical access to banking services due to bank branch closures. Later, in 1999, the concept broadened to include people with constrained access to mainstream financial services (European Commission, 2008). Hence, financial exclusion does not only involve lack of physical access but also limited access to credit and modern payment methods. The concept has further evolved to include financial knowledge and education. Although various definitions of financial exclusion exist, no single universally accepted definition has emerged. For example, A. Leyshon *et al*. (1995) define it as processes that prevent disadvantaged groups from accessing the financial system. Similarly, A. Csiszárik-Kocsir & C. Lentner (2023) describe it as difficulties in accessing and using financial products and services that result in disadvantages in daily life. Financial exclusion is a complex concept involving multiple implicit and explicit dimensions recognised by both academics and policymakers. It refers to a situation in which individuals lack access to mainstream financial services such as bank accounts, insurance, and credit, resulting in severe difficulties. In brief, financial exclusion represents the problem, while financial inclusion is the solution, as argued by M. Goodwin *et al*. (1999). The first dimension of financial exclusion is access exclusion, defined as restrictions arising from risk assessment processes (European Commission, 2008). Individuals without bank accounts are more vulnerable to financial shocks and are deprived of access to financial services. Moreover, lack of access to digital financial services, such as mobile money, limits the ability to transfer funds across distances, thereby reducing remittances and consumption. Consequently, financially excluded individuals rely on less safe and more expensive alternatives, which negatively affects their well-being.

The second dimension is usage exclusion, defined as limited or ineffective use of financial products and services (European Commission, 2008). While account ownership enables saving, borrowing, and payments, limited usage deprives individuals of these benefits. Barriers to usage include high fees, lack of trust, insufficient proof of payment, and institutional accessibility, as identified by M. Rashdan & N. Eissa (2020). According to the Consumer Financial Protection Bureau (2015), financial well-being is defined as a state of financial control, resilience, and freedom of choice. The Global Findex framework conceptualises FWB through financial resilience and financial worry. Financial resilience reflects the ability to cope with unexpected shocks and depends on income, behaviour, financial systems, and policy environments (Apriyanti *et al*., 2024). Financial worry, on the other hand, reflects stress and anxiety related to financial instability, as discussed by K. Dirkx *et al*. (2022).

MATERIALS AND METHODS

Sample description and variables for binary logistic regression design

This research is considered as an exploratory study whereby the authors try to investigate the socioeconomic inequalities within the distribution of the financial exclusion in Egypt by identifying the most disadvantaged subgroups of the population. Then, it employs Binary Logistic Regression Model to measure the effect of financial exclusion on financial well-being considering socioeconomic inequalities. For this, this part presented the sample size and characteristics, measures and statistical modelling used to fulfil the objectives of the research. This research depended on data drawn in 2021 wave of the Global Findex Database which relies on nationally representative surveys of individuals aged 15 and above. The data was collected through the Gallup World Poll depending on a standardised questionnaire. The survey utilised a probability sampling methodology. The survey adheres to recognised ethical standards for research involving human participants, encompassing voluntary participation, informed consent, and rigorous protection of respondents' privacy and confidentiality. Participants' personal data were utilised only for specified research objectives and protected by suitable data security methods, with access limited to authorised individuals (Gallup, 2025). In Egypt, a stratified multistage cluster sampling design was employed, where primary sampling units were initially selected, followed by the households, then the individuals who are the members of the chosen households. Sampling weights were further utilised to correct for selection bias and to guarantee national representativeness. Data collection was performed through face-to-face interviews. The sample excluded the frontier governorates Frontier governorates (Matruh, Red Sea, New Valley, North Sinai, and South Sinai) since they are remote and represent less than 2 percent of the total population. The final sample consisted of 1,003 respondents (Demirgüç-Kunt *et al*., 2021). The data collection methods complied with recognised ethical norms adhered by the World Bank Group. Participation was voluntary, and informed consent was secured from all participants prior to the interview. Responses were anonymised, and the confidentiality of the information was upheld in accordance with the data provider's rules. The sample characteristics are described in Table 1.

Table 1. Description of the variables

Type of variable	Variable	Description/ Operational measure
Explained variables	Financial Resilience	This indicator takes "0" in case the individual achieved resilience by any source other than financial institution and "1" if the individual achieved resilience through any financial institution
	Financial Worry	This indicator takes "0" if the individual experienced "no worry at all" at the reference period and "1" if the individual experienced any level of financial worry including "very worried" and "somewhat worried"
Explanatory variables	Access Exclusion	This indicator takes "0" if the individual has no access to financial services and institutions and "1" if otherwise
	Usage Exclusion (for the Purpose of Saving, Borrowing, and Payment including sending and receiving money)	This indicator takes "0" if the individual doesn't use the financial services for any purpose, and "1" if otherwise
	Income	Within economy household income quintile. This variable takes "1" if the household income is among the poorest quintile of the population, takes "2" if the household income is among the second quintile, takes "3" if the household income is within the middle quintile, takes "4" if the household income is among the fourth quintile, and takes "5" if the household income is within the richest quintile
	Gender	Takes "1" if the respondent is female and takes "0" if the respondent is male
	Educational Attainment	Takes "1" if the respondent completed primary or less, "2" if the respondent competed secondary school, and "3" if the respondent completed tertiary education or more
	Type of Place of Residence	Takes "1" if the respondent lives in a rural area, and "2" if the respondent lives in an urban area
	Working Status	Takes "1" if the respondent is working, and "2" if the respondent is not working
	Age	Ranges between 15 – 99+. Then the age is categorised into the following categories in order to prepare descriptive statistics provided in Table 2: takes "1" if the respondents' age ranges between 15 -29, "2" if it ranges between 30 – 39, "3" if it ranges between 40 – 49, "4" if it ranges between 50 – 59, and "5" if it ranges between 60 or above

Source: formulated by the authors

Since the research employs Binary logistic regression model, all variables used are binary ones that take two values "0" and "1" as demonstrated in Table 1. Additionally, when measuring the inequalities in financial exclusion, socioeconomic characteristics- Income, Gender, Educational Attainment, Place of Residence, Working Status, and Age- act as predictors for the inequalities, as the authors measured the unequal distribution of the financial indicators with respect to the sample disaggregated by these socioeconomic characteristics.

Descriptive statistical method and gender inequality measures

First, the authors used the percentage distribution to show the percentages of financially excluded individuals with respect to the dimensions of financial exclusion and financial well-being based on their socioeconomic characteristics. In this regard, "Chi-square test between proportions" is used to test the statistical significance of the difference between the percentage of financially excluded individuals for each socioeconomic characteristic of the respondents (McHugh, 2013). Second, the authors employ concentration curves and concentration index to further investigate the socioeconomic inequalities associated to financial exclusion. The concentration curves are incorporated as a descriptive method for visually representing the inequality in both dimensions of financial exclusion – access and broadly defined usage – as well as specific purposes of using financial services – namely usage for the purpose of saving, borrowing, receiving money, and sending money – ranked by various socioeconomic characteristics of respondents. With regard to the concentration index (CI), it is a measure of social and economic variations in terms of inequality, i.e. it is a standard measuring tool for inequality in the phenomenon under study which provides the magnitude of the concentration of a certain phenomenon (Kim *et al.*, 2020). It is calculated by quantifying the relative inequality between different subgroups formulated by another categorical variable, i.e., the financial exclusion between the deprived and non-deprived. According to A. Wagstaff & E. Van Doorslaer (2000), CI is calculated by the following formula:

$$CI = \frac{2}{n*\mu}\sum_{i=1}^{n} x_i R_i - 1, \quad (1)$$

where n – the sample size; x_i – the variable of interest, μ – its mean; R_i – the individual's i fractional rank in the SES indicator distribution.

For continuous (unbounded) variables, the confidence interval extends from −1 to +1. A negative value signifies concentration among the disadvantaged, whereas a positive value denotes concentration among the better-off. A higher absolute value of the CI indicates an increased level of inequality. When the variable of interest is binary, such as financial exclusion, the range of the concentration index is contingent upon the mean of the variable. In this instance, the mean μ denotes the ratio of individuals with a value of one. The limits of the confidence interval stem from the most disparate distributions of the binary outcome. The highest value of the CI is attained when all individuals with $x = 1$ are aggregated among the better-off, whereas the

minimum is reached when they are concentrated among the disadvantaged. In these extreme scenarios, the concentration index is constrained between $\mu - 1$ and $1 - \mu$ (Wagstaff, 2005). The reliance of the bounds on the mean indicates that the CI is not directly comparable among binary variables with varying means. To mitigate this constraint, normalised version of the CI is frequently employed, in this case:

$$\mu = \frac{n-j}{n}. \quad (2)$$

$CI = 1 - \mu + \frac{1}{n}$, for large samples, the (1/n) term becomes very small, and the minimum and maximum tend to $(\mu - 1)$ and $(1 - \mu)$ respectively. And the CI is normalised by dividing it by either the reciprocal of the mean or the bound of the concentration index, rescaling the CI to reside within the interval [−1, 1]. In empirical applications, such as T. Ásgeirsdóttir & D. Dagný (2013) and H. Amirian *et al*. (2014), the CI normally does not surpass 0.5 in absolute value. Generally, values ranging from 0.2 to 0.3 signify a high degree of inequality, values from 0.1 to 0.2 denote moderate inequality, and values below 0.1 reflect low inequality.

Binary logistic regression model

It is used to study the determinants of financial well-being. Financial well-being is measured through two main indicators: financial resilience and financial worry.

Financial resilience is defined as a binary variable that signifies an individual's ability to depend on formal financial resources during emergencies. The score is 1 if the respondent said that their primary source of emergency finances within the 30 days preceding the survey would be borrowing from a bank, employer, or private lender; otherwise, it is 0.

Financial worry is defined as a composite binary indicator that signifies if an individual experiences financial stress in essential life domains. The result is 1 if the respondent, at the time of the survey, indicated financial concern regarding at least one of the following: old age, medical expenses, bills, or educational fees; otherwise, it is 0.

Thus, the research undertakes two models whereby in the first model, "financial resilience" is employed as the explained variable while in the second model, "financial worry" is employed as the explained variable.

The binary logistic regression model estimates the probability of success of the outcome variables (e.g., the probability of having financial resilience by any source other than financial institution) based on the explanatory variables (socioeconomic characteristics). It does so by transforming the probability into a log-odds (logit) scale. The relationship between the predictors and the log-odds of the outcome is assumed to be linear. The logistic regression model is expressed as follows:

$$log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n, \quad (3)$$

where p – the probability of success of the outcome variable; $log\left(\frac{p}{1-p}\right)$ – the log-odds of the outcome variable; β_0 – the intercept; β_1,..., β_n – the regression coefficients; x_1, ..., x_n – the predictors. The coefficients (β) are typically estimated using maximum likelihood estimation (MLE). The odds ratios (OR) by exponentiating the coefficients (e^{β}). If OR is greater than 1 indicates a positive effect of the predictor on the log-odds of the outcome, while an OR less than 1 indicates a negative effect, and OR equals 1 indicates no effect (Hosmer *et al*., 2013)

Since there were many explanatory variables, the research employed "Stepwise Regression Method" that is used mainly to automatically filter out the insignificant variables and end up with the best fit model. The statistical significance of the effect of each predictor is tested by the Wald test. The model fit is evaluated using Omnibus test; which tests the overall model statistical significance, Pseudo R^2, whose interpretation is similar to the R^2 in linear regression model, specifically it measures the amount of variability in the log-odds of the outcome variable explained by the regression line, and Hosmer-Lemeshow test, which test the equality between the observed and the estimated outcome (Agresti, 2013; Hosmer *et al*., 2013). All statistical analyses were performed using Stata 17. A *p*-value of less than 0.05 was considered statistically significant. Data used in this research is available on the website of the World Bank Group (Development Research Group..., 2022).

RESULTS AND DISCUSSION

This section presents the results of the distribution of financial exclusion and financial well-being dimensions according to socioeconomic characteristics of respondents followed by concentration curves and concentration index results and ended with binary logistic regression model results

Distribution of financial exclusion and financial well-being dimensions according to the socioeconomic characteristics of respondents. The percentages of financially excluded individuals with respect to the dimensions of financial exclusion and financial well-being based on their socioeconomic characteristics is shown in Table 2.

Table 2. The percentage distribution of financial exclusion dimensions, and financial well-being dimensions according to the socioeconomic characteristics of respondents

Socioeconomic characteristics	Financial exclusion dimensions		Financial well-being dimensions		
	Access exclusion	Usage exclusion	Financial resilience	Financial worry	Total
	Unbanked (Percentage of adults)	Percentage of respondents with inactive accounts	Percentage of respondents who have resilience by any source other than a financial institution	Percentage of respondents who have any financial worry	N
Income					
Poorest 20%	76.7%	88.7%	88.7%	97.5%	159
2nd quintile	80.0%	88.7%	93.3%	95.3%	150
3rd quintile	73.3%	79.0%	91.8%	92.8%	195
4th quintile	67.6%	76.7%	87.6%	93.3%	210

Table 2. Continued

Socioeconomic characteristics	Financial exclusion dimensions		Financial well-being dimensions		
	Access exclusion	Usage exclusion	Financial resilience	Financial worry	Total
	Unbanked (Percentage of adults)	Percentage of respondents with inactive accounts	Percentage of respondents who have resilience by any source other than a financial institution	Percentage of respondents who have any financial worry	N
Income					
Richest 20%	44.6%	55.4%	75.8%	84.1%	289
χ^2 (*df*)	43.1(4)*	36.5(4)*	27.2(4)*	25.2(4)*	
Gender					
Male	61.1%	70.8%	86.7%	89.6%	517
Female	70.0%	78.8%	85.4%	93.6%	486
χ^2 (*df*)	1.13(1)*	0.93(1)*	0.08(1)*	0.43(1)*	
Place of residence					
Urban	64.8%	74.0%	86.1%	91.2%	893
Rural	70.0%	80.0%	85.5%	94.5%	110
χ^2 (*df*)	149.7(1)*	180.5(1)*	159.4(1)*	175.3(1)*	
Working Status					
Working / Employed	61.7%	71.1%	85.4%	93.0%	460
Not Working/ Unemployed	68.5%	77.7%	86.6%	90.2%	543
χ^2 (*df*)	0.11(1)*	0.19(1)*	0.85(1)*	1.49(1)*	
Educational Attainment[1]					
Completed primary school or less	65.7%	76.8%	85.8%	94.5%	379
Completed secondary school	70.6%	78.4%	88.9%	91.3%	496
Completed tertiary education or more	43.7%	53.2%	75.4%	83.3%	126
χ^2 (*df*)	17.9(2)*	24.7(2)*	47.4(2)*	55.0(2)*	
Age Intervals					
15-29	85.3%	90.8%	92.7%	86.4%	273
30-39	70.2%	80.2%	86.8%	96.9%	258
40-49	62.1%	72.0%	85.1%	95.0%	161
50-59	57.9%	68.6%	83.0%	91.2%	159
60 +	32.9%	45.4%	77%	88.2%	152
χ^2 (*df*)	126.3(4)*	114.5(4)*	21.8(4)*	23.5(4)*	
Total	**65.4%**	**74.6%**	**86.0%**	**91.5%**	**1,003**

Note: [1] – the total doesn't equal to 1003 because of the existence of missing values within this variable; * – p-value < 0.05
Source: calculated by the authors depending on STATA software output

With reference to Table 2, the findings showed that regarding "income", the most financially excluded individuals lie in the "Poorest 20%" since 76.7% of them lacked access and are unbanked while only 44.6% among the richest quintile are financially excluded. Additionally, results reflected that among this category of respondents who already had access, 88.7% were with inactive accounts. With respect to FWB dimensions, results showed that 88.7% of the poorest 20% faced financial resilience whereas 97.5% faced financial worry. Concerning "Gender", findings demonstrated that "females" are the most financially excluded, the percentage of unbanked females is higher than that of unbanked males by 9.9% Moreover, results reflected that the percentage of females wth inactive accounts exceeded that of males with 8%. The results showed that females experienced lower financial resilience than their male counterparts by 1.3% whereas they experienced higher financial worry by 4%.

It can also be noted that rural residents are the most financially excluded ones as almost 70% of rural respondents tended to be unbanked adults. Among those who opened accounts, 80% of rural respondents tended to have inactive accounts. The findings in Table 2 showed that individuals in rural areas experienced lower financial resilience than their counterparts in urban areas by 0.6% whereas they experienced higher financial worry by 3.3%. Pertaining to the "Working status", the results demonstrated that the unemployed are more financially excluded relative to the employed

ones since 68.5% among unemployed respondents tended to be unbanked adults. Furthermore, 77.7% of unemployed respondents suffers usage exclusion. The unemployed people experienced higher financial resilience than their counterparts by 1.2% while interestingly, 93% of employed respondents experienced financial worry The findings showed that least financially excluded segment were the highly educated individuals. It appeared that percentage of unbanked adults for the highly educated ones were found to be less excluded than the less educated ones by almost 22%. Moreover, the percentage of the highly educated respondents who have inactive accounts was lower than those who were less educated by 23%. And the highly educated individuals experienced higher financial resilience than their less educated counterparts by around 12% whereas they experienced higher financial worry by around 9.5%. With respect to "age", the findings revealed that financial exclusion is higher among younger individuals who experienced the highest rates of both access and usage exclusion. On the other hand, younger individuals – particularly the youth – demonstrated higher level of financial resilience than older ones, while the elderly experienced the highest degree of financial worry.

Socioeconomic inequalities in financial exclusion measured by concentration curves and concentration index

Each of the following figures shows the results of the concentration curves followed by the concentration index value, elaborating the inequality in financial exclusion with respect to each of the previously mentioned socioeconomic characteristics in both dimensions of financial exclusion – access and broadly defined usage – as well as specific purposes of using financial services. Concerning income inequality, the findings showed a statistically significant inequality in both dimensions of financial exclusion – access and usage – across income groups in Egypt, with values of the concentration index of 0.21 and 0.27 respectively which reflects a high level of inequality. These positive values indicate that both access and usage are highly concentrated among higher-income groups, suggesting that lower-income individuals face a higher degree of financial exclusion relative to their richer counterparts as shown in Figure 1 which corresponds to the results of Table 2. By digging deeper into the specific purposes of using financial services, results revealed that there is a statistically significant inequality in the use of financial services for saving and receiving money (CI = 0.37 and 0.2 respectively), indicating higher concentration among higher-income individuals. In contrast, Figure 1 shows that richer individuals were found to be more excluded when it comes to using financial services for the purpose of borrowing since richer individuals tend to borrow less (CI = –0.2) indicating higher concentration among the poorest. Finally, results showed no statistically significant inequality among income groups in the use of financial services for sending money.

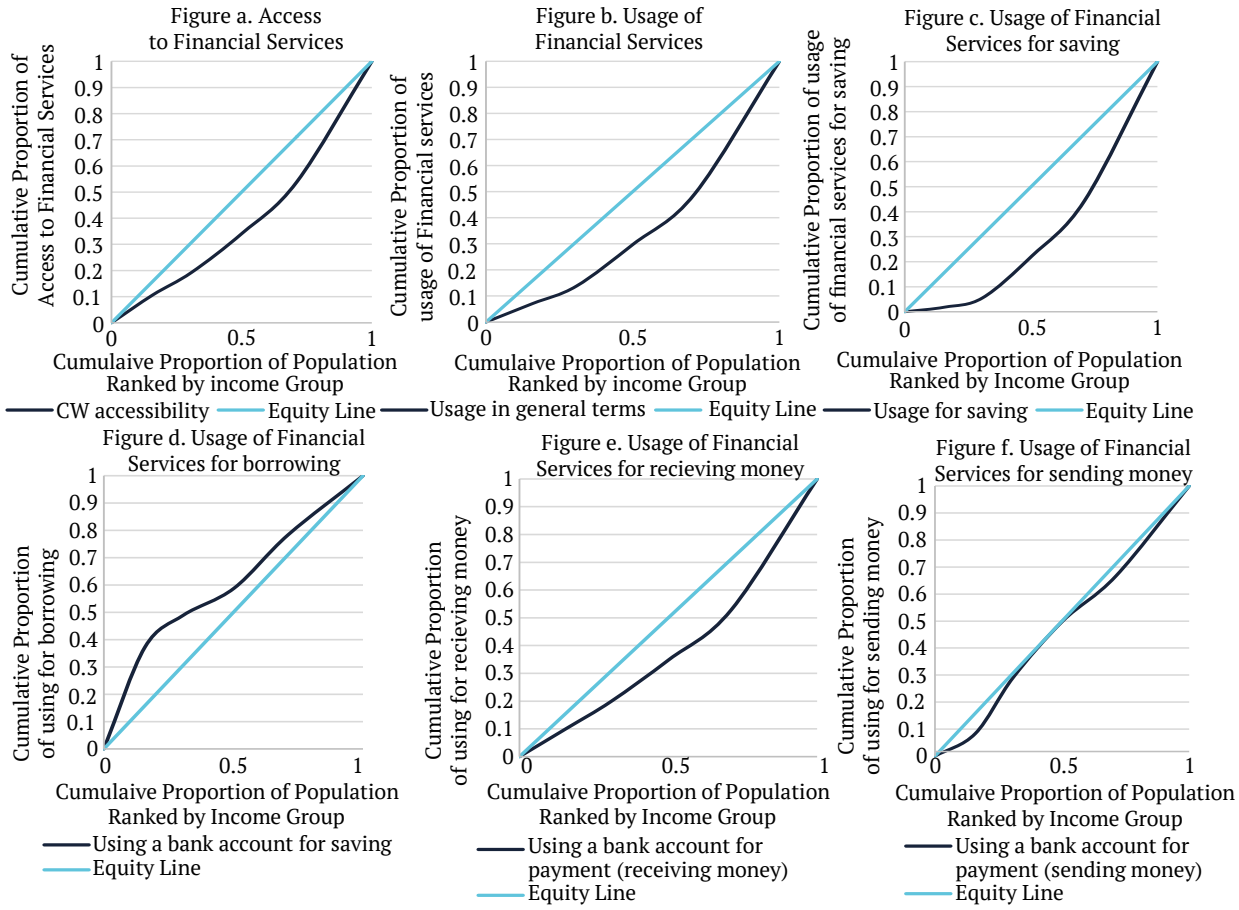

Figure 1. Concentration curves of the dimensions of financial exclusion across income groups

Source: calculated by the authors depending on STATA software output

The second classification is concerned with measuring the concentration of financial exclusion across gender. The findings also revealed a statistically significant inequality in both dimensions of financial exclusion across gender with greater exclusion of females that conforms with results of Table 2. Notably, the degree of concentration differs in each dimension of financial exclusion. There is a greater concentration with respect to "usage" (CI = 0.107) than "access" (CI = 0.0814) dimension which implies that females experienced moderate level of inequality concerning "usage" while low level of inequality concerning "access" of financial services. With respect to the specific purposes of using financial services, findings further demonstrated that females also suffered from more financial exclusion with the exception of "usage for the purpose of sending money" where males exhibited higher level of financial exclusion. Concerning the specific purposes of using financial services, the highest degree of concentration is found in the purpose of borowing (CI = 0.2), followed by "saving" (CI = 0.17) then "receiving money" (0.13) (Fig. 2). To put it differently, the results reflected high level of inequality for the purpose of "borrowing" while moderate level of inequality for both the purposes of "saving" and "receiving money".

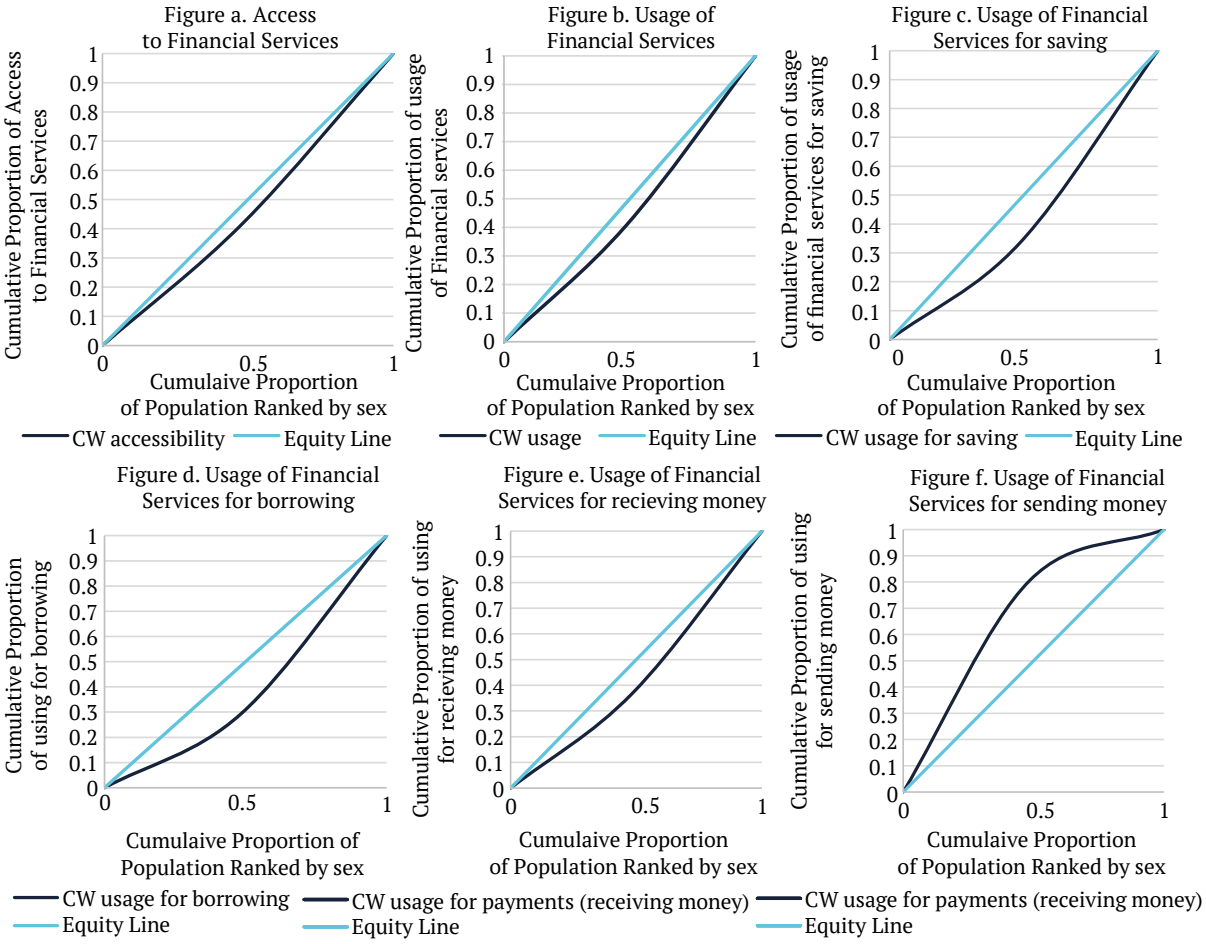

Figure 2. Concentration curves of the dimensions of financial exclusion across gender
Source: calculated by the authors depending on STATA software output

Third, with respect to the place of residence, the findings showed no statistically significant concentration among the Egyptians in account ownership (access to financial services) whereas there was a statistically significant inequality when it comes to the use of financial services as shown in figures. This indicates that rural population experienced higher degree of financial exclusion in using financial services relative to their urban counterparts (CI = 0.0633). It is worth mentioning that individuals in rural area faced low level of inequality in using financial services relative to their urban counterparts. Concerning the specific purposes of using financial services, the findings found no statistically significant concentration for any these purposes across rural and urban regions (Fig. 3).

Fourth, regarding the working status of respondents, the findings also showed a statistically significant inequality in both dimensions of financial exclusion – namely, access and broadly defined usage – with concentration index of 0.0653 and 0.0874 respectively which reflected low level of inequality. With respect to the specific purposes of using financial services, the findings demonstrated a statistically significant inequality in the distribution of using a bank account for only the purpose of "receiving money" with a concentration index of 0.0832 which reflected low level of inequality whereas no statistically significant concentration was found for any of the rest purposes (Fig. 4).

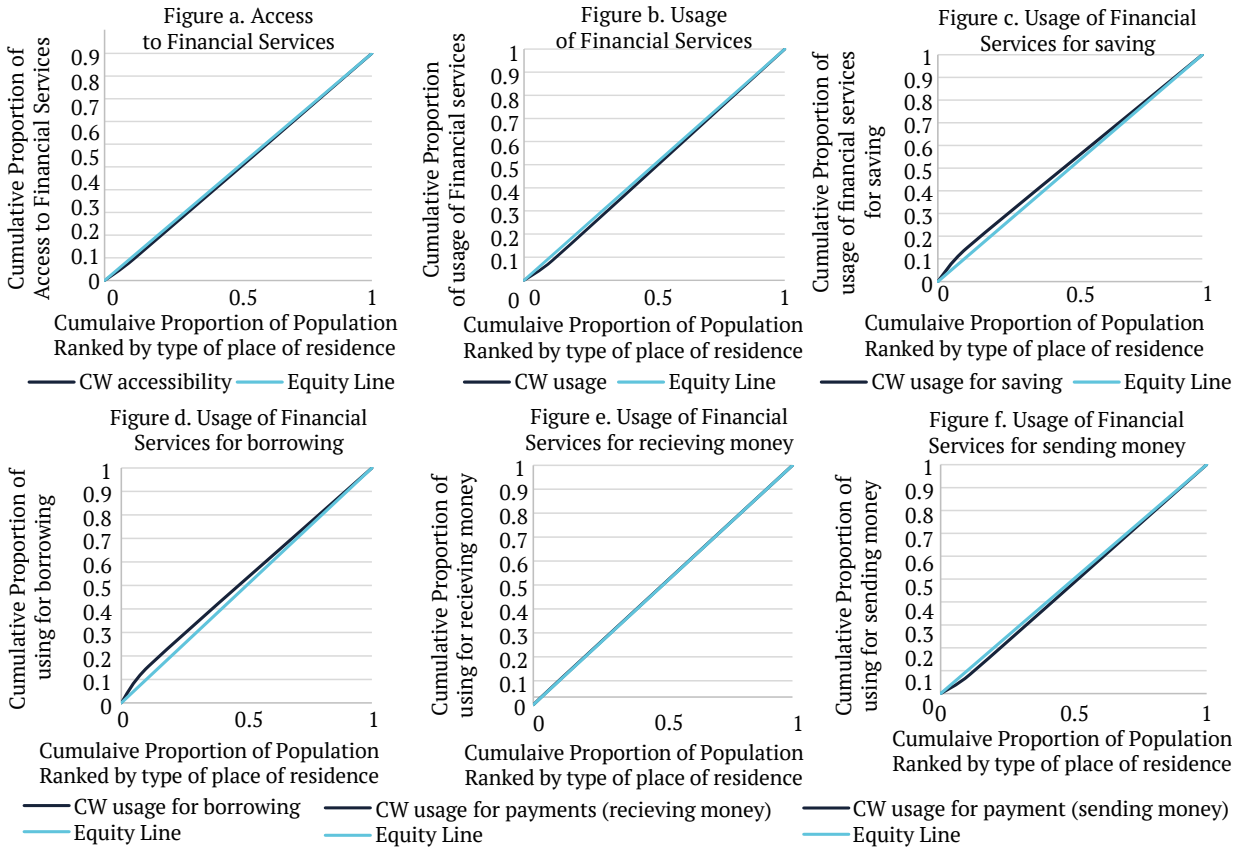

Figure 3. Concentration curves of the dimensions of financial exclusion with respect to the place of residence
Source: calculated by the authors depending on STATA software output

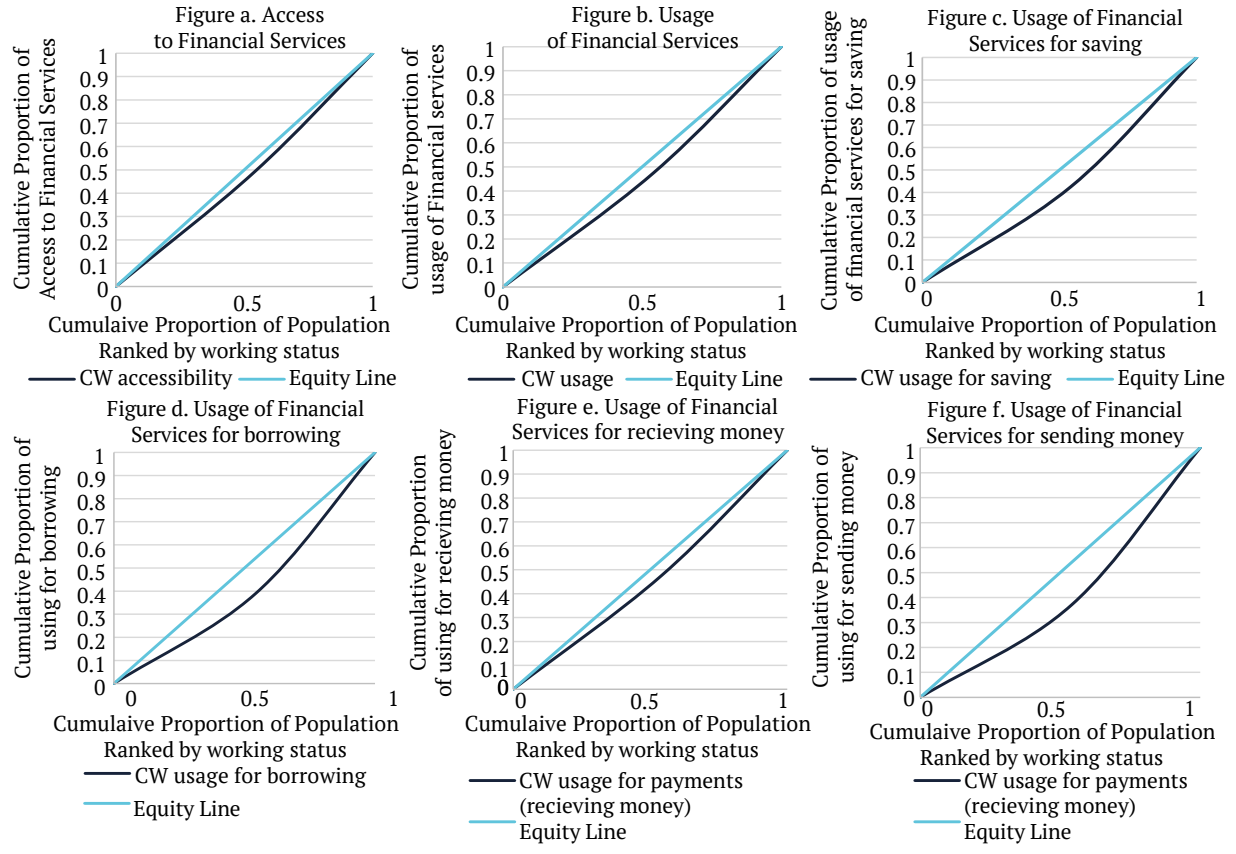

Figure 4. Concentration curves of the dimensions of financial exclusion ranked by working status
Source: calculated by the authors depending on STATA software output

Fifth, findings indicated a statistically significant inequality in the distribution of both dimensions of financial exclusion among the Egyptians ranked by educational attainment. The positive values of the index reflected that, in general, less educated individuals are more financially excluded compared to highly educated ones which agrees with results of Table 2. Crucially, there is a greater concentration with respect to the "usage" (CI = 0.1135) than "access" (CI = 0.0692) dimension which implies that less educated individuals experienced higher degree of financial exclusion when it comes to using financial services as opposed to account ownership. Stated otherwise, less educated individuals faced low level of inequality concerning "access" of financial services, but moderate level concerning "usage". Regarding the specific purposes of using financial services, the findings demonstrated a statistically significant inequality in the distribution of using a bank account only for the purpose of saving with a concentration index of 0.4122. This postive value of the CI reflects a high level of inequality indicating greater exclusion of less educated individuals in Egypt. On the other hand, no statistically significant concentration was found for any of the rest purposes (Fig. 5).

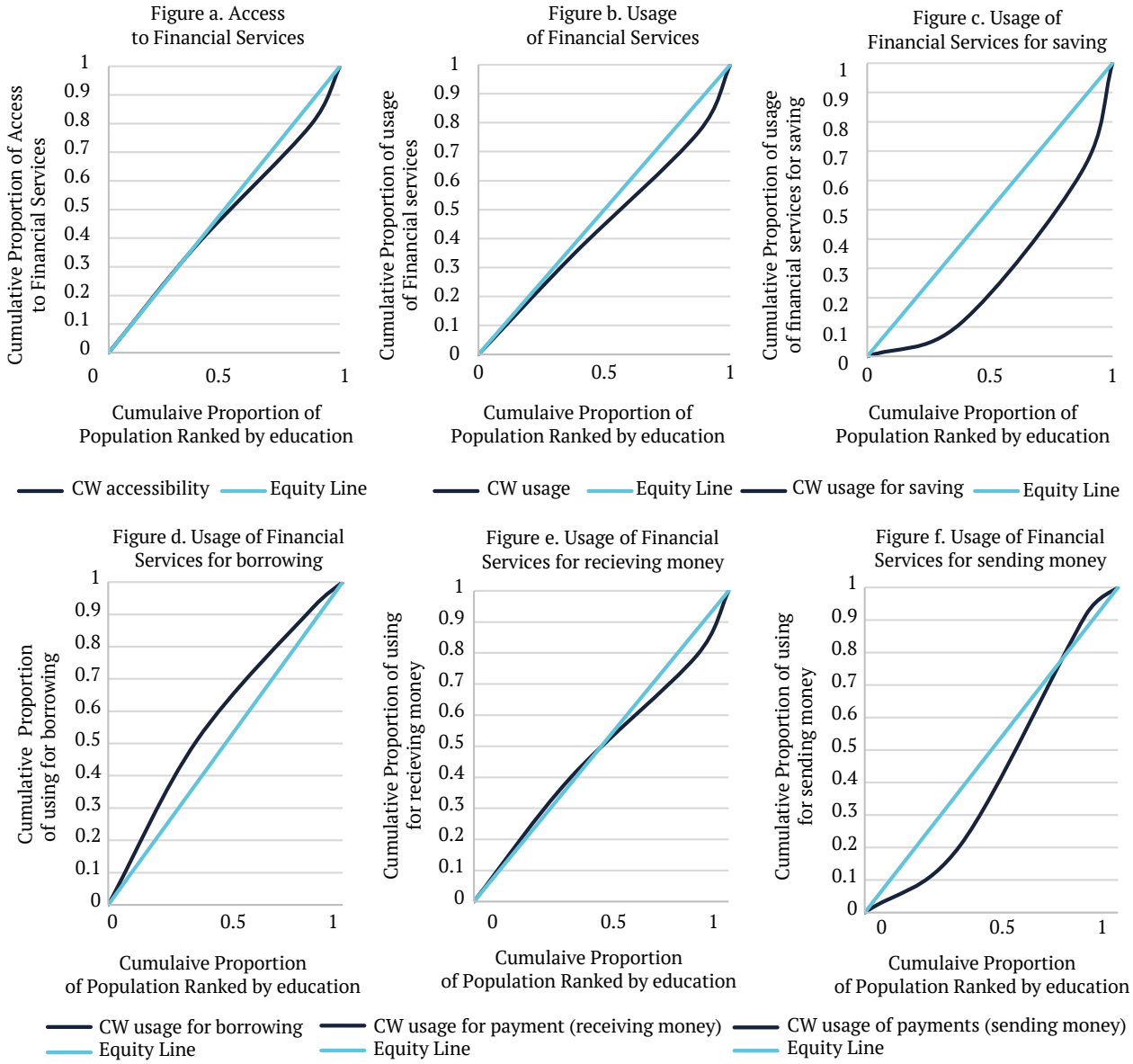

Figure 5. Concentration curves of the dimensions of financial exclusion with respect to education

Source: calculated by the authors depending on STATA software output

The final classification is concerned with measuring the concentration of financial exclusion with respect to age. The findings further showed a statistically significant inequality in both dimensions of financial exclusion across age with greater exclusion of young respondents which agrees as well with results of Table 2. With respect to the specific purposes of using financial services, findings further demonstrated that youth also faced more financial exclusion in "usage for the purpose of receiving money", whereas the elderly exhibited higher level of financial exclusion when it comes to "usage for the purpose of saving". On the other hand, inequality in usage for the purpose of borrowing and sending money were found to be statistically insignificant (Fig. 6).

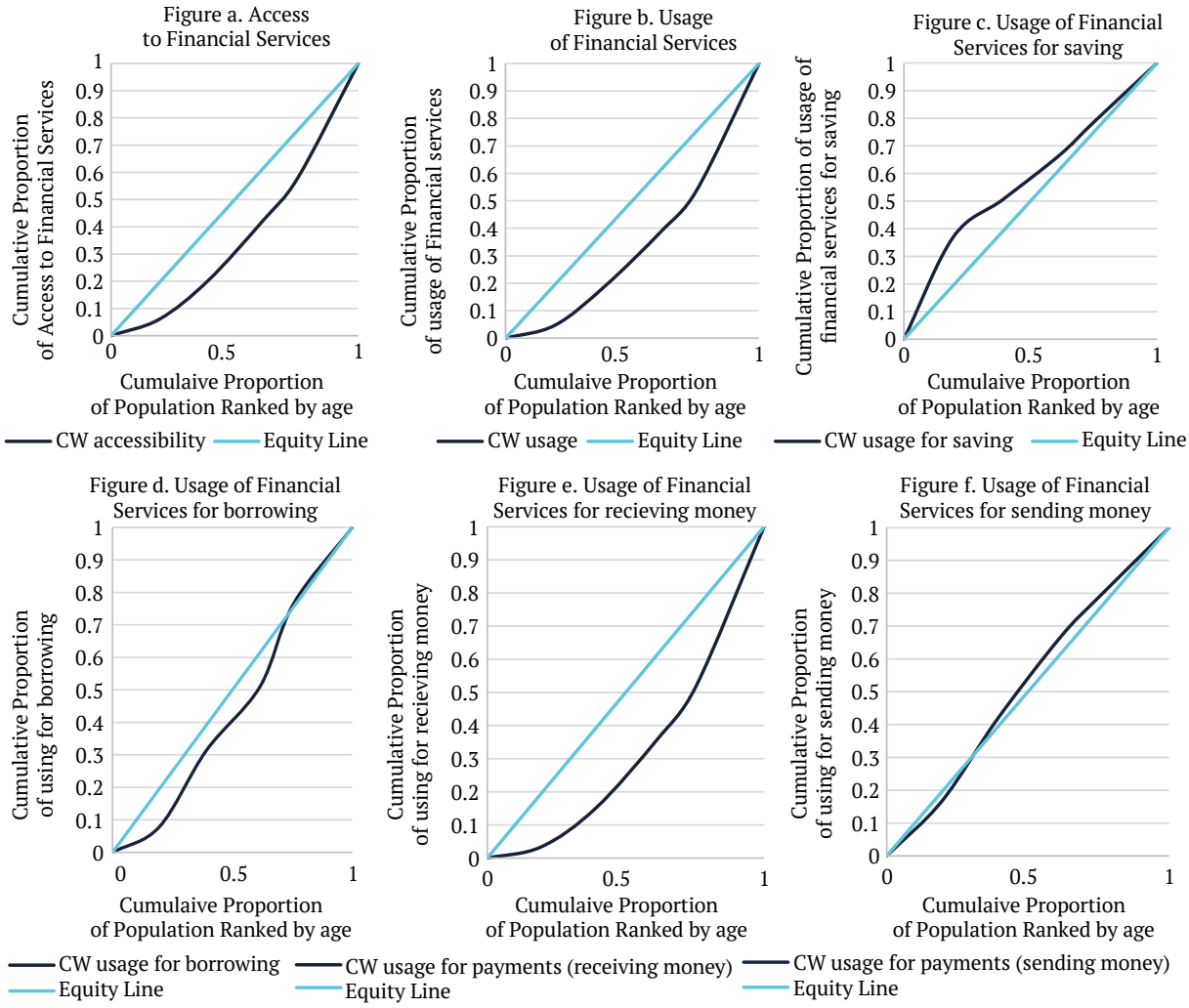

Figure 6. Concentration curves of the dimensions of financial exclusion across age
Source: calculated by the authors depending on STATA software output

Inspite of the greater concentration with respect to the "usage" than "access" dimensions (CI = 0.3167, CI = 0.2768 respectively), both fell under the category of high level of inequality among the youth respondents. Concerning the specific purposes of using financial services, the degree of concentration in "usage for the purpose of receiving money" recorded 0.3541 which indicates higher exclusion among the young respondents while -0.1825 for "usage for the purpose of saving" indicating higher exclusion among the elder respondents.

Determinants of financial resilience and financial worry

This section starts with presenting the goodness of fit measures followed by an interpretation of the regression model (Table 3).

Table 3. The Goodness-of-fit measures of the financial resilience model

Test	Chi-square	Df	Significance
Omnibus test	85.988	6	0.000
Hosmer and Lemeshow Test	5.805	8	0.669
Pseudo R^2	**Value**		
Cox & Snell R Square	0.082		
Nagelkerke R Square	0.148		

Source: calculated by the authors depending on STATA software output

The Omnibus test showed that the model is statistically significant at 0.01 level of significance. The Hosmer and Lemeshow test assured that the model has acceptable predictive ability since its null hypothesis stated that there is no difference between the observed and predicted values of the outcome variable. The pseudo R^2 ranged from nearly 0.1 to 0.15 which is not acceptable since the acceptable values of these measures is 0.2 – 0.4 (Hagle & Mitchell, 1992). Consequently,

this result may be due to the limited predictors and the absence of other behaviour-related factors that could explain the resilience on the individual level more appropriately. Results in Table 4 showed that when the respondent isn't using their account for saving, this is accompanied with lower odds for being financially resilient (Exp(β) = 0.14, P-value < 0.01). As the respondent's age increases, the odds for being financially resilient increases (Exp(β) = 1.02, P-value < 0.01).

Table 4. The determinants of financial resilience

Variables	*β*	Sig.	*Exp(β)*	95% of *Exp(β)*	
				Lower	Upper
Usage for saving **(ref.*: yes)**	-1.963	0.000	0.140	0.077	0.255
Respondent age	0.017	0.004	1.018	1.006	1.030
Within-economy household income quintile **(ref.*: richest)**		0.002			
Within-economy household income quintile (1)	-0.524	0.079	0.592	0.330	1.062
Within-economy household income quintile (2)	-1.135	0.002	0.321	0.157	0.659
Within-economy household income quintile (3)	-0.994	0.001	0.370	0.201	0.683
Within-economy household income quintile (4)	-0.615	0.020	0.540	0.321	0.909

Note: ref. refers to the reference category of the variable
Source: calculated by the authors depending on STATA software output

The income level of the respondents showed a significant effect on the odds of being financially resilient, if the within-economy household (HH) income refers that the HH is poorest, the odds of being financially resilient became 0.6 times the odds of the richest HH. The odds of being financially resilient of the poorer HH and the middle class HH are about one third of the odds of the richest HH, while the odds of the rich HH is about half the odds of the richest HH. Moreover, the results showed that the individuals' access of financial services and institutions, the respondents' usage for borrowing, usage for payments, gender, educational attainment, the working status and the type of place of residence are not statistically significant predictors. The research also employed "Stepwise Regression Method" that is used in the previous model for the same reason mentioned above (Table 5).

Table 5. The Goodness-of-fit measures of the financial worry model

Test	Chi-square	df	Sig.
Omnibus test	76.438	8	0.000
Hosmer and Lemeshow Test	6.552	8	0.586
Pseudo R^2	**Value**		
Cox & Snell R Square	0.074		
Nagelkerke R Square	0.167		

Source: developed by the authors

The Omnibus test showed that the model is statistically significant at 0.01 level of significance. The Hosmer and Lemeshow test assured that the model has acceptable predictive ability since its null hypothesis stated that there is no difference between the observed and predicted values of the outcome variable. The pseudo R^2 ranged from nearly 0.1 to 0.17 which, by approximation, is acceptable. Results in Table 6 showed that when the respondent isn't using his/her account for saving, this is accompanied with very elevated odds for having financial worry (Exp(β) = 6.14, P-value < 0.01). The results also showed that female respondents have higher odds of being financially worried if compared to male respondents (Exp(β) = 2.7, P-value < 0.01). As the respondent's age increases, the odd for having financial worry increases slightly (Exp(β) = 1.02, P-value < 0.01). The respondents' working status showed a illogical result since the odds of having financial worry increases among the working group rather than the non-working group (Exp(β) = 2.9, P-value < 0.01). Although it may be explained by the socio-economic framework. Employment does not always guarantee financial security, especially in communities marked by low wages and income volatility. Employed individuals may have heightened financial obligations, exacerbating perceived financial stress, whereas unemployed individuals may depend on familial or social assistance. This pattern aligns with the notion of working poverty (World Bank, 2020).

Table 6. The determinants of the financial worry

Variables	*(β)*	Sig.	*Exp(β)*	95% of *Exp(β)*	
				Lower	Upper
Usage for saving **(ref.*: yes)**	1.815	0.000	6.143	3.169	11.905
Respondent sex **(ref.*: male)**	0.990	0.000	2.691	1.547	4.680
Respondent age	0.019	0.010	1.019	1.004	1.034
Respondent working status **(ref.*: not working)**	1.066	0.000	2.904	1.652	5.104
Within-economy household income quintile **(ref.*: richest)**		0.000			
Within-economy household income quintile (1)	1.925	0.004	3.535	1.502	8.320
Within-economy household income quintile (2)	1.263	0.004	2.694	1.366	5.315
Within-economy household income quintile (3)	0.991	0.001	2.993	1.537	5.828
Within-economy household income quintile (4)	1.096	0.004	3.535	1.502	8.320

Source: calculated by the authors depending on STATA software output

Regarding the income level of the respondents, results showed a significant effect on the odds of being financially worried, if the within-economy household (HH) income refer that the HH is poorest or rich, the odds of having financial worries is 3.5 times the odds of the richest HH. The odds of being financially worried of the poorest HH and the middle class HH are about three times the odds of the richest HH. The results showed that the individuals' access of financial services and institutions, the respondents' usage for borrowing, usage for payments, educational attainment, and the type of place of residence are not statistically significant predictors of being very or somewhat worried. The sample consists of 1,003 respondents. the research investigated the socioeconomic inequalities within the distribution of the financial exclusion in Egypt by identifying the most disadvantaged subgroups of the population using the concentration index and concentration curves. Then, it employed Binary Logistic Regression Model to measure the effect of financial exclusion on financial well-being controlling for the socioeconomic characteristics of respondents. The results showed that 65.4% of the population has no access to any financial institution, 74.6% are financially excluded with respect to usage, 86% had financial resilience, and 91.5% had experienced any financial worries (Table 7).

Table 7. Summary of concentration index findings

	Access Exclusion	Usage Exclusion	Usage Exclusion: Saving	Usage Exclusion: Borrowing	Usage Exclusion: Sending Money	Usage Exclusion: Receiving Money
Income	High	High	High	Moderate (Rich)	Insignificant	High
Gender	Low	Moderate	Moderate	High	High (Men)	Moderate
Place of Residents	Insignificant	Low	Insignificant	Insignificant	Insignificant	Insignificant
Working Status	Low	Low	Insignificant	Insignificant	Insignificant	Low
Education	Low	Moderate	High	Insignificant	Insignificant	Insignificant
Age	High	High	Old moderate	Insignificant	Insignificant	High

Source: developed by the authors

Concerning income inequality, the findings showed a statistically significant high-level of inequality in both dimensions of financial exclusion- access and usage – across income groups in Egypt. This indicates that both access and usage are highly concentrated among higher-income groups, suggesting that lower-income individuals face a higher degree of financial exclusion relative to their richer counterparts. This result goes along with A. Rashdan & N. Eissa (2020) as they mentioned in their papers that already the poor have suffered from insufficient funds, so this hindered them from being banked ones. While the richest suffered less. On the other hand, the richest people are less financially excluded as they are considered the preferred target group for formal financial institutions because of their higher credit ratings, lower probability of defaults, and more stable and well-recognised income which goes along with M. Esquivias *et al*. (2020). Additionally, this result is aligned with P. Ozili (2021) that stated that they lacked access to modern ICT infrastructure which hinders them from maintaining online for a reasonable period.

As for the concentration of financial exclusion across gender, the findings revealed a statistically significant inequality in access and general usage across gender with greater exclusion of females that conforms with percentage distribution. The findings also showed that females also suffered from more financial exclusion in all financial

usage specific purposes with the exception of "usage for the purpose of sending money" where males exhibited higher level of financial exclusion. In the report of the Central Bank of Egypt (2023), the authors mentioned that females preferred to use informal channels in using funds due to low required guarantees on the contrary of formal channels. The findings showed no statistically significant concentration among the Egyptians disaggregated by the type of place of residence (urban vs. rural) in account ownership (access to financial services) whereas there was a statistically significant inequality when it comes to the use of financial services. The results revealed that rural population experienced higher degree of financial exclusion in using financial services relative to their urban counterparts, that is aligned with T. Hassouba (2025) where she has mentioned that the coverage of banks branches in rural areas is less than that in urban ones. Pertaining to the "Working status", the findings showed a statistically significant inequality in both dimensions of financial exclusion – access and broadly defined usage – which reflected low level of inequality. With respect to the specific purposes of using financial services, the findings demonstrated a statistically significant, yet minimal, inequality in the distribution of using a bank account for only the purpose of "receiving money" which reflected low level of inequality whereas no statistically significant concentration was found for any of the rest purposes.

The level of educational can be considered as a competitive advantage of the individuals since the positive values of the concentration index reflect that, in general, less educated individuals are more financially excluded compared to highly educated ones. Crucially, there is a greater concentration with respect to the "usage" than "access" dimension which implies that less educated individuals experienced higher degree of financial exclusion when it comes to using financial services as opposed to account ownership. Stated otherwise, less educated individuals faced low level of inequality concerning "access" of financial services, but moderate level concerning "usage", which matches with the results of A. Rashdan & N. Eissa (2020) that attributed the reason to the intensified financial awareness and financial literacy among all strata of the population. Regarding the specific purposes of using financial services, the findings demonstrated a statistically significant inequality in the distribution of using a bank account only for the purpose of saving.

The final inequality measure was concerned with measuring the concentration of financial exclusion with respect to age. The findings further showed a statistically significant inequality in access and general usage – across age with greater exclusion of youth. Findings demonstrated that youth also faced more financial exclusion in "usage for the purpose of receiving money", whereas elder people exhibited higher level of financial exclusion when it comes to "usage for the purpose of saving". On the other hand, inequality in usage for the purpose of borrowing and sending money were found to be statistically insignificant. Results of the regression model showed that financial usage is a significant determinant of financial resilience since if the respondent isn't using the bank account, the respondent has lower odds for being financially resilient. This result is aligned with the findings of F. Hamid *et al*. (2023) who showed that, in emerging economies, higher levels of financial inclusion in terms access and usage increases the probability of being financially resilient. The respondent's age also has shown to be a significant determinant of financial resilience, whereas the respondents' age increases, the odds for being financially resilient increases. The income level of the respondents showed a significant positive effect on the odds of being financially resilient. These results are consistent with previously introduced findings of A. Tinta *et al*. (2022), and R. Hassan *et al*. (2025). While the results showed that the individuals' access of financial services and institutions, the respondents' usage for borrowing, usage for payments, gender, educational attainment, the working status and the type of place of residence are not statistically significant explanatory variables of financial resilience (Table 8).

Table 8. Summary of regression results

	Financial resilience	**Financial Worry**
Income	Significant direct	Significant inverse
Age	Significant direct	Significant direct
Gender	Insignificant	Significant females higher worry
Education	Insignificant	Insignificant
Working status	Insignificant	Significant employed higher worry
Place of residence	Insignificant	Insignificant
Access	Insignificant	Insignificant
Usage for saving	Significant not using = lower resilience	Significant not using = high worry
Usage for borrowing	Insignificant	Insignificant
Usage for payment (sending and receiving)	Insignificant	Insignificant

Source: developed by the authors

As for the determinants of financial worries, the results also showed that female respondents have higher odds of being financially worried if compared to male respondents and as the respondent's age increases, the odd for having financial worry increases, but slightly. The respondents' working status showed a strange result since the odds of having financial worry increases among the working group rather than the non-working group. Regarding the income level of the respondents, results showed a significant inverse effect of income on the odds of being financially worried, that is as the income level decreases, the odds of experiencing financial worries increases. These results are consistent with the determinants of financial worries studies by F. Magwegwe *et al*. (2020),

and W. Shair *et al*. (2025). The results showed that the individuals' access of financial services and institutions, the respondents' usage for borrowing, usage for payments, educational attainment, and the type of place of residence are not statistically significant predictors of being very or somewhat worried. Based on the results discussed, the following table presents the comprehensive action plan (Table 9).

Table 9. Comprehensive action plan

Recommendation	Execution Authority	Executive Action
At Macro-level		
Updating the current National Financial Inclusion Strategy) that would be tailored to the specific needs of each marginalised group	■ Central Bank of Egypt (CBE) ■ Ministry of Finance ■ Financial Regulatory Affairs	■ Developing new financial products ■ Facilitating the legal and financial procedures ■ Determining the suitable channels to reach out for them (as brochures, Traditional and Modern Social Media Platforms)
Catalysing the shift to cashless economy on both government and citisens' scales	■ Egyptian Banking Institute ■ National Council for Payments (NCP) ■ Ministry of Communications and Information Technology (MCIT)	■ Ongoing upgrading National Payments Systems ■ Incentivising wider adoption of electronic payments
Fostering investments on campaigns that reap the fruits of financial inclusion through enhancing Public-Private Partnership (PPP)	■ Public authorities could be represented in Ministry of Culture and Maspero ■ Private entities could be represents in major advertising companies in Egypt through CSR	■ Applying a marketing strategy that employs social media platforms as: Facebook, Instagram, Twitter, LinkedIn to display ads and marketing messages
At Micro-level		
Concerning Poor people		
Designing a wide variety of low-cost, flexible financial products and promoting incentive mechanisms to attract a greater segment of the poor	■ Ministry of Social Solidarity ■ Banks and other financial institutions	■ Offering more micro-savings, micro-insurance, and small-denomination credit channels ■ Introducing reduced fees or reward programs for using digital payments for individuals receiving social security assistance and other low-income groups ■ Disseminating financial education commonly attended places such as literacy classes through bank representatives who would raise awareness of financial services and their benefits
Concerning Females		
Enhance generally "Women Empowerment' through financial inclusion and especially entrepreneurs under the slogan Workshops for Women entrepreneurs on in Work areas"	■ National Council for Women (NCW) ■ Association for the Development and Enhancement of Women (ADEW) ■ UN Women Egyptian Office	■ Organising a series of workshops to include women entrepreneurs under the slogan of «Women Inclusion through Financial Inclusion Tools» which can be stated as a prerequisite for taking the license of opening a company or project ■ Designing gender-sensitive financial products that meet the specific needs of women especially informal workers and single mothers
	■ National Council for Childhood and Motherhood (NCCM) ■ USAID Egypt – Gender and Women's Empowerment Programs	■ Arranging free workshops for women in attractive places that concern women as gyms, beauty centres and women supports day under their sponsor ■ Employ free ads in social media platforms (Twitter, Facebook and Instagram)
Concerning rural people		
Broadening rural people's understanding of financial services and updates related to newly introduced products	■ Banks and financial institutions (mainly Nasser Social Bank) ■ Civil society organisations (as Caritas Egypt for outreach programs)	■ Reinforcing institutional capacity within banks by employing specialised staff dedicated to help rural people in accessing or using financial services and understanding information about financial services and the required procedures ■ Fostering partnerships with civil society organisations and agricultural cooperatives to promote financial education through disseminating attractive and simple videos (step-by-step) that help them use financial services ■ Strengthening the engagement of respected community leaders to raise financial awareness in rural communities

Table 9. Continued

Recommendation	Execution Authority	Executive Action
Concerning non-working people		
Enhancing build of financial skills and widening the awareness about financial benefits of financial products which at the end promotes learning-by-doing method	■ Banks and other financial institutions ■ Microenterprise agencies ■ Ministry of Manpower	■ Depending on trained volunteers in collaboration with banks and under the auspices of the Ministry of Manpower to offer assistance and support about financial services that best suit job seekers ■ Strengthening mobile-based financial education interactive tools that teach entrepreneurship and financial literacy for attracting entrepreneurs ■ Greater Engagement of local NGOs to offer support and raise financial awareness to unemployed people with entrepreneurial potential
Concerning less educated people		
Put into practice know your customer rules	■ Representatives from banks and NGOs ■ Ministry of Communications and Information Technology (MCIT)	■ Increase awareness through offering a simplified mechanisms for complains in Arabic language ■ Regular SMSs about the tips, benefits and usage of financial products ■ Use suitable social media tools to offer stories about successful micro businesses that expanded after inclusion of financial banking products
Concerning Youth		
Designing a campaign under the slogan of "Financial Services for all – No one is left behind"	■ Ministry of Youth and Sports	■ Arranging a sports competition day at universities and clubs ■ Creating posters and advertisements on various social media platforms, shopping malls, universities, clubs … etc. ■ Spreading more booths inside universities to raise greater financial awareness and offer less costly financial products with simplified procedures

Source: developed by the authors

Hence, the study offers a comprehensive set of recommendations on both scales (macro-level and micro-level) that can be applied through offering a concrete action plan that elaborates actionable steps to enhance Egypt to robust financial inclusion through coordination among various concerned execution authorities that put it into executive actions.

CONCLUSIONS

In this research, the authors address financial exclusion. Financial exclusion between various socioeconomic classes is still evident despite the progress achieved. Regarding the first objective findings of the descriptive statistical analysis showed statistically significant difference in the percentages of financially excluded individuals concerning the dimensions of financial exclusion and financial well-being based on their socioeconomic characteristics With respect to access exclusion, results revealed that 76.7% of the poorest 20%, 70% of the females, 70% of the rural, 68.5% of the unemployed, 65.7% of the uneducated and 85.3% of the young respondents were unbanked. On the other hand, concerning usage exclusion, results revealed that 88.7% of the poorest 20%, 78.8% of the females, 80% of the rural, 77.7% of the unemployed, 76.8% of the uneducated and 90.8% of the young respondents had inactive accounts. Concerning the concentration curves and index, findings revealed the prevalence of socioeconomic inequality across both dimensions of financial exclusion except for access exclusion in the place of residence. Regarding the specific purposes of using financial services, socioeconomic inequality was evident with the purpose of saving among the poorest 20%, females, least educated and older individuals. Furthermore, the richest individuals as well as females suffered from higher exclusion with respect to the use of financial services for the purpose of borrowing whereas the poorest individuals, females, the unemployed, and youth suffered from higher exclusion pertaining to the purpose of receiving money. Finally, men appeared the most disadvantaged group who experienced exclusion concerning the purpose of sending money. Regarding the second objective of this research, results of the first regression model indicated that income and age had significant positive effect on financial resilience whereas usage exclusion for the purpose of saving had a significant negative effect. Results of the second model showed a significant positive effect of age and working status on financial worry, but a significant negative effect of income. In addition, being a female is associated with higher financial worry. Future research can investigate the interrelationships among financial inclusion, gender inequality, and incorporate in-depth entrepreneurship which may contribute to closing the gender gap and reaching out for more marginalised groups. In addition, another area of

research may explore the role of digital financial inclusion in strengthening financial health.

FUNDING
None.

ACKNOWLEDGEMENTS
None.

CONFLICT OF INTEREST
None.

REFERENCES
[1] Agresti, A. (2013). *Categorical data analysis*. New York: John Wiley & Sons. doi: 10.1002/0471249688.
[2] Amirian, H., Poorolajal, J., Roshanaei, G., Esmailnasab, N., & Moradi, G. (2014). Analyzing socioeconomic related health inequality in mothers and children using the concentration index. *Epidemiology, Biostatistics, and Public Health*, 11(3), article number e9086-1. doi: 10.2427/9086.
[3] Apriyanti, N., Harisriwijayanti, H., & Bella, S. (2024). Financial resilience: Strategies for building a strong money foundation. *Coopetition Jurnal Ilmiah Manajemen*, 15(2), 389-396.
[4] Ásgeirsdóttir, T.L., & Ragnarsdóttir, D.Ó. (2013). Determinants of relative and absolute concentration indices: Evidence from 26 European countries. *International Journal for Equity in Health*, 12(1), article number 53. doi: 10.1186/1475-9276-12-53.
[5] Central Bank of Egypt. (2022). *Main highlights of the: Financial inclusion strategy (2022-2025)*. Retrieved from https://www.cbe.org.eg/-/media/project/cbe/page-content/rich-text/financial-inclusion/the-central-bank-of-egypt-launches-the-financial-inclusion-strategy-(2022-2025).pdf.
[6] Central Bank of Egypt. (2023). *Women's financial inclusion, digital financial services and COVI-19 policy response: Case of Egypt*. Retrieved from https://www.cbe.org.eg/-/media/project/cbe/page-content/rich-text/financial-inclusion/reports/women's-financial-inclusion-digital-financial-services-and-covid-19-policy-response-case-of-egypt.pdf.
[7] Coats, J., & Bajtelsmit, V. (2024). *Measures and drivers of financial well-being*. Murfreesboro: TAA Institute.
[8] Consumer Financial Protection Bureau. (2015). *Financial well-being: The goal of financial education*. Retrieved from https://files.consumerfinance.gov/f/201501_cfpb_report_financial-well-being.pdf.
[9] Csiszarik-Kocsir, A., & Lentner, C. (2023). Financial exclusion from the perspective of financial literacy in the digital world of the 21st century through the example of Hungary. *Transformations in Business & Economics*, 22(3), 266-280.
[10] Demirgüç-Kunt, A., Klapper, L., Singer, D., & Ansar, S. (2021). *Financial inclusion, digital payments, and resilience in the age of COVID-19*. Washington: World Bank Group.
[11] Development Research Group, Finance and Private Sector Development Unit. (2022). *Global financial inclusion (global findex) database 2021*. Cairo: World Bank. doi: 10.48529/Q9HG-RF28.
[12] Dirkx, I., Gerards, R., Schreurs, B., & Welters, R. (2022). *Money on my mind: Investigating the dynamics of financial worry*. Limburg: Maastricht University.
[13] el Baz, H.M. (2020). Financial inclusion in Egypt: Challenges and recommendations. *L'Egypte Contemporaine*, 111(538), 520-577. doi: 10.21608/espesl.2020.214263.
[14] Esquivias, M.A., Sugiharti, L., Jayanti, A.D., Purwono, R., & Sethi, N. (2020), Mobile technologies, financial inclusion and inclusive growth in East Indonesia. *Journal of Telecommunications and the Digital Economy*, 8(2), 123-145. doi: 10.18080/jtde.v8n2.253.
[15] European Commission. (2008). *Financial services provision and prevention of financial exclusion*. Retrieved from https://www.bristol.ac.uk/media-library/sites/geography/migrated/documents/pfrc0806.pdf.
[16] Fahmy, M., & Ghoneim, H. (2023). Financial inclusion demand-side determinants: Analysis from Egypt. *Management & Sustainability: An Arab Review*, 2(3), 255-284. doi: 10.1108/MSAR-08-2022-0035.
[17] Gallup. (2025). *Privacy statement*. Retrieved from https://login.gallup.com/Home/PrivacyStatement#:~:text=The%20protection%20of%20personal%20privacy,at%20Privacy_Administrator@Gallup.com.
[18] Goodwin, D., Adelman, L., Middleton, S., & Ashworth, K. (1999). Debt, money management and access to financial services: Evidence from the 1999 PSE survey of Britain. *Center for Research in Social Policy*, 8, 1-47.
[19] Hamid, F., Loke, Y., & Chin, P. (2023). Determinants of financial resilience: Insights from an emerging economy. *Journal of Social and Economic Development*, 25, 479-499. doi: 10.1007/s40847-023-00239-y.
[20] Hassan, R.U., Shair, W., Asim, M., & Ahmad, S. (2025). Unequal resilience: Exploring the determinants of financial resilience in South Asia. *Journal of Economic Impact*, 7(2), 135-145.
[21] Hassouba, T. (2025). Financial inclusion in Egypt: The road ahead. *Review of Economics and Political Science*, 10(2), 90-111. doi: 10.1108/REPS-06-2022-0034.
[22] Hosmer, D.W., Lemeshow, S., & Sturdivant, R.X. (2013). *Applied logistic regression*. New York: John Wiley & Sons. doi: 10.1002/9781118548387.
[23] Kaur, S., & Kapuria, C. (2020). Determinants of financial inclusion in rural India: Does gender matter. *International Journal of Social Economics*, 47(6), 747-767. doi: 10.1108/IJSE-07-2019-0439.
[24] Kim, S.W., Haghparast-Bidgoli, H., Skordis-Worrall, J., Batura, N., & Petrou, S. (2020). A method for measuring spatial effects on socioeconomic inequalities using the concentration index. *International Journal for Equity in Health*, 19(1), article number 9. doi: 10.1186/s12939-019-1080-5.
[25] Klapper, L., Singer, D., Starita, L., & Norris, A. (2025). The global findex database 2025: Connectivity and financial inclusion in the digital economy. Washington: World Bank Group.

[26] Leyshon, A., & Thrift, N. (1995). Geographies of financial exclusion: Financial abandonment. *Transactions of the Institute of British Geographers*, 20, 312-341. doi: 10.2307/622654.
[27] Magwegwe, F., MacDonald, M., Lim, H., & Heckman, S. (2020). Determinants of financial worry. *Journal of Consumer Affairs*, 57(1), 171-221. doi: 10.1111/joca.12496.
[28] Mathew, V., Kumar, S., & Sanjeev, M.A. (2024). Financial well-being and its psychological determinants – an emerging country perspective. *FIIB Business Review*, 13(1), 42-55. doi: 10.1177/23197145221121080.
[29] McHugh, M.L. (2013). The chi-square test of independence. *Biochemia Medica*, 23(2), 143-149. doi: 10.11613/BM.2013.018.
[30] Milana, C., & Ashta, A. (2020). Microfinance and financial inclusion: Challenges and opportunities. *Strategic Change*, 29(3), 257-266. doi: 10.1002/jsc.2339.
[31] Ozili, P.K. (2021). Financial inclusion-exclusion paradox: How banked adults become unbanked again. *Financial Internet Quarterly*, 17(2), 44-50. doi: 10.2478/fiqf-2021-0012%0A.
[32] Rashdan, A., & Eissa, N. (2020). The determinants of financial inclusion in Egypt. *International Journal of Financial Research*, 11(1), 123-136. doi: 10.5430/ijfr.v11n1p123.
[33] Sain, M.R.M., Rahman, M.M., & Khanam, R. (2019). Financial exclusion and the role of Islamic finance in Australia: A case study in Queensland. *Australasian Accounting, Business and Finance Journal*, 12(4), 256-280. doi: 10.14453/aabfj.v12i4.3.
[34] Sehrawat, K., Vij, M., & Talan, G. (2021). Understanding the path toward financial well-being: Evidence from India. *Frontiers in Psychology*, 12, article number 638408. doi: 10.3389/fpsyg.2021.638408.
[35] Shair, W., Hassan, R.U., Asim, M., & Virk, M.I. (2025). Exploring the determinants of financial worrying in South Asia: A micro-level analysis. *Journal of Business and Management Research*, 4(3), 873-902. doi: 10.64105/jbmr.04.03.553.
[36] Sinani, M. (2021). Financial well-being, theoretical concepts. *International Journal of Social Science and Education Research Studies*, 1(3), 82-89.
[37] Tinta, A.A., Ouédraogo, I.M., & Al-Hassan, R.M. (2022). The micro determinants of financial inclusion and financial resilience in Africa. *African Development Review*, 34(2), 293-306. doi: 10.1111/1467-8268.12636.
[38] Wagstaff, A. (2005). The bounds of the concentration index when the variable of interest is binary, with an application to immunization inequality. *Health Economics*, 14(4), 429-432. doi: 10.1002/hec.953.
[39] Wagstaff, A., & Van Doorslaer, E. (2000). Equity in health care finance and delivery. *Handbook of Health Economics*, 1(B), 1803-1862. doi: 10.1016/S1574-0064(00)80047-5.
[40] World Bank. (2020). *Poverty and shared prosperity 2020*. Retrieved from https://www.worldbank.org/en/publication/poverty-and-shared-prosperity-2020.

Діна Мохіє
Доктор філософії у галузі економіки, доцент
Каїрський університет Айн-Шамс
11566, вул. Ель-Халіфа Ель-Мамун, м. Каїр, Єгипет
https://orcid.org/0000-0002-7044-0998
Нура Анвар Абдель-Фатах
Доктор філософії у галузі біостатистики, доцент
Каїрський університет
12613, вул. Гамаа, 1, м. Каїр, Єгипет
Доцент
Університет Бадр у Каїрі
11829, Бадр-Сіті, м. Каїр, Єгипет
https://orcid.org/0000-0002-0339-2252
Ноха Ях'я
Доктор філософії у галузі економіки, доцент
Каїрський університет Айн-Шамс
11566, вул. Ель-Халіфа Ель-Мамун, м. Каїр, Єгипет
https://orcid.org/0009-0006-9589-1679

Дослідження фінансової ексклюзії крізь призму соціально-економічної нерівності: наслідки для фінансового добробуту

Анотація. Метою дослідження було виміряти рівень соціально-економічної нерівності, що виникає внаслідок фінансової ексклюзії, а також оцінити її вплив на фінансовий добробут населення залежно від різних соціально-економічних характеристик. У дослідженні використано дані опитування Global Findex 2021 року, оприлюдненого у 2023 році, на вибірці з 1003 респондентів. Нерівність фінансової ексклюзії вимірювалася за допомогою індексу концентрації та кривих концентрації. Для аналізу впливу фінансової ексклюзії на фінансовий добробут застосовано модель бінарної логістичної регресії. Результати дослідження показали, що соціально-економічна нерівність виступає ключовим чинником фінансової ексклюзії, яка найбільше проявляється серед бідних, жінок, сільського населення, безробітних, осіб з низьким рівнем освіти та молоді. Щодо ексклюзії доступу, встановлено, що 76,7 % найбідніших 20 %, 70 % жінок, 70 % сільського населення, 68,5 % безробітних, 65,7 % неосвічених та 85,3 % молодих респондентів не мають банківських рахунків. Водночас щодо ексклюзії використання з'ясовано, що 88,7 % найбідніших 20 %, 78,8 % жінок, 80 % сільського населення, 77,7 % безробітних, 76,8 % неосвічених і 90,8 % молодих респондентів мають неактивні рахунки. Крім того, результати регресійного аналізу показали, що дохід, вік і ексклюзія використання з метою заощадження мають статистично значущий вплив на фінансову стійкість. Водночас ексклюзія використання з метою заощадження, вік, зайнятість і стать істотно впливають на фінансову тривожність. Це дослідження робить вагомий внесок у наукову літературу, заповнюючи прогалину в розумінні соціально-економічної нерівності, пов'язаної з фінансовою ексклюзією, оскільки дозволяє ідентифікувати групи фінансово виключених осіб. У роботі запропоновано план дій, що містить конкретні кроки, спрямовані на зменшення фінансової ексклюзії та підвищення фінансового добробуту населення в Єгипті

Ключові слова: маргіналізація від формальних фінансових інституцій; фінансова стійкість; фінансова тривожність; демографічні характеристики; індекс концентрації; бінарна логістична регресія

ЕКОНОМІКА РОЗВИТКУ
Міжнародний економічний журнал

Том 25, № 1
2026

Відповідальний редактор:
Н. Проскурніна

Підписано до друку 26.03.2026
Формат 60*84/8
Ум. друк. арк. 8,9
Наклад 50 прим.

Видавництво: Харківський національний економічний університет імені Семена Кузнеця
61166, пров. Інженерний, 1-А, м. Харків, Україна
E-mail: info@ecdev.com.ua
https://ecdev.com.ua/uk

ECONOMICS OF DEVELOPMENT
International Economic Journal

Volume 25, No. 1
2026

Managing Editor:
N. Proskurnina

Signed to the print 26.03.2026
Format 60*84/8
Conventional Printed Sheet 8.9
Circulation 50 copies

Publisher: Simon Kuznets Kharkiv National University of Economics
61166, 1-A Inzhenerny Ln., Kharkiv, Ukraine
E-mail: info@ecdev.com.ua
https://ecdev.com.ua/en