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INTRODUCTION

This issue of the journal presents a collection of articles devoted to the current challenges facing the modern economy and the financial sector. The authors address issues related to the functioning of financial market institutions, the effectiveness of regulatory mechanisms, the reliability of decision-making processes in the capital market, the development of data analysis methods, and the impact of digital transformation and sustainable development on the operations of businesses and financial institutions. The articles are united by an interdisciplinary perspective on economic processes and a commitment to identifying the factors that influence the security, stability, and efficiency of modern economic systems.

The issue opens with a study devoted to the activities of Polish institutions responsible for protecting participants in the insurance market. The authors analyze the actions of supervisory and consumer protection authorities in identifying irregularities in the insurance market, highlighting the most common problems and the instruments used to address them.

Subsequent articles address the functioning of the capital market and the application of quantitative methods in supporting financial decision-making. One of them presents an assessment of the accuracy of stock market recommendations issued by brokerage firms, highlighting the limited effectiveness of stock price forecasts. The second study presents a new method for determining the optimal threshold for binary classification using time-dependent ROC curves and demonstrates its application in credit scoring models.

Issues related to tax law and the security of economic transactions also feature prominently in this issue. The analysis of the use of the STIR system to freeze bank accounts assesses the effectiveness of this instrument in curbing tax fraud and its compliance with the principles of protecting taxpayers' rights.

This issue also includes studies on contemporary economic transformation processes. One of them analyzes the functioning of e-commerce in Ukraine under wartime conditions, highlighting the ability of businesses and consumers to adapt in a crisis situation and the role of the digital economy in maintaining business continuity. The second focuses on ESG reporting in the Polish banking sector, highlighting the importance of transparency in non-financial information for supporting sustainable development and integrating environmental, social, and corporate governance aspects into banks' operations.

The articles in this issue present a broad spectrum of research topics, ranging from regulatory and methodological issues to challenges related to digitalization and sustainable development. Their common thread is the search for solutions that enhance the efficiency of the financial market and economic institutions, as well as the provision of research findings that can serve as inspiration for both the academic community and economic practitioners. We hope that the studies presented here will serve as a valuable source of knowledge and inspiration for further research into the rapidly changing conditions of the modern economy.

Małgorzata Jabłońska
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POLISH FINANCIAL SUPERVISION AUTHORITY, THE FINANCIAL OMBUDSMAN, AND THE OFFICE OF COMPETITION AND CONSUMER PROTECTION FOR THE YEARS 2014–2023

ABSTRACT

The theoretical background: Compared to other participants in the financial market, insurance service clients typically possess limited specialist knowledge and, most often, restricted experience. The lack of comprehensive knowledge and potentially improper identification of insurance needs may result in a range of concerns directed at insurance companies. Establishing effective legal frameworks to safeguard the interests and rights of insurance market clients is one of the key principles in building the stability of the entire financial system. In Poland, there are institutions authorized to take action in response to irregularities in the activities of entities providing financial services. These include, above all, the Financial Ombudsman (RF), the Polish Financial Supervision Authority (KNF), and the Office of Competition and Consumer Protection (UOKiK).

The purpose of the article: The main aim of this article is to determine whether irregularities in the Polish insurance market are identified by the aforementioned institutions. An additional objective is to specify the nature of these irregularities, the areas they affect, their scope, and, finally, the actions taken in response to any reported or observed irregularities.

Methodology: The research is based on data from requests to the Financial Ombudsman, reports filed with the Financial Supervision Authority, the register of prohibited clauses maintained by UOKiK, and the register of prohibited clauses (based on rulings of the Court of Competition and Consumer Protection) for the years 2014–2023.

Results of the research: The analysis shows that the institutions under study effectively identify irregularities in the insurance market—these cover a wide range of practices and concern both life insurance (Section I) and other personal and property insurance (non-life insurance, Section II). The most frequently identified irregularities recorded by the Financial Ombudsman and the Financial Supervision Authority included, among others, claim dismissals, refusals to pay or disputes over the amount of compensation, delays in the claims handling process, and insurance premiums. UOKiK identified a number of prohibited contractual provisions used by insurance companies.

Keywords: consumer protection, insurance market, financial services

JEL Class: G22, G28, G18



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Introduction

The financial market constitutes a comprehensive network of relationships between entities involved in the accumulation and allocation of financial resources, primarily formed by consumers, entrepreneurs, financial institutions, and the state (Rutkowska-Tomaszewska, 2013, pp. 42–43). A consumer is defined as a natural person who enters into a legal transaction with an entrepreneur that is not directly related to their business or professional activity (Civil Code, 1964, art. 22). An entrepreneur, on the other hand, is a natural person, legal entity, or organizational unit conducting business or professional activity in their own name (Civil Code, 1964, art. 43).

The financial market is characterized by a vast number of transactions, which may become areas prone to abuse, including violations of consumer interests (Sebastianka, 2020, p. 62). Consumers of financial services typically possess limited knowledge – rarely of a specialist nature – along with minimal experience and information gaps, which places them in a weaker position in transactions (Pachuca-Smulka, 2018, pp. 107–126).

The challenge of ensuring consumer safety and protection in the financial market is faced by all countries. Over the years, initiatives aimed at enhancing consumer protection in financial services have emerged. These initiatives aim to strengthen the consumer perspective in regulatory standards, supervisory practices, and business initiatives (Monkiewicz & Monkiewicz, 2019, p. 33).

Consumer protection in the financial market is deemed crucial, as the absence of effective safeguards may negatively impact the stability of the entire financial system. The rapid development of financial markets and the introduction of innovations may intensify the risk of fraud, misuse, and abuse of consumers (Czechowska, Stawska & Witczak, 2020, p. 113).

The main aim of this article is to determine whether irregularities in the Polish insurance market are identified by institutions responsible for consumer protection, i.e., the Financial Ombudsman, the Polish Financial Supervision Authority, and the Office of Competition and Consumer Protection. The article attempts to answer the following research questions:

- What is the scope, nature, and scale of the identified irregularities in the insurance market in Poland?
- What directions and instruments of intervention are applied by the RF, KNF, and UOKiK?

Literature review

Consumer protection in the Polish insurance market is ensured through various means, including legal regulations – many of which have been introduced in recent years to strengthen consumer safeguards – and the activities of public institutions. The pro-consumer orientation is reflected in

Directive (EU) 2016/97 of the European Parliament and of the Council on insurance distribution (Insurance Distribution Directive, IDD), adopted on January 20, 2016. The primary objective of the Directive is to enhance the level of consumer protection.¹ The IDD Directive has been supplemented by delegated regulations governing various aspects of insurance distribution. In Poland, the provisions of the Directive were implemented into national law through the Act on Insurance Distribution (Act on Insurance Distribution, 2017). It imposes an obligation on insurance distributors (insurance undertakings, insurance agents, and insurance brokers) to determine, based on information obtained from the client, the client's demands and needs. Furthermore, distributors are required to provide the client with objective information about the insurance product in a clear and comprehensible manner, in order to enable the client to make informed decisions. The purpose of analyzing clients' needs is to prevent inappropriate sales practices (*misselling*) (Fras, 2020, p. 60), as the information gathered allows the distributor to assess whether the client belongs to the target for the given insurance product (Orlicki, 2019). The obligation to provide the client with objective information about the insurance product in a clear and comprehensible manner is intended to enable the client to make an informed choice and to understand the scope of the insurance coverage being offered (Nawracała, 2019, p. 52). This activity, as a fundamental element of the insurance contract conclusion procedure, should contribute to improving communication between insurance undertakings and other distributors, and, above all, with the client (Orlicki, 2017, p. 25). A specific legal regime has been established for the offering of insurance-based investment products. These types of contracts are additionally subject to Regulation (EU) No 1286/2014 on key information documents for packaged retail and insurance-based investment products (PRIIPs).² The provisions of this Regulation grant the supervisory authority the power to introduce so-called product intervention measures, i.e., a general ban or restriction on the performance of certain activities related to the product in question.³ Taking into account the interests of consumers, the supervisory authority exercised its right and imposed a ban on the marketing, distribution, and sale of certain insurance-based investment products. This decision, adopted by the Polish Financial Supervision Authority on July 15, 2021,

¹ Recital 43: "In order to ensure that the same level of protection applies and that the consumer can benefit from comparable standards, in particular with regard to disclosures, it is essential that a level playing field is established between all distributors of insurance products."

² Regulation (EU) No 1286/2014 of the European Parliament and of the Council of November, 26 2014 on key information documents for packaged retail and insurance-based investment products (PRIIPs), together with Commission Delegated Regulation (EU) 2017/653 of March 8, 2017 supplementing the aforementioned Regulation by laying down regulatory technical standards for the presentation, content, review and revision of key information documents, as well as the conditions for fulfilling the requirement to provide such documents, applies to entities offering insurance-based investment products.

³ The purpose of introducing product intervention measures is to protect investors in the insurance market by eliminating serious threats to the proper functioning of financial markets or to the stability of the financial system.

applies to life insurance contracts linked to unit-linked funds (UFK) that meet specific risk-related criteria.⁴

In Poland, the main public institutions acting in the interest of all insurance market clients are the Financial Ombudsman (RF) and the Polish Financial Supervision Authority (KNF) (Wierzbicka, 2015, pp. 71–79). Other entities involved in consumer protection include the Office of Competition and Consumer Protection (UOKiK). In this context, it is also important to highlight the role of district and municipal consumer ombudsmen, who provide consumers with free legal assistance, as well as out-of-court arbitrators and mediators who facilitate the resolution of disputes between financial market institutions and recipients of financial services.⁵

The Financial Ombudsman operates pursuant to the Act of August 5, 2015 on the Handling of Complaints by Financial Market Entities and on the Financial Ombudsman (Act on the Handling of Complaints by Financial Market Entities and on the Financial Ombudsman, 2015). The Act granted clients of financial market entities the right to submit a so-called complaint, raising objections concerning the services provided by such entities. The RF represents the interests of clients of financial market entities who, from the perspective of the insurance market, may include policyholders, insured persons, beneficiaries, or persons entitled under an insurance contract. Consumers of insurance services may submit an application to initiate proceedings before the RF if the complaint they submitted to the insurance undertaking did not result in the recognition of their claims, or if the complaint was upheld in their favor but the undertaking failed to perform the actions to which the accepted complaint obligated it. Participation of the financial market entity in the proceedings is mandatory. The consideration of an application does not necessarily result in the initiation of an intervention by the Financial Ombudsman; in justified cases, the Ombudsman may refrain from taking action or subject the application to further review.

The Polish Financial Supervision Authority operates on the basis of the Act of July 21, 2006 on Financial Market Supervision (Act on Financial Market Supervision, 2006). Art. 2 defines the general objective of financial market supervision: to ensure the proper functioning, stability, security, and transparency of the financial market, to foster trust in the market, and to protect the interests of its participants – also through the provision of reliable information on market operations and the implementation of objectives set out in the provisions of the Act.

⁴ The decision of the Polish Financial Supervision Authority of July 15, 2021 (ref. DNM-DNMZWP.6065.79.2021) introduced a ban on the marketing, distribution, and sale of insurance-based investment products – specifically, life insurance contracts linked to unit-linked funds (UFK) – as part of a product intervention measure. In the content of the decision, the KNF indicated an optional element in the form of a suspensive period, stating that the decision would take effect on January 1, 2022.

⁵ Customer protection in the financial services market, www.knf.gov.pl (access as of: June 17, 2025).

The supervisory authority may conduct inspections of the operations and financial condition of insurance and reinsurance undertakings. These inspections may also cover the operations and financial condition of service providers performing outsourced insurance and reinsurance activities, as well as functions forming part of the governance system. Another form of supervisory activity carried out by the KNF is the so-called supervisory visit. It is conducted to examine and assess an individual matter arising in the course of an insurance or reinsurance undertaking's operations, in terms of compliance with governance system requirements and the solvency capital requirement (Act on Insurance and Reinsurance Activity, 2015, art. 342, art. 353). Based on the findings of such supervisory activities, the authority issues recommendations addressed to the supervised entity. Where sector-wide impact is required, the KNF issues relevant recommendations or guidelines for all insurance undertakings. The supervisory authority has issued a number of recommendations and guidelines to present its expectations about how supervised entities should operate in the areas of insurance distribution and claims handling.⁶

In the event of a breach of applicable legal provisions, the KNF may apply administrative supervisory measures in the form of financial penalties imposed on insurance undertakings, management board members, or authorized representatives. Information on the imposed penalty, including its amount and the nature of the violation, is made available to the public.

Based on the provisions of the Act of May 22, 2003 on Compulsory Insurance, the Insurance Guarantee Fund and the Polish Motor Insurers' Bureau (Act on Compulsory Insurance, the Insurance Guarantee Fund, and the Polish Motor Insurers' Bureau, 2003, art. 14(3a)), the supervisory authority applies supervisory measures as specified in the Act of September 11, 2015 on Insurance and Reinsurance Activity (Act on Insurance and Reinsurance Activity, 2015, art. 362). These regulations pertain to the failure to pay compensation by a domestic insurance company within the statutory deadline⁷ (Celczyńska, 2016). In the event of failure to pay compensation within the required timeframe, the Financial Supervision Authority may, by decision:

⁶ KNF is currently in the process of developing new recommendations for insurance undertakings concerning insurance distribution, which are to supersede the Guidelines of June 24, 2014 for insurance undertakings on insurance distribution (www.knf.gov.pl/en/?articleId=93272&p_id=19, access as of: June 17, 2025)

⁷ Pursuant to art. 14(1) of the Act on Compulsory Insurance, the insurance company is required to pay compensation within 30 days of the date the claim is reported. If, however, it is not possible to clarify the circumstances necessary to determine the insurer's liability or the amount of compensation within this period, then, based on paragraph 2 of this article, compensation should be paid within 14 days from the clarification of these circumstances (with due diligence), but no later than within 90 days from the date of the claim notification. The 90-day period may be extended only in strictly defined cases, i.e., when determining the insurer's liability or the amount of compensation depends on pending criminal or civil proceedings. In any case, the insurer is obliged to pay the undisputed portion of the compensation within 30 days. Within this period, the insurance company is also required to inform the entitled party in writing about the reasons for the inability to satisfy their claim in whole or in part, as well as the anticipated date for taking a final position regarding the entitled party's claims.

- impose a financial penalty of up to PLN 3 million on a member of the management board of the insurance company;
- impose a financial penalty on the insurance company of up to PLN 20 million or an amount equivalent to 0.5% of the gross written premium reported by the insurance company in its most recent annual financial statement, if the equivalent of 0.5% of the gross written premium exceeds PLN 20 million, and, in the case where the company has not conducted any business activity – up to PLN 100,000.

The Office of Competition and Consumer Protection is the central authority of governmental administration in Poland. The principal legal basis governing the activities of UOKiK is the Act of February 16, 2007 on Competition and Consumer Protection (Act on Competition and Consumer Protection, 2007).

The competencies of UOKiK in the area of consumer protection include, inter alia:

- conducting proceedings concerning practices infringing collective consumer interests;
- conducting proceedings aimed at declaring contractual terms in standard form agreements as prohibited (so-called abusive clauses);
- publishing consumer warnings.

The term “abusive clauses” is commonly used with reference to prohibited contractual provisions as mentioned in art. 3851 of the Civil Code. This provision states that contract terms concluded with a consumer that have not been individually agreed are not binding if they shape the consumer’s rights and obligations in a manner contrary to good practice, grossly violating their interests (Orlicka & Orlicki, 2015, p. 119). Prohibited contractual terms (found in general insurance conditions) play a particularly important role in shaping the content of insurance contracts. A characteristic feature of abusive clauses is the prohibition of their use in consumer transactions,⁸ which is sanctioned by their lack of binding force (Szczepańska, 2017, p. 28).

Prior to the amendment of the Act on Competition and Consumer Protection taking effect, i.e., before April 17, 2016, it was the Court of Competition and Consumer Protection (SOKiK) that determined the abusive nature of contract clauses. Contractual terms found abusive by a final judgment of SOKiK were entered into the register of abusive clauses and, from that moment, their use in consumer transactions was prohibited. However, after the aforementioned amendment took effect, it is now the President of the Office who conducts proceedings regarding the

⁸ This prohibition was introduced in art. 385¹–385³ of the Civil Code. The purpose of this regulation is to provide consumers with more effective protection in contractual relations with professionals.

recognition of a contract template provision as abusive. In an administrative decision, the President decides whether a given clause is abusive and whether to prohibit its further use. A decision of the President of UOKiK declaring a contract template provision as abusive is effective only in relation to the entrepreneur who used it and all consumers who concluded a contract with that entrepreneur based on the clause indicated in the decision.⁹

Research methods

The study was conducted based on data obtained from:

- applications submitted to the Financial Ombudsman in the field of commercial insurance;
- notifications submitted to the Polish Financial Supervision Authority concerning the activities of domestic insurance companies;
- the register of prohibited clauses (based on rulings of the Court of Competition and Consumer Protection);
- decisions issued by the President of the Office of Competition and Consumer Protection.

The collected source material was derived from the *Reports on the Activities of the Financial Ombudsman*, the *Reports on the Activities of the Polish Financial Supervision Authority* and the *Financial Supervision Authority*, and the *Register of Prohibited Clauses*.

The following data and information were obtained for the purposes of the study:

- from RF – the number and subject matter of submitted applications, the number and type of charges formulated, and the procedure for handling the submitted applications (for the years 2015–2023);
- from KNF – the number and scope of interventions, the number and type of inspections carried out, the number of recommendations issued, as well as statistics and amounts of penalties imposed on insurance companies (for the years 2014–2021);
- from UOKiK – register of abusive clauses in the area of insurance services (for the years 2014–2023).

Differences in the years covered by the analysis result from data availability. The obtained data concerns only commercial insurance offered by domestic insurance companies. The data was subjected to a quantitative and dynamic analysis.

⁹ *Abusive clauses*, www.uokik.gov.pl (access as of: June 25, 2025).

Results

The Polish Insurance Market: Gross Written Premium Trends, 2014–2023

Over the last decade, the market has been influenced by changing economic conditions, regulatory developments, and shifts in consumer demand. These factors have affected both the overall level of premiums and their composition across different insurance classes.¹⁰

Figure 1.

Gross written premiums in Poland, 2014–2023 (at 2023 prices, PLN million)



Source: Polish Chamber of Insurance (2023), *Annual Report of the Polish Chamber of Insurance*, <https://piu.org.pl/raporty-roczne/raport-roczy-piu-2023-online> (access as of: June 25, 2025), p. 63.

According to the Polish Chamber of Insurance' Annual Report 2023, the real value of gross written premiums in Section I has exhibited a downward trend since 2014, following intermittent two-year periods of relative stability, ultimately reaching a minimum of PLN 22.8 billion (i.e., 22,848 million) in 2023. This decline was primarily driven by a systematic reduction in insurance within class 3,¹¹ despite a temporary increase observed in 2021, when premiums rose to PLN 28.2 billion.

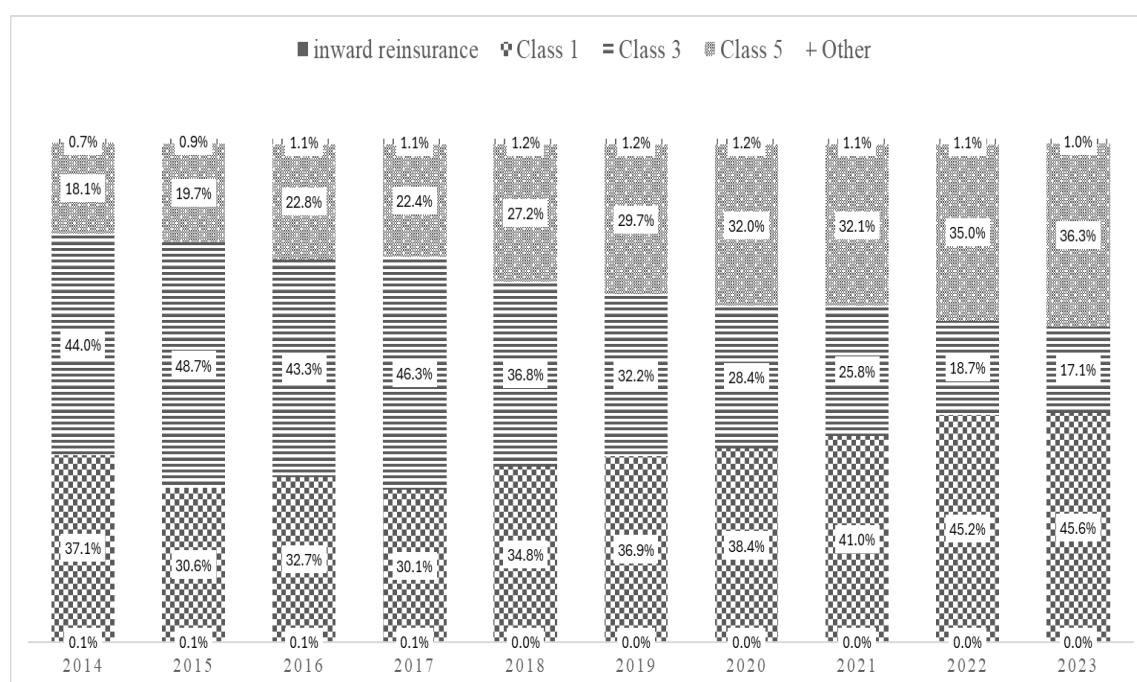
In contrast, premiums in Section II have demonstrated a sustained upward trend since 2014, largely attributable to the expansion of motor insurance. Although the growth rate decelerated in 2019, a subsequent inflation-driven increase led to a peak of PLN 60 billion in 2021. Thereafter, premiums in Section II declined, reaching their lowest level in six years, at PLN 56 billion in 2023.

¹⁰ Classes as defined in the Annex to Act of September 11, 2015 on Insurance and Reinsurance Activity

¹¹ Life insurance linked to investment funds (unit-linked), including index- and value-linked life insurance.

Figure 2.

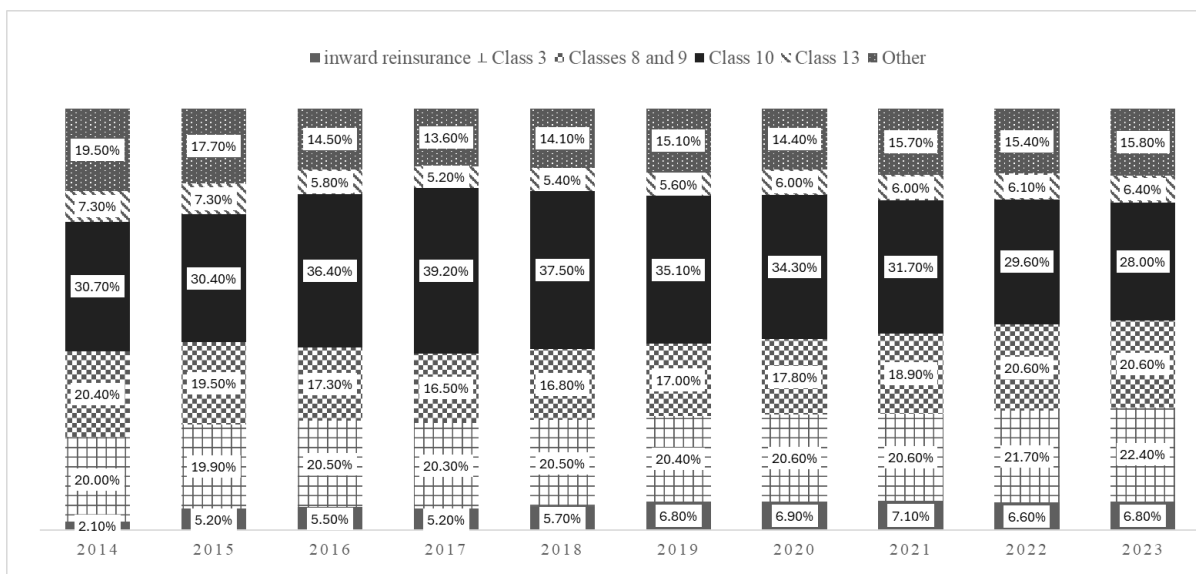
Change in the structure of gross written premiums in Section I in Poland, 2014–2023 (%)



Source: Polish Chamber of Insurance (2023), *Annual Report of the Polish Chamber of Insurance*, <https://piu.org.pl/raporty-roczne/raport-roczny-piu-2023-online> (access as of: June 25, 2025), p. 66.

Since 2019, classes 1 and 5¹² have dominated Section I, accounting for 81.8% of gross written premiums in 2023. In 2014–2015, class 3 increased its share to 48.7%. In 2016, its share fell to 43.3%. In 2017, it rebounded to 46.3%; however, from 2018 onwards, it experienced a marked and sustained decline. By 2023, class 3's share had dropped to 17.1%, while classes 1 and 5 increased to 45.6% and 36.3%, respectively.

¹² Class 1 – life insurance, class 5 – supplementary accident and sickness insurance (if related to life insurance contracts).

Figure 3.*Change in the structure of gross written premiums in Section II in Poland, 2014–2023 (%)*

Source: Polish Chamber of Insurance (2023). *Annual Report of the Polish Chamber of Insurance*, <https://piu.org.pl/raporty-roczne/raport-roczny-piu-2023-online> (access as of: June 25, 2025), p. 66.

In Section II, motor insurance – MTPL (class 10) and casco (class 3) – dominates. Property insurance (classes 8 and 9) ranks next, with a steady increase observed since 2017. The combined share of these three groups amounted to 71.0% of gross written premiums in 2023, broadly in line with the level recorded a decade earlier and 0.9 pp lower than in 2022.

Changes in the structure of insurance, reflected in the evolving structure of gross written premiums, are transmitted into the structure of complaints submitted to the Polish Financial Supervision Authority, the Financial Ombudsman, and the Office of Competition and Consumer Protection, indicating a link between market composition and consumer dispute patterns.

The Financial Ombudsman's actions in the field of signals sent by consumers of insurance services

Over 2015–2023, the Financial Ombudsman received a total of 103,758 requests relating to business insurance, of which 31,581 requests related to Section I insurance (30% of all requests), and 71,781 requests were in respect of Section II insurance (69% of all requests).

In percentage terms, most Section I insurance requests filed with the RF over 2015–2023 were concerned with accident and sickness insurance (63%, 19,953 requests in total, or an average of 2,217 requests a year), followed by life insurance (19%, 6,123 requests in total, or an average of 761 requests a year). For Section II insurance, the highest percentage of requests pertained to motor third-party liability insurance (42%, 29,989 requests in total, or an average of

3,332 requests a year), followed by business third-party liability insurance (12%, 8,306 requests in total, or an average of 922 requests a year). The concerns raised in the reports to the Financial Ombudsman related to different issues (Table 1). Over 2015–2023, a total of 103,758 concerns were raised in the request (an average of 12,950 a year). In percentage terms, the most concerns were about “claim dismissals” (a total of 48,500, or an average of 5,389 a year), “disputes over compensation or benefits granted” (a total of 32,665, or an average of 3 629 a year), and premium-related (a total of 7,702, or an average of 858 a year).

Table 1.

Allegations contained in complaints concerning commercial insurance submitted to the Financial Ombudsman, 2015–2023

Concerns	Year									Total	As %
	2015	2016	2017	2018	2019	2020	2021	2022	2023		
Total	11,612	13,021	14,356	14,043	12,780	10,551	9,295	8,819	9,281	103,758	100.00%
Claim dismissals	4,987	5,939	6,775	6,464	6,078	5,103	4,430	4,232	4,492	48,500	74.90%
Disputes over compensation or benefits granted	3,366	4,028	4,580	4,631	4,224	3,433	2,879	2,659	2,865	32,665	50.45%
Premium (amount, refund, request for payment of premium)	1,333	1,186	1,045	916	890	720	583	571	476	7,720	11.92%
Delay in compensation proceedings	727	552	504	553	367	297	309	313	394	4,016	6.20%
Refusal to cancel, reduce, or pay by installments penalties and recourse liabilities	157	231	222	242	201	266	224	251	311	2,105	3.25%
Insurance procedures	218	205	269	203	150	150	184	222	210	1,811	2.80%
Understated policy surrender value	190	432	491	414	397	145	85	–	–	2,154	3.33%
Difficulty in accessing claim files	283*	146	114	283	177	67	362	99	60	1,308	2.02%
Denial of insurance continuation	36	36	69	63	55	51	44	35	19	408	0.63%
Interpretation of insurance regulations	83	40	45	20	24	19	5	6	–	242	0.37%

Concerns	Year									Total	As %
	2015	2016	2017	2018	2019	2020	2021	2022	2023		
Change of the general terms and conditions during the term of the contract	2	13	4	8	19	9	2	6	1	64	0.10%
Improper policy management	19	26	43	20	28	63	16	18	8	241	0.37%
Denial of policy surrender value	8	16	5	9	10	4	6	–	–	58	0.09%
Change of the sum insured	3	5	4	2	14	3	6	–	1	38	0.06%
Late policy surrender	8	1	–	2	7	–	1	–	–	19	0.03%

Source: Own study.

The data shows that the RF intervened in 79% (81,736) of the submitted applications, did not intervene in 16% (16,685) and decided to re-examine 5% (5,396) of the submitted applications.

Measures taken by the Polish Financial Supervision Authority to protect the interests of insurance service recipients

Although the Polish Financial Supervision Authority does not function as a dispute resolution body, it monitors complaints and reports from consumers as part of its supervisory role over the insurance market. These actions serve preventive, interventionist, and supervisory purposes.

The KNF accepts complaints and reports related to unfair practices of insurance companies, delays or refusal to pay compensation or benefits, misconduct by insurance agents or brokers, or limited access to key information.

Between 2014 and 2021,¹³ a total of 16,788 reports were registered concerning the activities of domestic insurance companies in Poland, of which 87% related to non-life insurance activities (Section II). The total number of submissions received by the Financial Supervision Authority regarding life insurance companies (Section I) amounted to 2,197, with a year-on-year decline observed (Table 2). The highest proportion of reports concerned “payout refusals” (17%), “surrender value” (16%), and “agent negligence” (11%). The observed decrease in surrender value-related complaints can be attributed to both a systematic reduction in insurance within class 3 in Section I, as noted above, and amendments to the regulatory provisions governing policy surrender.

¹³ For the years 2022–2023, data at this level of granularity is not provided by the supervisory authority.

Table 2.

Reports to the Polish Financial Supervision Authority, Section I insurers, 2014–2023
(by a reporting reason)

Reported concerns	2014	2015	2016	2017	2018	2019	2020	2021	Total	As %
Payout refusal	61	73	63	56	45	31	24	24	377	17%
Surrender value	113	98	42	26	25	14	16	8	342	16%
Agent negligence	90	66	71	14	1	3	3	2	250	11%
Contractual performance	20	25	36	26	26	24	15	11	183	8%
Insurer's information policy	73	81	12	7	7	1	2	2	185	8%
Dilatory conduct	27	27	24	12	22	21	10	16	159	7%
Unit valuation or insurer's investment performance	15	18	49	34	25	9	3	0	153	7%
Compensation amount	16	24	23	21	11	10	9	6	120	5%
Difficulty inspecting loss file	11	15	16	6	4	4	3	5	64	3%
Loss adjustment process concerns	0	0	0	3	17	14	9	6	49	2%
Interpretation of GTCs	0	2	4	1	3	4	7	1	22	1%
Difficulty making the contract	2	7	1	3	2	3	3	2	23	1%
Changes to GTCs	6	2	3	3	0	1	3	4	22	1%
Refusing insurance coverage	1	2	2	0	0	3	2	1	11	1%
Cross-border activities of domestic entities	0	0	9	0	0	1	1	0	11	1%
Other	69	57	35	21	21	15	2	6	226	10%
Total	504	497	390	233	209	158	112	94	2,197	100%
Absolute increases, chain-linked	–	–7	–107	–157	–24	–51	–46	–18	–	–
Relative increases, chain-linked	–	–1%	–22%	–40%	–10%	–24%	–29%	–16%	–	–

Source: Own study.

Between 2014 and 2021, the total number of submissions concerning the activities of domestic non-life insurance companies (Section II) amounted to 14,581. The number of such sub-

missions decreased year by year (Table 3). The largest proportion of reports concerned “compensation amount” (29%), “dilatory conduct” (26%), and “payout refusal” (14%). There was much less information on potential distribution irregularities in Section II insurance undertakings.

It is noteworthy that the sustained growth in gross written premiums has not been reflected in a corresponding decline in the number of complaints in Section II.

Table 3.

*Reports to the Polish Financial Supervision Authority, Section II insurers, 2014–2023
(by a reporting reason)*

Reported concerns	2014	2015	2016	2017	2018	2019	2020	2021	Total	As %
Compensation amount	886	986	731	517	312	226	280	237	4,175	29%
Dilatory conduct	883	683	641	581	323	267	195	265	3,838	26%
Payout refusal	531	385	285	277	193	159	120	132	2,082	14%
Difficulty inspecting loss file	180	199	112	171	173	398	146	94	1,473	10%
Loss adjustment process concerns	0	0	0	118	360	268	249	182	1,177	8%
Contractual performance	31	32	107	64	63	46	20	24	387	3%
Difficulty terminating the contract	66	64	38	49	34	31	28	16	326	2%
Unfair debt recovery	1	20	67	61	53	39	17	15	273	2%
Premium amount	34	22	31	35	35	21	21	13	212	1%
Difficulty making the contract	5	6	4	5	6	8	9	18	61	0%
Other	110	133	100	75	52	35	29	43	577	4%
Total	2,727	2,530	2,116	1,953	1,604	1,498	1,114	1,039	14,581	100%
Absolute increases, chain-linked	–	–197	–414	–163	–349	–106	–384	–75	–	–
Relative increases, chain-linked	–	–7%	–16%	–8%	–18%	–7%	–26%	–7%	–	–

Source: Own study.

Reports submitted to the Polish Financial Supervision Authority should serve as a basis for initiating supervisory activities in insurance and reinsurance undertakings.¹⁴ During the reporting

¹⁴ It was not possible to determine whether the indicated actions were the result of the reports listed in Table 2 and Table 3.

period, the KNF carried out a total of 146 inspection procedures, conducted 82 supervisory visits, and issued 821 post-inspection recommendations.

Furthermore, during the reporting period, the KNF imposed penalties on a total of 94 entities in the insurance sector (Table 4). The majority of the sanctioned entities were non-life insurance undertakings (Section II), accounting for 97% of the total.

Non-life insurance undertakings were also penalized for violations of art. 18(2) of the Act on Insurance Activity,¹⁵ by setting insurance premiums at a level that did not ensure, at a minimum, the fulfilment of all obligations arising from insurance contracts and the coverage of the costs of conducting insurance activity. These violations concerned insurance classes 3 and 10, as defined in the annex to the Act of September 11, 2015 on Insurance and Reinsurance Activity (Act on Insurance and Reinsurance Activity, 2015), during the periods in which the Act was in force. Penalties imposed on life insurance undertakings concerned violations of the obligation to effectively manage assets and liabilities, as well as the placement of financial resources in assets whose risks the company was unable to properly identify, measure, or manage.

Table 4.

Actions undertaken by the Polish Financial Supervision Authority with respect to domestic insurance undertakings operating in Section I and Section II, 2014–2023

Action	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
inspections	17	20	12	14	15	14	12	14	14	14	146
supervisory visits	–	–	13	11	21	9	7	7	7	7	82
post-inspection recommendations	108	96	22	88	93	66	82	79	65	122	821

Source: Own study.

The highest level of penalties imposed was recorded in 2018 (PLN 2,395,000). Relatively high penalty amounts were registered in the years: 2017 (PLN 1,843,000) and 2019 (PLN 1,677,000). Conversely, the lowest penalty amount occurred in 2020 (PLN 130,000). During this period, a financial penalty was imposed on only two insurance companies: AXA Ub-
ezpieczenia TUiR and Compensa TU SA Vienna Insurance Group. The year 2020 stands out in this regard throughout the analyzed period. It can be reasonably inferred that this situation is

¹⁵ Act on Insurance Activity of May 22, 2003 (consolidated text: Journal of Laws of 2003, No. 124, item 1152) was replaced by Act of September 11, 2015 on Insurance and Reinsurance Activity (consolidated text: Journal of Laws of 2015, item 1844).

related to the Covid-19 pandemic, which significantly affected the functioning of public administration, businesses, courts, as well as financial market institutions, including the Financial Supervision Authority.

Considering the amounts of financial penalties imposed by the supervisory authority on individual insurance companies, the lowest were:

- the amount of PLN 3,000, imposed on BRE Ubezpieczenia TUiR (2014);
- and PLN 5,000, imposed on Aviva TU S.A. (2014).

On the other hand, the highest penalty of PLN 899,000 was imposed on PZU SA (2019). During the analyzed period, the Financial Supervision Authority most frequently imposed penalties on the following insurance companies: PZU SA (nine times); Generali TU SA (eight times); Compensa TU S.A. Vienna Insurance Group (seven times). It is also worth noting that in some years, these companies were penalized two or even three times (Generali in 2018).

Table 5.

Penalties imposed by the Financial Supervision Authority resulting from violations of art. 14(1)–(3) of the Act on Compulsory Insurance, 2014–2023

Insurance company	Amount of the penalty (PLN)									
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Aviva TU SA	5,000*	–	–	–	10,000*	–	–	–	–	–
AXA Ubezpieczenia TUiR	–	–	–	–	–	–	50,000*	–	–	–
Benefia TU SA	40,000*	–	–	–	–	–	–	–	–	–
BRE Ubezpieczenia TUiR	3,000**	–	–	–	–	–	–	–	–	–
Compensa TU SA	70,000* 70,000*	–	250,00*	50,000*	–	–	80,000*	–	65,100*	67,100*
Concordia Polska TUW	–	–	–	3,000*	–	13,000*	–	–	–	–
Generali TU SA	–	100,000*	–	260,000*	97,000* 90,000* 100,000*	100,000*	–	155,600* 162,000*	–	–
Gothaer TU SA (from 2019: Wiener TU SA)	100,000*	–	–	–	57,000* 35,000*	60,000*	–	–	–	72,200**
INTER Polska SA	–	–	–	–	1,000*	–	–	–	–	–
InterRisk TU SA VIG	50,000*	45,000*	100,000*	–	50,000*	–	–	–	–	–
Link4 TU SA	25,000*	–	–	20,000*	–	–	–	–	–	58,900**

Insurance company	Amount of the penalty (PLN)									
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
MTU Moje TU SA	40,000*	–	–	–	–	–	–	–	–	–
Pocztowe TOW	–	–	–	25,000**	40,000**	–	–	–	–	–
PZU SA	115,000*	–	–	140,000*	750,000* 750,000*	899,000* 370,000**	–	397,000**	685,200* 546,300*	–
STU Ergo Hestia SA	100,000**	–	–	320,000*	–	–	–	–	270,400**	–
TUiR Allianz Polska SA	–	–	–	180,000* 180,000*	–	–	–	–	106,500*	139,900*
TUiR WARTA SA	120,000*	–	–	590,000*	380,000*	–	–	80,000*	–	–
TUiR WARTA SA (as the legal successor of HDI Asekuracja TU SA)**	100,000*	–	–	–	–	200,000**	–	–	–	–
TUW TUW	30,000*	20,000*	30,000*	–	–	35,000*	–	–	–	–
TUZ TUW	7,000**	–	–	–	15,000*	–	–	–	65,800*	–
Uniq TU SA	–	–	–	75,000*	20,000*	–	–	32,800* 51,000*	91,800*	146,300*
TOTAL	875,000	165,000	380,000	1,843,000	2,395,000	1,677,000	130,000	878,400	1,831,100	484,400

Source: Own study.

Legend:

* – violation of art. 14(1)–(3) of the Act on Compulsory Insurance, the Insurance Guarantee Fund, and the Polish Motor Insurers' Bureau, in connection with identified cases of delays in granting and paying compensation or failure to meet information obligations.

** – violation of art. 14(1)–(2) of the Act on Compulsory Insurance, the Insurance Guarantee Fund, and the Polish Motor Insurers' Bureau, in connection with identified cases of delays in granting and paying compensation.

The largest share of the amount of penalties imposed by the KNF for violations of the provisions of art. 14 of the Act on Compulsory Insurance was held by PZU SA (44%). Such a concentration of penalties on the largest player in the motor third-party liability insurance area may result not only from its market share,¹⁶ but also from systemic problems in claims handling. The next places are occupied by: Warta SA (11%) and Generali TU SA (10%). A 6% share was

¹⁶ In 2023, PZU SA's market share in motor third-party liability (MTPL) insurance (as measured by gross written premium) was 29.7%. For comparison, the market share of TUiR Warta SA was 22.5%. Based on: *Annual Report of the Polish Chamber of Insurance*, Warsaw 2023; *PZU SA Financial Statements for the year ended December 31, 2024*; *Solvency and Financial Condition Report of TUiR WARTA SA as of December 31, 2023*, and for the financial year ending on that date.

held by both Ergo Hestia and Compensa. Meanwhile, “Other insurance companies” (a total of 16 entities) account for 23% of the overall structure.

Actions of the Office of Competition and Consumer Protection regarding “abusive clauses” in the insurance market

Based on the information presented in Table 6, the following categories of abusive clauses can be distinguished:

- limiting the liability of the insurance company;
- automatic renewal of voluntary insurance contracts;
- excessive requirements regarding documentation or safeguards;
- and the method of determining the value of the insured object or benefit.

Judgments of the Court of Competition and Consumer Protection in the analyzed period concerned three life insurance companies (Section I) and four non-life insurance companies (Section II), including four judgments against Ergo Hestia.

Table 6.

Provisions in insurance services deemed abusive by the Office of Competition and Consumer Protection, 2014–2019

Date of UOKiK judgment	Defendant	Prohibited clause
2015.06.09	TU na Życie WARTA SA	The insurer’s liability in relation to each insured person is excluded for a period of 24 months from the first day of the month in which the policyholder enrolled the insured in the insurance contract, in the event of the insured’s death, if the event was caused by an illness that was diagnosed or treated prior to that date.
2015.06.25	STU Ergo Hestia SA	Ergo Hestia is also not liable for damage arising during the normal operation of the vehicle (resulting from natural wear and tear), or for damage caused by shocks on uneven road surfaces, or damage resulting from corrosion or manufacturing defects, as well as damage resulting from improperly performed previous repairs.
2015.11.17	D.A.S. Towarzystwo Ubezpieczeń Ochrony Prawnej SA	An insurance contract concluded for a period of at least one year shall be extended for another year unless the policyholder or the insurer terminates the contract by submitting a written statement at least six weeks before the end of the insurance period. Unless otherwise agreed by the parties, the provisions of the preceding sentence also apply to insurance contracts concluded for a period shorter than one year, with the subsequent period of the contract lasting one year.
2016.01.21	Compensa TU SA Vienna Insurance Group	A vessel is considered to be properly secured in an open area if it is fastened with a mooring line of at least 8 mm in diameter (depending on the size of the boat) to a permanent post, marina cleat, or another fixed point along the waterways. The fastening should be locked with a padlock or a similar type of lock.

Date of UOKiK judgment	Defendant	Prohibited clause
2016.04.01	STU Ergo Hestia SA	Pursuant to this clause, while maintaining the other provisions of the motor vehicle insurance contract against loss, destruction, or damage (Autocasco) that are not amended by this clause, and upon payment of an additional premium, Autocasco insurance shall be extended in such a way that, during the insurance period, the market value of the vehicle is deemed to be the sum insured specified in the contract, provided that this sum has been determined in accordance with § 15(1) and (3)–(5) of the General Terms and Conditions of Autocasco Insurance.
2016.04.01	STU Ergo Hestia SA	In situations where the sum insured has not been determined in accordance with § 15(1) and (3)–(5) of the General Terms and Conditions of Autocasco Insurance, the market value of the vehicle during the insurance period shall be deemed to be the market value as of the date the insurance contract was concluded, but not higher than the sum insured specified in the contract.
2017.01.09	Uniq TU SA	Upon returning to Poland, the insured must submit to Uniq TU S.A. the original medical bills as well as other documents related to the treatment, containing at least the following information: the first and last name, date of birth of the person treated, the name of the illness, a description of the medical services provided, the duration of the treatment, the names of prescribed medications, and a record confirming payment or another document serving as proof of payment for the treatment, in cases where the insured has paid the medical costs themselves.
2017.09.06	PZU na Życie SA	Within the meaning of the regulations concerning childbirth and births
2018.01.18	STU Ergo Hestia SA	§ 11 Ergo Hestia is not liable for damage: 5) resulting from theft of the vehicle or its parts if: d) the claimant has not submitted to Ergo Hestia the vehicle documents on the basis of which the vehicle was authorized for use on the day of the loss, as well as all keys (factory devices) used to open the vehicle, in a number not less than stated in the insurance application, together with a complete set of devices used to activate anti-theft devices, unless the vehicle was lost as a result of robbery.
2019.02.20	Generali Życie TU SA	For the calculation of the policy value and the additional value, the sale price of a participation unit applicable on the valuation day following the day on which the insurance company registers the complete set of documents required for the payout, together with the application for the payout of the surrender value, shall be used.

Source: Own study.

Administrative decisions of the President of UOKiK regarding prohibited provisions in contract templates (Table 7) have only been issued since 2022. By the end of the analyzed period (i.e., by the end of 2023), five decisions were recorded. It should be emphasized here that all of them concerned life insurance companies (Section I). The key areas identified and resolved as prohibited provisions included:

- the “abuse” of allocation and distribution fees (their amount and structure);
- manipulation of the amount of fees and their indexation, as well as lack of transparency (changes in the amount of fees could be made at any time, without the obligation to consult or obtain the policyholder’s consent).

Table 7.

Decisions resulting in the recognition of contract template clauses as abusive in insurance services by the Office of Competition and Consumer Protection, 2016–2023

Date of decision	Insurance company	Prohibited clause (summary)
2022.02.22	MetLife Towarzystwo Ubezpieczeń na Życie i Reasekuracji SA	“Allocation fee: Period of premium payments (in years) 1st year – 75% of the invested premium 2nd year – 45% of the invested premium From the 3rd year onwards – none EXPLANATION: In the first and second year of premium payments, a portion of the invested premium is allocated to cover the Company’s costs related to concluding the contract”.
2022.06.03	UNIQA TU na Życie SA	“Distribution fee expressed as a percentage Within the AXA On-Line service and in correspondence, the distribution fee expressed as a percentage is referred to as an initial fee. It is charged on the basic premium: (...)”. “The Company charges the following fees: (...) a distribution fee – a fee expressed as a percentage in relation to the basic premium and the additional investment premium, as well as a fixed amount, collected to cover the Company’s costs related to concluding the insurance contract (acquisition costs)...” “Allocation fee Within the AXA On-Line service and in correspondence, the allocation fee is referred to as an initial fee. It is charged on the basic premium: (...)”
2022.12.13	TU Allianz Życie Polska SA	FEES, FEE INDEXATION “1. The amounts of the administrative, allocation, handling, operational fees, as well as the percentage fees for the payout of account value, are specified in the insurance contract. 2. The amounts of the administrative, handling, and operational fees may be increased. The increase may occur no more than once in a given insurance year. 3. Any increase in the amount of fees will be made in accordance with an index determined by the Company, which shall not exceed the higher of the following indices: the increase in prices of goods and services for consumers or the increase in average wages in the enterprise sector, as published by the Central Statistical Office, covering the period from the first day of the month in which the amount of fees was set to the first day of the month preceding the month in which the new amount of fees was determined. 4. A change in the amount of fees in accordance with the above rules does not constitute an amendment to the insurance contract and does not require the policyholder’s consent. The Company is obliged to promptly inform the policyholder about any increase in fees”.
2023.02.20	Generali Życie TU SA	“Allocation fee on the regular premium due and paid in the first and second policy year (...)”. “The allocation fee is charged to cover the costs incurred by the Company in connection with concluding the contract, i.e., product implementation costs, the Company’s margin, and acquisition costs”. “The allocation fee is collected by the Company by reducing the amount of each regular premium due and paid in the first and second policy year by the allocation fee specified in the Table”.
2023.07.23	Vienna Life TU na Życie SA	“Initial fee on the Regular Premium: (...) in the first Policy Year – 50%; in the second Policy Year – 50%. In a given Policy Year, the amount of the fee will be divided into as many equal parts as there are Regular Premiums due in that Policy Year and collected at the time each paid Regular Premium is credited to the Fund Units Account”.

Source: Own study.

Conclusions

The obtained results confirm that the Financial Ombudsman, the Polish Financial Supervision Authority, and the Office of Competition and Consumer Protection identify irregularities in the Polish insurance market, which indicates the functionality of the institutional consumer protection system.

The identified irregularities are wide-ranging and concern both life and non-life insurance. Their nature is mainly concentrated around disputes over the performance of benefits (claim dismissals, compensation amounts, delays), indicating a systemic problem in the area of claims handling. The scale of the phenomenon, measured by the number of complaints and interventions, remains significant, although a downward trend is observed in selected areas.

The institutions apply complementary instruments of influence: intervention activities (RF), supervisory-control and sanctioning measures (KNF), and the elimination of prohibited market practices through decisions and the register of abusive clauses (UOKiK). Such a model indicates a multilevel and relatively coherent system of response to irregularities. The activities of these institutions contribute to limiting selected market pathologies (e.g., a decline in the use of prohibited clauses); however, they do not eliminate them entirely, which confirms the need for continued supervision and further improvement of regulatory instruments. What should be emphasized here is the positive significance of consumer-protective legal regulations in the area of life insurance with unit-linked funds (UFK), which have been in effect since January 1, 2016 (Act on Insurance and Reinsurance Activity, 2015, art. 21, art. 26):

- prior to concluding an insurance contract with a UFK, the insurance company should conduct a survey with the client regarding their needs, knowledge, and experience in the field of life insurance, as well as their financial situation;
- the policyholder has the right to withdraw from the contract within 60 days of receiving for the first time the annual information on the amount of benefits due under the concluded insurance contract;
- in the event of the policyholder's withdrawal from the insurance contract, the insurance company shall charge a surrender fee, but not exceeding 4% of the value of paid premiums.

It can be concluded that the introduced legal solutions were accompanied by a decrease in the number of reports submitted to the Polish Financial Supervision Authority concerning the activities of life insurance companies in the areas of: surrender value, agent negligence, and the information practices of insurance companies (Table 2).

The persistence of irregularities may result, among other things, from information asymmetry and the weaker negotiating position of consumers vis-à-vis insurers, which favors suboptimal decision-making and generates conflicts at the stage of contract performance. In turn, the effectiveness of identifying and limiting irregularities is important not only for consumer protection but also for the stability of the insurance market. A key direction for further action remains increasing product transparency and standardizing distribution practices.

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ACCURACY OF VALUATIONS IN STOCK RECOMMENDATIONS

ABSTRACT

The purpose of the article. The purpose of the article is to assess the accuracy of equity recommendations issued by brokerage institutions on the Polish capital market. The study focuses on sell-side recommendations and aims to verify the hypothesis that stock exchange recommendations are characterised by low accuracy, leading to significant deviations between target and market prices.

Methodology. The research was conducted on a unique dataset comprising 5,295 recommendations for 303 companies listed on the Warsaw Stock Exchange, covering the period from October 2005 to May 2023. The methodology is based on a static approach, evaluating the accuracy of each recommendation by comparing its target price with the actual market price on the expiration date. Statistical tests such as the one-sample t-test and chi-square test were used to validate the research hypotheses and determine the effect size.

Results of the research. The results reveal that 71% of the recommendations demonstrated an unacceptable level of inaccuracy (defined as a deviation greater than 15%), while only 11% were deemed accurate. The average overvaluation reached 51.38%. These findings indicate that equity recommendations, while widely used by investors, may not be fully reliable as a basis for investment decisions due to systematic forecasting errors and behavioral biases among analysts.

Keywords: relevance, brokerage recommendations, valuation, financial market, brokerage houses

JEL Class: G12, G24



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Introduction

Modern capital markets are characterized by high complexity and a dynamic flow of information, which significantly complicates investment decision-making. In this context, stock exchange recommendations published by brokerage houses and financial institutions play a vital role. They serve as an information channel between analysts and investors, offering structured forecasts regarding the future value of financial instruments and providing indications on whether to buy or sell them (Dąbrowski, 2013).

Despite their popularity, stock exchange recommendations are subject to considerable controversy concerning their accuracy and objectivity. Literature highlights multiple factors that may contribute to the limited effectiveness of these forecasts, including analysts' cognitive biases, reliance on simplified or heuristic valuation models, and potential conflicts of interest stemming from institutional affiliations (Imam et al., 2008; Bradshaw, Brown & Huang, 2010).

The primary objective of this article is to empirically verify the accuracy of stock exchange recommendations on the Polish capital market, with particular emphasis on sell-side recommendations. The study covers over 5,295 recommendations issued between 2005 and 2023 for companies listed on the Warsaw Stock Exchange. The breadth of this dataset makes the research one of the most comprehensive studies on the accuracy of stock recommendations in the context of the Polish market.

The study employs a static approach, comparing the target price stated in the recommendation with the actual market price on the recommendation's expiration date. This allows for a clear and measurable evaluation of the accuracy of analysts' forecasts. The main hypothesis assumes that stock exchange recommendations are characterized by low accuracy, understood as a statistically significant deviation between the forecasted and actual prices.

The subsequent sections present a literature review, a description of the research methodology, an analysis of the empirical results, and final conclusions that provide a foundation for further reflection on the effectiveness and credibility of stock exchange recommendations.

Literature Review

Opinions and recommendations¹ made public by institutions engaged in capital market analysis and brokerage houses are a popular source of information for both institutional and individual investors. For many investors, the overwhelming volume of information about companies listed on the Warsaw Stock Exchange (WSE) constitutes a significant challenge. Recommendations

¹ In the literature, recommendations can be found under many names. They appear as recommendations or reports of brokerage, stock exchange, investment analysts. The term brokerage only refers to recommendations issued by licensed securities brokers and investment advisors, as well as by financial institutions with the appropriate authorization.

can serve as an initial filter for instrument selection and may provide a basis for investment decisions. One of the roles of stock recommendations is to direct attention to specific securities, attract new potential investors, and interest individuals seeking capital growth opportunities. Financial institutions continue to be perceived as professional and trustworthy providers of financial services, despite reputational turbulence in recent years (Dąbrowski, 2013).

The popularity of stock recommendations remains high, especially during periods of market instability (Loh & Stulz, 2018). This may be explained by the tendency of investors to transfer the responsibility for investment decisions to analysts (Majewski, 2008). Recommendations aim to encourage investors to buy (buy recommendations) or sell (sell recommendations) financial instruments. Typically, these analyses are based on fundamental and ratio analysis. Financial institutions issuing recommendations have an advantage over individual investors due to simplified access to information directly from companies, which results in more comprehensive and detailed data (Dąbrowski, 2013).

Two primary types of recommendations are commonly distinguished: sell-side² and buy-side³, based on the issuing entities and the target recipients (Prusak, 2015). This study focuses on sell-side recommendations. The process of creating stock recommendations involves the use of fundamental and ratio-based methods, which should rely on objective market data and incorporate rational assumptions made by analysts (Radke, 2023).

Stock recommendations can be evaluated using various criteria and over different time horizons. This study concentrates specifically on the criterion of forecast accuracy, particularly on whether the market price of the financial instrument reaches the target price specified in the recommendation on its expiration date.

The choice of this evaluation criterion is justified by its universal nature, allowing for comparability regardless of the internal classification procedures and price range definitions used by individual brokerage houses. The essence of the adopted method lies in measuring the deviation between the market price and the target price indicated in the recommendation. The smaller the deviation, the higher the assessed accuracy of the recommendation.

The accuracy and effectiveness of investment recommendations have been the subject of numerous empirical studies. Most of these focus on verifying the hypothesis that it is possible to achieve abnormal returns by relying on analyst recommendations (e.g., Keller, 2020; Soucek

² These are recommendations made by brokerage firms for their clients (corporate and individual ones). They play a supply-side role, that is, they are designed to increase the turnover of the brokerage firm and at the same time increase profits through the commission earned.

³ They are prepared by analysts working for companies, engaged in investment management, such as pension funds, investment funds or insurance institutions. They are intended to support the demand side, i.e., they provide recommendations on how to shape their investment portfolio.

& Wasserek, 2014). Alternative approaches include evaluating whether the target price is achieved at any point during the recommendation's validity period (e.g., Prusak, 2011; Zaręba & Konieczka, 2014; Brycz & Włodarczyk, 2017), commonly referred to as the dynamic approach. Another concept assumes the analysis of whether the market price reaches a target price range specified in the analytical report.

In this article, the authors focus on the so-called static approach to assessing recommendation accuracy, wherein the key point of reference is the congruence between the market price and the target price on the strictly defined expiration date.

The issue of recommendation accuracy has been widely examined in both international and domestic research. A comprehensive example is the study conducted by Bradshaw, Brown, and Huang (2010), which analyzed U.S. market data from 2000–2009. The authors found that only 38% of the recommendations reached the indicated target price within a 12-month investment horizon. The remaining 62% failed to achieve the forecasted price level, suggesting significant deviations caused by excessive optimism or pessimism in analysts' forecasts. Asquith et al. (2005) examined 1,126 analytical reports from 1997–1999 in the U.S. For recommendations based on the multiplier method, the target price was reached in 48.4% to 55.1% of cases. For those using the discounted cash flow (DCF) method, accuracy was 52.3%, indicating moderate effectiveness of valuation techniques.

In Europe, Bolliger (2004) analyzed data from 14 capital markets and found that older forecasts exhibited significantly lower accuracy than the newer ones, suggesting the usefulness of applying time-based weights when assessing the predictive value of analyst reports.

In Poland, Biedrzyński (2008) studied 516 recommendations issued between January 1, 2006, and February 1, 2008, assessing forecast accuracy over two timeframes: after nine months and at the end of the observation period. The average deviation between market and target prices was 44.77% and 60%, respectively. In the nine-month analysis, 271 cases were undervalued and 120 overvalued, indicating a predominance of pessimistic forecasts. By the end of the study period, only 36.5% of recommendations had reached the target price, while 63.5% were inaccurate, confirming significant forecast deviations.

Prusak (2011), analyzing 470 recommendations with target prices over 6-, 9-, and 12-month horizons, used a 10% deviation threshold as the criterion for forecast accuracy. The accuracy rates were 30% (6 months), 68% (9 months), and 21.92% (12 months), confirming a negative correlation between forecast horizon and accuracy. The financial daily *Parkiet* analyzed 71 reports concerning selected WSE-listed companies and found that forecasts issued during bull markets were significantly overestimated compared to actual outcomes.

Kowalke (2015) focused on the usefulness of recommendations in terms of achieving target prices. In his study, only 30% of recommendations deviated less than 10% from projected levels, indicating a relatively low predictive accuracy of equity analysis.

Radosław Pastusiak (2016) examined recommendations for ten WSE-listed companies to determine whether excessive optimism was present among analysts. His study, covering 2000–2013 with a 250-session recommendation horizon, found that valuations were on average overestimated by approximately 30%, indicating a bias toward optimistic predictions not reflected in market prices.

In his subsequent study (2018), Pastusiak analyzed over 10,500 recommendations between 2000 and 2014. He found that buy recommendations were, on average, overestimated by 29%, while sell recommendations were underestimated by 12%.

Dąbrowski (2013) analyzed recommendations for five blue-chip companies between 2007 and 2012. He found that analysts were overly optimistic, with 70% of recommendations being “buy” and only 30% being “sell”. Only 44.63% of the recommendations reached the target price within the planned timeframe.

One of the earliest studies in this field was conducted by Cowles (1933), who concluded, based on historical data, that analysts’ forecasting performance was no better than chance. Bradshaw (2002), analyzing 103 reports published in 1998–1999, found that analysts often used target prices merely to justify their recommendations rather than as independent forecasts of a security’s value.

Methodology

To fulfill the research objective concerning the accuracy of stock recommendations, the study analyzed sell-side⁴ recommendations issued by Polish and foreign brokerage houses for companies listed on the main and alternative markets of the Warsaw Stock Exchange (WSE). To verify the analysts’ bias defined as the difference between the target price and the market price on the recommendation’s expiration date — it was necessary to collect the stock prices of each examined company on that date. Quotations were obtained using the Stooq [www.stooq.pl] and WSE [www.gpw.pl] platforms. This data enabled the calculation of the deviation between the target price and the market price at the end of the recommendation’s validity period, which was essential for verifying the main hypothesis related to the presence of excessive optimism among analysts.

The research sample, constructed according to the aforementioned criteria, consisted of 5,295 recommendations issued by 28 different institutions (brokerage houses) for 303 companies.

⁴ These are recommendations issued by analysts/institutions that also offer to sell and buy or handle trading in the instruments being evaluated. The paper focuses only on recommendations made by brokerage houses, while knowing that this type of report can also be prepared by other entities.

In exploring the presence of excessive analyst optimism in equity valuations based on brokerage reports, the research adopted maximally broad sampling criteria to construct a comprehensive database, while maintaining methodological consistency and integrity. An inherent limitation in examining the Polish stock market is the historical constraint imposed by the Warsaw Stock Exchange's inception date – April 6, 1991. However, the early years of the WSE differed significantly from the present in terms of the number of listed companies, institutional participation, frequency of valuations and recommendations, investor activity, and regulatory framework.

Another important consideration is that legal regulations concerning stock recommendations were not fully developed at the WSE's inception. The relevant legal framework was only introduced with the Regulation of October 19, 2005, on information constituting recommendations related to financial instruments, their issuers, or sponsors (Dz.U. 2005 no 206 item 1715). Therefore, the present study includes only those recommendations issued after October 24, 2005, the date the regulation came into force.

Ultimately, the sample covers the period from October 25, 2005, to May 12, 2023 – more than 17 years. This timeframe is one of the longest among all studies related to stock recommendations conducted on the Polish capital market. Consequently, the conclusions drawn from this analysis should provide a more comprehensive view of the capital market than prior research efforts.

It is also important to note that the analyzed period encompasses multiple business and market cycles, thereby enabling the assessment of the studied phenomena under both bear and bull market conditions, as well as during periods of general economic prosperity and downturn.

The span from October 2005 to May 2023 covers 211 months. Based on several prominent economic and financial cycle theories, it is noteworthy that according to Wośko (2005), the average business cycle in Poland lasts about 52.7 months, while a full stock market cycle lasts about 31.2 months. Thus, the study period includes approximately four full business cycles and nearly seven full market cycles. Furthermore, the Kitchin cycle, which lasts about 40 months (Godłówn-Legiędź, 2018), is represented almost five times in this period. As for the Juglar cycles, lasting 8–10 years (Szarzec, 2019), the sample covers approximately two full cycles.

In summary, the timeframe was selected based on regulatory compliance, data availability, and its capacity to reflect all phases of the economic and market cycles. This allows for a full and nuanced depiction of the studied phenomenon.

In the study, 3-, 6-, 9-, and 12-month time horizons were applied. Accuracy was defined as the percentage deviation between the target price and the stock's closing price at the respective time intervals (i.e., after 3, 6, 9, and 12 months from the recommendation issuance date). The

deviation was calculated using the following formula (Bonini et al., 2010; Kerl, 2011; Flotyński, 2015; Prusak, 2015; Drewniak, 2017):

$$O_k = \left| \frac{CD - C_k}{C_k} \right| * 100\%$$

where: O_k – the deviation of the target price from the market price at the end of the studied period (after 3, 6, 9, or 12 months); CD – the target price specified in the recommendation report; C_k – the actual closing market price at the end of the studied period (i.e., on the recommendation expiration date).

Subjective accuracy thresholds were established, as illustrated in the following table:

Table 1

Subjective accuracy

Accuracy	Deviation Range
Accurate	<0% to 5%>
Acceptable	(5% to 15%>
Unacceptable	Above 15%

Source: Own study.

This subjective classification was based on earlier studies by Błażej Prusak (2015), Sebastian Majewski and Agnieszka Majewska (2017), and Jarosław Klepacki (2019) on recommendation accuracy. Majewski classified recommendations as accurate when the deviation was $\pm 5\%$, while Klepacki considered deviations $\leq 3\%$ as very accurate, $3\%–5\%$ as accurate, $5\%–10\%$ as acceptable, and $>10\%$ as unacceptable. Prusak's scale included: $0–5\%$ (very good), $5–10\%$ (good), $10–15\%$ (average), $15–20\%$ (poor), and $> 20\%$ (very poor).

To test the main hypothesis, the study employed the one-sample t-test for means. The t -distribution is a theoretical distribution of relative frequencies of t -values obtained from an infinite number of randomly drawn samples of a specific size from a population (King & Minium, 2020). The test statistic for the one-sample t-test is given by:

$$t = \frac{\bar{X} - \mu_x}{s_{\bar{x}}}$$

where: $\bar{X}$ – sample mean; μ_x – hypothetical population mean; $s_{\bar{x}}$ – estimated standard error of the mean.

This test determines whether the average characteristic value in the population is equal to a specific hypothesized value. The null hypothesis takes the form $H_0: \mu = \mu_x$, where μ_x is a hypothetical value. while the alternative hypotheses may be expressed as (Malska & Koziorska, 2015): H_1 : (I) $\mu \neq \mu_x$; (II) $\mu > \mu_x$; (III) $\mu < \mu_x$.

The student's t -test used quantitative data: attitudes – understood as the deviation of the target price from the market price at the end of the study period, i.e., after 3, 6, 9 and 12 months after the stock market recommendation. According to a subjective assumption based on the literature, a threshold for the occurrence of over-optimism above 15% deviation of the target price from the market price at the end of the period under study, i.e., after 3, 6, 9 and 12 months after the stock market recommendation was made, was adopted.

The fundamental research decision is to determine how large the difference between the hypothetical value of μ_x and the true value of μ_x must be. In the general case, it is convenient to express the size of the difference between μ_{hip} and μ_{praw} in terms of the number of standard deviations of the measure used. Such an indicator is called the effect size and is denoted by the symbol “ d ” (King & Minium, 2020).

$$d = \frac{\mu_{hip} - \mu_{praw}}{\sigma}$$

For practical purposes, this formula has been transformed to post:

$$d = \frac{\bar{X} - \mu_{praw}}{\sigma_x}$$

The dCohen index expresses the difference related to the size of the standard deviation of a set of observations, not the standard error. If we do not know the value of σ_x , we can estimate it using s . The resulting estimate of d is called g (Hedges correction).

$$estimated\ d = g = \frac{\bar{X} - \mu_{praw}}{s_x} = \frac{\bar{X} - \mu_{praw}}{\sqrt{\frac{SS_x}{n-1}}}$$

The effect size proposed by Cohen is defined as: 0.2 – small; 0.5 – average; 0.8 – large.

In order to confirm the presence of over-optimism among stock analysts, inference was also carried out on the frequency, that is, the number of observations that appear in each category of the distribution of abundances. The discrepancy between observed counts and expected counts is expressed as a statistic that is called Chi-square (χ^2). This test was developed for categorical data, that is, expressed in terms of qualitative categories. It can be thought of as

a test comparing proportions. Due to the probability of one out of five attitudes, equal proportions of 0.2 were assumed.

This test allows us to answer the question of whether the relative abundances observed in the specified categories of the sample distribution of abundances are consistent with the set of such hypothetical (expected) abundances, which we assume to be true in the population distribution. The χ^2 statistic for a single sample is calculated from the formula:

$$\chi^2 = \sum \left(\frac{(f_0 - f_e)^2}{f_e} \right)$$

where: f_e – expected count; f_0 – observed count, we sum the values calculated for all the categories that were considered in solving the problem.

Jacob Cohen would propose an appropriate measure of effect size for χ^2 compliance tests was the ω ratio. To calculate the ω -ratio, one must first convert the abundance to a ratio. The formula for the effect size is as follows:

$$\hat{\omega} = \sqrt{\sum \left(\frac{(p_0 - p_e)^2}{p_e} \right)}$$

where: p_0 – observed ratio; p_e – expected ratio.

The effect size proposed by Cohen is defined as: 0.1 – small effect; 0.3 – average effect; 0.5 – large effect.

Results

In Table 2, the authors presented descriptive statistics of the study group. The average overvaluation was 51.38%, standard deviation was 73.59%. The highest overvaluation of the recommendation price was 1034.55%. It was observed for a buy recommendation issued on 24.11.2021 for Aforti Holding S.A., where the recommended price was PLN 15.6, the price on the day of issuance was PLN 5.7, while the market price on the maturity date was 1.38. However, perfectly hit recommendations, i.e., when the modulus from the deviation of the recommended price and the market price was 0.00%, there were 12 for 9 companies.

Table 2

Stats

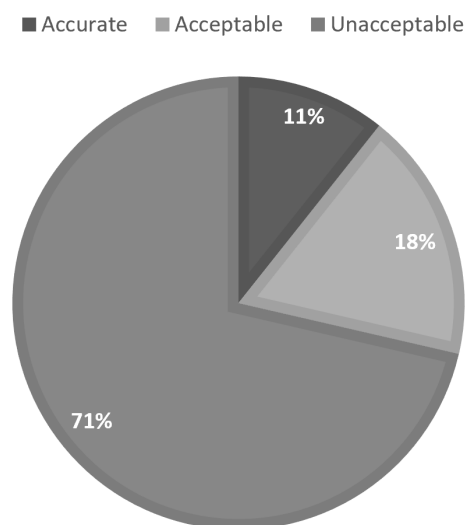
Variable	Type	Accuracy
Sample number	Statistic	5295
Range	Statistic	1034.55%
Minimum	Statistic	0.00%
Maximum	Statistic	1034.55%
Mean	Statistic	51.38%
	Std. Error	1.01%
Standard Deviation	Statistic	73.59%
Variance	Statistic	5415.78
Skewness	Statistic	4.454
	Std. Error	0.034
Kurtosis	Statistic	31.731
	Std. Error	0.067

Source: Own study.

The frequencies of the recommendation relevance scale, i.e., accurate, acceptable, unacceptable, are illustrated in Figure 1.

Figure 1

Frequencies of recommendation relevance scale



Source: Own study.

From the frequency distribution presented above for the entire sample, it can be deduced that for 71.00% of the recommendations the relevance was unacceptable, i.e., the recommended price differed from the target price by more than 15.00% at the end of the maturity period. Relevance at the acceptable level was shown by 18% of recommendations. In contrast, for only 11% of recommendations the target price was accurately predicted.

To test whether the hypothesis that stock market recommendations characterize low accuracy is true, the student's t-test for one mean was applied, assuming a significance level of 0.05. The following hypotheses were put forward:

$$H_0: \mu_x = 15\%$$

$$H_1: \mu_x > 15\%$$

Table 3

One-sample Test (test Value = 0.15)

Variable		Value
t		50.652
df		5295
Significance	One-Sided p	<.001
	Two-Sided p	<.001
Mean Difference		51.22638%
95% Confidence Interval of the Difference	Lower	49.2437%
	Upper	53.2090%

Source: Own study.

Table 4

One-sample effect sizes

Variable	Standardizer*	Point Estimate	95% Confidence Interval	
			Lower	Upper
Cohen's d	73.59198%	.696	.666	.726
Hedges' correction	73.60241%	.696	.666	.726

Source: Own study.

Legend:

* – the denominator used in estimating the effect sizes. Cohen's *d* uses the sample standard deviation. Hedges' correction uses the sample standard deviation, plus a correction factor.

Analysis using a one-sample Student's *t*-test indicates that it is statistically significantly greater than the accepted valuation error threshold of 15%, which is understood as the limit deviation of the target price from the market price at the end of the period under study, above which inaccurate recommendations are found. Thus, it falls into the rejection area, which obliges the rejection of hypothesis H_0 in favor of alternative hypothesis H_1 . The effect sizes of Cohen's *d*, as well as Hedges', are at 0.73–0.74, which is considered an average value close to large (King & Minium, 2020: 339). The plus sign means that the true value is greater than the hypothetical value, which allows the research conclusion that the accuracy of the recommendation is unacceptable.

In order to confirm the presence of over-optimism in stock market recommendations, a χ^2 consistency test was performed for categorical data, viz. The hypothesis H_0 was formulated, that the proportions between categories are equal (there are no differences in the distribution of counts between categories).

$$H_0: P_{\text{Accurate}} = P_{\text{Acceptable}} = P_{\text{Unacceptable}} = 0.3(3)$$

$$H_1: P_{\text{Accurate}} \neq P_{\text{Acceptable}} \neq P_{\text{Unacceptable}} \neq 0.3(3)$$

Table 5
Frequency

	Observed N	Expected N	Residual
Accurate	564	1765.0	−1201.0
Acceptable	949	1765.0	−816.0
Unacceptable	3782	1765.0	2017.0
Total	5295		

Source: Own study.

Table 6
Test value

	Accuracy
Chi-Square ⁵	3499.459
df	2
Asymp. Sig.	<.001

Source: Own study.

⁵ 0 cells (0,0%) have expected frequencies less than 5. The minimum expected cell frequency is 1765,0.

For the examined randomness of the distribution of variables, the χ^2 test is used for these variables. The χ^2 test ($df = 2$, $N = 5295$) = 3499.459 and $p < 0.001$. This gives grounds to reject the null hypothesis in favor of the alternative hypothesis that the distribution of the variable is not random. We also calculated the effect size for the Chi-square (ω) concordance test $\hat{\omega} = 0.66$, a large effect (King & Minium, 2020).

The study of the authors in the case of both statistical tests showed low relevance of recommendations. The results of the research are consistent with the results conducted previously for both the Polish market (Biedrzynski, 2008; Kwołke, 2012; Prusak, 2015; Pastusiak, 2016, 2018) and foreign markets (Bradshaw et al., 2010).

An attempt to explain the lack of relevance of recommendations may be the fact that analysts use both sophisticated and heuristic valuation models to determine target prices (e.g., Demirakos et al., 2010; Imam et al., 2013; Gleason et al., 2013). Analysts' choice of valuation model depends on various factors, such as analyst and company characteristics, customer preferences and market prices (e.g., Glaum & Friedrich, 2006; Imam et al., 2008; Demirakos et al., 2010; Shahed Imam et al., 2013).

Interview-based research indicates that analysts switch from advanced valuation models to heuristic models during periods of a positive sentiment to achieve higher valuations (e.g., Glaum & Friedrich, 2006; Imam et al., 2008). In an interview conducted by Imam et al. (2008), an analyst covering the construction sector stated: "We are staking a guess as to what the share price will be, rather than guessing what the value of the company will be. The stock price is influenced by two things: one is stock market sentiment on earnings and the other is earnings, it's hard to guess what the sentiment on earnings will be and what the earnings will be. Valuations are basically house words. You're trying to guess what the market will do 12 months from now." From there, the interview authors concluded that when the market is doing well and stock prices are trending upward, it is important for analysts to focus on long-term growth, which captures the price-to-earnings (P/E) to earnings growth (PEG) ratio. Demirakos et al. (2010) found, based on a content analysis of stock market reports, that the discounted cash flow (DCF) model is more often used by analysts when sentiment is low. Tan & Yu (2019) confirmed this on a large sample of analysts' reports.

Another group is behavioral errors, which in the case of financial analysts are generally translated into reports and recommendations. Because of conflicts of interest between company divisions, and in particular because units are responsible for handling brokerage houses or banks, reports produced by analysts may not be entirely independent and objective (Tan & Yu, 2019). In other words, an analyst may feel pressure to issue buying recommendations if the company

that employs him or her is simultaneously handling the issuance process of a particular company. Investors should take into account the possibility of error on the part of the analyst and take into account the specifics of their company, this will help investors select the most objective reports (Baker et al., 2021).

Information processing error, which involves incorrect processing of information on the basis of which assumptions are made for stock valuations, also plays an important role in stock valuations. Analysts in valuations have to collect and process information, much of which is not related to the valuation, but some of which is crucial to the decision-making process. It is important to include only factual information in the valuation. Analysts often make decisions under the influence of past experience, as well as completely random current events. As a result, they succumb to cognitive errors due to incorrect information processing, which interacts to make potentially erroneous decisions (Baker et al., 2021).

There may also be a self-control error among stock analysts, understood as an error of self-discipline and the translation of immediate gratification into long-term goals. It can lead to ineffective behavior to satisfy desires of a short-term nature (Baker et al., 2021).

In summary, the literature provides two explanations for why target prices have only limited investment value for investors (Buxbaum et al., 2019):

- they are optimistically biased as a result of analysts' work-related incentives,
- they are based on insufficient valuation assumptions and forecasting techniques that do not reflect intrinsic values well.

Discussion / Conclusion

The research conducted allowed for an in-depth analysis of the accuracy of stock market recommendations made by financial institutions operating on the Polish capital market. Based on an extensive sample of more than 5,200 recommendations issued over a period of more than 17 years, it was possible to make an unambiguous assessment of the effectiveness of analysts' predictions, understood as the consistency of the target price with the market price on the date of maturity of the recommendation.

The results of the empirical analysis showed a statistically significant deviation of target prices from actual market valuations. As many as 71% of the recommendations were characterized by a deviation of more than 15%, which – according to the adopted methodology – qualifies them as inaccurate. Only 11% of the recommendations could be considered accurate in a strict sense, and 18% were within the range of acceptable error. Such a high level of divergence indicates the systematic nature of underestimations or overestimations, which largely supports the hypothesis of the presence of excessive optimism in analysts' prognoses.

The use of the student's t-test and the chi-square test of concordance made it possible to statistically confirm the established research hypotheses. Both methods unequivocally showed a significant over-representation of recommendations with low relevance and a high level of effect, which underscores the importance of the problem and its scale.

In light of the presented results, it seems reasonable to conclude that stock market recommendations – despite their informational importance and popularity among investors are not a fully reliable tool to support the process of making investment decisions. The limited accuracy of recommendations may be due to various reasons, including:

- the use of simplified or heuristic valuation models;
- emotional and sentimental influence of the market;
- cognitive errors on the part of analysts (e.g., anchoring heuristics, confirmation effect);
- potential conflicts of interest between analysts and issuers of financial instruments.

It is clear from the analysis and literature review that the complexity of the market is often not fully reflected in the valuation models used. These models, although based on quantitative data, are not immune to analysts' subjective assumptions, which can lead to structural overvaluation of financial instruments. Given that the study covered a period exceeding four economic and seven stock market cycles, it should be emphasized that analysts' forecasts may have been strongly influenced by the phase of the market. An increase in the accuracy of recommendations in downturns or its decrease in bull market periods could be an important topic for future dynamic analysis.

Qualitative analysis indicates that, in addition to the numerical values themselves, the language and formulation of the reports could also affect investors' perception and interpretation of the recommendations. The use of vague statements, overconfidence on the part of analysts or the absence of alternative scenarios can reinforce behavioral heuristics on the part of the audience. In many cases, analysts do not disclose the detailed parameters adopted in valuation models (e.g., the discount rate adopted, growth rates), which limits the possibility of their independent verification. Increasing transparency could promote a better understanding of the sources of deviations.

Given the observed level of predictive errors, it seems reasonable to postulate the introduction of mechanisms to verify the effectiveness of recommendations *ex post* (e.g., in the form of analyst ratings published by independent institutions), which could reduce the phenomenon of the so-called herding effect and promote analytical quality over publication quantity.

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OPTIMAL THRESHOLDING FOR BINARY CLASSIFICATION APPLIED IN CREDIT SCORING

ABSTRACT

The paper concerns a new method of classifying individuals into two subpopulations and demonstrates the application of this method in credit scoring. Individuals are classified into two subpopulations depending on the duration T of a certain phenomenon (e.g., default). The duration may be shorter or longer than a certain fixed value t . It is assumed that the variable T is not known at the time of classification, so the explanatory continuous predictive marker is used instead. The optimal acceptance threshold for a predictive marker is determined by a time-dependent receiver operating curve (ROC) estimated from a random sample. A typical complexity of time-to-event data is that observations in the sample can be right-censored. Therefore, the estimation is based on a sequential random sampling and the Kaplan–Meier estimator.

Keywords: binary classification, sequential random sampling, sensitivity and specificity, time-dependent ROC curves

MSC Classification: 62L10, 62L12, 62N02, 62P05



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Introduction

Economic, demographic, social or biometric research frequently faces the problem of classifying objects into one of two subpopulations. For example, in credit scoring, such subpopulations may consist of borrowers who default on their loans or not. In clinical trials, the groups may comprise individuals who test positive or negative for a given condition.

The first concept of the classification method was developed by Ronald Fisher (1936), with the aim of finding a certain linear function of the measurements by which the populations are best distinguished. The discrimination function was defined by Fisher as a linear combination of physical measurements that separates two species of irises, i.e., *Iris setosa* and *Iris versicolor*. Between 1936 and 1940 Fisher published four articles on statistical discriminant analysis that became a common method used in statistics.

David Durand recognized in 1941 that a similar method can be employed to distinguish between good and bad loans (Thomas, 2000). In the 1980s, good credit card scoring results convinced banks to use statistically derived models in lending decisions. In the 1990s, the rise of direct marketing led to the use of scorecards to improve the response rate to advertising campaigns. Today, classification methods are used in many business decision-making practices, including credit scoring, bankruptcy prediction, fraud detection, or medical diagnostics, among others. A wide range of methods and their improvements have also been proposed. Such methods include, among others, linear, quadratic, and logistic discriminant analysis.

In the classic medical setting, the notions ‘sensitivity’ and ‘specificity’ were defined to distinguish between two groups of individuals, i.e., with positive and negative outcomes, based on a binary predictive marker. They are mainly used to measure validity of diagnostic tests (Godyn et al., 1991; Tetrault, 1991; Altman & Bland, 1994; Dickie, 1994). The first one (sensitivity) means the probability of correct classifying an individual with a positive outcome, while the second one (specificity) refers to the probability of correct classifying of a subject with a negative outcome. Both probabilities are estimated as respective empirical proportions. Sensitivity could be estimated by the observed true-positive fraction (TPF) and specificity – by the true-negative fraction (TNF).

When the predictive marker Y is continuous, the threshold criteria $Y \geq c$, $Y < c$ are used to define sensitivity and specificity. When multiple predictors are involved, the Y variable is usually represented by the probability of a positive outcome, either using logistic regression conditioned by the values of the explanatory variables, or using any increasing function of this probability. In medical research, the predictive marker may also be established from a linear combination of biomarkers and other medical measurements (Zhang & Yu, 1998; McNutt et al.,

2003; Diaz-Quijano, 2012; Patil & Durairaj, 2015). In credit scoring, Y can be developed from various financial or economic characteristics of the loan applicants (Crook et al., 2007; Hu & Ansell, 2007; Thomas, 2009). In predicting corporate failure, a financial, micro- or macroeconomic measures are employed (Altman, 1968; Ohlson, 1980; Kovacova & Klietnik, 2017; Kovacova et al., 2019) etc.

The correct predictive threshold c of the predictive marker Y plays an important role in the classification problem, since the number of correctly classified units depends on the selected threshold value. There are two types of misclassification errors in any classification method: a type-I error, i.e., the probability of misclassifying a bad unit as a good one, and a type-II error, the probability of misclassifying a good unit as a bad one. Most comparative studies utilize these two types of error rates as accuracy measures of classifiers (Jamain & Hand, 2008). For the continuous predictive marker, it is possible to calculate the Gini index or certain measures of information gain for various cutoff points (Breiman et al., 1984) or to apply a more comprehensive approach based on the Receiver Operating Characteristic curve (ROC) (Green & Swets, 1966; Lloyd, 1998). The ROC curve displays the sensitivity versus 1-specificity for all the possible cutoff points c . It allows both to find the optimal threshold of c and to evaluate basic classification summaries (Baker, 2003).

In many studies, the primary goal is to predict the onset of some phenomenon of interest (e.g., the onset of a default, failure, disease, remission, etc.) in a certain period. For instance, a patient may not be considered as cancer-free when the remission time is less than five years, so cancer-free patients can be recognized when their remission time will be at least five years. In such cases, dynamic sensitivity and specificity should be computed for different time points t . However, in practice, the time to event of interest, T , is often right-censored. It means, that for some individuals, it is not possible to know whether $T < t$ or $T \geq t$ for some fixed points t .

Various approaches have been proposed to deal with the time-dependent classification. Heagerty et al. (2000) used the Kaplan–Meier survival estimator (Kaplan & Meier, 1958) in defining sensitivity and specificity. To ensure the monotonicity of both measures, they considered the nearest neighbor estimator of the bivariate distribution of the random pair (T, Y) . Chambless and Diao (2006) proposed a model for estimating sensitivity and specificity as well as the so-called AUC measure conditioning on the observed times-to-event, i.e., in a similar way as in the Kaplan–Meier estimator. Other estimators were derived directly from a fitted conditional survival function, given the decision variable Y . Uno et al. (2007) proposed an inverse probability of censoring weighting method, Pepe (1997, 1998, 2000) used different regression models and adopted the generalized linear model methods in the statistical inferences,

Hung and Chiang (2010a, 2010b) used generalized linear models with time-varying coefficients to characterize the conditional distribution of the time-to-event variable and to derive the time-dependent AUC as a function of covariate values.

This study proposes a novel classification method for assigning individuals to two subpopulations based on a time-to-event outcome using a continuous predictive marker. The optimal threshold is determined via time-dependent ROC curves, accounting for right-censored data through sequential sampling and Kaplan–Meier estimation, conditional on the subsets $Y \geq c$ and $Y < c$. Sequential sampling treats observations incrementally, ensuring efficient use of available information and reducing bias due to censoring.

The main research hypothesis is that the proposed method provides an effective and reliable approach to determining the optimal classification threshold in the presence of right-censored time-to-event data.

The general concept of the binary classification

Suppose that there is a population, $\mathcal{G}$, consisting of disjoint subpopulations $\mathcal{G}_0$ and $\mathcal{G}_1$, such that $\mathcal{G} = \mathcal{G}_0 \cup \mathcal{G}_1$, $\mathcal{G}_0 \cap \mathcal{G}_1 = \emptyset$. For simplicity, individuals in the set $\mathcal{G}_1$ will be termed cases, while the others will be termed controls.

Assume that a unit randomly drawn from $\mathcal{G}$ has to be assigned to one or the other set based on a certain variable Y in such a way that when the observed value of Y satisfies the inequality $Y \geq c$, then an individual goes to $\mathcal{G}_1$, otherwise it goes to $\mathcal{G}_0$. Therefore, Y and c will be termed the predictive marker and the predictive threshold, respectively.

To classify individuals as controls or cases, the following two phases can be defined. First, available information is integrated to generate a numerical value of the predictive marker, Y , e.g., a score. Then, the score is compared with the predictive threshold c .

Let Y_0 and Y_1 denote the continuous marker Y in the subpopulations $\mathcal{G}_0$ and $\mathcal{G}_1$, respectively, i.e.,

$$Y_0 = Y|\mathcal{G}_0, Y_1 = Y|\mathcal{G}_1.$$

Let H_0 and H_1 be the distribution functions of variables Y_0 and Y_1 , respectively, and let H denote a distribution function of Y ; hence

$$H_0(y) = P(Y_0 < y) = P(Y < y|\mathcal{G}_0),$$

$$H_1(y) = P(Y_1 < y) = P(Y < y|\mathcal{G}_1),$$

and

$$H(y) = P(Y < y).$$

For a given threshold c , the probabilities

$$\bar{H}_1(c) = 1 - H_1(c) = P(Y \geq c | \mathcal{G}_1)$$

and

$$H_0(c) = P(Y < c | \mathcal{G}_0),$$

reflect sensitivity and specificity of the marker Y , respectively.

The main challenge is to choose an appropriate threshold value of c . If we choose the smallest value of c possible, all individuals will be assigned to cases, regardless of which sub-population they actually belong to. In this case, the probability of being classified into $\mathcal{G}_0$ and $\mathcal{G}_1$ will be 0 and 1, respectively. Conversely, if the value of c is the highest possible, all individuals will be classified to controls, so the probability of being classified into $\mathcal{G}_0$ and $\mathcal{G}_1$ will be 1 and 0, respectively. Therefore, c must be carefully selected to ensure that both probabilities of correct classification are relatively high. In selecting the optimal threshold value of c , the Receiver Operating Characteristic Curve (ROC) seems to be a very useful and comprehensive tool. This concept will be discussed in the next section.

ROC curves

The ROC curve analysis is a well-established method, especially in clinical trials, to investigate the discriminatory capacity of diagnostic tests or prognostic clinical markers. In the continuous settings, the ROC curve is a set of points in the (p_0, p_1) plane, where $p_0 = \bar{H}_0(c)$ and $p_1 = \bar{H}_1(c)$, and c runs over the set of real numbers, i.e.,

$$ROC = \{(\bar{H}_0(c), \bar{H}_1(c)), c \in \mathbf{R}\}.$$

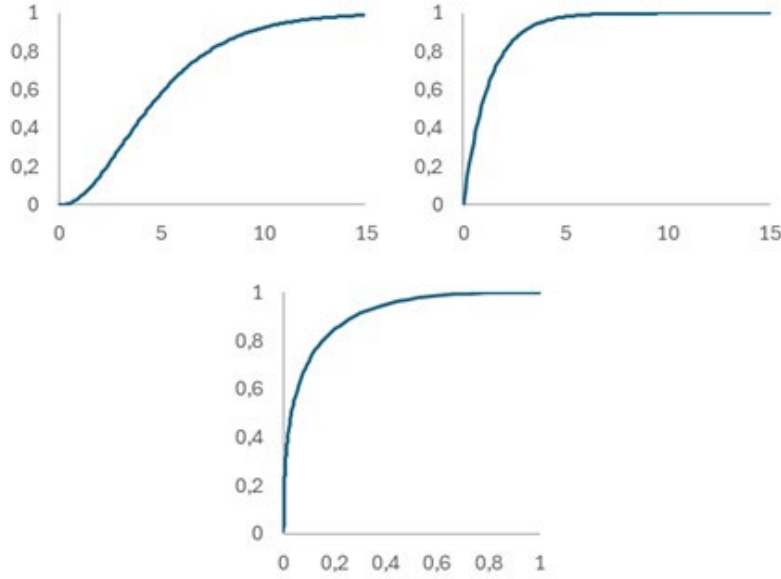
Another way to look at the ROC curve is to view it as a monotone increasing function $[0,1] \rightarrow [0,1]$ built using functions $\bar{H}_0$ and $\bar{H}_1$. The general formula for the ROC function is then as follows

$$ROC(c) = \bar{H}_1(\bar{H}_0^{-1}(c)), c \in \mathbf{R}.$$

Figure 1 illustrates an example of the ROC curve corresponding with some distribution functions.

Figure 1.

The ROC curve for two cumulative distribution functions H_0 (top left) and H_1 (top right)



Source: Original figure prepared by the author for demonstration.

It is an instrumental tool in finding a value of c that minimizes the risk of misclassification of units into controls or cases. The higher is the ROC curve in the unit square $[0,1] \times [0,1]$, the better is the capacity to distinguish both subpopulations $\mathcal{G}_0$ and $\mathcal{G}_1$ (see e.g., Heagerty et al., 2000). However, creating a ROC curve is not possible if the cumulative distribution functions $\bar{H}_0$ and $\bar{H}_1$ are not known. The problem is usually solved by estimating the curve from two random samples of controls and cases. Then, the estimated ROC curve takes the form

$$\widehat{ROC} = \left\{ \left(\hat{H}_0(c), \hat{H}_1(c) \right), c \in \mathbf{R} \right\},$$

where $\hat{H}_0(c)$ and $\hat{H}_1(c)$ are respective estimators of $\bar{H}_0(c)$, $\bar{H}_1(c)$, determined from random samples

$$Y_{01}, Y_{02}, \dots, Y_{0m},$$

and

$$Y_{11}, Y_{12}, \dots, Y_{1n},$$

where Y_{0i} , $i = 1, 2, \dots, m$, Y_{1i} , $i = 1, 2, \dots, n$ are independent copies of variables Y_0 and Y_1 sampled from subpopulations $\mathcal{G}_0$ and $\mathcal{G}_1$, respectively.

It is worth noting that $\hat{H}_0(\cdot)$, $\hat{H}_1(\cdot)$ are complement to the well-known empirical distribution functions $\hat{H}_0(\cdot)$, $\hat{H}_1(\cdot)$, respectively, so they can be defined for any $c \in \mathbf{R}$ as the following sums

$$\hat{H}_0(c) = \frac{1}{m} \sum_{i=1}^m \mathbf{1}(Y_{0i} \geq c),$$

$$\hat{H}_1(c) = \frac{1}{n} \sum_{i=1}^n \mathbf{1}(Y_{1i} \geq c).$$

where $\mathbf{1}(A)$ is the characteristic function of an event A , taking values 1 if the event A occurs, and 0 otherwise.

In the classical approach, it is assumed that membership status of a unit in $\mathcal{G}_0$ or in $\mathcal{G}_1$ does not change over time. In many problems however, individuals' status changes over time when it is predicted whether a subject will or will not experience an event (e.g., default, death, remission).

Suppose that the time to event of interest is a continuous random variable T with the distribution function F . We will assume that the subpopulation $\mathcal{G}_0$ consists of units with $T \geq t$, and the subpopulation $\mathcal{G}_1$ is formed by units with $T < t$. As the T variable is usually not known at the time of classification, the criterion for classifying individuals into $\mathcal{G}_0$ or $\mathcal{G}_1$ will be a random continuous variable Y related to T . We need to find the optimal predictive threshold c for Y to determine the possibly optimal classification of subjects into both subpopulations depending on whether the time-to-event is at least t or not. Naturally, the value of c will fluctuate with t . Thus, a sequence of ROC curves for possible time points t can be considered rather than a single ROC curve.

The sensitivity and specificity of the marker Y should be now expressed by relating it to the probability distribution of T . To express the dynamic sensitivity and dynamic specificity, Heagerty et al., (2000) used the Bayes formula combining the probability distributions of T and Y , i.e.,

$$\bar{H}(c|T < t) = P(Y \geq c|T < t) = \frac{P(Y \geq c, T < t)}{P(T < t)} = \frac{P(T < t|Y \geq c)P(Y \geq c)}{P(T < t)},$$

$$H(c|T \geq t) = P(Y < c|T \geq t) = \frac{P(Y < c, T \geq t)}{P(T \geq t)} = \frac{P(T \geq t|Y < c)P(Y < c)}{P(T \geq t)}.$$

The expressions can also be written as:

$$\bar{H}(c|T < t) = \frac{F(t|Y \geq c)\bar{H}(c)}{F(t)},$$

$$H(c|T \geq t) = \frac{\bar{F}(t|Y < c)H(c)}{\bar{F}(t)}.$$

In the further part, we will consider two equivalent expressions resulting from the Total Probability Rule applied in the denominators of both formulas. The transformed formulas take the form:

$$\bar{H}(c|T < t) = \frac{F(t|Y \geq c)\bar{H}(c)}{F(t|Y \geq c)\bar{H}(c) + F(t|Y < c)H(c)},$$

$$H(c|T \geq t) = \frac{\bar{F}(t|Y < c)H(c)}{\bar{F}(t|Y \geq c)\bar{H}(c) + \bar{F}(t|Y < c)H(c)}.$$

The reason underlying such a transformation is that the estimators of both expressions, introduced in the next section, ensure to be bounded in $[0,1]$.

The time-dependent ROC curve is now defined as follows

$$ROC_t = \{(1 - H(c|T \geq t), \bar{H}(c|T < t)), c \in \mathbf{R}\},$$

or equivalently

$$ROC_t = \{(\bar{H}(c|T \geq t), H(c|T < t)), c \in \mathbf{R}\}.$$

In practice, the time to event, T , which determines the true membership status of the i -th individual to one of the subpopulations $\mathcal{G}_0$ or $\mathcal{G}_1$, is often right-censored, therefore estimators of $F(\cdot | Y \geq c)$, $\bar{F}(\cdot | Y \geq c)$ and $F(\cdot | Y < c)$, $\bar{F}(\cdot | Y < c)$ adapted to right-censored data are required. Such estimators will be proposed in the next section. They are based on the sequential right-censored random samples and the well-known Kaplan-Meier estimation (Kaplan & Meier, 1958).

Sequential random sampling and the Kaplan-Meier estimator

It is usually expected that random copies T_i of time-to-event variable T are fully observable. However, this assumption becomes problematic when it cannot be satisfied due to right-censoring. Further, we will assume that censored survival times are observed, i.e. $X_i = \min(T_i, Z_i)$ instead of T_i , where Z_i are the so-called censoring times.

To estimate $F(\cdot | Y \geq c)$, $\bar{F}(\cdot | Y \geq c)$ as well as $F(\cdot | Y < c)$, $\bar{F}(\cdot | Y < c)$, we propose adopting a sequential sampling scheme which allows for an unbiased estimation of the aforementioned functions for any $t < t_0$ where t_0 is a positive real number fixed in advance, as opposed to the negatively biased standard Kaplan-Meier estimator $KM(t)$ which is undefined for some t if the largest observation in the sample is right-censored.

Suppose that there is given a fixed period t_0 of observation of individuals in a study. Individuals enter the study at random times, and the observation finishes at the end of that period. If the interesting event occurs for an i -th individual, then it yields the true time-to-event T_i , otherwise one observes a partial time to event, say Z_i , such that $Z_i < T_i$. In such a case, we say that Z_i right-censors the true time T_i . Variables Z_i are usually called censoring times. From a formal point of view, one observes the so-called censored survival times, which can be expressed as pairs (X_i, δ_i) , where

$$X_i = \min(T_i, Z_i),$$

and

$$\delta_i = \mathbf{1}(T_i \leq Z_i) = \begin{cases} 1, & \text{if } T_i \leq Z_i, \\ 0, & \text{otherwise.} \end{cases}$$

is the censoring indicator.

If the censoring times Z_i are random and independent of survival times T_i then the model (X_i, δ_i) is well known as the random and independent right-censorship model.

We will assume that the times-to-event, T_i , as well as the censoring times, Z_i , are continuous, mutually independent random variables with common distribution functions F and G , respectively. These assumptions imply that variables $X_i = \min(T_i, Z_i)$ are independent and have a distribution function, say K , satisfying the relation $K = 1 - \bar{F}\bar{G}$.

The sequential random sampling scheme will be defined as follows. Let t_0, c_0 be real fixed values, such that $0 < t_0 < \sup\{t: \bar{K}(t) > 0\}$, $c_0 < \sup\{c: \bar{H}(c) > 0\}$, and let $k \geq h \geq 2$ be some predefined integers. Assume that individuals arrive at random during the study and we record (X_i, δ_i) as well as Y_i until for k individuals the following inequalities hold

$$X_{i_j} \geq t_0, \quad j = 1, 2, \dots, k,$$

and for h of them, the following inequalities are satisfied at the same time

$$Y_{i_j} \geq c_0, \quad j = 1, 2, \dots, h.$$

It is worth noting that the size N of the random sample

$$(X_1, \delta_1, Y_1), (X_2, \delta_2, Y_2), \dots, (X_N, \delta_N, Y_N),$$

obtained in such a sampling scheme is a random variable.

Since we need a sorted sample, let us also define the $\leq_l$ relation as follows

$$(X_i, \delta_i, Y_i) \leq_l (X_j, \delta_j, Y_j) \Leftrightarrow (X_i < X_j) \text{ or } (X_i = X_j \text{ and } \delta_i \geq \delta_j).$$

An i -th observation in the sample reordered according to this relation will be denoted by $(X_{i:N}, \delta_{[i]}, Y_{[i]})$, where $\delta_{[i]} = \delta_j$ and $Y_{[i]} = Y_j$, if $X_{i:N} = X_j$.

Then, the sequential Kaplan–Meier-type estimator $KM(t)$ of the probability $\bar{F}(t)$ takes the form

$$KM(t) = \prod_{i: X_{i:N} \leq t} \left(1 - \frac{\delta_{[i]}}{N - i}\right), \quad t \leq t_0,$$

with the initial assumption that $KM(t) = 1$ whenever the set $\{i: X_{i:N} \leq t\}$ is empty. It is worth noting that such a sequential estimator is an unbiased estimator of the cumulative distribution function $\bar{F}$, even in the presence of right-censoring (see Rossa, 2008, 2009 for more details).

By analogy, the sequential Kaplan–Meier estimators $KM(t|Y < c)$, $KM(t|Y \geq c)$ of the respective probabilities $\bar{F}(t|Y < c)$ and $\bar{F}(t|Y \geq c)$ are as follows

$$KM(t|Y < c) = \prod_{i: X_{i:N} \leq t, Y_{[i]} < c} \left(1 - \frac{\delta_{[i]}}{N_1 - i}\right), \quad t \leq t_0, \quad c \leq c_0,$$

and

$$KM(t|Y \geq c) = \prod_{i: X_{i:N} \leq t, Y_{[i]} \geq c} \left(1 - \frac{\delta_{[i]}}{N_2 - i}\right), \quad t \leq t_0, \quad c \leq c_0,$$

where

$$N_1 = \#\{i: Y_{[i]} < c\}, \quad N_2 = \#\{i: Y_{[i]} \geq c\}.$$

For a fixed value of $t \leq t_0$, the empirical ROC curve takes the form

$$\widehat{ROC}(c, t) = \left\{ \left(\hat{H}(c|T < t), \hat{H}(c|T \geq t) \right), \quad c \leq c_0 \right\},$$

where $\hat{H}(c|T < t)$ and $\hat{H}(c|T \geq t)$ are defined as follows

$$\hat{H}(c|T < t) = \frac{[1 - KM(t|Y \geq c)]\hat{H}(c)}{1 - [KM(t|Y \geq c)]\hat{H}(c) + KM(t|Y < c)\hat{H}(c)},$$

$$\hat{H}(c|T \geq t) = 1 - \frac{KM(t|Y < c)\hat{H}(c)}{KM(t|Y \geq c)\hat{H}(c) + KM(t|Y < c)\hat{H}(c)},$$

with the convention that $0/0 \equiv 0$.

The functions $\hat{H}(c)$ and $\hat{H}(c)$ appearing in the numerators and denominators of both estimators, are defined as follows

$$\hat{H}(c) = \frac{1}{N-1} \sum_{i=1}^{N-1} \mathbf{1}(Y_i \geq c), \quad \hat{H}(c) = 1 - \hat{H}(c).$$

Note that estimators $\hat{H}(c|T < t)$ and $\hat{H}(c|T \geq t)$ are bounded in $[0,1]$.

Now, based on the estimator of the ROC curve it is possible to find an optimal predictive threshold c of the marker Y that ensures as high classifications accuracy as possible. This process will be illustrated in more detail using a credit-scoring application.

Application of the new class of ROC curve estimators in credit scoring

Credit scoring is the term used to describe formal statistical methods used for classifying applicants for credit into ‘good’ and ‘bad’ risk classes. Such methods have become important with the significant growth in consumer credit in recent years. A wide range of statistical methods has been applied to address this issue (see e.g., Hand & Henley, 1997; Abellan & Castellano, 2017, among others). One of them is based on time-dependent ROC curves. In the practice of credit-risk management, the models based on the receiver operating characteristic (ROC) curves are helpful in assessing e.g. the discriminatory power of the so-called scorecards.

Among consumers borrowing money from banks, there are almost always those who do not repay their loans according to the scheduled payments; such loans are called defaults. In this example, we consider the simple case of a fictitious bank that classifies 12-month loans as ‘good’ or ‘bad’ based on the probability that they will be fully repaid or will not be repaid before a fixed number of t months have passed. Typically, the classification should be performed before a decision to grant the loan is made, i.e., at the application stage. Since the bank cannot know in advance whether the loan will be repaid, creditworthiness has to be established using other available information, and typical sources for this are the loan application form, the applicants’ financial history and other characteristics.

To keep our presentation simple, let us consider 12-month loans and assume that the predictive marker Y_i is the monthly income of the i -th applicant. The classification rule is as follows: an i -th loan will be classified as ‘good’ when the value of Y_i is at least c , where c

is some decision threshold. The main problem with this approach is that we first need to find the optimal value of c that is based on the most recent data and has the highest probabilities of correctly classifying loans as repaid before t months have elapsed. To solve this problem, the time-dependent ROC curve will be employed. However, a random sample of the most recent loans approved by the bank is needed in order to establish a correct classification rule.

Let T_i represent the time between the date an i -th loan was approved and the date of its repayment, and let Z_i denote the time between the approval date and the current date (censoring time). The repayment time T_i of the loan longer than censoring time Z_i are not observable, which means that we can observe the smaller one, i.e. $X_i = \min(T_i, Z_i)$. We will call X_i the censored repayment time for the i -th loan. Observations are collected sequentially, and after each new loan is included, the sample is evaluated against a predefined stopping rule. The data collection continues until at least k observations satisfy the condition $X_i \geq t_0$, ensuring sufficient information about loans with relatively long durations, and simultaneously at least h observations satisfy the condition $Y_i \geq c_0$, ensuring adequate representation of individuals with higher values of the predictive marker.

This stopping rule ensures that the sample contains enough information to reliably estimate time-dependent classification measures. In the illustrative example, the parameters are set to $k = h = 2$, $c_0 = 2.2$ (Euro 1,000) and $t_0 = 27$ (months). The sample censored repayment times X_i , censoring indicators δ_i , and monthly incomes Y_i yielded by the experiment are shown in Table 1.

Table 1.

Input data

Censored time X_i	Censoring indicator δ_i	Income per month Y_i (Euro 1,000)
4	1	1.4
6	0	1.8
7.4	1	1.5
8	0	1.7
9.5	1	1.5
10.1	1	1.3
10.6	0	1.9
11	0	2

Censored time X_i	Censoring indicator δ_i	Income per month Y_i (Euro 1,000)
11.5	1	1.6
12.3	1	1.6
12.5	0	1.8
13	1	1.8
13.2	1	1.6
13.5	1	1.7
13.9	0	1.8
14	0	1.8
14.2	0	1.9
14.5	0	1.9
15.1	1	1.9
16	0	1.8
17.8	0	1.9
18	0	1.9
18.5	0	2
20.5	1	2
20.8	1	1.9
21	0	2
22	1	1.7
24	0	1.9
27.1	1	2
27.5	1	2
28	0	2.2
29	1	2.5

Source: author's own elaboration (sample data).

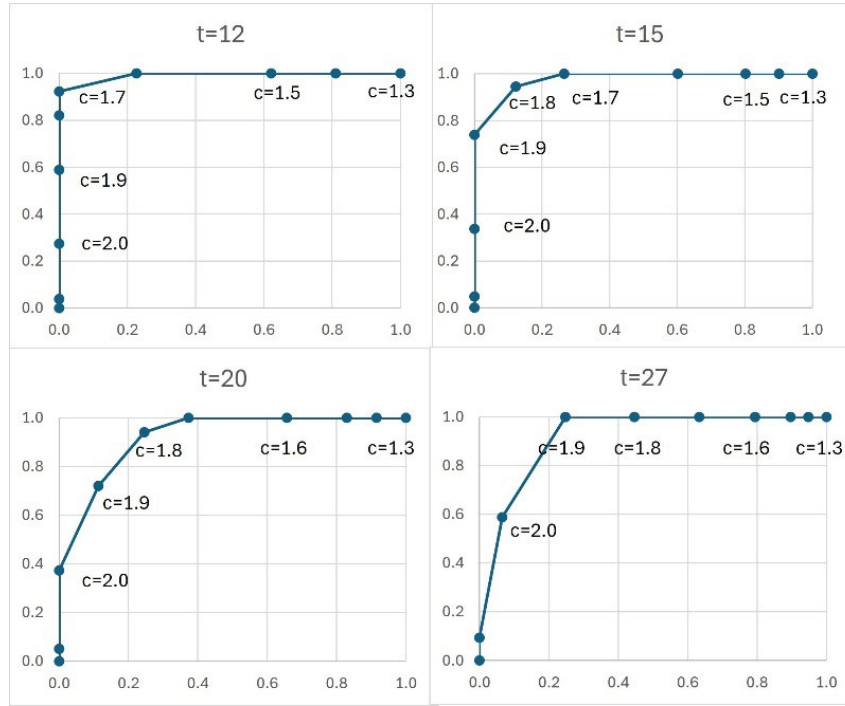
Table 2 reveals specificity and sensitivity values obtained using the data in Table 1 for some selected values of $t \leq t_0$.

Table 2.*Classification accuracy via sensitivity and 1-specificity measures*

c	1-spec.	sens.	c	1-spec.	sens.
t=12 months			t=20 months		
1.3	1	1	1.3	1	1
1.4	1	0.8106	1.4	1	0.9148
1.5	1	0.6212	1.5	1	0.8296
1.6	1	0.2269	1.6	1	0.6569
1.7	0.9231	0	1.7	1	0.3738
1.8	0.8212	0	1.8	0.9407	0.2455
1.9	0.5895	0	1.9	0.7199	0.1131
2	0.2735	0	2	0.3735	0
2.1	0.039	0	2.1	0.0523	0
2.2	0	0	2.2	0	0
t=15 months			t=27 months		
1.3	1	1	1.3	1	1
1.4	1	0.9013	1.4	1	0.9486
1.5	1	0.8026	1.5	1	0.8971
1.6	1	0.6018	1.6	1	0.7938
1.7	1	0.2652	1.7	1	0.6336
1.8	0.9453	0.1224	1.8	1	0.4463
1.9	0.7387	0	1.9	1	0.2474
2	0.3382	0	2	0.5886	0.0652
2.1	0.0482	0	2.1	0.0934	0
2.2	0	0	2.2	0	0

Source: Author's calculations based on sample data from the Table 1.

Based on data in columns 2 and 3 of Table 2, the coordinates of the ROC curve corresponding to some selected values of t can be plotted using the linear interpolation method (Figure 2). The optimal value of the predictive threshold c of the income per month is given by the point on the ROC curve, which is the nearest to the left upper corner of the unit square, i.e., whose coordinates are (0,1). In our example, the optimal value of c is 1.7 (Euro 1,000) if $t = 12$ (months), 1.8 (Euro 1,000) if $t = 15$ or $t = 20$ (months) and $c = 1.9$ (Euro 1,000) if $t = 27$ (months), as these values ensure relatively high probabilities that loans have been correctly classified into good or bad ones.

Figure 2.*Estimated ROC curves for four selected values of t* 

Source: author's own elaboration.

Final remarks

The proposed approach offers several advantages over traditional classification methods. First, it incorporates the time-to-event dimension, allowing classification to depend on whether an event occurs before or after a specified time t , rather than treating outcomes as static. Second, it properly handles right-censored data using the Kaplan–Meier estimator, avoiding information loss and potential bias. Third, time-dependent ROC curves enable a dynamic evaluation of classification performance across different time horizons. Fourth, the sequential sampling scheme ensures that the sample contains sufficiently informative observations, improving estimation efficiency. Fifth, the method allows for data-driven selection of the optimal threshold c , maximizing classification accuracy. From a credit scoring perspective, this enables more accurate assessment of default risk over a specified time horizon, supporting better-informed lending decisions and risk management.

However, the approach has some limitations. It relies on the assumption of independent right-censoring. Violation of this assumption may lead to biased estimates. Moreover, the procedure can be computationally demanding when multiple thresholds or time points are considered.

In summary, the proposed classification method, incorporating time-dependent ROC curves, sequential sampling, and Kaplan–Meier estimation, provides a more accurate and reliable determination of the optimal threshold for a continuous predictive marker in the presence of right-censored time-to-event data than traditional static classification approaches.

Disclosure statement

No potential conflict of interest is reported by the author.

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THE ASSESSMENT OF THE BANK ACCOUNT BLOCKADE BY THE USE OF STIR IN THE LIGHT OF SAC'S RULINGS

ABSTRACT

The purpose of the article. The purpose of the paper is the assessment of using STIR to blockade the bank account by the tax administration. The research hypothesis is as follows: The bank account blockade by the use of STIR is abused by the tax administration.

Methodology. The descriptive study including a critical attitude to the legal acts and literature as well as the case studies of NSA rulings were used as the scientific methods.

Results of the research. An important problem of taxpayer's security is tax frauds in VAT. One instrument to combat tax fraud is the blockade of bank account by the use of STIR. However, the tax authorities very seldom use that method. The analysis of SAC's rulings shows that the tax authorities do not abuse this instrument. The blockade of bank account by the use of STIR decreases the tax frauds.

Keywords: tax ordinance, STIR, blockade of bank account, combating tax frauds

JEL Class: H26, K34, H83



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Introduction

Tax frauds are getting an increasingly important issue. Especially the tax frauds in VAT are discussed as a public finance problem. VAT is one of the most important sources of revenue for the state budget. VAT carousels are one type of tax fraud. In order to protect the State Treasury interests and to ensure fair competition in the economy, there must be available measures to combat tax frauds. One of such measures is a bank account blocking under the STIR system. However, applying this measure to a bona fide business owner may jeopardize the business's operations. Blocking a company's funds may result in a loss of liquidity, which in turn may lead to its bankruptcy. Therefore, the tax authorities should only block bank accounts under the STIR system in exceptional cases.

The purpose of the paper is the assessment of using STIR to blockade the bank account by the tax administration. The research hypothesis is as follows: The blockade of the bank account by the use of STIR is abused by the tax administration. The descriptive study including a critical attitude to the legal acts and literature was used as well as the case studies of SAC's rulings.

1. The blockade of bank account as a measure to combat the carousel fraud

Generally, a carousel fraud involves international transactions (particularly intra-Community transactions) within the supply chain (Selera, 2014). It involves inflating the value of goods in transactions between companies. Entities participating in the scheme receive a refund of VAT that was not paid at an earlier stage of the transaction by the entities formally obligated to do so. Entities from several, or even a dozen or so countries, may be involved in such schemes. Some companies may participate in the chain of transactions without realizing it (Wójcik, 2011; Selera, 2014). Fraudsters exploit VAT harmonization to commit tax evasion. This is because, in the case of intra-Community supplies, the sale is subject to a 0% VAT rate. The tax is not paid until it reaches the country of destination (domestic sale) (Kołodziejski, 2015). A carousel fraud scheme involves the sale of goods using intra-Community supply and intra-Community acquisition mechanisms, with the supply chain being closed in such a way that the goods are ultimately sold to a buyer in the Member State from which they were originally acquired (usually to the entity that was at the beginning of the chain). This allows the transaction scheme to be repeated. A characteristic feature of these transactions is therefore a closed cycle of goods, meaning that they circulate — either in reality or only on paper — within the supply chain among successive participants in the trade.

Carousel schemes can involve both real and fictitious transactions.

In the case of real transactions, the scheme may look like this (Namysłowski, Ed., 2014):

- the first company in the chain purchases goods from another Member State; due to the method of settlement of the transaction (reverse charge), this company holds the goods in the country where the transport ends and treats the transaction as an intra-Community acquisition of goods not subject to VAT;
- the company then makes a domestic supply of goods; as a result, it receives the gross price from the purchaser, a portion of which — namely, the amount corresponding to the VAT — it is required to pay to the tax office; however, it does not make such a payment;
- the purchaser of such goods receives an invoice from the first company, which generally entitles them to deduct the VAT as input tax, and they make such a deduction either directly (through a tax refund) or indirectly (by reducing the tax due);
- the goods may be the subject of subsequent domestic supplies (e.g., to make it more difficult to detect the illegal activity), eventually ending up with an entity that sells them to another Member State; that entity recovers the excess input tax (in effect, the entire input tax due to the possibility of applying a 0% VAT rate to the supply resulting in the goods being sold outside the country, i.e., an intra-Community supply of goods;
- to create a carousel effect, the goods are returned to the country, and the purchaser—the first company in the supply chain — treats the purchase as an intra-Community acquisition of goods.

The term “carousel” refers precisely to the fact that, as a result of multiple transactions, the goods return to the original supplier (Selera, 2014).

The mechanism used in carousel fraud schemes may be based entirely on fictitious transactions that exist only on paper. One of the entities involved in the transaction claims an undue VAT refund. It records in its records, invoices documenting purchases of fictitious goods received from entities created specifically for this purpose. In contrast, the actual goods do not appear at any stage of the transaction (Duży, 2013). In these transactions, the parties to the actual transaction are falsified, the actual place of delivery or purchase is concealed, and the price, type of product range, or units of goods are manipulated (Derkacz, 2016).

The literature identifies the following types of entities involved in a carousel fraud:

- original seller;
- missing trader;
- buffer;
- the broker.

The original seller is the business entity that initiates the carousel scheme by purchasing goods under the intra-Community acquisition of goods and then supplying them. A missing trader generally fails to fulfill their obligation to report transactions, file accurate tax returns, and pay their tax liability, and then disappears, becoming untraceable to the tax authorities. Typically, such a taxpayer has no assets and has not done any actual business activity. A buffer is one of the links in the transaction chain — an entity that purchases goods in a domestic transaction for the purpose of reselling them, at a markup, also in a domestic transaction. The role of the buffer is to complicate the transaction and make it more difficult for tax authorities to identify tax fraud. Additionally, subsequent stages of the transaction are often designed to gradually generate input tax that will be claimed as a deduction and actually received from the tax office by the broker. The broker's role is to purchase goods within the country (as part of a VAT-taxable transaction) and then deliver them, resulting in the export of the goods to another Member State (Intra-Community Supply of Goods) (Kotowski, 2021).

Taxpayers who were unaware that they were participating in a criminal scheme were drawn into the scheme to defraud the VAT system in order to make it more difficult to detect. As a result, tax proceedings were conducted focusing on the issue of taxpayers' failure to exercise due diligence when purchasing goods and services in domestic transactions (Senderowski, 2025).

Different measures combating tax frauds have been implemented in the Polish tax system for the last decade.

An important measure to combat the tax evasion was the reform of tax administration and tax procedures in March 2017. The National Revenue Administration was created and it is responsible for governmental tax administration including tax offices and custom – fiscal offices (as the merger of fiscal control offices and customs offices). Both the tax offices and custom-fiscal offices may control the taxpayers. National Revenue Administration is also responsible for organising the information system for the control purposes and ensuring cooperation with the information systems of all subordinated offices. Additionally, the National Revenue Administration draws up the control plans (Zdunek, 2018). The reform of tax administration was involved in changes in tax proceedings. The custom-fiscal offices may use so called duty-fiscal control (a type of tax control procedure) to investigate the taxpayers who commit the tax fraud. In the framework of the duty-fiscal control the competences of tax administration were broadened, for example, they are able not only to investigate the documents but also to search persons, rooms and detain persons (Różycki, 2018).

Another important change in the tax system was the implementation of Standard Audit File for Tax. The taxpayers have to keep tax books electronically and send accounting data in a given standard format to the tax administration. The obligation of sending SAF Tax was adopted step

by step. First, the largest firms were obliged to send Standard Audit File for Tax from July 2016 and small taxpayers from the beginning of 2018 (Dzwonkowski, 2019). Poland has also decided to monitor the flow of goods and third-party data through the Electronic Transport Monitoring System (SENT) (Senderowski, 2025).

The provisions on registration of VAT taxpayers were changed to make it more difficult to act as the missing trader. The tax administration is able to reject the application for registration as a VAT taxpayer under some specific conditions (for example, if the data provided in the application for registration is inaccurate). The time of submitting the tax record was shortened. The taxpayers are obliged to submit their tax returns to the revenue office monthly as they could submit the tax returns quarterly. The tax liability of acquirer in special cases was widened in 2017. The split payment mechanism was implemented in July 2018 as one of the instruments aimed to decrease the carousel fraud (Michalik, 2019).

There were also changes in the Penal Code. New provisions including invoice-related offences, entered into force aiming at combating the falsification of invoices. The punishment for commitment of VAT frauds increased as well (Duży, 2020; Ocieczek, 2022).

Implementing the bank account blocking by the use of STIR in 2018 to the Polish tax system is another example of an instrument aiming at diminishing the tax fraud. The tax authority is able to block a banking account of taxpayers suspected of taking part in the tax fraud (Dzwonkowski, 2019).

Head of the National Revenue Administration is responsible for blocking a banking account. It may be performed under the authority of the Head of the National Tax Administration by the indicated heads of a customs and tax office (Regulation of Ministry of Finance February 2, 2022; Mariański, Ed., 2023).

The regulations use the term “qualified entity” to refer to an entity whose account may be blocked. The provisions specify who is considered a qualified entity, such as natural persons conducting business activities (Gurba, 2024).

The term STIR itself refers to the clearing house ICT system. This system is used to analyze cash flows in bank accounts. It is maintained and operated by the National Clearing House – as an interbank clearing house in Poland (Mikuła, 2018, pp. 27–32).

Banks and credit unions, as well as the National Clearing House, are required to promptly and continuously provide the Head of the National Revenue Administration with specific information (including details on payment orders and settlement accounts). In order to verify or supplement information regarding the possible use of a business account for purposes related to tax fraud, these institutions are also required to provide specific information upon request by the Head of the National Revenue Administration. Data is transmitted via the STIR system operated

by a clearing house that acts as an intermediary in the transmission of data and requests from the Head of the National Revenue Administration (Kieszkowski, 2018). Based on cash flow data provided by banks and the National Clearing House, as well as the additional criteria mentioned earlier, STIR automatically assigns an appropriate risk indicator to trading participants (Chądryński, 2019). It is noted that STIR analyzes financial flow data in real time to identify suspicious transactions (Szwed, 2025). Moreover, STIR is used not only to transmit the risk indicator but also to transmit other data, such as the IP address, location, and date of login to the suspicious account (Szulc, 2019a).

Next, based on data provided by STIR, the Head of the National Revenue Administration conducts a risk analysis of the use of banking activities for purposes related to tax fraud. (Kieszkowski, 2018). The risk analysis is conducted taking into account economic, geographic, subject-matter, behavioral, and connection criteria (Pogroszewska, 2018). If the results of a risk analysis indicate that a taxpayer may be using the services of banks or credit unions for purposes related to tax fraud, or for activities aimed at committing tax fraud, the Head of the National Revenue Administration may order the blockade of the account of the qualified entity for a period not exceeding 72 hours – so called short blockade (Kieszkowski, 2018).

The head of the National Revenue Administration submits a request to block the account of a qualified entity to the bank. The request must specify the account number of the qualified entity and the duration of the account block. Upon receipt of the request, the bank immediately blocks the account of the qualified entity (Szczęśniak, 2025). However, in 2018, the possibility of appealing the blocking of a qualified entity's account for a period of up to 72 hours and of appealing the scope of such blocking was abolished (Jabłoński, 2018).

The purpose of blocking bank accounts is to prevent entities suspected of tax fraud from transferring funds held in those accounts to another financial institution anywhere in the world (Babiarz, 2019). The regulations provide for the possibility of extending the period during which a qualified entity's account is blocked, specifying the procedure and conditions for doing so. The extension of the account block period is carried out by means of an order issued by the Head of the National Revenue Administration (Teszner, 2025).

An order to extend a block may be contested, and the order issued as a result of such an appeal may be challenged before the administrative court. At the same time, it is noted that the regulations do not explicitly provide for the right to challenge the substantive and technical act of establishing a block. There is also no provision that would allow for challenging this action through another appeal. As part of the appeal proceedings concerning the review of the legality of the order to extend the block, the legal and factual grounds for establishing the block must also be examined (Nykiel & Wilk, 2020).

The STIR system is used not only to block bank accounts, but also for: conducting risk analyses prior to initiating audits, preventing improper VAT refunds, and identifying and disrupting chains of companies engaged in fictitious transactions with one another (Sarnowski & Selera 2020, p. 40).

The introduction of bank account blocking into the tax system has caused controversy. The tax authorities have stated that account blocking is to be used as an extraordinary measure and will not be abused (Rudowski 2018, p. A16). According to Szulc (2019b), the initial actions taken by tax authorities regarding bank account blocks indicate that business owners need not fear abuse of authority in this regard. The procedures for imposing blocks are clear, and the risk of abuse by tax authorities is low (Chądryński, 2019). Research to date indicates no instances of abuse regarding bank account blocking by tax authorities (Witczak, 2022).

Tax advisors and experts have expressed concern that the blocking of bank accounts could be abused. There is a risk that it could be applied to taxpayers who are not knowingly involved in VAT fraud. The blocking of a bank account can undermine a company's liquidity. The introduction of the ability to block accounts under STIR has been compared to equipping tax authorities with nuclear weapons (Tarka, 2018, p. A 16; Mroziuk & Zalewski, 2019; Tarka, 2020). According to Kwietko-Bębnowski (2021, p. 22), an analysis of the Voivodship Administrative Court's rulings leads to the conclusion that the account block was caused by: tax officials' complete lack of knowledge regarding business models operating in the economy; a flawed interpretation of the regulations on account blocking; the raising of exaggerated allegations; the absence of any analysis of the factual circumstances supported by evidence, and the presence of minor discrepancies between the gross value of VAT invoices reported in JPK_VAT files and cash flows. In opinion of Matarewicz (2021) regulations on blocking bank accounts based on an algorithm unknown to anyone – except the tax officials involved – violate the constitutional principle of proportionality. It is also pointed out that this measure is not very effective, as the number of blocked bank accounts is disproportionately small compared to the total number of bank accounts classified as high-risk (Szymanek, 2023). In the literature it is suggested that a justification should be provided for requests to use a short blockade of banking account (Ochnio 2021, p. art. 119zv).

The tax administration uses the blockade of the bank account by the following: (see table 1).

Table 1.

The blockade of the bank account by the use of STIR by the tax administration (years 2022–2025)

	2022	2023	2024	2025
Number of blocked bank accounts for 72 hours	267	315	258	295
Number of blocked bank accounts prolonged for 3 months	266	308	257	295

Source: Ministry of Finance (2026).

The data in Table 1 shows that a number of blocked bank accounts is not very high. This suggests that the blockade of bank accounts is used seldom after the analysis of the case. To assess the use of blockade of bank accounts, the number of litigation with tax authorities should be analysed. The number of grievances and litigations with tax authorities is presented in the Table 2.

Table 2.

The number of grievances and litigations with tax authorities concerning the blockade of the bank account (years 2022–2025)

	2022	2023	2024	2025
Number of blocked bank accounts	267	315	258	295
Number of grievances	90	96	65	113
Number of orders setting aside the orders of the authority of the first instance in the whole and adjudicating on the merits of the case	5	6	0	3
Number of complaints to the Voivodship Administrative Court	53	41	29	54
Number of VAC's rulings setting aside the orders	8	13	2	4
Number of cassation appeals with SAC's filed by qualified entity	13	2	9	10
Number of SAC's rulings setting aside the orders	0	1	1	0

Source: Ministry of Finance (2026).

The data in Table 2 shows that a number SAC's rulings setting aside the orders is very low. It can be noted that the orders of the tax authorities do not abuse the law concerning the blockade of bank accounts.

2. Assessment of the tax authorities' use of bank account blocks

The assessment of the tax administration's use of account blockade was conducted through an analysis of case studies — the Supreme Administrative Court (SAC) rulings. Taxpayers who disagree with the tax authorities' order regarding the blockade of bank accounts under the STIR system may file a complaint with the Voivodship Administrative Court (VAC). Due to the two-tier nature of court proceedings in Poland, the parties (both taxpayers and tax authorities) may file a cassation appeal with the Supreme Administrative Court. The analysis of Supreme Administrative Court rulings concerning bank account blockade is intended to serve the purpose of this article and to verify the adopted hypothesis. As of December 15, 2024, the Lex database contained Seven Supreme Administrative Court (SAC) judgments related to account blocking issued between 2022 and 2024. This timeframe stems from the fact that earlier years were covered by a separate study. All seven NSA judgments were analyzed.

All rulings assessed the validity of the orders to impose a blockade of bank account, although in some cases the court also examined other issues. Among these other issues were procedural matters concerning the delivery of the order without involving the attorney-in-fact. Among other things, the courts' authority to review the so-called short blockade (for 72-hours) was evaluated. However, in all seven rulings, the Supreme Administrative Court addressed the issue of applying a blockade under STIR. The Supreme Administrative Court upheld the actions of the tax administration authorities in all cases. To assess the use of STIR for account blockade, selected individual cases will be presented in detail, taking into account the Supreme Administrative Court's opinion.

In Judgment of June 30, 2023, case no. I FSK 190/23, the Supreme Administrative Court upheld the tax authority's imposition of a blockade. According to the Court, the extension of the blockade was justified by a real concern regarding the non-fulfillment of a tax obligation estimated at PLN 3,974,715 and the use of banks for purposes related to tax fraud. The company's real estate is secured by a mortgage of significant value (PLN 4,831,500), and its fixed assets are of little value; therefore, neither the company's financial standing nor its economic performance guarantees the fulfillment of the estimated liability. The court agreed with the tax authorities' findings, which indicated that the company was involved in supply chains that did not reflect actual economic transactions. According to the tax authorities, the funds credited to the taxpayer's accounts may have originated from transactions constituting tax fraud. In the court's

view, when describing a carousel fraud, one cannot disregard the actions of the taxpayer's business partners; therefore — as it is obvious — these actions have a direct impact on the taxpayer's factual and legal situation, as well as on the accuracy of the invoices the taxpayer uses. Regarding the nature of tax fraud, the findings made by the tax authority may directly concern the business partners of the qualified entity who are involved in earlier stages of the business transaction and in respect of whom there is a reasonable suspicion that they are participating in tax carousels. According to the court, in cases involving the blockade of a bank account, the results of the risk analysis and the associated reasonable concern that the taxable entity will fail to fulfill an existing or future tax obligation are therefore of key importance. Thus, according to the court, the imposition of a so-called short blockade was justified by circumstances indicating that the funds entering the company's accounts may have originated from transactions constituting tax fraud. Moreover, the company had recorded invoices that most likely did not document the actual course of economic events, as they were issued by entities that do not conduct actual business activities (no registered address and no active tax liability, bank account blockade imposed under STIR, and removal from the VAT register of active taxpayers due to a lack of contact).

Another ruling analyzed was the decision dated December 2, 2022, case no. I FSK 1496/22. In imposing a so-called "short blockade" the Head of the National Revenue Administration took into account that the taxpayer's suppliers indicated to commit a potential tax fraud. This assessment was reflected in the finding that these entities settled transactions without using bank accounts, and, if a payment had already been made to an account, they withdrew significant amounts of cash. They also purchased goods from entities removed from the VAT taxpayer registry. The business partners of taxpayer's suppliers were also removed from the VAT taxpayer registry due to failure to file returns or a lack of contact with them, inconsistencies in registration filings, and false information in those filings. Moreover, the taxpayer's suppliers reported inconsistent volumes of purchases and sales in their VAT returns and VAT SAF-T, and many of them failed to settle their tax liabilities, reporting transactions between themselves. The findings in this regard were not challenged in the cassation appeal; rather, the taxpayer merely invoked their good faith in dealings with the business partners and lack of awareness of any irregularities.

Deciding to extend the blockade, the tax authority took into account the fact that, during the period from August 1, 2020, to January 17, 2022, the company made no payments via bank accounts to three of the seven business partners whose operations were analyzed, and made only partial payments to the other three entities (the amount of outstanding receivables totaled PLN 6,866,167.50). Significant cash withdrawals (totaling approximately PLN 2.6 million) were made from the taxpayer's bank accounts. No debits related to salary payments were recorded in the company's bank accounts, even though the PIT-4R tax return indicated that the company

employed one employee. These circumstances, which are atypical for standard business operations, provided grounds for a reasonable suspicion that the supply chain in which the company participated did not reflect genuine business transactions but was used for tax fraud. The justification for the decision also referred to findings regarding the company's financial situation. These findings indicated that the company does not have sufficient assets to cover the estimated tax liability of over PLN 2.4 million. The company does not own any real estate and does not hold any valuable rights related to real estate. The company owns a passenger car valued at approximately PLN 150,000. According to the CIT-8 tax return for 2020, the company reported income of PLN 99,601.27. As of the date the blockade was extended, approximately PLN 375,000 had been frozen in the company's account. In the 2020 balance sheet, the taxpayer reported fixed assets valued at PLN 97,906.50, current assets valued at PLN 524,986.06, and liabilities and provisions for liabilities totaling PLN 287,287.76. The taxpayer did not challenge the specific findings, but only disputed their assessment. In the court's view, the mere fact of having funds in a bank account is not a valid argument against the blockade of those funds. The taxpayer did not dispute the finding that, shortly after the account was credited, the funds held in the bank account were frequently withdrawn in cash. The court held that the evidentiary requirements for proceedings concerning the blocking of a bank account differ from those applicable to tax proceedings aimed at determining the amount of a tax liability. In cases of this nature, the authorities' assertions are not conclusive or decisive from the perspective of the tax matter, since the authority, when deciding to impose a blockade, does not conduct an evidentiary proceeding to the extent required to issue a tax decision. The circumstances cited in such a situation are intended solely to substantiate the possibility that the activities of, among others, banks could be used for purposes related to tax fraud or for acts aimed at committing tax fraud. The tax authority's role is therefore merely to establish the likelihood of specific events that are relevant to the grounds for a bank account blockade, rather than to prove them.

In the next analysed case, the tax authorities determined that:

- between January 2020 and March 2021, the taxpayer deducted the input tax shown on invoices issued by S. p.l.c.;
- during this period, the company taxpayer transferred funds in the amount of PLN 7,966,250.60 to S. p.l.c.;
- in turn, the main supplier of S. p.l.c. during this period was P. p.l.c.;
- P. sp. p.l.c., having received funds from S. p.l.c., did not pay its suppliers (i.e., S.1 p.l.c. and G. p.l.c.);

- S.1 p.l.c. did not file tax returns for the period from January to December 2020 and was removed from the VAT taxpayer registry as of February 10, 2021;
- G. p.l.c. reported purchases from unreliable entities (those that did not file tax returns or did not report purchases in them);
- funds from P. p.l.c.'s accounts were withdrawn in cash at ATMs or bank branches.

In addition, during the appeal proceedings, the Head of the National Revenue Administration determined that W. S. (the taxpayer's CEO) held a payment card linked to an account maintained by S.A. for P. p.l.c. during the period from January 1, 2020, to April 2, 2021.

In the opinion of the Supreme Administrative Court, the totality of circumstances regarding the company's financial and asset situation justifies the concern that the taxpayer will fail to fulfill a tax obligation that may have arisen due to the unjustified deduction of input tax shown on the invoices issued by S. p.l.c. These circumstances include the fact that the company does not possess fixed assets (real estate or fixed assets other than a single passenger car) and that the taxpayer has not reported a significant (accounting) profit or a (taxable) income — in its CIT-8 tax return for 2018, the company reported a loss; for 2019, it reported a small amount of income (PLN 4,949.61); for 2020, it reported a loss of PLN 19,655; from January 2021 to March 2021, it did not make any advance payments for corporate income tax.

According to the Supreme Administrative Court, in proceedings concerning the blocking of a bank account, it is not necessary to prove that the entity participated in tax fraud — suspicion is sufficient; and in proceedings concerning the extension of the blocking of a qualified entity's account, it is not necessary to prove that the entity has failed to fulfill its obligations — a reasonable suspicion is sufficient.

The next case concerns a judgment of the Supreme Administrative Court dated May 17, 2022, Case No. I FSK 371/22. In the case under review, the tax authority specifically noted that, based on the information gathered (obtained, among other things, through an analysis of the cash flows in the bank accounts, comparisons between the cash flows in those accounts and the transactions reported in the SAF-T_VAT files submitted by the taxpayer and their business partners, data obtained from the Central Register of Vehicles and Drivers and the Central Land and Mortgage Register), the taxpayer — a qualified entity — may be involved in the use of the financial sector for tax fraud. As noted, the taxpayer's business partners — namely, companies K. and S. — had their bank accounts blocked and customs and tax audits were initiated. Company A. makes purchases directly from company S. and from company K.

Consequently, in the opinion of tax authority, the data collected indicated that the taxpayer may be involved in the use of the financial sector for tax fraud by including in the submitted

SAF-T _VAT files invoices for which there is a reasonable suspicion that they do not reflect actual economic events. The VAT shortfall estimated by the tax authority for the period from April 2020 to March 2021 totaled PLN 334,753.50. The tax authority analyzed the SAF-T files submitted by the taxpayer, and this analysis showed that the taxpayer made the majority of its purchases (72.51%) from high- and elevated-risk counterparties, namely K. p.l.c., S. p.l.c., and A. p.l.c. Furthermore, an analysis of the taxpayer's bank account in connection with the data shown in the SAF-T _VAT files submitted by the Party and the entities in question revealed discrepancies between the declared and reported amounts. Furthermore, the authority verified the registered addresses, business operation addresses, and addresses where accounting records were stored for the taxpayer's direct suppliers. At the addresses indicated for the registered office and business operations of K. and S., the address of the registered office and the address for storing accounting records were identical, and a single-family home was reportedly located at the address indicated for the registered office and business operations of K. However, at the address where the accounting records were supposed to be stored, there was an abandoned building. Meanwhile, the registered office address of the third contractor (Company A.) was supposed to be located in a "virtual office," and no one was found at the business address. Company A, on the other hand, made purchases directly from Company S. (52.74% of all purchases, totaling PLN 1,345,402.15, VAT: PLN 309,442.51) as well as from Company K. (5.72% of all purchases, totaling PLN 146,000, VAT: PLN 33,580). In fact, the only assets from which the taxpayer's tax liabilities could have been paid were the funds in their bank accounts. As established — and as was not effectively challenged in the cassation appeal — the taxpayer did not own any real estate or fixed assets; they owned only a car from 2008.

Since, the taxpayer had deducted input tax based on invoices that the tax authority suspected of being fraudulent, and involving the taxpayer's financial situation, there was a reasonable concern that the taxpayer would fail to fulfill the obligation specified in the contested decision.

Most importantly, the taxpayer failed to explain the discrepancies noted in the contested decision regarding their settlements with Company S., in relation to which an underpayment of PLN 357,930 was identified (which results from a comparison of the total amount of the taxpayer's money transfers made during the analyzed period to that entity with the value of purchases from that entity declared by the taxpayer in its JPK-VAT files submitted for that period — as noted in the response to the cassation complaint). In addition, the taxpayer failed to note that the tax authority had recorded in the contested decision that it had received the amount of PLN 86,100 from K. p.l.c. on March 19, 2021, and, importantly, did not deny that this amount constituted a refund for an erroneous payment made by the taxpayer. In the court's view, it was difficult

to agree with the taxpayer that they had clarified, during the proceedings, all the doubts raised by the authorities regarding discrepancies in financial settlements with business partners.

The next analyzed ruling was the decision dated February 16, 2022, case no. I FSK 2514/21.

The tax authority extended the blocking of the bank account. The taxpayer filed a complaint with the Voivodship Administrative Court, which overturned the decision to extend the blocking of the bank account. The tax authority filed a cassation appeal against the Voivodship Administrative Court's ruling. The cassation appeal was granted, and as a result, the Voivodship Administrative Court's judgment was overturned. Therefore, firstly the ruling of the Voivodship Administrative Court is presented and then the Supreme Administrative Court one.

For nearly a year, the taxpayer failed to report the tax due, despite significant revenues from the supply of goods, as evidenced by bank statements and confirmed by their business partners' SAF-T_VAT files. However — as the court of first instance further noted — the decision to extend the blocking period failed to take into account a material change in the factual circumstances that occurred between the issuance of the decision of July 19, 2021, and the issuance of the contested decision on August 4, 2021. On July 20, 2021, the company filed VAT-7 returns along with explanations of the reasons for the correction and SAF-T_VAT files for the period under review, disclosing both input and output tax.

The court noted that, in issuing the order, the Head of the National Revenue Administration merely stated that, during the blocking procedure, they were not the authority competent to assess the content of the submitted tax return amendments, as these would be subject to verification during the customs and tax audit. At the same time, citing preliminary information obtained from the Customs and Tax Office in K., which is conducting the tax audit, they noted that the submitted corrections still do not reflect a correct settlement of the value-added tax for the periods under review. The complainant company, in fact, included VAT invoices documenting intra-Community acquisitions of goods in the input tax records twice, which led to an overstatement of the input tax. In the opinion of the court of first instance, the Head of the National Revenue Administration, in considering the complaint, failed to address the substance of the arguments and evidence presented therein and relied solely on the evidence gathered at the time the decision of July 19, 2021, was issued. Such consideration of the complaint violated, in the opinion of the court of first instance, the principle of two-instance proceedings.

The court of first instance then found that, in the case at hand, the key point was that if the tax due as declared by the taxpayer in its amended returns and SAF-T_VAT files actually corresponded to the tax calculated as a result of the risk analysis, then the grounds for imposing the block, as indicated in the decisions of the tax authorities of both instances, were, in principle, no

longer applicable. They noted that in a situation where the appellant company, upon noticing irregularities in the submitted returns and SAF-T_VAT files, immediately corrected those documents and filed a voluntary correction, it was difficult to accept that maintaining the blockade of the bank accounts was still necessary and that it prevented tax fraud.

According to the Supreme Administrative Court, one cannot agree with the assessment made by the court of first instance that, in the case, there was a violation of the two-instance principle set forth in Article 127 of the Tax Ordinance, as stated in the reasoning of the contested judgment.

Taking into account the specific nature of proceedings concerning the blocking of an account and the its extension, and in light of the time and subject-matter limitations — namely, the limited range of evidence that may be used during the blocking procedure — the Head of the National Revenue Administration does not conduct a strict evidentiary proceeding.

In these proceedings, it is not necessary to prove that the company participated in tax fraud, that it knowingly failed to file tax returns, or that it will not fulfill its tax obligations. It is sufficient, in fact, to have a reasonable concern that potential tax obligations will not be fulfilled. This constitutes a specific exception where, due to the nature of the referring provision, the regulations contained in Section IV of the Tax Ordinance will not apply as fully as the taxpayer expects and as the court of first instance held.

According to the Supreme Administrative Court, the role of the Head of the National Revenue Administration is therefore merely to establish the likelihood of certain events (actions, circumstances) in the context of the grounds for blocking a bank account, rather than to prove them. For this reason, in proceedings concerning the blocking of a bank account, the correctness of the tax authorities' findings is not assessed as final and binding for the determination of the tax liability (these tasks are carried out in the course of assessment and administrative court proceedings concerning the tax decision), but only whether the circumstances provided by the tax authority justify the application of such a blocking, and thus whether the authority has established a *prima facie* case for the bank account blocking.

In the opinion of the Supreme Administrative Court, in light of the findings to date, there was a reasonable suspicion that the taxpayer continued to use the financial sector for tax fraud even after July 20, 2021, as the facts of the case had not changed as a result of the filing of amended tax returns. The taxpayer's explanation that its failure to report both output and input tax in both the VAT-7 returns and the SAF-T_VAT files filed for the periods from August 2020 – May 2021, and its failure to report the value of supplies and acquisitions was “the result of an error consisting in failing to select the option to load data from the accounting software's buffer and from the VAT registers” were unconvincing insofar as the company had been making this error for over a year. During this period, the taxpayer “failed to notice” that, while making sales

to nearly 1,500 entities for a total net amount of PLN 10,898,360.37, it had not accounted for PLN 2,505,152.67 in VAT. The Supreme Administrative Court accepted the conclusion indicated in the statement of reasons of order given by the tax authorities that the reason for filing the corrections was not the taxpayer's stated intention to correct an accounting error, but rather the initiation of an audit of the company by tax authorities. As the Supreme Administrative Court stated it was highly unlikely that, for nearly a year, the taxpayer "failed to notice" that it was not reporting output tax in its tax returns. Furthermore, and importantly, as the Head of the National Revenue Administration also noted, despite the taxpayer having filed amended returns, there remains a high likelihood of incorrect settlement of value-added tax.

According to the Supreme Administrative Court these findings therefore established that there was a justified risk of non-performance of an existing or potential future tax obligation in this case. Indeed, the mere suspicion of failure to account for and remit the due value-added tax provides grounds for concluding that there is a reasonable concern regarding non-performance of the tax liability. Furthermore, it was also demonstrated that there is a disparity between the value of the complainant company's assets and the approximate amount of the tax liability.

Another ruling analyzed was the decision dated January 26, 2022 case no. I FSK 2393/21.

The tax authority extended the block on the bank account. The taxpayer filed a complaint with the Voivodship Administrative Court, which overturned the decision to extend the block on the bank account. The tax authority filed a cassation appeal against the Voivodship Administrative Court's ruling. The cassation appeal was granted, and as a result, the Voivodship Administrative Court's judgment was overturned.

The tax authority analyzed the cash flows in the taxpayer's bank accounts for the period from January 2020 to October 2020. No payments from major business partners were recorded in this bank account. In addition, with regard to this account, the tax authority noted numerous cash withdrawals from ATMs (nearly 50% of all transactions) totaling 463,500.00 PLN. The risk analysis also indicated that the manner in which this account was used — namely, the absence of payments from contractors and the making of cash withdrawals — remained unchanged during the subsequent period, from November 1, 2020, to December 15, 2020. An analysis of the SAF-T_VAT files revealed that, in the case of the taxpayer's direct suppliers, the businesses listed as their main contractors and suppliers had not reported any sales to the taxpayer's designated suppliers in their own SAF-T_VAT files. In addition, the tax authority pointed to the low credibility of the taxpayer's suppliers. These entities exhibited characteristics of missing trader: their registered office was either a virtual office or office with unreachable management; the entity was managed by a foreign national without appointing a representative; there was a short period between the com-

mencement of operations and their suspension; disproportionately low share capital of the entities, relative to the value of declared turnover and purchases; significant turnover already in the first months after the entity began supplying goods; sudden cessation of operations.

The Supreme Administrative Court found that the gathered evidence, in particular the risk analysis, justified the application of account blockade including “short-term blockade” in this case.

Conclusions

VAT fraud is a significant problem for public finances. One of the measures designed to combat this harmful practice is the blocking of bank accounts through the STIR system. However, for certain entities, the application of such a block may pose a threat to their operations. This applies particularly to those entities that are not actually involved in activities related to tax crimes. The conducted research allows us to conclude that the research hypothesis was rejected. In none of the cases analyzed did the Supreme Administrative Court (NSA) find that the tax authority had unjustifiably blocked a bank account.

An analysis of these rulings shows that in each case there are specific circumstances indicating the possibility that the entities were involved in VAT fraud. In each case, there were specific circumstances that, in the opinion of the Supreme Administrative Court, justified the blocking of the account. When deciding to block a bank account, the tax authorities took multiple factors into account. These were not hasty decisions based solely on a cursory, random analysis of data concerning a single aspect of the company's operations. The conducted research indicates that the blocking of bank accounts under the STIR system is not abused by tax authorities. The existence of such a tool contributes to reducing the scale of tax fraud and enhances the security of the public finance system, as well as economic transactions, by eliminating entities engaged in tax fraud.

The research conducted indicates that the Supreme Administrative Court holds that the tax authority is therefore required to present information suggesting, at most, the likelihood that banks' activities are being used for purposes related to tax fraud or for acts aimed at tax fraud, rather than to prove this fact.

A key finding from the analysis of the Supreme Administrative Court's rulings is that the Head of the National Revenue Administration does not strictly conduct evidentiary proceedings as a second-instance body. According to the Supreme Administrative Court, in proceedings concerning the blocking of a bank account, it is not necessary to prove that the entity participated in tax fraud — suspicion is sufficient; and in proceedings regarding the extension of the blocking of a qualified entity's account, it is not necessary to prove that the entity will fail to fulfill its obligations — a reasonable fear is sufficient.

The Supreme Administrative Court has confirmed that appeals against decisions to extend the blocking of a bank account are also subject to review regarding the grounds for the so-called “short-term blocking.”

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E-COMMERCE TRANSFORMATION UNDER WARTIME CONDITIONS: EVIDENCE FROM UKRAINE'S DIGITAL ECONOMY

ABSTRACT

The Russian invasion of Ukraine in February 2022 constituted an unprecedented situation for studying e-commerce behavior under extreme conflict conditions. The aim of the article is to examine how Ukraine's digital commerce sector responded to the disruptions of active warfare, analyzing transformations in supply chains, consumer behavior, digital payment adoption, and small and medium-sized enterprise (SME) responsiveness. The research methodology includes a synthesis of academic literature, institutional reports, market analytics, and a primary consumer survey (n = 210, May 2025), this study identifies key adaptation patterns that emerged between 2022 and 2024. The results of research show that, contrary to expectations of sustained contraction, Ukraine's e-commerce market demonstrated remarkable adaptive capacity: online retail maintained a significant share of total retail sales and major platforms recovered within months of the invasion. The consumer behavior shifted significantly towards necessity driven purchasing, patriotic preference for domestic brands, and heightened price sensitivity. SMEs increasingly leveraged digital marketplaces to maintain operational continuity. Persisting structural challenges include rural digital infrastructure gaps, regulatory barriers to cross-border e-commerce, and logistics network fragility. The findings contribute to the emerging literature on e-commerce in crisis contexts and offer evidence-based recommendations for post-war economic reconstruction. The Ukrainian case provides broader lessons for digital economy responsiveness under geopolitical instability.

Keywords: e-commerce, Ukraine, war, digital economy, consumer behavior

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1. Introduction

E-commerce has been widely recognized as a transformative force in modern economies, enabling firms to transcend geographical barriers, reduce transaction costs, and access global markets (Czajkowski, 2011; Eurostat, 2023). Scholars have documented its capacity to accelerate economic development in emerging markets through improved resource allocation, entrepreneurial activity, and financial inclusion (Chaffey, 2015; Turban et al., 2018). However, the behavior of e-commerce systems under conditions of armed conflict remains comparatively underexplored in academic literature, largely because such extreme disruptions are rare and difficult to study systematically. The Russian invasion of Ukraine, launched on February 24, 2022, created precisely such a situation. The conflict inflicted massive destruction on physical infrastructure, displaced millions of people, severed established logistics routes and subjected the Ukrainian economy to repeated energy blackouts. Under such conditions, prevailing theory might predict a protracted collapse of consumer markets and digital commerce. Instead, available evidence suggest a more complex and in many respects counter – intuitive dynamic: Ukraine’s e-commerce sector proved remarkably resilient, adapted with speed, and in some segments actually registered growth attributable directly to wartime conditions. This article has three main objectives. First, it provides a comprehensive review of the structural factors shaping Ukrainian e-commerce prior to and during the war. Second, it analyses the principal channels through which the conflict affected supply chains, consumer behavior, digital payments, and SMEs (small and medium-sized enterprises) performance. Third, it draws on primary survey data and secondary market data to construct an evidence-based assessment of the sector’s trajectory and prospects. The research hypotheses developed on the basis of the goals of the article are as follows: H1: Structural factors in Ukraine facilitated proper utilization and development of the e-commerce sector after the outbreak of war in 2022; H2: Consumer spending in Ukraine changed significantly in the direction of the most essential and domestically produced goods; H3: E-commerce sector in Ukraine demonstrated resilience and contributes to the mitigation of the effects of war on the national economy.

2. Literature Review and Theoretical Framework

2.1. E-Commerce in Emerging Economies: Drivers and Barriers

The theoretical foundations of e-commerce research draw on multiple disciplines, including information systems, economics and organizational behavior. Porter’s framework for competitive advantage (Öz, 2019) has been extended to the digital domain, with scholars identifying lower operational costs, market reach, and data-driven customer management as core sources of online com-

petitive advantage. Other authors (Molla and Licker, 2005) proposed an influential model of e-commerce adoption in developing countries, identifying perceived e-readiness, organizational readiness, and external environment as key determinants. Applying this framework to Ukraine reveals a society with high internet penetration (exceeding 90%) but historically lower rates of online transactional activity relative to its EU neighbors, constrained by consumer trust deficits, logistical fragmentation, and regulatory gaps.

Lawrence and Tar (2010) systematically documented the barriers to e-commerce in developing nations: inadequate telecommunications infrastructure, limited access to digital payment mechanisms, cultural preferences for in-person retail, and weak legal frameworks governing online transactions. These barriers were broadly present in Ukraine prior to war and have been compounded by the conflict's destructive impact on physical and digital infrastructure in affected regions. Yet, as argued by Sigma Consulting Group (2023) and confirmed by OECD analysis (2024), crises can paradoxically accelerate adoption by increasing relative convenience of digital channels when offline alternatives are disrupted or unsafe.

2.2. E-Commerce Under Crisis and Conflict

The academic literature on e-commerce under conditions of crisis has grown substantially since the COVID-19 pandemic. McKinsey's global research (2020) documented a dramatic acceleration of digital adoption during pandemic lockdowns, with five years of expected e-commerce growth compressed into approximately twelve months. The pandemic literature provides a useful comparator for Ukraine, though the wartime context differs in critical respects: physical infrastructure destruction, population displacement, sustained energy insecurity, and active combat operations create qualitatively different challenges for digital commerce than health related lockdowns. Within Ukraine specifically, Maksymenko (Maksymenko et al., 2024) documented the market's pre-war trajectory, characterizing it as exhibiting strong growth momentum disrupted by the 2022 invasion. Gamova et al. (2024) analyzed the innovative dimensions of e-commerce adaptation during the war, identifying platform flexibility and logistics restructuring as key resilience mechanisms. Sharov et al. (2024) examined the financial dimension, concluding that while absolute revenues declined in dollar terms in 2022, the relative share of online retail in total sales actually increased as physical retail suffered proportionally greater disruption. These studies collectively suggest that e-commerce, precisely because of its digital and distributed character, is better positioned than traditional retail to absorb the shocks of armed conflict.

2.3. Digital Payments in Conflict Economies

The resilience of digital payment infrastructure is a vital precondition for e-commerce. Research on financial systems in conflict zones have generally emphasized their fragility, yet the Ukrainian case offers evidence of significant institutional durability. The National Bank of Ukraine's (NBU) emergency response protocols, developed following the 2014 partial occupation of Donbas and Crimea, proved decisive in maintaining cashless payment continuity after February 2022 (European Payments Council, 2023). Yurieva (2024) analyses the post-war conceptual evolution of cashless payment systems in Ukraine, identifying tokenization, NFC technology, and mobile wallets as key vectors of change accelerated by wartime necessity. Visa's economic modelling (2024) demonstrates that each 1% increase in card usage contributes approximately \$67 billion in annual consumption globally, underscoring the macroeconomic significance of Ukraine's payment digitalization for post-war recovery.

3. Methodology

This article employs a mixed method research design, combining systematic secondary analysis with primary survey data. The secondary analysis draws on academic journal articles, institutional reports from the OECD (2022) and UNDP (2024), market data from Promodo (2025), Statista (2024) and InVenture (2024), as well as policy documents and legal texts from Ukrainian governmental sources.

The primary data component consists of an online consumer survey conducted between May 15 and 30, 2025 ($n = 210$). The instrument comprised 19 questions covering online purchasing frequency before and after February 2022, product categories, motivations, payment methods, supply chain disruption experiences, income changes, and attitudes towards Ukrainian e-commerce platforms. The survey was distributed in Ukrainian and English languages via Google Forms, reaching respondents through university networks, social media, and the researcher's personal contacts. The sample included respondents from 18 Ukrainian regions plus Kyiv, providing good geographic breadth; 56.7% of respondents are female, 37.1% male, and 6.2% preferred not to disclose their gender. The largest age group was 18–24 years (36.7%), followed by 45–54 (16.7%), under-18 (13.3%), 35–44 (12.4%), 25–34 (11%), and 55+ (10%). The occupational distribution encompasses full-time employees (23.8%), self-employed (11.4%), part-time workers (11.4%), retired (8.1%), unemployed (6.2%), and pupils (7.1%), with students constituting the largest single group (29%). The survey's primary limitation is sampling bias: convenience sampling via the researcher's networks over-represents urban, younger, and more digitally active respondents. This limitation is partially mitigated by the geographic diversity of the sample and the bilingual distribution mechanism. Secondary sources are critically

evaluated for methodological robustness, recency, and source credibility. All monetary values reported in USD are converted from UAH using period-appropriate NBU (National Bank of Ukraine) exchange rates.

4. Research Results

4.1. The Ukrainian E-Commerce Market: Pre-War Baseline and Wartime Trajectory

Prior to the invasion, Ukraine's e-commerce market had experienced sustained growth, rising from approximately \$1.2 billion in 2017 to an estimated \$4 billion by 2020 – a figure representing an 8.8% share of total retail trade and a threefold increase over five years (Soul Partners & Baker Tilly Ukraine, 2021). Despite this expansion, the market was characterized by structural underdevelopment relative to regional peers: per capita annual e-commerce spending stood at approximately \$104, nearly five times lower than in neighboring Poland. Major domestic marketplaces dominated the landscape, with Rozetka, Prom.ua, Epicentr, Bigl.ua, and Allo collectively accounting for over 82% of B2C online sales. The COVID-19 pandemic had already accelerated market maturation, driving 41% growth in 2020 and a further 27% in 2021 – significantly above the global average of 15%. By 2021, online marketplaces had developed sophisticated logistics partnerships, digital payment integrations, and multi-vendor platforms. This pre-existing digital infrastructure proved critical to the sector's ability to absorb the wartime shock. In 2024, e-commerce accounted for approximately 10% of all retail sales in Ukraine, with around 11 million active online shoppers conducting an average of 17 purchases per year (TS2 Technology & Strategy, 2025). Total online consumer spending reached approximately UAH 239 billion (approximately \$5.9 billion) in 2024, representing a 25% nominal increase over 2023 (AllRetail Ukraine, 2025). However, when adjusted for UAH/USD exchange rate dynamics – the hryvnia depreciated significantly during the conflict – dollar denominated growth figures are more modest, highlighting the analytical importance of dual-currency reporting.

4.2. Supply Chain Disruption and Logistics Restructuring

The war inflicted severe structural damage on Ukraine's logistics network. Russia's blockade of Black Sea ports eliminated the primary export channel through which approximately 90% of Ukrainian agricultural exports had previously flowed, with grain exports declining by over 80% in the first months of the conflict (Zinchenko, 2023). Energy infrastructure attacks intensified from autumn 2022, producing recurring nationwide blackouts that disrupted warehousing, transport, and communications systems. This resulted in significant delivery delays and cargo damages, also in case of e-commerce. Companies responded by relocating warehousing capacity from eastern and central Ukraine to safer western regions, though this created acute warehouse

shortages in western cities and contributed to cost increases (inVenture, 2025). For domestic e-commerce, the logistics restructuring had direct consequences for delivery times, product availability, and operational costs. Nova Poshta – which processes approximately 85% of Ukrainian parcel deliveries – adapted through a series of innovations including battery-powered automated lockers, Starlink satellite connectivity for branch communications, and geo-distributed warehouse strategies. These adaptations enabled the company to maintain service continuity even during extended blackout periods, providing critical infrastructure for the e-commerce ecosystem (Nova Poshta, 2025).

4.3. Consumer Behavior: Shifting Priorities and Digital Adaptation

The wartime transformation of Ukrainian consumer behavior has been documented across multiple dimensions. The Ukrainian Retail Association reported losses exceeding UAH 50 billion in the retail sector by June 2022, with food retailers bearing a disproportionate share of the burden (Ukrainian Retail Association, 2022). This structural shock catalyzed rapid adaptation by both consumers and retailers. Consumer survey data from our primary study reveals a significant bifurcation in post-invasion shopping frequency. Out of 210 respondents, 36.2% reported shopping online more frequently than before the war, 28.1% maintained their pre-war frequency, 23.3% reduced online shopping activity, and 12.4% ceased online shopping entirely. The drivers of increased online activity were primarily practical: convenience (66,7% of the respondents), product availability (53,85), lower prices (53,5%), limited access to physical stores (36,7%), and the desire to support Ukrainian businesses (35,7%). Lopusnyak et al. (2025) document the emergence of what might be termed “wartime consumer austerity” – a systematic reorientation of household spending away from discretionary items towards essential goods, driven by income insecurity and heightened uncertainty. Income effects are significant: the primary survey of the authors found that approximately 60% of respondents experienced some form of income decline, with 25.7% reporting significant decreases and 11.9% reporting total income loss. Concurrently, 38.6% of survey respondents indicated they now always compare prices before online purchases, and 22.9% reported doing so frequently. Prior to the war, most respondents were making online purchases quite rarely, which represented 32.9% of participants, as the own research of the authors showed. This indicates that shopping online was not a common habit for people from Ukraine. Perhaps because they preferred shopping in physical stores, had limited access to digital services, or only used online platforms for occasional purchases. The second-largest group, 28.1%, reported shopping online once a month. These monthly shoppers were most likely balancing practical needs with budgeting, using e-commerce, when necessary, not just for entertainment. Meanwhile, 18.6% were weekly

shoppers. This group possibly relied more on online stores for regular items such as groceries, essentials, or frequent purchases, indicating a solid integration of digital platforms into their routines. Some respondents, to be more precise – 12.4%, indicated that they bought or sold something online on a daily basis. These individuals were clearly very active online consumers, probably due to the convenience or advantages such as discounts and fast delivery. They might have used online shopping for their groceries and food delivery, as it is now more and more convenient to do so. The smallest group, making up 8.1%, reported never shopping online, which could reflect a variety of factors, including lack of access to the internet or digital devices, a preference for traditional shopping methods, or economic constraints limiting their ability to participate in e-commerce. Once the full-scale war began, the situation shifted. A larger percentage of people, 36.2%, said they started shopping online more often. This indicates that for many, e-commerce became even more important, likely due to limited access to physical stores, safety concerns, or a need for convenience during times of disruption. Interestingly, 28.1% of respondents reported that their online shopping habits remained the same. It is possible that this group of people continued with their usual routines despite the war times. On the other hand, 23.3% of participants began shopping online less often, possibly due to economic challenges, changes in living conditions, or a reduced need for non-essential purchases. The cause of this change could be also due to the need to save more money as a majority of people from Ukraine now want to feel more secured and be sure that if something happens, they have a ‘safety cushion’ and can rely on that money. Moreover, a significant portion, 12.4%, stated that they had completely stopped shopping online. This may indicate serious financial hardship, relocation to areas with poor internet access, or simply a shift in priorities under wartime conditions. A notable attitudinal shift documented by Gradus Research Company (2024) is the growth of consumer economic nationalism: approximately 69% of Ukrainians now actively support domestic producers, and 56% of those who tried new brands during the war did so explicitly to support Ukrainian businesses. Respondents to the authors’ survey confirmed this pattern, with 35.7% citing support for Ukrainian sellers as a primary reason for online shopping. The survey’s trust assessment found 50% of respondents rating their trust in Ukrainian online platforms at 4 or 5 (on a 5-point scale), compared with only 19.6% expressing low trust (ratings 1 or 2).

4.4. Digital Payment Infrastructure: Resilience and Expansion

Ukraine’s digital payment infrastructure underwent its most significant stress test and simultaneously its most rapid maturation during the war period. Drawing on emergency protocols developed in response to the 2014 conflict, the NBU moved decisively in the early days of the invasion

to maintain cashless payment functionality, actively encouraging retailers and service providers to prioritize card acceptance and imposing a UAH 100,000 cap on cash withdrawals while leaving digital transactions unrestricted. By 2024, the scale of cashless adoption was significant. According to NBU data (National Bank of Ukraine, 2025), Ukrainian consumers conducted over 8.6 billion card transactions totaling more than UAH 6.5 trillion, of which 94.6% by volume and 64.5% by value were cashless. Retail payments represented 73% of all transactions, with online purchases accounting for 13.6% by volume (UAH 622 billion). The total number of payment cards issued by Ukrainian banks reached approximately 132 million by January 2025 – a 15% annual increase – while the volume of actively used contactless cards grew 14% to 35 million. Tokenized NFC based cards surged by 33% to 16.5 million, such that every fourth active card in Ukraine is now tokenized (Association of Ukrainian Banks, 2025). The NBU's Power Banking initiative – a network of over 2,370 bank branches across approximately 400 cities equipped with backup power, alternative communications, and reinforced logistics – proved decisive in maintaining payment infrastructure continuity during blackout periods. This institutional response illustrates a broader pattern: wartime necessity drove institutional innovation that yielded durable improvements in digital financial infrastructure. Visa economic modelling estimates that a 5% annual increase in digital payment adoption over five years could reduce the size of Ukraine's informal economy by 11–13% while significantly boosting tax revenues (Visa Inc., 2024). Mastercard research, on the other hand, indicates that 58% of Ukrainian SMEs have now adopted digital payments, with over two-thirds reporting growth in both revenue and customer traffic attributable to digitalization (Mastercard, 2024). These findings suggest that Ukraine's digital payment transformation, accelerated by the war, will yield structural economic benefits extending well beyond the conflict period.

4.5. E-Commerce as a Lifeline for SMEs

Pre-war data from the OECD indicated that only 4.2% of small and 6.2% of medium-sized Ukrainian enterprises were involved in e-commerce as of 2021, far below the OECD average. The war has significantly altered this landscape. Digital platforms have offered SMEs the ability to reduce fixed costs by eliminating physical retail dependence, reach customers beyond conflict affected areas, and maintain business continuity despite forced relocation or physical infrastructure loss. Major domestic platforms – most notably Rozetka (18.4 billion UAH in 2022 revenue, fully recovered to pre-war scale within six months), Prom.ua (225.2 million UAH net profit in the first year of the war, with sales remaining 20% above pre-war levels), and Epicentr (1.5 billion UAH marketplace turnover in 2023) – have served as critical digital infrastructure for Ukrainian SMEs. International platforms have also expanded their role: Etsy hosts approximately 55,000

Ukrainian sellers, eBay approximately 12,000, and Amazon approximately 10,000, collectively enabling access to international markets. The Ukrainian government's Diia.Business initiative (Ministry of Digital Transformation of Ukraine, 2023) and the e-Robota program have provided essential institutional support. The e-Robota program disbursed over UAH 776 million in microgrants to 3,321 recipients in 2022 alone, generating more than 8,300 new jobs. By the end of 2023, nearly UAH 2.27 billion had been allocated to approximately 9,600 grantees expected to create over 20,000 additional positions (Government of Ukraine, 2024).

Despite these achievements, significant barriers to SME digital participation persist. Rural regions face acute digital infrastructure limitations, including damaged telecommunications networks and insufficient internet coverage. Complex bureaucratic procedures continue to restrict platform development, particularly for cross-border multi-vendor marketplaces. SMEs in rural areas often lack awareness of government support programs, and geographic disparities in access to Diia.Business centers constrain inclusive digitalization.

4.6. Legal and Regulatory Framework

Ukraine's e-commerce legal architecture is based on Law No. 675-VIII "On E-commerce" (Verkhovna Rada of Ukraine, 2015), which establishes the freedom to conduct business through digital channels, mandates the legal equivalence of electronic and written contracts, and provides the procedural framework for online transactions. Supplementary provisions in the Civil Code (Articles 205, 207, 641) and the Law "On Consumer Rights Protection" reinforce consumer protections in digital commerce. Petrunenko et al. (2023) have noted that while this framework was adequate for peacetime conditions, wartime circumstances have revealed gaps related to 'superior force' provisions, digital platform liability under martial law and cross-border data flows with EU partners. The 2023 Global E-commerce Access program implemented through Diia.Business represents a significant step towards bridging the knowledge and regulatory gap for Ukrainian SMEs aspiring to sell internationally. The PULSE digital analytics platform, launched by the Ministry of Digital Transformation, provides entrepreneurs with real-time market data to navigate a rapidly changing economic environment (Teremetskyi, 2024, p. 61). As Ukraine progresses towards a possible EU accession, harmonization of digital commerce regulation with the EU's Digital Single Market framework will be a central policy priority, with significant implications for cross-border e-commerce opportunities.

5. Discussion

The evidence reviewed in this article support a central empirical claim: Ukrainian e-commerce has displayed systemic resilience under the most challenging conditions, driven by a combination

of technological flexibility, institutional adaptability, and consumer behavioral adjustment. This finding contributes to a growing body of literature – exemplified by the pandemic-era studies of McKinsey and sectoral analyses from the OECD – suggesting that digital commerce systems possess structural properties enabling them to absorb and adapt to major disruptions more effectively than traditional retail. Several mechanisms contribute to this resilience. First, the distributed architecture of e-commerce platforms allows for rapid replication and geographic relocation of operational capacity. When the eastern warehouses were destroyed or evacuated in Ukraine, the western facilities expanded. Second, digital payment systems proved more robust to physical infrastructure degradation than cash-based alternatives, with the NBU’s proactive institutional response preventing the payment system paralysis that might otherwise have accompanied the energy infrastructure attacks. Third, the shift to online channels served as a form of risk management for both consumers and businesses: for consumers, it eliminated the safety risk of physical retail visits in conflict affected areas, while for businesses, it reduced exposure to the fixed costs and physical targeting vulnerabilities of brick-and-mortar operations.

However, the resilience narrative should not obscure genuine fragility. The 12.4% of our survey respondents who ceased online shopping entirely, and the 60% who experienced income declines, represent millions of Ukrainians for whom e-commerce has become less, not more, accessible during the war. The displacement of millions of Ukrainians – both internally and as refugees to the EU countries – has altered the demographic composition of the domestic market in ways that aggregate statistics may understate (Razumkov Centre, 2024). Rural communities and older populations, already marginally integrated into digital commerce, face heightened exclusion as the war’s damage concentrates in their regions and as government support infrastructure remains predominantly urban. The dual currency analytical framework employed in this study – evaluating e-commerce performance in both UAH and USD – reveals an important analytical subtlety. Nominal UAH revenue growth across most e-commerce categories in 2024 conceals significant real-value erosion when measured in more stable international currency. The electronics sector’s 18% UAH growth translating to only 8% USD growth is emblematic: Ukrainian e-commerce is growing in volume and in domestic purchasing power terms, but the dollar denominated value of its output remains constrained by macroeconomic pressures including currency depreciation, inflation, and reduced real wages. Policymakers and international partners evaluating Ukraine’s e-commerce recovery should employ both approaches to avoid systematic misinterpretation.

Comparative perspective is instructive. UNCTAD’s analysis of digital economy development in the Global South (2023) documents similar patterns of crisis-accelerated e-commerce adoption, particularly in conflict-affected or disaster-prone economies. The Ugandan and Rwandan experiences of mobile money growth following institutional disruptions share

structural parallels with Ukraine's cashless payment surge. What distinguishes Ukraine is the combination of pre-existing technological sophistication, strong institutional infrastructure (NBU, a functioning banking system, established logistics players) and significant international support, which together enabled a faster and more comprehensive digital adaptation than in most comparator cases.

6. Conclusions and Policy Recommendations

This article has examined the multidimensional impact of Russia's invasion in 2022 on Ukraine's e-commerce sector. The first general conclusion is that Ukraine's e-commerce ecosystem has demonstrated exceptional resilience, recovering rapidly from the initial shock of February 2022 and achieving sustained market growth in subsequent years. The sector's distributed digital architecture, pre-existing platform infrastructure, and the adaptive responses of major players (particularly Rozetka, Nova Poshta, Prom.ua, and the NBU) were central to this performance. Second, the war has accelerated structural changes in the e-commerce landscape that are likely to persist beyond the conflict: the expansion of cashless payments, the growth of grocery e-commerce and social commerce, the digital transformation of SMEs, and the emergence of economic nationalism as a significant consumer motivation. These changes create a larger, more sophisticated digital market base from which post-war recovery can proceed. Third, significant distributional challenges remain. The benefits of e-commerce resilience have been unevenly distributed, with urban, younger, and higher-income populations benefiting disproportionately. Rural areas, older consumers, and those most severely affected economically by the war face heightened exclusion from digital markets. The presented conclusions allow to state that all of the research hypotheses indicated in the introduction of the article, H1, H2, H3, are confirmed.

On the basis of these findings, the following policy recommendations are advanced. For the Ukrainian government: continued investment in telecommunications infrastructure in rural and conflict affected areas, simplification of regulatory procedures for cross-border e-commerce, expansion of e-Robota and Diia.Business programs with specific outreach to rural SMEs, and prioritization of e-commerce framework harmonization with EU Digital Single Market standards as part of accession preparations. For international partners and development organizations: targeted support for Ukrainian SME digital export capacity, focusing on logistics cost reduction and foreign language platform integration, investment in digital payment infrastructure resilience for conflict affected regions and systematic data collection on e-commerce performance under conflict conditions to contribute to the growing scholarly literature in this field. For business stakeholders: the Ukrainian e-commerce market presents genuine opportunities for firms with the resilience and adaptability to operate in a high-risk, high-volatility environment. The large, digitally

engaged consumer base, sophisticated payment infrastructure, and government commitment to digital transformation represent favourable structural conditions that will strengthen considerably in the post-conflict period.

In conclusion, Ukraine's e-commerce experience during the 2022–2024 war period offers a compelling case study in digital economy resilience. It demonstrates that e-commerce – when supported by robust institutions, adaptive platforms and supportive policy – can serve not merely as an economic convenience but as a critical component of national economic survival and recovery.

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ESG REPORTING BY COMMERCIAL BANKS IN POLAND AS PART OF SUPPORTING SUSTAINABLE ECONOMIC DEVELOPMENT – A CASE STUDY OF BANK MILLENNIUM AND SANTANDER BANK POLSKA

ABSTRACT

The purpose of the article. The purpose of the article is to analyze ESG reporting in the banking sector based on the example of Bank Millennium and Santander Bank Polska SA. The study focuses on the activities undertaken by banks in the environmental, social, and governance dimensions and on the role of ESG reporting in increasing transparency and supporting sustainable development principles in the financial sector.

Methodology. The study was conducted using the case study method. The analysis was based on annual reports and sustainability reports of Bank Millennium and Santander Bank Polska SA for the years 2024–2025. The research covered ESG-related activities in three dimensions: environmental, social, and corporate governance.

Results of the research. The results indicate that the analyzed banks are systematically developing ESG-related activities and integrating sustainability issues into their business operations. The study shows that ESG reporting contributes to increasing the transparency of the financial sector and supports the transformation of the economy towards a more sustainable development model.

Keywords: ESG reporting, banking sector, sustainable development, corporate governance, sustainability reporting

JEL Class: G21, Q56, M14, M48



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Introduction

In a knowledge-based economy, intangible assets and non-financial factors such as customer satisfaction, good relations with employees, business partners, suppliers, service recipients, and the local community are becoming increasingly important in creating value for organizations. Contemporary companies are increasingly assessed in terms of their ESG¹ performance, which results from growing public awareness of the effects of climate change, social inequality, and corporate governance standards. Consequently, there is a growing demand for reliable data and assessments of companies in terms of ESG. Companies that score highly in this area are perceived as more attractive to investors interested in sustainable development, particularly in the SME sector. This type of reporting serves as a tool to support the building of an environmentally friendly image for the organization. Its main purpose is to provide stakeholders with reliable and credible information on the nature of the company's activities, the scale of their impact on the environment, and the methods used to minimize any negative impacts.

Financial institutions, which cooperate with the business sector in many areas, have been moving towards a more sustainable development model in recent years, including through the development of financial offers and tools aimed at businesses, in particular the small and medium-sized enterprise (SME) sector. In a business context, sustainable development encompasses processes and activities that enable a company to remain solvent in the long term – all of these activities are partly the domain of financial institutions.

The aim of this paper is to analyze sustainable development management in the banking sector, with particular emphasis on Bank Millennium and Santander Bank Polska S.A. in 2024–2025. Two research hypotheses are formulated:

H1: Commercial banks in Poland systematically develop ESG-related activities and integrate sustainability principles into their core operations.

H2: ESG activities undertaken by the analyzed banks contribute to increased transparency and support the transformation towards a more sustainable economy.

The analysis focuses on three ESG dimensions – environmental, social, and corporate governance – which form the foundation of the contemporary approach to responsible and long-term financial activity in the context of its impact on the SME sector.

Literature review

The products offered by banks are one of the key sources of external financing in the economy, so they play an important role in filling the investment gap and supporting the transition to a more sustainable economy. They do this by offering appropriate financial tools, products, and services.

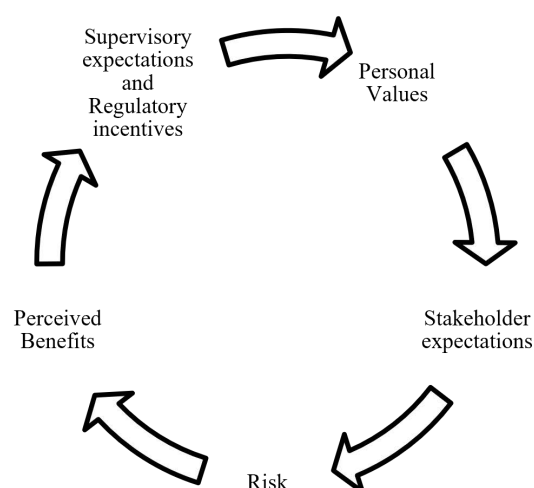
¹ Environmental, Social, and Governance.

Sustainable banking products and services enable the accumulation and use of customer savings and the channeling of investments into projects that support the Sustainable Development Goals. The funds accumulated through such products are used to finance activities that meet the sustainability criteria in accordance with the EU Taxonomy. The key features of these products are practicality, transparency, and comprehensibility. Customers should be able to verify what goals their deposited funds support and to what extent the investment products they purchase contribute to financing sustainable activities (Kulińska & Sadłocha, 2022).

Banks perform roles related to capital allocation and savings accumulation, performing functions such as deposit-taking, lending, and clearing. Due to these tasks, they should meet standards characteristic of public trust institutions, which entails imposing specific obligations on them in the area of social responsibility (Barczyk, 2019). Since the 1990s, domestic commercial banks have been undertaking various initiatives for the benefit of society and the environment, but their motivations and degree of involvement vary. The main reasons why banks have started to include social and environmental aspects in their management strategies are regulatory compliance and concern for their reputation and brand image (Gajdka et al., 2023).

Figure 1

Banks' motivations for including sustainable finance information in their strategies



Source: Own study based on: Gajdka et al. (2023).

Legal regulations concerning sustainable development have been evolving for nearly thirty years, and their full implementation is expected in 2025–2026. In the banking sector, they focus on issues related to reporting and disclosure, adapting operational strategies, and ESG risk management. At the same time, the responsibility of management staff in this area is growing. ESG

requirements are becoming a key factor in development and competitiveness, not only in Europe but also in global markets (Kosztowniak, 2026). In the European Union, there are regulations in force concerning ESG disclosure reporting by organizations, including financial institutions. These are set out in Directive 2014/95/EU (NFRD – *Non-Financial Reporting Directive*), which amended the earlier Directive 2013/34/EU. It requires large public-interest entities with more than 500 employees to publish non-financial information covering environmental, social, human rights, and anti-corruption issues. In Poland, these provisions were introduced into the Accounting Act at the end of 2016, and reporting in accordance with the new requirements began in 2017 (Zabawa & Łosiewicz-Dniestrzańska, 2023). In 2019, the NFRD was improved by *the Sustainable Finance Disclosures Regulation* (SFDR, 2019/2088) by financial market participants and Regulation PE and Council 2020/852/EU, the so-called Taxonomy (Kosztowniak, 2026). In turn, in 2024, the NFRD was replaced by the CSRD (*Corporate Sustainability Reporting Directive*), which extends the scope of reporting and introduces mandatory data verification by independent entities. The first reports compliant with the new directive will appear in 2025 and will cover information for 2024. In addition, the SFDR requires financial market participants to disclose the impact of investment decisions on sustainable development, ESG risk management strategies, and remuneration policies in this context (Zabawa & Łosiewicz-Dniestrzańska, 2023).

Banking, an important pillar of the financial sector, plays a significant role in the sustainable development of enterprises. Sustainable development is one of the most important trends in recent years, which is why investors feel a strong need to ensure conditions for responsible investment. This is possible through the analysis of corporate social responsibility principles, corporate governance structures, and environmental issues implemented by financial institutions when making investment decisions (Ersoy et al., 2022). Reporting on sustainability issues aims to meet the needs of stakeholders by providing information on the impact of a financial institution's activities on its environment, thus enabling the assessment of the effects of its actions.

ESG factors directly affect the operational, financial, and investment activities of companies and banks. Business partners and contractors expect companies to define their ESG and sustainable development goals and strategies, because the manner, scope, and effects of incorporating ESG factors into a company's activities have a positive impact on business development and cooperation with stakeholders (Osicka et al., 2023). Environmental factors (E) relate to how a financial institution's activities use natural resources and affect the environment. They include aspects such as the impact of greenhouse gas emissions on climate change, climate risk and opportunity management, energy, water, and other resource consumption, pollution and waste control, and the impact on biodiversity and the natural environment. Social factors (S) relate to how a financial institution affects the multistakeholder around it, including employees, customers,

suppliers, local communities, and other stakeholders. Social factors also include working conditions and health and safety in the workplace. Corporate governance (G) aspects, on the other hand, covers the internal practices, control mechanisms, and procedures that a financial institution uses to manage its activities, make effective decisions, comply with the law, and meet the needs of its stakeholders (Warsaw Stock Exchange, 2023).

Methods

The article uses the case study method, which allows for an in-depth analysis of selected entities in their actual operating context. The subject of the analysis are two financial institutions, namely Bank Millennium S.A. and Santander Bank Polska S.A. These institutions were selected due to their significant position in the banking market and the availability of detailed reports on their activities and ESG reporting.

The primary research method was the analysis of annual reports and sustainability reports published by the analyzed banks, including strategic documents in which the banks set out their priority objectives for the coming years. In particular, the “Management Board Report on the Activities of Bank Millennium S.A. and the Bank Millennium S.A. Capital Group” for 2024 and 2025 and the “Management Board Report on the Activities of the Santander Bank Polska S.A. Capital Group” for 2024 and 2025, which contain statements on sustainable development prepared in accordance with applicable non-financial reporting standards.

The analysis of the reports focused on identifying the banks’ activities in three main ESG areas: environmental (E), social (S), and corporate governance (G). Based on the content of the reports, key initiatives and activities undertaken by the banks in the years analyzed were identified. Subsequently, a comparative analysis was carried out to identify similarities and differences in the approach to implementing ESG strategies in both institutions. The results of the analysis were presented in the form of tabular summaries covering the banks' activities in specific ESG areas in 2024–2025. This approach enabled a transparent comparison of the scope and directions of development of the activities undertaken by the analyzed financial institutions in the area of sustainable development. In this context, the conclusions obtained were related to the development goals in the area of sustainable development of the SME sector in the coming years.

Results

ESG Strategy and Approach to Sustainable Development at Bank Millennium – Main Areas of Environmental, Social, and Corporate Governance Activities

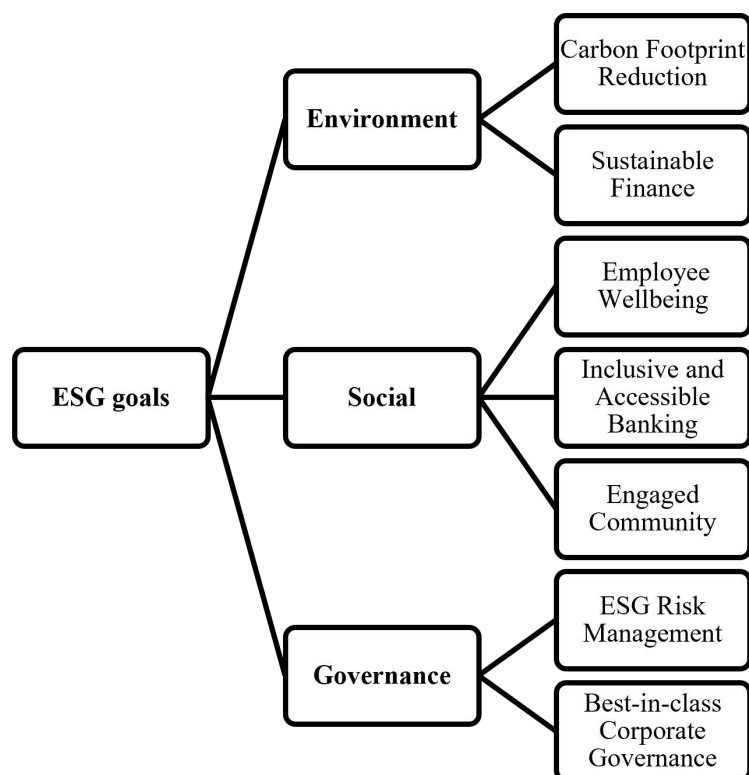
Bank Millennium was established in 1989 as one of the first private banks in Poland, starting its operations under the name *Bank Inicjatyw Gospodarczych BIG SA*. In 1990, after its first public

offering, it became a private bank, initially focusing on corporate clients. The Bank Millennium Group pursues an effective and transparent Sustainable Development Policy, which sets out the key principles for supporting sustainable development. It includes activities aimed at reducing environmental impact, combating corruption and bribery, building social value, and strengthening relations with local communities. The policy also emphasizes the protection of human rights, the promotion of diversity, the prevention of exclusion, the consideration of environmental and social factors in management, and cooperation with suppliers. In addition, the Bank offers sustainable financial products that support decarbonization goals and building a more equitable society (Bank Millennium, 2026b).

On October 28, 2024, the Bank announced a new strategy for the Bank and the Bank Millennium Group for 2025–2028, called “*Strategy 2028 – Value and Growth.*” It is based on innovation and dynamic growth. In this strategy, the Bank emphasizes the important role of sustainable development in its operations, guided by its principles and mindful of their positive impact on the economy, the environment, and society. As part of its strategy, Bank Millennium has also defined ESG goals covering three key areas: *environment, society, and governance* (Bank Millennium, 2024b).

Figure 2

Bank Millennium’s ESG goals based on the 2025–2028 Strategy



Source: Own study based on the Bank Millennium, 2024.

As part of the implemented strategy, Bank Millennium plans to implement a number of measures aimed at achieving its strategic goals. In the area of sustainable development, initiatives are planned to increase energy and water efficiency in branches and measures to increase the share of zero-emission vehicles. The bank intends to maintain 100% of its electricity from renewable sources and to adopt a comprehensive transformation plan. An important element of these measures is to provide financing for the energy transition for companies and to develop expertise in public programs and green projects. In addition, the Bank plans to maintain its policy of not financing the coal sector and coal-based energy, while expanding its range of green products.

As part of building ESG awareness, Millenium Bank will continue its educational initiatives aimed at customers. The bank intends to develop a transparent remuneration policy and take measures to reduce the gender pay gap. An important aspect of the strategy is promoting a culture of continuous learning and implementing initiatives that support employee well-being. The organization also strives to strengthen a culture of diversity, equality, and inclusiveness, as well as to increase the accessibility of services and education for customers. An important goal of the ESG strategy is to promote regular savings and investments, provide dedicated solutions for young customers, and develop financial education programs. The bank also plans to develop financing programs and educational initiatives for micro and small businesses, as well as to continue developing the employee volunteer program implemented by the Bank Millennium Foundation. It also plans to maintain its position as the Ambassador of Culture in Poland. In terms of ESG risk management, it plans to further improve risk assessment and its integration into the credit process. The bank intends to implement ESG risk measures, monitor its exposure to climate risk, and develop a methodology for conducting climate stress tests along with scenario analysis. In addition, it intends to take actions supporting the transformation plan through effective ESG risk management. The bank also commits to the timely implementation of new regulations and the adaptation of internal processes to the applicable requirements. An important element of the strategy is the continuous review and application of current ESG regulations, the development of data management in this area, and the implementation of comprehensive initiatives to build ESG awareness (Bank Millennium, 2024).

Since 2006, Bank Millennium has published an annual social report presenting key aspects of the bank's impact on sustainable economic, social, and environmental development. The document addresses the most important stakeholder groups, including customers, employees, shareholders, business partners, society, and the natural environment. Since 2011, the scope of information and structure of the report have been in line with GRI standards, ensuring transparency and comprehensiveness in reporting the bank's activities for sustainable development (Bank Millennium, 2026a). In 2025, Millennium Bank prepared its first sustainability report in accordance with ESRS standards, implemented under the CSRD directive (ESG Trends, 2025). The document serves as

a non-financial report in accordance with Article 49b of the Accounting Act and contains a summary of the Group's activities in the area of sustainable development, covering economic, social, and environmental aspects. The Bank Millennium Group has a “*Bank Millennium Group Environmental Policy*” in place, which defines three main areas of pro-environmental activity:

- the Bank’s own pro-environmental activities – striving to minimize its impact on the environment through effective resource management, monitoring energy, water and fuel consumption, and implementing environmentally friendly operational solutions;
- environmentally friendly products and responsible financing – offering products that support environmental goals, financing projects related to renewable energy sources;
- environmental education – conducting activities to raise environmental awareness among employees, customers, and partners (Bank Millennium, 2024).

Issues related to climate change, social change, and corporate governance have been embedded in the Bank Millennium Group’s business strategy for years. As part of the Bank’s strategy for 2025–2028, a number of initiatives have been planned to further strengthen the effectiveness of these areas in supporting sustainable development.

Table 1

Environmental, social, and corporate governance issues in Bank Millennium’s ESG reports for 2024 and 2025

Activities	2024	2025
Environmental Activities		
Purchase of energy from renewable sources	Obtaining 100% of electricity from renewable sources	Continuing efforts to reduce emissions and increase the share of low-carbon energy in the bank’s operations
Installation of renewable energy sources	The photovoltaic installation in Gdańsk produced 22.64 mwh of electricity	The photovoltaic installation in Gdańsk produced 21.68 mwh of electricity, which reduced the demand for energy from the grid
Energy-efficient buildings and lighting	The bank’s headquarters are equipped with building management systems that support energy consumption optimization; all headquarters offices are equipped with LED lighting	More than 15,000 light fixtures in the head office have been replaced with energy-efficient LED lighting, which has contributed to a reduction in electricity consumption
Optimization of building systems	The operating time of installations was optimized by changing the operating parameters of lighting, ventilation, and air conditioning	The optimization of ventilation, air conditioning, and lighting systems has been continued by adjusting schedules and operating parameters
Energy efficiency of branches	Energy-efficient LED banners and systems for controlling their operating time are used in branches; restrictions on the operation of air conditioning have been introduced	The LED lighting replacement program covered 230 bank branches, and energy-efficient LED banners with automatic operating time control are used in the branches

Activities	2024	2025
Rational energy management	Air conditioning in the head office is set to 21°C and does not operate outside working hours; educational activities on rational energy consumption were conducted	Measures to reduce energy consumption in the bank's infrastructure were continued, including through the modernization of systems and management of technical installations
Reduction of energy consumption in IT systems	Server virtualization has made it possible to reduce the number of devices in the data center and limit energy consumption	Server virtualization was continued, which reduced energy demand and the load on cooling systems
Low-carbon mobility	Limits on the use of individual means of transport were introduced, and the use of remote communication was promoted	The vehicle fleet was modernized by replacing gasoline-powered vehicles with hybrid and electric cars, and rail travel and online meetings were promoted
Eco-friendly employee mobility	Bicycle parking and sanitary facilities for employees were made available at the bank's headquarters	Continued activities supporting the use of bicycle transport and reducing emissions related to commuting
Support for reducing emissions among customers	The range of financing options for sustainable development projects was expanded	A carbon footprint calculator for businesses was made available, and the range of green investment financing products was expanded
Social Activities		
Working conditions and employee safety	Measures were implemented to ensure safe and stable working conditions and to monitor employee satisfaction levels	Measures to improve working conditions and programs supporting employee well-being were continued
Employee skills development	Training programs and activities supporting the professional development of employees were implemented	The development of training and competency programs for bank employees was continued
Equality and diversity	Measures were implemented to support equal treatment of employees and diversity in the workplace	The diversity policy and activities supporting equal opportunities in employment were continued
Employee volunteering	Employee involvement in social initiatives and projects supporting local communities	The "Our People" employee volunteer program was implemented, supporting social and environmental projects
Financial education for customers	Educational initiatives on financial management and responsible use of financial services were implemented	Educational activities and tools supporting customers in making informed financial decisions were developed
Support for local communities	Engagement in social activities and projects supporting the development of local communities	Social initiatives and projects supporting the development of local communities were continued
Corporate Governance		
Management structure	A management system was implemented, comprising the management board and supervisory board, responsible for overseeing strategy implementation and risk management	The management system based on cooperation between the management board and the supervisory board and supervision of the implementation of the strategy and ESG activities was continued
Risk management	A risk management system was introduced, covering the identification, assessment, and monitoring of financial and non-financial risks	The risk management system was developed, including the integration of ESG factors into risk management and business decision-making processes
ESG risk management	Work began on developing an environmental and social risk management system for the bank's operations	The ESG risk management framework and ESG indicator monitoring were developed
Internal control system	An internal control system covering internal audit, compliance, and risk management was introduced	The development of the internal control system and monitoring of the bank's compliance with regulations and standards on ESG continued

Activities	2024	2025
Ethics and corporate responsibility	A code of ethics and procedures for preventing abuse and conflicts of interest were applied	The application of ethical principles was continued and mechanisms for reporting irregularities were developed
Transparency and reporting	Financial reports and sustainability reports were published in accordance with applicable reporting standards	Reporting in accordance with ESRS standards was continued and the scope of ESG disclosures was increased

Source: Own study based on: Bank Millennium, 2025, 2026a.

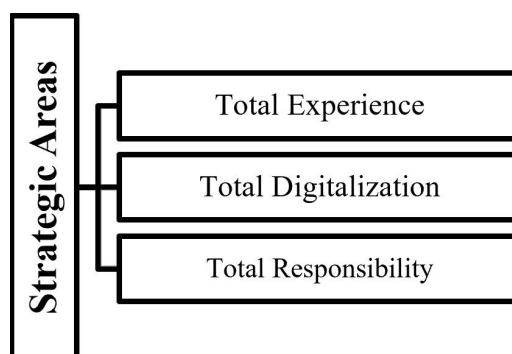
As part of its strategic approach, Bank Millennium has implemented and planned climate change mitigation initiatives that do not entail significant financial expenditure. These initiatives are primarily operational in nature and are embedded within existing processes. Separately, Bank Millennium integrates sustainable financing activities into its core lending operations and therefore does not require substantial additional investment or incremental operating costs. In addition, the Bank has committed a dedicated allocation of PLN 5 billion to support new sustainable financing initiatives over the period 2025–2028 (Bank Millennium 2024).

ESG Strategy and Approach to Sustainable Development at Santander Bank Polska – Main Areas of Environmental, Social, and Corporate Governance Activities

Santander Bank Polska is one of the leading financial groups and the largest privately-owned bank in Poland. It provides comprehensive financial services to individual customers, micro-enterprises, small and medium-sized companies, as well as domestic and international corporations. Santander Bank Polska offers its customers a wide range of financial products tailored to the needs of different customer groups. The bank divides its offer into five segments: Individual Customers, Private Banking, Small Businesses, and Large Businesses and Corporations.

Figure 3

Santander Bank Polska's strategy for 2024–2026



Source: Bank Millennium, 2024, p. 23.

Santander Bank Polska's ESG strategy for 2024–2026 is based on the assumption that people, both customers and employees, are the key factor in development. The bank aims to support them in achieving everyday success by building long-lasting and trust-based relationships. The strategy consists of three pillars. The first pillar of the strategy, *"Total Experience,"* focuses on building a positive image of the bank as the one that is close to people and creates an emotional bond with customers by caring for their needs and comfort in using the services. The second pillar, *"Total Digitalization,"* reflects the growing role of digital channels in customer relations. Santander invests in modern technologies, develops innovative solutions, and streamlines processes to enable customers to access services in a convenient and efficient manner. At the same time, the bank strives to create simple and intuitive tools for its employees, which translates into higher quality of service and organizational efficiency. The last pillar, *"Total Responsibility,"* emphasizes the importance of sustainable development and a responsible approach to business. The bank also declares that ethical conduct, care for the environment, and involvement in local communities are an integral part of its business model. The bank makes informed decisions, taking into account the long-term consequences of its actions for both customers and future generations (Erste Group Bank AG, 2024).

The bank emphasizes that its goal is to create value for all stakeholders including customers, employees, shareholders, local communities, and the natural environment. The Santander Group's ESG goals can be divided into three main areas:

Environmental (E);

Social (S);

Corporate Governance (G) (Erste Group Bank AG, 2024).

Santander Bank Polska pursues a strategy based on a stable sustainable development model, which prioritizes balance between environmental, social, and corporate governance (ESG) aspects. The bank consistently strives to achieve climate neutrality by 2050, develops green financing, and supports customers and businesses in the energy transition process. At the same time, it conducts activities aimed at financial education and building a diverse and friendly work environment, which is confirmed by the Great Place to Work certificate. A key element of the strategy is social and environmental responsibility, confirmed by the ISO 14001 certificate and compliance with international ESG standards and the UN Sustainable Development Goals (SDGs). By integrating its business activities with the principles of responsibility, the Santander community is strengthening its market position while creating long-term value for customers, employees, shareholders, and local communities (Erste Group Bank AG, 2024).

The year 2024 was a turning point in ESG reporting by Santander Bank Polska. For the first time, a consolidated sustainability statement was prepared in accordance with the requirements of

Directive (EU) 2022/2464 (CSRD) of the European Parliament and of the Council and based on the European Sustainability Reporting Standards (ESRS). Unlike the 2023 report, the 2024 publication covers the entire Santander Bank Polska Capital Group, consolidating data from all subsidiaries. It includes a full double materiality analysis, examining both the impact of the Group's activities on the environment and society, as well as the ESG risks and opportunities for the Bank's business model. In addition, ESG reporting has been closely integrated with financial reporting, which means that the sustainability statement is an integral part of the Capital Group's financial statements. Procedures for identifying, assessing, and monitoring ESG-related risks and opportunities have also been implemented in accordance with the guidelines of the *European Financial Reporting Advisory Group* (EFRAG). The change in reporting has increased the transparency, scope, and quality of non-financial data, and has also allowed for deeper integration of ESG issues into the Bank's business model and financial reporting (Santander Bank Polska, 2024).

Table 2

Environmental, social, and corporate governance issues in Santander Bank Polska's ESG reports for 2024 and 2025

Activities	2024	2025
Environmental Activities		
Management of environmental impact in financial activities	Taking environmental factors into account in investment analysis and financial decisions, through analysis of, among other things, customers' environmental management strategies, climate impact, use of natural resources, and pollution prevention	Continued consideration of environmental factors in investment analysis and in risk management and financial decision-making processes relating to assets and clients
Development of sustainable financing and green products	Introduction of investment funds classified as products compliant with Articles 8 and 9 of the SFDR, supporting environmental objectives and sustainable investments, into the product portfolio	Increase in the share of ESG funds' net assets in the total assets of investment funds managed by the Bank from 4.4% to 5.38%
Financing of environmental projects	Implementation of a sustainable finance classification system covering, among other things, green bonds and green loans for environmental projects	An increase in green financing in line with the internal sustainable financing and investment classification system was recorded
ESG data management and reporting system	A sustainability report was prepared in accordance with the European ESRS reporting standards introduced by the CSRD directive	The ESG data collection and processing system was developed, creating a central data repository and procedures for quality control of data reported in the area of sustainable development
Strategic approach to sustainable development	Environmental measures were implemented as part of the ESG strategy and responsible banking covering climate and environmental issues	The implementation of the "responsible banking and sustainable development policy" was continued, defining the bank's approach to environmental and climate issues

Activities	2024	2025
Social Activities		
Equality and anti-discrimination in the workplace	The principles of equal treatment, anti-discrimination and ensuring appropriate employment conditions set out in organizational policies, including the “responsible banking and sustainable development policy” and the “respect and dignity policy,” were implemented	The principles of respect for individuality and equal treatment of employees have been implemented, which is part of many of the bank’s organizational policies, including the diversity and organizational culture policy
Diversity and inclusiveness in the organization	Measures were taken to promote equality and diversity, as well as to monitor indicators relating to the proportion of women in management positions and the level of the pay gap	Initiatives supporting a culture of diversity and inclusiveness were implemented, including employee networks, diversity ambassadors, educational activities, and partnerships with social organizations
Employee competence development and training	Employee development was supported through activities related to improving qualifications and developing professional competencies	Continued activities for the professional development of employees through training and initiatives supporting the improvement of qualifications
Equal pay and remuneration policy	The pay equality index and other indicators of pay equality and female representation in the organization were monitored	Implemented the principles of equal pay for work of equal value and monitored indicators of the pay gap and gender pay differences
Impact on local communities	Corporate social responsibility (CSR) activities were carried out targeting local communities in Poland	CSR activities aimed at having a positive impact on communities and monitoring the potential social impact of funded projects were continued
Corporate Governance		
Role of management and supervisory bodies	The supervisory board exercises ongoing supervision over the bank’s activities and receives regular reports on its operations, risk levels, and the achievement of strategic objectives	The Management Board is responsible, among other things, for managing the bank’s affairs, implementing its strategy, preparing business and financial plans, and implementing and supervising corporate governance principles
Remuneration system for management and supervisory bodies	The rules for remunerating members of the management board and supervisory board are set out in separate remuneration policies adopted by the general meeting, and their implementation is supervised by the supervisory board	The remuneration policy sets out the rules for determining fixed and variable remuneration and is consistent with the bank's strategy and risk management
Linking remuneration to ESG performance	The variable remuneration of management board members and key managers depends on the assessment of their performance and the achievement of financial and non-financial objectives	The remuneration system is linked to the achievement of sustainable development goals, and ESG is one of the factors taken into account when determining bonuses for management
Internal control and risk management system	The bank has a risk management system in place covering, among other things, credit, market, operational, legal, and ESG risks	The development of the risk management system was continued, covering, among others, financial, operational, and sustainable development risks
Prevention of corruption and irregularities in operations	Cases of contract termination due to corruption or bribery violations were monitored – none occurred during the reporting period	The corporate governance system includes policies and procedures for business conduct and the prevention of corruption and abuse

Source: Own study based on: Santander Bank Polska S.A., 2026, pp. 137–313; Santander Bank Polska S.A., 2025, pp. 152–328.

Santander Bank Polska S.A. (2026). Management Board Report on the Activities of the Santander Bank Polska S.A. Capital Group in 2025 (including the report on the activities of Santander Bank Polska S.A.). Santander Bank Polska S.A. pp. 137–313; Santander Bank Polska S.A. (2025). Management Board Report on the Activities of the Santander Bank Polska S.A. Capital Group in 2024 (including the report on the activities of Santander Bank Polska S.A.). Santander Bank Polska S.A. pp. 152–328.

Santander Bank Polska's ESG reports for 2024–2025 show consistent implementation of its sustainable development and business ethics strategy. The bank effectively combines care for its employees, customers, and communities with high standards of corporate governance, risk management, and anti-corruption. The report for 2025 presents a more comprehensive and transparent approach than in 2023 and 2024. Progress is visible in the inclusion of ESG criteria in decision-making processes and daily operations, which indicates the increasing maturity of the sustainable development strategy within the Capital Group.

Discussion

An analysis of banks' annual reports and sustainability statements indicates that one of the important areas of their activity is supporting the transformation of the economy towards a more sustainable development model. A comparative analysis of ESG activities presented in the tables for Bank Millennium and Santander Bank Polska indicates significant continuity of initiatives undertaken in the analyzed period 2024–2025. Both institutions continue to pursue environmental activities aimed at reducing the impact of banking activities on the environment and improving the energy efficiency of infrastructure.

Table 3

Millenium Bank – current initiatives and new initiatives in the ESG report in the analyzed years

Similarities	Differences
Continuation of environmental activities; in the years analyzed, the Bank implemented initiatives aimed at reducing energy consumption and the impact of its activities on the environment, including the optimization of building systems and increasing the energy efficiency of its branches	Expansion of technological activities in 2025 – server virtualization and modernization of the vehicle fleet by increasing the share of hybrid and electric vehicles
Energy efficiency of infrastructure; in the years analyzed, activities related to the modernization of lighting and energy consumption management in the Bank's buildings and branches were carried out	New customer support tools were implemented in 2025, i.e., the bank provided companies with a carbon footprint calculator to analyze greenhouse gas emissions
Actions for low-carbon mobility; in both 2024 and 2025, the bank promoted the reduction of transport-related emissions and the development of more environmentally friendly forms of employee mobility	Development of green financing in 2025 – the scope of activities supporting the financing of pro-environmental investments and climate transformation of customers was increased

Similarities	Differences
The bank's social policy – in the years analyzed, activities aimed at employee development, equality and diversity, and building a safe working environment were continued	Greater employee involvement in environmental initiatives in 2025. Employee volunteer programs and educational activities related to environmental protection were developed
Corporate governance and ESG management; in the years analyzed, the bank applied a management system based on cooperation between the Management Board and the Supervisory Board and developed ESG risk management mechanisms	Development of climate risk management in 2025. As part of the 2028 Strategy, a system for monitoring ESG indicators and activities related to climate transformation was developed

Source: Own study based on tables concerning environmental, social, and corporate governance issues in Bank Millennium, 2024, 2025.

In the case of Bank Millennium, activities in the three areas above focused primarily on optimizing the operation of building systems, modernizing lighting, and managing energy consumption in the bank's branches. A similar continuity can be seen at Santander Bank Polska, where environmental factors were taken into account in investment analysis and financial decision-making processes in both years, and activities related to the financing of low-carbon projects and energy transition were carried out.

Table 4

Santander Bank Polska – current initiatives and new initiatives in the ESG report in the years analyzed

Similarities	Differences
Consideration of environmental factors in financial activities; in the years analyzed, the bank took environmental factors into account in its investment analysis and financial decision-making processes	Development of sustainable financing in 2025. The share of ESG fund assets in the net assets of investment funds managed by Santander TFI increased
Actions in the field of energy transition and financing of environmental projects; in the years analyzed, the bank carried out activities related to the financing of low-carbon projects and energy transition	Increased financing of low-carbon projects in 2025. There was an increase in financing for projects related to renewable energy sources, energy efficiency, and low-carbon transport
The bank's social policy; in the years analyzed, the bank implemented activities related to equal treatment of employees, anti-discrimination, and supporting employee development through training and development initiatives	Expansion of diversity and inclusion activities in 2025. Employee initiatives supporting a culture of diversity and educational and partnership activities in this area were developed
Corporate governance and supervision system in the years analyzed, a management system based on cooperation between the Management Board and the Supervisory Board and supervision of strategy implementation and risk levels was in place	Development of the ESG risk management system in 2025. The development of a risk management system that also covers risks related to sustainable development was continued
Remuneration policy for management bodies; in the years under review, the remuneration of members of the Management Board and Supervisory Board was regulated by remuneration policies adopted by the relevant bodies of the Bank	Stronger link between remuneration and ESG objectives in 2025. The bonus system took into account the achievement of sustainable development objectives when assessing the performance of management

Source: Own study based on tables on environmental, social, and corporate governance issues in Santander Bank, 2025, 2026.

The above comparison of banks' activities in improving environmental, social, and corporate governance issues also shows differences in the directions of ESG activities, mainly in 2025. Santander Bank Polska has seen the development of sustainable financing, which has manifested itself in an increase in the share of ESG fund assets and an increase in financing for projects related to renewable energy sources, energy efficiency, and low-emission transport. At Bank Millennium, on the other hand, the development of environmental activities focused more on technological and operational solutions, such as server virtualization, modernization of the car fleet, and the implementation of tools supporting customers in analyzing their carbon footprint. In the social area, both banks maintained activities related to employee development, promoting equality and diversity, and building a safe working environment. At the same time, in 2025, both institutions expanded the scope of these activities. Santander Bank Polska developed employee initiatives supporting a culture of diversity and inclusiveness, while Bank Millennium increased employee involvement in environmental activities through the development of employee volunteering and educational initiatives. With regard to corporate governance, the analysis indicates the stability of ESG management systems in both banks. Both Santander Bank Polska and Bank Millennium had a management system based on cooperation between the Management Board and the Supervisory Board, and ESG risk management mechanisms were developed. At the same time, further development of these mechanisms can be observed in 2025. Santander Bank Polska strengthened the link between the management remuneration system and the achievement of ESG objectives, while Bank Millennium developed a system for monitoring ESG indicators and climate risk management as part of its strategy.

To sum up, the results of the analysis indicate that both banks implemented ESG activities on a continuous basis during the period under review, developing previously implemented solutions. The differences between the institutions mainly concern the directions of intensification of activities in 2025 – at Santander Bank Polska, greater emphasis was placed on the development of sustainable financing and the integration of ESG objectives with the remuneration system, while at Bank Millennium, activities focused more on technological solutions, customer support tools, and the development of environmental and educational initiatives involving employees.

A limitation of this study is that it relies solely on the analysis of documents, in particular annual reports and sustainability reports published by the banks analyzed. This means that the conclusions are based on information disclosed by the financial institutions themselves. Furthermore, the study covers only two commercial banks operating in Poland and a limited period of analysis (2024–2025), which may limit the possibility of generalizing the results to the entire banking sector.

Conclusions

The analysis of the annual reports and sustainability reports of Bank Millennium and Santander Bank Polska indicates that both banks are actively implementing measures related to the implementation of ESG strategies and are gradually integrating environmental, social, and corporate governance issues into their core business activities. An analysis of documents for the years 2024–2025 shows that activities in these areas are ongoing and form part of the long-term development strategies of both institutions.

In the environmental area, banks are taking measures to reduce the impact of their operations on the environment, increase the energy efficiency of infrastructure, and support the energy transition of the economy through the development of green financing. During the period analyzed, there has been a noticeable increase in initiatives related to the financing of pro-environmental investments and the creation of tools to support companies in reducing emissions and improving energy efficiency.

In the social area, the activities of both banks focus primarily on supporting employee development, promoting diversity and equality in the workplace, and engaging in social and educational initiatives. At the same time, banks are taking measures to raise customer awareness of sustainable development and support enterprises in the process of economic transformation.

In terms of corporate governance, both banks implement policies that increase transparency, accountability, and oversight within the organization. Anti-corruption programs, monitoring compliance with ethical standards, and incorporating ESG criteria into relations with suppliers and business partners are all part of a strategic approach to sustainable development. Corporate governance at both banks is closely linked to environmental and social activities, demonstrating comprehensive ESG integration.

The activities observed in both banks are aligned with global trends in sustainable finance, including responsible investing, climate neutrality, and increasing regulatory expectations across Europe and globally. The findings indicate that Bank Millennium and Santander Bank Polska are consistently advancing their ESG strategies, enhancing transparency, and strengthening the effectiveness of managing environmental, social, and economic impacts. Importantly, the comparative analysis suggests that each bank may benefit from adopting selected practices from one another. For instance, Santander Bank Polska's integration of ESG considerations into executive remuneration represents a more advanced governance mechanism that could be further explored, particularly in assessing its effectiveness in driving ESG performance and accountability.

Based on the research conducted, several recommendations can be formulated for the Polish banking sector. First, banks should continue to expand their range of products and services that support the energy transition of businesses, particularly in the SME sector, which often faces

financial and organizational barriers to implementing solutions aligned with sustainable development goals. Second, it is advisable to further integrate ESG criteria into risk management processes and investment project evaluation systems. Third, banks should strengthen educational initiatives aimed at customers, raising awareness of the benefits of sustainable financing and reducing the negative environmental impact of business activities. The development of tools enabling companies to monitor emissions and assess the effectiveness of pro-environmental measures is also of significant importance. The results of the analysis indicate that the combination of the development of green financial products, customer education, and effective ESG risk management may constitute one of the key factors supporting the transformation of the Polish economy toward a more sustainable development model.

In summary, the findings confirm both research hypotheses, indicating that the analyzed banks systematically develop ESG activities and integrate sustainability principles into their operations, while simultaneously enhancing transparency and supporting the transition towards a more sustainable economy.

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