Justyna **ZABAWA**   •   Ewa **ŁOSIEWICZ-DNIESTRZAŃSKA**

ENVIRONMENTAL RESPONSIBILITY OF BANKS VERSUS THEIR FINANCIAL EFFICIENCY. EVIDENCE FROM THE WARSAW STOCK EXCHANGE

Justyna **Zabawa** (ORCID: 0000-0001-5303-5029) – *Wroclaw University of Economics and Business*
Ewa **Łosiewicz-Dniestrzańska** (ORCID: 0000-0001-7195-4088) – *Wroclaw University of Economics and Business*

Correspondence address:
Komandorska 118/120, 53-345 Wroclaw, Poland
e-mail: justyna.zabawa@ue.wroc.pl

ABSTRACT: The significance of our research is connected with the many regulations in the European Union concerning ESG issues. These documents are very often related to environmental aspects and concern banks as public trust entities. We focus on banks on the Warsaw Stock Exchange (WSE), which constitute the main part of the Polish banking sector. We examine the relationship between financial efficiency and environmental responsibility in the banking sector. We identified three objectives for our research: first: to assess financial efficiency in the banks under study, second: to assess eco-management in banks listed on the WSE, third: to investigate whether there is a relationship between environmental responsibility as an ESG element of banks and their financial efficiency. The above objectives correspond with the research hypothesis adopted: Among the banks analysed, there is a correlation between a bank's financial performance and the Bank Ecologisation Index (BEI-2). This study refers to the period 2019-2021 to show the influence of the Covid-19 pandemic. We adopt various research methods to measure the environmental responsibility of banks and to examine the relationship between ecological engagement and banks' financial ratios. In our research, we use descriptive statistics, linear ordering methods, standardised sum methods, synthetic measures of development, box plots, and analysis of the financial and non-financial reports of the entities analysed. The paper consists of five parts: introduction, literature review and research goals, materials and methods, results and discussion, and conclusions. Our results show that among the banks analysed, there is no statistically significant correlation between financial results and the Bank Ecologisation Index (BEI-2). This may be due to the fact that, as a result of the economic instability caused by the COVID-19 pandemic, banks in Poland have slowed down their growth potential and investments in greening have shifted to the longer-term perspective.

KEYWORDS: bank, financial efficiency, ESG (environmental, social, governance), environmental responsibility

Introduction

Banking activities in modern times are increasingly being carried out in accordance with CSR. In recent years, banks have placed more and more emphasis on the environmental aspect, which means increasing investment in environmental protection while informing their surroundings about these activities. Such activities are also undertaken by banks so as to increase their competitiveness and the efficiency of their operations, which is of particular interest to their owners. While the problem of CSR in business in general is a very widely discussed aspect in contemporary research and literature (Zabawa & Kozyra, 2020; Ganzo, 2014), there is a noticeable paucity of studies providing clear results of analyses on the relationship between the financial performance of banks and their environmental responsibility.

Banks' pro-environmental initiatives are known to be costly (Klimontowicz et al., 2021) and not immediately beneficial (Chang et al., 2021; Ibrahim et al., 2021). More is known about the positive impact on banks' bottom lines of pro-environmental measures in the area of reduction of CO_2 emissions (Bătae et al., 2021), but less research is available confirming the cost-effectiveness of financing green investments by gifting credits to clients.

This research aims to provide robust evidence on the existence of a link between the financial performance of the banks studied versus their greening index (Bank Ecologisation Index, BEI), which was developed for the purpose of this study.

The study advances previous analyses on the phenomenon of pro-environmental initiatives in banks and contributes to the current literature on ESG in the banking sector. It follows on from previous research (Zabawa & Kozyra, 2020) on the relationship between financial performance and banks' involvement in pro-environmental initiatives, taking into consideration global factors such as the COVID-19 pandemic and the ongoing war in a neighbouring country.

The research is significant in the context of current and future planned regulations concerning ESG issues. Many of the regulations are dedicated to different industries in the European Union, including banks as public trust entities. From the point of view of our research into the banking sector, the following EU regulations concerning ESG issues are important: 2014/95/EU Directive of Non-Financial and Diversity Information by Certain Large Undertakings and Groups (NFDR), the Corporate Sustainability Reporting Directive (CSRD), EU Taxonomy, European Commission guidelines on the disclosure of climate-related information, the Sustainable Finance Disclosure Regulation (SFDR), and Sustainable Development Goals (SDG).

In our research, we focused on banks as the main part of the financial sector in many countries of the EU. We analysed banks on the Warsaw Stock Exchange (WSE), which is the main part of the Polish banking and financial sector. The total assets of all commercial banks in Poland in 2021 constituted 90.8% of the total assets held by the Polish banking sector (NBP, 2021). The share of the banks analysed in our study in the assets of the whole banking sector in Poland was 64%. Measurement and evaluation of the banks' involvement in environmental activities was carried out on the basis of reports at the end of 2021.

This research refers to the period 2019-2021 so that we are also able to show the influence of the Covid-19 pandemic.

A variety of sources were used in the research, e.g., scientific articles and statistical data, financial and ESG bank reports, and reporting principles (e.g., Global Reporting Initiative—GRI Standards). We applied the following methods: descriptive statistics, linear ordering methods, standardised sum method, synthetic measure of development, Spearman's correlation coefficients, box plots, and Ward analysis. These were supported by analyses of financial and non-financial bank reports and ratio analyses of banks. In accordance with the above conditions, analysis of the literature and current regulations, the three main goals of the research are:
- evaluation of financial effectiveness in the analysed banks,
- evaluation of eco-management in banks listed on the Warsaw Stock Exchange (WSE),
- examining the relationship, if it exists, between environmental responsibility as a part of banks' ESG and their financial effectiveness.

The above objectives correspond with the following research hypothesis relating to the group of analysed banks in the period 2019-2021: among the analysed banks, there is a correlation between a bank's financial results and the Bank Ecologisation Index (BEI-2).

Our results show that among the analysed group of banks in the time period of the study, there is no correlation between a bank's financial results and the Bank Ecologisation Index (BEI-2). This was confirmed by Spearman's correlations and graphs.

Our paper consists of five parts: introduction, literature review and research goals, materials and methods, findings and results, discussion and conclusions.

Literature review and research goals

Literature review

In domestic and foreign literature, we can observe a growing number of publications addressing the problem of ecological responsibility/environmental responsibility in banking activities. While the problem is widely described with regard to CSR issues, it is still rarely addressed in the area of ESG issues, and it has not yet been developed in the relatively new Green Deal approach. Table 1 summarises the results of queries for scientific papers related to green finance and ESG in connection with banks, as returned by the Web of Science database between 2019 and 23.08.2022.

Table 1. Scientific papers concerning environmental responsibility in the context of bank operations (Web of Science)

Topic	Number of papers			
	2019	2020	2021	2022 *(until 08.23)*
CSR	102	131	142	82
Green finance	4	5	19	10
ESG	9	15	18	10
Green Deal *(Green Deal – generally)*	0 *(8)*	0 *(24)*	1 *(35)*	0 *(30)*
ESG, efficiency	0	3	5	2

Source: authors' work based on the Web of Science database [23-08-2022].

A growing number of publications addressing the issue of environmental responsibility in banking activities can be observed in both domestic and foreign literature. While the topic is widely described with regard to CSR issues, it is still rarely addressed in the area of ESG issues and has not yet been developed in the relatively new Green Deal approach. However, it is still possible to identify a relatively small number of publications addressing the links between the financial efficiency of institutions and the implementation of ESG measures, in which the environmental dimension is one of many analysed in the banking sector (Soana, 2011; Paulík et al., 2015; Huang et al., 2017; Daszyńska-Żygadło et al., 2021; Klimontowicz et al., 2021; Bose et al., 2021).

Many recent publications (Lagasio et al., 2021; Wang et al., 2022; Murè et al., 2021; Chiaramonte et al., 2022) refer to the issue of green banking in a general way without a clear contextual link to financial efficiency. Zhou et al. (2021) report that most existing studies ignore the relationship between CSR and bank financial performance, while they emphasise the positive impact of CSR on bank financial performance, but only in the long term. The results presented by Bolibok (2021) suggest that banks that are more environmentally responsible show a positive sensitivity to their financial performance to a greater extent than banks that attach less importance to the environment. Ibrahim et al. (2021), in their research, conclude that banks' CSR initiatives should be considered investments, as returns only appear in the long term.

There is also a dynamic shift in the term CSR towards the more precise term ESG (Environmental, Social and Corporate Governance). Taking ESG into account in economic decisions is not just a trend but a new reality that is a considerable challenge and perhaps controversial in many ways (Gutiérrez-Torrenova, 2021). In practice, this means taking into account environmental, social and governance factors in addition to financial factors in the economic decision-making process. Based on these

factors, non-financial ratings and assessments of banks are created, which can be used in regulations adjusting bank capital requirements to promote green financing and mitigate climate-related risks in the area of bank investments (Neisen & Bruhn, 2021).

Some authors (Chang et al., 2021) take a positive view of banks engaging in green lending, which moderates the relationship of ESG factors to banks' financial performance. In relation to the environmental factor, banks in developed Asian economies are becoming more cost-effective through environmentally friendly activities, but it is still unclear whether the costs of ESG have exceeded the benefits. The benefit of banks' pro-environmental actions is also reported in other studies (Bătae et al., 2021). The authors describe a positive relationship between emission reductions and the financial performance of the banks studied but do not obtain confirmation of a positive impact on this performance either through social responsibility policies or an increase in the quality of the corporate governance system. In a study conducted on a group of Polish banks (Klimontowicz et al., 2021). The authors conclude that banks' pro-environmental behaviour has no statistically significant correlation with other performance indicators. Most climate change is caused not only by human actions but also by general business patterns that often negatively affect the environment.

The year 2021 was a time when many companies declared intensive efforts in support of the *UN Sustainable Development Goals* or the goals of the *Paris Agreement* and the pursuit of climate neutrality for the EU by 2050. The European Green Deal policy is the EU's response to these issues. Rapidly advancing climate change and environmental degradation are now key challenges of the modern world and thus constitute a threat to Europe. The European Green Deal policy is the EU's response to these problems and sets the ambitious goal of achieving a climate-neutral Europe by 2050. This raises practical challenges for companies in terms of the support they expect in the form of subsidies, as well as for the banks which should offer companies appropriate financial instruments in addition to subsidies (Purkayastha & Sarkar, 2021). The European Climate Law is supposed to ensure predictability and stability during the transition. An important element of this law is to provide financial markets with reliable data in order to properly manage risks and financial products (such as green bonds). Toth and other authors (Tóth et al., 2021) argue that it is important for banks to disclose sustainability information, both through economic and ESG performance, as they influence most industries through their investments and loans. Research findings (Gunawan et al., 2022) highlight the inadequacy of sustainability and green banking disclosures. Economic disclosures are the most prevalent, while environmental disclosures are still limited.

The energy crisis caused by Russia's invasion of Ukraine must not derail efforts to combat climate change. It should mobilise countries to continue their efforts with greater determination. Moving away from Russian energy resources offers the opportunity for many benefits, i.e. energy independence, a stronger basis for long-term economic growth, and climate impact mitigation.

The concern in the Polish banking sector is the much greater dependence of Polish bank customers on non-renewable resources (e.g. coal) than in Western Europe, and thus, the lower absorption potential of the domestic market for EU climate instruments and funds. Banks are concerned that many Polish customers will not be able to meet the high criteria for access to such new programs and solutions. The above is evidence of the persistence of a research gap with regard to measuring the environmental responsibility of banks by attempting to quantify their internal economy (in the context of pro-environmental solutions) and pro-environmental offerings to individual customers and businesses.

Regulations concerning ESG

Issues concerning ESG in the financial sector are not only analysed and described in research papers by many authors. In the EU, there are many regulations concerning ESG, with special attention paid to environmental issues (Figure 1).

Selected EU regulations which should be applied by banks concerning ESG issues, with particular emphasis on environmental responsibility, include 2014/95/EU Directive of Non-Financial and Diversity Information by Certain Large Undertakings and Groups (NFDR), the Corporate Sustainability Reporting Directive (CSRD), EU Taxonomy, European Commission guidelines on the disclosure of climate-related information, the Sustainable Finance Disclosure Regulation (SFDR), and Sustainable Development Goals (SDG).
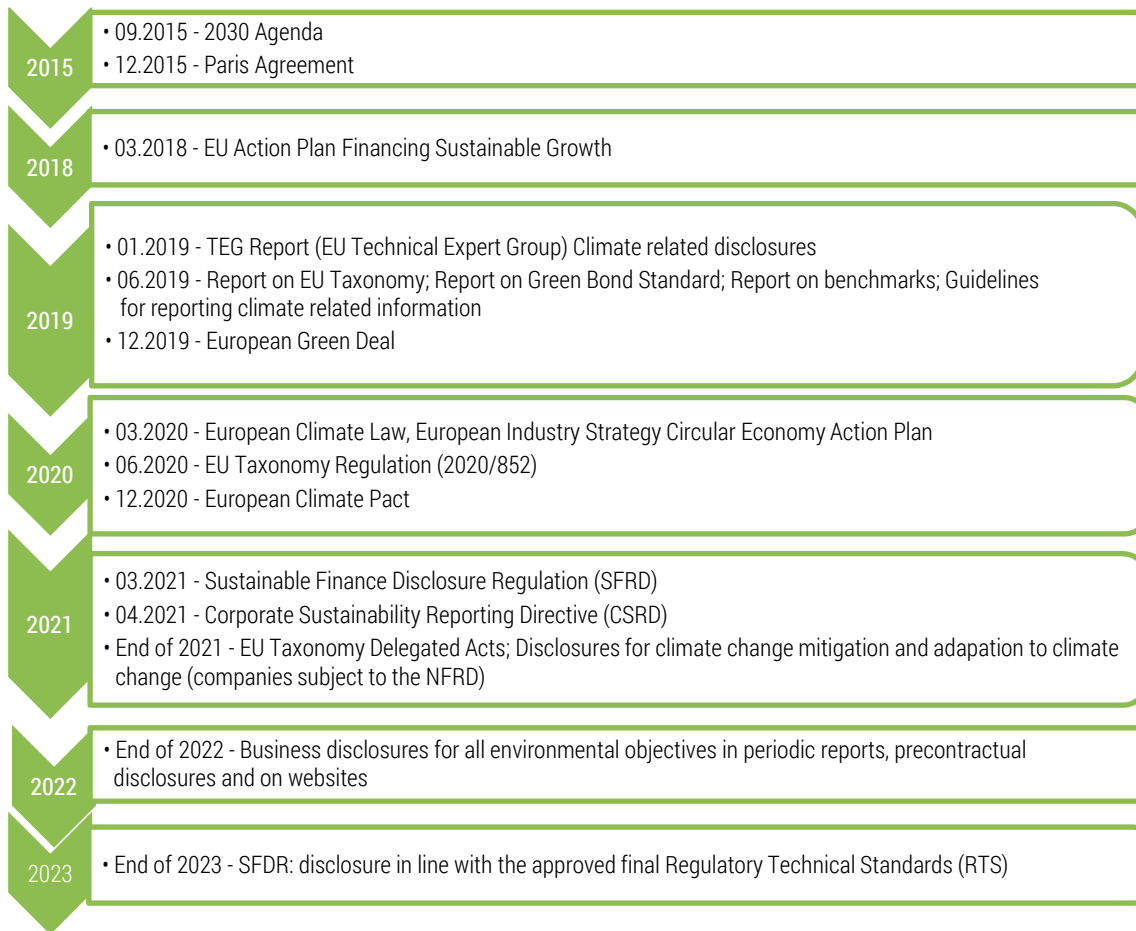
2015	• 09.2015 - 2030 Agenda • 12.2015 - Paris Agreement
2018	• 03.2018 - EU Action Plan Financing Sustainable Growth
2019	• 01.2019 - TEG Report (EU Technical Expert Group) Climate related disclosures • 06.2019 - Report on EU Taxonomy; Report on Green Bond Standard; Report on benchmarks; Guidelines for reporting climate related information • 12.2019 - European Green Deal
2020	• 03.2020 - European Climate Law, European Industry Strategy Circular Economy Action Plan • 06.2020 - EU Taxonomy Regulation (2020/852) • 12.2020 - European Climate Pact
2021	• 03.2021 - Sustainable Finance Disclosure Regulation (SFRD) • 04.2021 - Corporate Sustainability Reporting Directive (CSRD) • End of 2021 - EU Taxonomy Delegated Acts; Disclosures for climate change mitigation and adapation to climate change (companies subject to the NFRD)
2022	• End of 2022 - Business disclosures for all environmental objectives in periodic reports, precontractual disclosures and on websites
2023	• End of 2023 - SFDR: disclosure in line with the approved final Regulatory Technical Standards (RTS)

Figure 1. Chronological overview of ESG regulations

Source: authors' work based on BNP Paribas (2021).

The NFDR Directive came into force for Polish institutions on the 1st of January 2017. It refers to public trust institutions, including banks (Zabawa & Kozyra, 2020). The institutions must disclose in their reports or separate documents important information concerning environmental data, social and human resources (HR) data, respect for human rights and action counteracting corruption and bribery (Zabawa, 2018; Directive, 2014).

The Corporate Sustainability Reporting Directive (CSRD) is a new EU legislation requiring all large companies to publish regular reports on their environmental and social impact activities. The CSRD will apply to all large EU companies, including banks, that exceed at least two of the following criteria: – more than 250 employees; – a turnover of more than 40 million euros; – total assets of 20 million euros. The CSRD will significantly expand the scope and content of the EU's existing non-financial reporting regime under the Non-Financial Reporting Directive (NFRD). Under Article 8 of the EU Taxonomy Regulation, entities within the scope of the NFRD are also required to report on their Taxonomy alignment. The amendments made by the CSRD therefore mean that a broader range of entities will also be required to make disclosures of their Taxonomy alignment. Another key difference between the NFRD and CSRD is that the new rules will introduce a mandatory audit and assurance regime to ensure the reliability of data and avoid greenwashing and/or double accounting (Stehl et al., 2022).

Currently, institutions can choose the standards that suit them for preparing non-financial reports. In the literature, there are many papers concerning the role of non-financial reports, including integrated reports, in the banking sector (Ryszawska & Zabawa, 2018; Kundid Novokmet & Rogošić, 2016; International Integrated Reporting Council, 2013; Murawski, 2017; Schiopoiu Burlea, 2019). The most popular guideline standards for environmental and social reporting were prepared by the Global Reporting Initiative (GRI). GRI guidelines cover rules for communicating the influence

of business activities on CSR and ESG issues (Zabawa, 2018; GRI, 2023). There are many detailed indicators and disclosures concerning specific parts of reports.

The Standards (GRI, 2023) are designed as a modular set, delivering an inclusive picture of an organisation's material topics, their related impacts, and how they are managed. The GRI Standards cover:

- Universal Standards – currently revised to incorporate reporting on human rights and environmental due diligence, connected with intergovernmental expectations – and apply to all organisations,
- New Sector Standards enable more consistent reporting on sector-specific impacts,
- Topic Standards – adapted to be used with the revised Universal Standards, they list disclosures relevant to a particular topic: Economic – (GRI 200), Environmental (GRI 300) and Social (GRI 400).

The GRI Topic Standards contain disclosures for providing information on topics. Examples include standards on waste, occupational health and safety, and tax. Each standard incorporates an overview of the topic and disclosures specific to the topic, as well as how an organisation manages its associated impacts. GRI topic standards refer to environmental responsibility: GRI 301 – Materials, GRI 302 – Energy, GRI 303 – Water and Effluents, GRI 304 – Biodiversity, GRI 305 – Emissions, GRI 306 – Waste (2020), and GRI – 308 Supplier Environmental Assessment. The standard 300 series is used by banks to show eco-management inside the organisation and its influence on the environment.

Research goals and research hypothesis

Due to the difficult crisis conditions in which banks had to operate in Poland, analysis of the literature and current regulations, we defined the three goals of the study as follows:
1) evaluation of financial effectiveness in the analysed banks,
2) evaluation of eco-management in banks listed on the Warsaw Stock Exchange (WSE),
3) examining the relationship, if it exists, between environmental responsibility as a part of banks' ESG and their financial effectiveness.

The above objectives correspond with the following research hypothesis relating to the group of analysed banks in the period 2019-2021: Among the analysed banks, there is a correlation between a bank's financial results and the Bank Ecologisation Index (BEI-2).

Materials and methods

In this study, to measure eco-management in banks and examine the relationship between financial efficiency and environmental responsibility in the banking sector in 2019-2021, we used a modification of the procedure from our article from 2020 (Zabawa & Kozyra, 2020). In this way, we defined BEI-2 (Bank Ecologisation Index, version 2), in which we were forced to exclude Level I data: Expenses related to the promotion of pro-environmental activities. In this way this was caused by the lack of access to the data, which is currently data that is not publicly available.

Our research consists of the four following phases:
1) Procedure for the determination of BEI-2.
2) Measuring BEI-2 in the analysed banks.
3) Evaluation of the financial situation in the banks.
4) Examining the relations between BEI-2 and financial ratios.

Phase 1. This phase involves preparing a procedure for the determination of BEI-2. The synthetic BEI-2 indicator will be used to check which banks are involved in ecologisation processes. The preparation phase will proceed according to a linear ordering method (multidimensional comparative analysis). In the last step of creating the procedure, three groups of bank ecologisation levels will be established.

The procedure consists of four stages:

1. A set of criteria will be established to properly determine the involvement of banks in pro-environmental activities at each of two identified levels:
- Level I — Internal management,
- Level II — Products connected with protecting environment.

Table 2. Criteria characterising the pro-environmental engagement of a banking institution

Level	Criteria
Level I	1.1. Water consumption (GRI 303). 1.2. Paper consumption (GRI 301). 1.3. Electricity consumption (GRI 302). 1.4. Fuel consumption (GRI 301).
Level II	2.1. Number of pro-ecological credits and loans for individual clients in the bank's offer of products. 2.2. Number of pro-ecological credits and loans for enterprises* in the bank's offer of products.

*SME – small and medium enterprises; big companies.
Source: authors' work based on Zabawa and Kozyra (2020), GRI (2023), Dziawgo (2010).

In the modified version of our procedure, we focused on two levels. Level I, which is related to eco-management inside an organisation, was modified according to the current non-financial reports. In this group of criteria, we include factors that were reported by the banks. The criteria from level I related to matching indices in accordance with the GRI Standards. For each criterion in the set, we checked the values at the end of 2021, along with the unit of measurement used (e.g., tons, Kw/h, etc.).

2. The second stage of our procedure will involve measurement of each criterion for each of the anlysed institutions. The procedure will consist of analyses of their respective non-financial disclosures in the analysis period.
3. Determining the value of a synthetic Bank Ecologisation Index (BEI-2) will be carried out based on the standardised sum method as one of the available linear ordering methods in multidimensional comparative analyses. Multidimensional comparative analysis (MCA) is a discipline of science associated with the study of comparability between items (companies, countries, regions) described by multiple properties (Dziechciarz, 2012). The resulting value will be used to measure and evaluate the level of pro-environmental involvement of the banks under study. A stimulant is defined as a larger-the-better variable and a destimulant as a smaller-the-better variable. The method involves a two-step approach based on (Dziechciarz, 2000).
3.1. For each item (i.e. bank), the sum of the variable values is calculated using the following equation (1):

$$p_i = \sum_{j=1}^{n}(z_{ij} \cdot w_j),$$

(1)

where:
z_{ij} – value of the i-th item's j-th normalised variable,
n – number of studied criteria,
w_j – weight of the j-th variable, with assigned weights satisfying the following requirements:

1) $w_j \geq 0$
2) $\sum_{j=1}^{m} w_j = 1$

3.2. For each studied item, the measurement of development will be calculated as a value of the BEI index using the following equation (2):

$$BEI\_2_i = \frac{p_i - p\_0}{p_0 - p\_0},$$

(2)

where (3,4):

$$p_0 = \sum_{j=1}^{n} z_{0j} \cdot w_j, \tag{3}$$

$$p_{\_0} = \sum_{j=1}^{n} z_{\_0j} \cdot w_j. \tag{4}$$

For the method used in the research, it is necessary to appoint two abstract items:
- P_0 – a pattern which is characterised by the best values of the analysed features,
- $p_{\_0}$ – an anti-pattern, which is characterized by the weakest values of the analysed features,
- z_{0j} and $z_{\_0j}$ represent the criteria values for each of the two abstract items, that is, pattern and anti-pattern, respectively.

The values of the BEI-2 index are contained in the range 0-1. The measurement of development will equal 1 for a pattern and 0 for an anti-pattern. The higher the value obtained in this manner, the higher the rank of the studied multi-dimensional item: in this case, the level of pro-environmental involvement of a banking institution. Based on the calculated values, a broad sample of banks may be categorised in order from the worst to the best in terms of their pro-environmental involvement.

4. The next stage of the procedure involves formulating a model consisting of three classes of a bank's environmental maturity. At the last stage of procedure development, according to the procedure assumptions, we determined the following three classes of bank ecologisation:
- first-class (best class) – this class covers banks with the highest BEI values: [2/3* (BEImax-BEImin); BEImax],
- second class – this class includes banks with a medium BEI value: [1/3* (BEImax-BEImin); 2/3*(BEImax-BEImin)],
- third class – this class covers banks with the lowest BEI values, for which the value of the researched index is in the range: [BEImin; 1/3* (BEImax-BEImin)].

Phase 2. This phase involves evaluation of the degree of all commercial banks' involvement in the realisation of tasks resulting from their ecological orientation. Based on data collected from analytical evaluations of non-financial disclosures, a Bank Ecologisation Index (BEI-2) will be calculated for each of the entities under examination, including the WIG-ESG Index. The WIG-ESG index has been calculated since September 3, 2019 based on the value of the portfolio of companies listed on the WSE, including banks recognised as socially responsible entities, i.e. those that comply with the principles of socially responsible business, in particular in the field of environmental, social, economic and corporate governance issues (GPW Benchmark, 2023). To show our results, in phase 2, we used box plots and Ward's method.

Phase 3. This phase involves analysis of the financial efficiency of environmentally responsible banks by applying financial analysis indicators typically adopted in analysis of the financial efficiency of contemporary banks (Kochaniak, 2010; Zabawa & Kozyra, 2020):
- ROA (Return on Assets),
- ROE (Return on Equity),
- C/I (Cost to Income),
- IMR (Interest Margin Ratio),
- TCR (Total Capital Ratio).

The ratios ROA, ROE and IMR are larger-the-better variables, while C/I is a smaller-the-better variable. In the context of bank solvency, TCR is a larger-the-better variable. Analyses of financial performance indicators will be performed on the basis of descriptive statistical measures.

This phase will also include determination of an aggregate indicator representing the financial situation of a commercial banking institution, and estimation of the threshold ratio above which the BEI index grows significantly. The pattern development method will be used for the calculation of the aggregate indicator (Dziechciarz, 2000).

In our research procedure, the determination of an aggregate index for financial situation is based on the use of the variables ROA, ROE, C/I, IMR and TCR. It is assumed that all the variables are normalized and take the form of larger-the-better variables. The pattern method used in the research

requires the use of two abstract items (similarly as in the standardized sum method): a pattern (z_{0j}), which is characterised by the best values of the analysed features, and an anti-pattern z_{-0j}, which is characterised by the weakest values of the analysed features.

The next step involves examination of the similarities between items (banks), with the aim of establishing a point of reference for the evaluation of banks. The distance from this point (e.g. Euclidean) can be used as a measurement of each bank's departure from the model pattern of development. The distance from the pattern is calculated using the following equation (5):

$$d_{io} = \sqrt{\sum_{j=1}^{m}(z_{ij} - z_{0j})^2}, \tag{5}$$

where:
z_{ij} – value of the i-th item of the j-th normalised variable,
d_{io} – Euclidean distance between the i-th item and the model pattern of development.

The last step in of the pattern development method involves determination of a development measurement for each of the studied items based on the following equation (6):

$$DM_i = 1 - \frac{d_{io}}{d_0}, \tag{6}$$

where:
DM_i – development measurement of the i-th bank,
d_0 – distance between the pattern and the anti-pattern (7):

$$d_o = \sqrt{\sum_{j=1}^{m}(z_{0j} - z_{-0j})^2}. \tag{7}$$

The DM values are in the range of 0-1. The higher the DM value, the more pronounced the level of the studied complex phenomenon, or in this case, the higher the financial effectiveness of the banking institutions under examination.

Phase 4. The phase covers investigating the correlations between the degree of involvement of the banks in the process of increasing environmental responsibility and their financial results. This relation will be analysed using selected statistical tools such as Spearman's correlation coefficient and scatter plots.

Findings and results

Subjective scope of the analysis

We verified our research empirically among a group of banks listed on the WSE. The plan was described in detail in section three above. The institutions from the WSE in Poland are the main part of the Polish banking and financial sector. We analysed all banks on the WSE, excluding Getin Noble Bank S.A. This bank was excluded from our research because of its financial troubles in the years analysed. In 2022, following the opening of restructuring procedures, the bank was taken over by the Bank Guarantee Fund according to the Act on the Bank Guarantee Fund, Deposit Guarantee Scheme and Resolution of the 10th June 2016.

At the end of 2021, the assets of institutions comprising the Polish financial system amounted to PLN 3.5 trillion or 9.6% higher than a year earlier (NBP, 2021). The growth in assets was primarily driven by the rising value of the banking sector and open pension fund assets. In 2021, banking sector assets grew to a smaller extent than a year earlier, and their share in financial sector assets was at a similar level as in 2020, at 73%. In the same period, assets held by all commercial banks were PLN 2,320.2 billion, constituting 90.8% of the total assets of the Polish banking sector (NBP, 2021). The share of our analysed banks in the assets of the whole banking sector in Poland was 64%.

Measuring the pro-environmental involvement of banks from the WSE

Measurement and evaluation of the pro-environmental involvement of the group of banks studied was carried out according to phase 1. This phase was presented in detail in section three of this paper.

Information pertaining to the values of each detailed criterion was collected on the basis of a very detailed analysis of non-financial reports prepared at the end of 2021, as well as financial products offered by the banks studied. The criteria from Level I (internal management) were used for the non-financial reports of banks. The wealth of this data was then normalised through unitarisation of each variable with proper recognition of their character (larger-the-better variables were transformed to smaller-the-better variables). The criteria included in Level I are smaller-the-better variables (destimulants), while those in Level II take the form of smaller-the-better variables (stimulants). The values of the Level I criteria were related to employment figures in the banks listed on the WSE (as of the end of 2021). The evaluation of the pro-environmental involvement of the banks from the WSE is presented in Table 3, including the synthetic index BEI-2 and information concerning participation in the ESG-Index.

Table 3. Bank Ecologisation Indexes for the analysed banks

	Bank	ESG-Index	Level I	Level II	BEI-2
1	Alior Bank S.A.	1	0.858	0.500	0.679
2	Bank Handlowy w Warszawie S.A.	1	0.755	0.000	0.378
3	Bank Millenium S.A.	1	0.214	0.000	0.107
4	Bank Ochrony Środowiska S.A.	0	0.742	1.000	0.871
5	Bank Polska Kasa Opieki S.A.	1	0.441	0.250	0.345
6	BNP Paribas Bank Polska S.A.	1	0.450	0.500	0.475
7	ING Bank Śląski S.A.	1	0.559	0.375	0.467
8	mBank S.A.	1	0.468	0.250	0.359
9	Powszechna Kasa Oszczędności Bank Polski S.A.	1	0.351	0.125	0.238
10	Santander Bank Polska S.A.	1	0.534	0.500	0.517

According to the research plan, this stage also involved the determination of candidates for the three classes of bank environmental maturity:
- I class (0.617–0.871) – 2 banks: Alior Bank S.A. and Bank Ochrony Środowiska S.A.
- II class (0.362–0.617) – 4 banks: Bank Handlowy w Warszawie S.A; BNP Paribas Bank Polska S.A.; ING Bank Śląski S.A. and Santander Bank Polska S.A.
- III class (0.107–0.362) – 4 banks: Bank Millenium S.A.; Bank Polska Kasa Opieki S.A.; mBank S.A. and Powszechna Kasa Oszczędności Bank Polski S.A.

Banks with a I class classification may be perceived as benchmarks for other financial institutions in the context of environmental responsibility in the banking sector. Figure 2 presents a box-plot visualisation of the BEI-2 index findings and its component: eco-management. According to the data in Table 3 and Figure 2, Bank Ochrony Środowiska S.A. (BOŚ) received the highest BEI-2 value: 0.871.

In the box plot in Figure 2, we focused in particular on BEI-2 and one component of the index, that is eco-management. The synthetic index BEI-2, as an averaged measure of the two levels, shows a symmetric distribution, not including one outlier: Bank Ochrony Środowiska S.A. (BOŚ)[1]. We additionally used cluster analysis in our research, as shown in Figure 3.

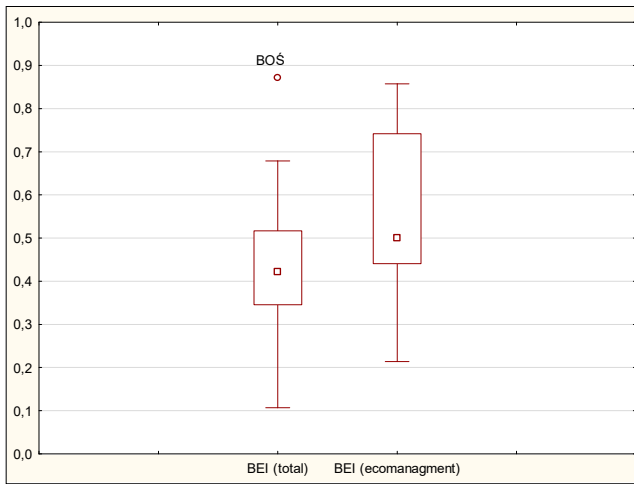1   Bank Ochrony Środowiska in English: *Environmental Protection Bank.*

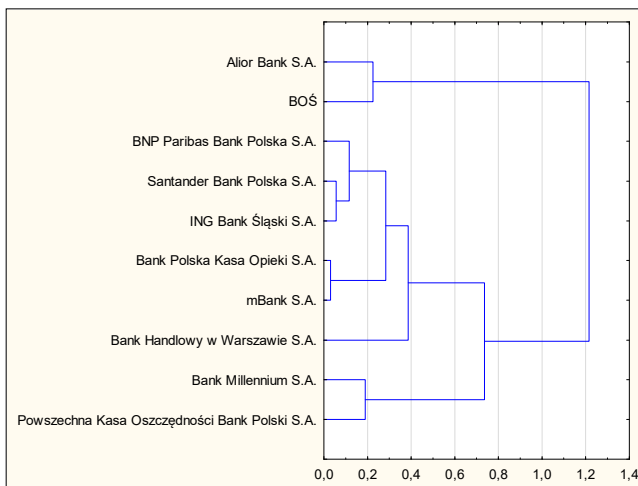**Figure 2.** Box plot for BEI-2 (BEI total)
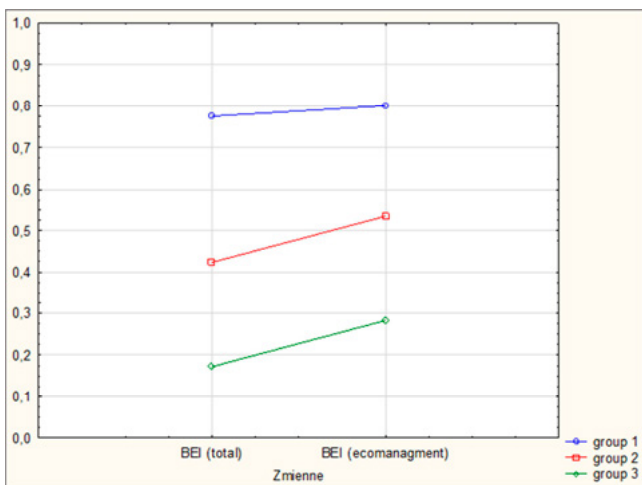

Figure 3. Ward's analysis

Figure 4. Cluster analysis / (k-means method)

The classification of banks was conducted using cluster analysis, where Ward's method at the Euclidean distance was chosen as the agglomeration method. Two variables were included here: BEI-2 and eco-management (level I). An identical classification was obtained using the k-average method (Figure 4). Using this analysis, Tyree groups of banks were obtained:

- Group 1: Alior Bank S.A. and Bank Ochrony Środowiska S.A.
- Group 2: Bank Handlowy w Warszawie S.A.; BNP Paribas Bank Polska S.A.; ING Bank Śląski S.A. Santander Bank Polska S.A., mBank SA, Bank Polska Kasa Opieki SA.
- Group 3: Bank Millenium SA and Powszechna Kasa Oszczędności Bank Polski S.A.

Group 1 contains the most ecologically oriented banks in terms of two variables: synthetic index BEI-2 and BEI (eco-management).

Financial effectiveness of banks listed on the WSE

According to the procedure from our previous publication (Zabawa & Kozyra, 2020), we used the following ratios in the evaluation of financial standing for the group of banks studied: ROA, ROE, IMR, C/I and TCR. The above-mentioned ratios are very useful in the evaluation of banking sector, and are typically adopted in the analysis of the financial efficiency of contemporary banks. The descriptive statistics of the financial ratios in the analysed banks are presented in Table 4.

Table 4. Descriptive statistics of financial ratios in the analysed banks [in %]

	2021					
	Arithmetic-mean	Median	Minimum value	Maximum value	Standard deviation	Coefficient of variation
ROA	0.384	0.475	-1.313	1.182	0.829	216.070
ROE	3.556	5.600	-20.468	17.466	11.107	312.347
IMR	2.233	2.242	1.279	3.344	0.534	23.899
C/I	42.896	43.727	32.753	51.757	5.609	13.075
TCR	17.914	18.285	14.600	20.990	2.226	12.427
	2020					
	Arithmetic-mean	Median	Minimum value	Maximum value	Standard deviation	Coefficient of variation
ROA	-0.021	0.157	-1.529	0.739	0.717	-3388.915
ROE	-0.493	1.334	-16.243	7.281	7.197	-1460.357
IMR	2.375	2.311	1.651	3.637	0.554	23.344
C/I	45.599	45.591	34.033	52.970	6.121	13.423
TCR	20.073	20.290	14.980	23.900	2.813	14.014
	2019					
	Arithmetic-mean	Median	Minimum value	Maximum value	Standard deviation	Coefficient of variation
ROA	0.817	0.790	0.378	1.210	0.326	39.933
ROE	7.166	6.642	3.275	10.974	2.548	35.557
IMR	2.711	2.656	2.169	4.199	0.594	21.917
C/I	44.270	44.943	33.478	54.087	6.434	14.534
TCR	18.773	18.500	15.650	22.840	2.408	12.828

Source: authors' work using banks' financial statements.

The analysis relates to the period 2019-2021 and is based on financial statements for the group of analysed banks. We calculated the arithmetic mean, median, minimum value, maximum value, standard deviation and coefficient of variation. Analysis of the financial data in this time period was

related to presentation of the impact of the Covid-19 pandemic. We wanted to include the most recent financial data from financial statements in our research. During our analysis (January and February 2023), the banks published financial statements for the period up to 2021.

Determination of an aggregate indicator (Development measurement) relating to the financial situation of the studied banks proceeded in accordance with the procedure described in section three (materials and methods). The aggregate indicator of financial effectiveness was calculated on the basis of ROA, ROE, C/I, IMR and TCR. The resulting values of the indices for the years 2019-2021 are presented in Table 5.

Table 5. Development measurements in the analysed banks for 2019-2021

		DM 2019	DM 2020	DM 2021
1	Alior Bank S.A.	0.2759	0.4212	0.4563
2	BNP Paribas Bank Polska S.A.	0.1713	0.5902	0.5254
3	Bank Handlowy w Warszawie S.A.	0.2636	0.3492	0.4625
4	Bank Millennium S.A.	0.2994	0.4117	0.2222
5	Bank Ochrony Środowiska S.A.	0.0993	0.0414	0.2519
6	Bank Polska Kasa Opieki S.A.	0.4692	0.4893	0.5379
7	Santander Bank Polska S.A.	0.5765	0.6209	0.6454
8	ING Bank Śląski S.A.	0.5050	0.5913	0.5261
9	mBank S.A.	0.4253	0.5961	0.4477
10	Powszechna Kasa Oszczędności Bank Polski S.A.	0.6633	0.4575	0.6982

Analysis of correlations between the financial effectiveness and environmental involvement of the analysed banks

The next stage of the adopted study procedure was to carry out a correlation test between the aggregate synthetic greening indicator BEI-2 and the eco-management and aggregate indicator (DM – development measurement), which describes the financial situation of the banks under study in 2019, 2020 and 2021. Correlation testing was carried out using the Spearman's rank correlation matrix, which is a method that is relatively resistant to the occurrence of outlier observations. However, based on the results (presented in Table 6), the hypothesis that among the banks analysedthere is a correlation between bank's financial results and the Bank Ecologisation Index (BEI-2) is not positively verified. Our results show that among the banks analysed, there is no statistically significant correlation between financial results and the Bank Ecologisation Index (BEI-2). The values of the Spearman correlation coefficient achieved slightly negative values in each of the analysed periods, therefore not providing grounds for acceptance of the existence of a dependence of the analysed ecological variables on the financial variables.

Table 6. Spearman's rank correlation coefficient in the tested banks

Variable	Spearman's rank correlation coefficient	
	BEI-2 (total)	BEI (eco-management)
DM 2019	-0.454545	-0.406061
DM 2020	-0.030303	-0.200000
DM 2021	-0.103030	-0.175758

On the basis of the scatter plots (Figure 5) for the surveyed banks for the period 2019-2021, no correlation (either negative or positive) can be established between the studied data. The examined time frame is very heterogeneous. The first year, 2019, was an economically stable year without negative influences from the economy-in contrast to the next two years, in which the COVID-19 pandemic, followed by high inflation, caused significant turbulence in the banks' activities.
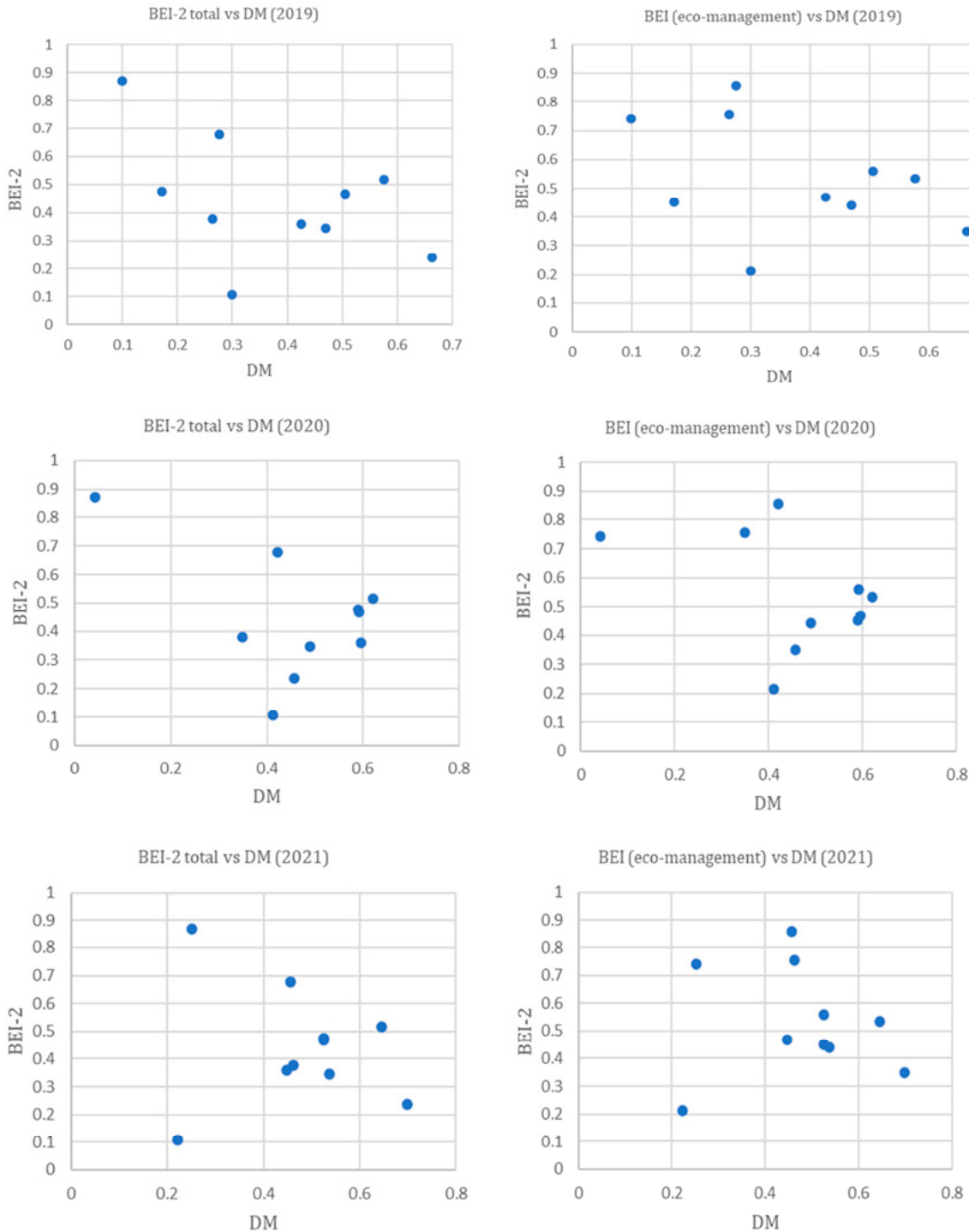

Figure 5. Scatter plots of the relationship of the total BEI-2 and BEI (eco-management) vs DM indicators for 2019-2021

Discussion and conclusions

In the last decade, public consciousness has grown on a wide range of issues, including climate change, water and food crises, modern slavery, poverty and conflict. Currently, society has increasing expectations of the role businesses should play in tackling some of the planet's biggest challenges (PWC, 2022). Institutions are expected not only to minimise their negative impact, but also to contribute positively to both society and the environment. Corporate sustainability is therefore all about creating long-term value by implementing strategies that incorporate environmental, social and governance (ESG) dimensions in addition to economic ones.

The ESG aspect regarding financial institutions is very significant in the context of current regulations, especially in the EU. For this reason, we tried to adopt a procedure from previous research (Zabawa & Kozyra, 2020) to show the environmental responsibilities of banks in the years 2019-2021. The intention was to show the influence of Covid-19 on the banking sector and banks' eco-activities. In the literature from the area we studied, we find evidence of a favourable relationship between banks' involvement in green financing and their financial performance, but these are usually benefits achieved over the long term (Bătae et al., 2021; Zhou et al., 2021; Ibrahim et al., 2021). Examples from the Polish banking sector described in the literature (Bolibok, 2021; Klimontowicz et al., 2021) are not so satisfactory and confirm the results of our study that there is no statistically significant relationship between the financial performance of the banks analysed and their environmental commitment.

In all the environmental analyses we carried out, Bank Ochrony Środowiska S.A. (BOŚ) ranked first. The BEI-2 indicator reached the highest value for this bank: 0.871. The box plot was included as an outlier observation, with the highest value of the indicator under study. In addition, using the cluster analysis method, this bank also found itself in the group of the most environmentally responsible banks. The bank was classified as a Class I bank according to the environmental maturity model. Our research confirms that this bank can serve as a benchmark for other banks in the context of the environmental responsibility of banks. In the area of financial performance, this bank strongly deviates negatively from the best banks (Development measurements, Table 4), which is a consequence of the "materialization of risks concerning the lending of investments in Renewable Energy Sources in earlier years. The bank carried out the restructuring of the loan portfolio financing wind farms, which resulted in the creation of additional write-downs" (BOŚ, 2017). This confirms the view that the instability of regulation in the financing of environmental investments is also not conducive to the development of ESG.

The lack of confirmation of the posed hypothesis can largely be attributed to the disruption caused by the collapse of the economy in the initial phase of the pandemic, which also badly affected the banking sector as a whole. The importance attached to the green economy during this period was also somewhat pushed back. The period of research connected with the COVID-19 pandemic was difficult for the banking sector in Poland and other countries as well. The main banks' aim at this time was financial efficiency, and clients of banks were not interested in environmental investments. The regulations focused on the current solutions to economic problems, including the banking sector.

The research was difficult and highly detailed due to the very thorough and multithreaded data analysis. We also identify other limitations of our study, i.e., the short period of the study, the small group of banks surveyed (we used banks from the WSE as a selection criterion), the lack of data on the expansion in promoting environmental activities in the analysed group of banks, the lack of data on the number and value of loans extended for eco-investments.

Our research fills a gap in the literature on environmental responsibility in the banking sector, especially in the context of the Green Deal. Green Deal agreements commit EU countries to achieving climate neutrality by 2050. The role of the banking sector in this area is difficult to overestimate. For this reason, there is a need for publications on environmental responsibility in the banking sectors, especially in the EU.

It would be valuable to continue the analysis in the following years in the banking sectors of other countries, such as other EU member states. Economic and then political instability caused by the Covid-19 pandemic and Russia's invasion of Ukraine has slowed the growth potential of banks in Poland, while investments in greening pay off in the long term. It would also be worthwhile to include in the study the impact of armed conflicts in areas that have a significant impact on energy resources affecting the environment. The role of the banking sector in environmental protection is very large,

if only by financing green investments. Banks' concerns about the development of pro-environmental products and services come from the fact that the formal requirements for access to such new programs and solutions are too stringent, and many of their potential customers will not be able to meet them.

Acknowledgements

The contribution of the authors

Conceptualization, J.Z. and E.L.D.; literature review, J.Z. and E.L.D.; methodology, J.Z. and E.L.D.; writing, J.Z. and E.L.D.; conclusions and discussion, J.Z. and E.L.D.

The authors have read and agreed to the published version of the manuscript.

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Justyna ZABAWA • Ewa ŁOSIEWICZ-DNIESTRZAŃSKA

ODPOWIEDZIALNOŚĆ ŚRODOWISKOWA BANKÓW W KONTEKŚCIE ICH ŚRODOWISKOWEJ ODPOWIEDZIALNOŚCI. PRZYKŁAD GIEŁDY PAPIERÓW WARTOŚCIOWYCH W WARSZAWIE

STRESZCZENIE: Znaczenie naszych badań wiąże się z licznymi regulacjami w Unii Europejskiej dotyczącymi zagadnień ESG. Dokumenty te bardzo często dotyczą aspektów środowiskowych i banków jako jednostek zaufania publicznego. W badaniach skupiamy się na bankach notowanych na Giełdzie Papierów Wartościowych w Warszawie, które stanowią główną część polskiego sektora bankowego. Badamy związek między efektywnością finansową a odpowiedzialnością środowiskową w sektorze bankowym. Zidentyfikowałyśmy trzy cele naszego badania: pierwszy: ocena efektywności finansowej w badanych bankach, drugi: ocena ekozarządzania w bankach notowanych na Giełdzie Papierów Wartościowych w Warszawie, trzeci: zbadanie, czy istnieje związek między odpowiedzialnością środowiskową jako elementem ESG banków a ich efektywnością finansową. Powyższe cele korespondują z przyjętą hipotezą badawczą: Wśród analizowanych banków istnieje korelacja pomiędzy wynikami finansowymi banku a wskaźnikiem Bank Ecologisation Index (BEI-2). Dodatkowo, niniejsze badanie odnosi się do okresu 2019-2021, aby pokazać wpływ pandemii Covid-19. Stosujemy różne metody badawcze, aby mierzyć odpowiedzialność środowiskową banków i badać empiryczną zależność między zaangażowaniem środowiskowym a wynikami finansowymi banków. W naszych badaniach wykorzystujemy statystyki opisowe, metody porządkowania liniowego: metodę sum standaryzowanych i syntetyczną miarę rozwoju, wykresy pudełkowe oraz metody analityczne do badania sprawozdań finansowych i niefinansowych analizowanych banków. Artykuł składa się z pięciu części: wstępu, przeglądu literatury i celów badawczych, materiałów i metod, wyników i dyskusji oraz wniosków. Nasze wyniki pokazują, że wśród analizowanych banków nie ma istotnej statystycznie korelacji między wynikami finansowymi banku a Indeksem Ekologizacji Banku (BEI-2). Może to wynikać z faktu, że na skutek niestabilności gospodarczej spowodowanej pandemią Covid-19, banki w Polsce wyhamowały swój potencjał wzrostu, a inwestycje w ekologię zostały przesunięte na dalszą przyszłość.

SŁOWA KLUCZOWE: bank, efektywność finansowa, ESG, odpowiedzialność środowiskowa