DOI: 10.55643/fcaptp.5.64.2025.4877

REGULATION OF BANKING ACTIVITIES IS AN IMPORTANT TOOL FOR STIMULATING GREEN INVESTMENTS: CASE BY SELECTED UPPER MIDDLE-INCOME COUNTRIES

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ABSTRACT

The article examines the mechanism of banking regulation as an important tool for stimulating green investment and green financing for sustainable development. The subject of the study is to identify the causality between banking regulation methods and green investment indicators. The object of the study is countries whose income level exceeds the average (mainly European and Central Asian countries, as well as Azerbaijan). The diagnostics are carried out within the framework of clusters formed depending on the specifics of the banking regulation process, with the involvement of statistical data from the World Bank for the above-mentioned regions and countries. At the same time, indicators characterizing separate parameters of monetary policy and sustainable development are covered. In particular, the position of the Republic of Azerbaijan was established on the basis of cluster analysis using appropriate methods and tools. At the next stage of analysis, logical connections were established through modeling and testing, and a comparative characteristic of country clusters was carried out, which was necessary for verifying or disavowing the proposed hypothesis. The developed conclusions and recommendations can be used by government agencies in developing the strategy and tactics of the policy being pursued and in making management decisions.

Keywords: regulation of banking activities, banking regulation instruments, green financing, sustainable investment, middle-income countries, Europe & Central Asia, Azerbaijan

JEL Classification: E52, O13, Q56

INTRODUCTION

INTRODUCTION

The urgency of transitioning toward sustainable development and combating climate change has brought green investment to the forefront of global policy agendas. In this context, banking regulation has emerged as a pivotal mechanism for mobilizing financial resources toward environmentally responsible projects. For Azerbaijan and upper-middle-income countries in Europe and Central Asia (ECA), the relevance of this issue is especially acute due to their transitional economic status, exposure to environmental degradation, and growing dependence on foreign investment and international financial frameworks.

These countries are navigating the dual challenge of maintaining economic growth while aligning with global environmental standards, including the EU Green Deal and Paris Climate Agreement goals. However, the institutional capacity and regulatory maturity in many of these nations remain uneven. This creates a critical need to assess whether banking regulation is effectively fostering or impeding the flow of green capital.

In Azerbaijan, the financial sector is evolving rapidly, yet questions persist about the alignment of regulatory frameworks with green finance principles. Similarly, ECA upper-middle-income countries are under increasing pressure from international lenders, investors, and domestic stakeholders to enhance environmental transparency, corporate

Received: 21/06/2025
Accepted: 13/10/2025
Published: 31/10/2025

responsibility, and sustainable lending practices. Given the region's susceptibility to climate-related risks and reliance on extractive industries, strategic banking regulation could serve as a lever for environmental transformation.

Therefore, examining whether and how banking regulation influences green investment in these specific geopolitical and economic contexts is not only timely but crucial for designing targeted policies, aligning financial systems with sustainability goals, and ensuring long-term macro-financial stability. This topic directly contributes to academic, policy, and institutional debates on the effectiveness of green finance mechanisms in emerging markets.

LITERATURE REVIEW

The nexus between banking regulation and green investment is increasingly central in discussions about sustainable economic development, especially in transitional and upper-middle-income countries such as Azerbaijan and its peers in the ECA region. The literature landscape reveals multidimensional insights into how financial regulations, institutional contexts, and macroeconomic environments interact to influence the flow of green finance.

Several studies underscore the role of financial instruments and institutional banking models. Krause et al. (2024) and Draksaite et al. (2018) highlight the variety of green financial instruments, including green bonds, that depend heavily on regulatory backing. Kozmenko and Vasyl'yeva (2008) further reveal how specialised innovative investment banks can become vehicles for sustainability-oriented capital under appropriate financial supervision. Filipava &Murshudli (2023) provide a global perspective on this issue by detailing how both banks and non-banking institutional investors influence the structure and growth of the green finance market, emphasizing the regulatory support required to scale these models internationally.

Regulatory influence on green banking practices is clearly demonstrated in the works of Adhikari et al. (2025) and Ahmar et al. (2024), who both found that compliance with green banking regulations and disclosures enhances customer trust and organisational accountability. In similar contexts, Alkindi and Utami (2025) show that Islamic banks performing well in terms of green practices are often aligned with both ethical and profitability standards, facilitated by conforming regulatory frameworks. Murshudli (2023) further reinforces this argument by exploring how green banking serves as a tool for sustainable development, advocating for targeted banking policies that embed environmental criteria into lending and investment decisions.

The institutional governance framework is also pivotal. Djalilov et al. (2015) and Vasileva and Lasukova (2013) connect regulatory pressure and CSR with better banking performance in transition economies. Dobrovolska et al. (2024) and Dachi and Kasztelnik (2024) show that weak institutions, lack of judicial enforcement, and high corruption rates, especially where regulation is poorly implemented, hinder green investment. Mammadov (2023) and Filipava & Murshudli (2023) emphasize that international banking practices have a measurable influence on green finance development in Azerbaijan, underlining how cross-border regulatory convergence and financial sector openness can support or hinder sustainability efforts.

Studies such as Lyeonov et al. (2023) and Garbowski et al. (2019) expand this by discussing the importance of macro-financial stability and the constraints posed by shadow economies. Kuzior et al. (2021) add a microeconomic dimension, emphasising public pressure as a bottom-up regulatory driver for green energy transitions in Ukraine.

From a methodological innovation perspective, Derradj and Toumache (2025) provide a text-mining-based insight into how international institutions frame socioeconomic challenges, including sustainability, in policy reports. This contributes to understanding how global narratives shape national regulatory responses.

The literature also reflects growing attention to data-driven analysis of green finance. Minh Sang (2024) and Kangalakova et al. (2025) provide bibliometric overviews showing rising scholarly and policy interest, while Srihari et al. (2024) employ volatility modelling to assess sustainable investment performance, revealing regulatory sensitivity to market behaviour. Similarly, Abhilash et al. (2023) show how bond attributes and, implicitly, regulations affect yields in the green bond market.

In regional case studies, Boros et al. (2023) document Hungary's banking response to green finance during COVID-19, indicating a role for emergency regulation. Obagbuwa and Munzhelele (2024) show that perception gaps in South Africa about over- or under-investment are often shaped by inconsistent regulatory enforcement.

For Azerbaijan and similar ECA economies, the regional dimension is well-represented. Polishchuk (2023) and Streimikiene et al. (2024) articulate how fintech, regulatory innovation, and EU-aligned policy frameworks promote digital and green transformation.

DOI: 10.55643/fcaptp.5.64.2025.4877

Socio-political and cultural influences on green finance are increasingly relevant. Ray (2024), Tessema (2025), and Selmane et al. (2025) analyse how inequality, CSR, and youth values shape financial systems, often in parallel with regulatory changes. Oe et al. (2023) provide behavioural insights into how green leadership policies mediate residents' settlement intentions, supporting the argument that policy credibility can trigger long-term sustainable investments.

Meanwhile, communication and environmental awareness, though indirectly related, serve as precursors to public support for regulatory reforms. Bhandari (2024) explores the links between crisis communication, youth perception, and sustainability culture, arguing for the integration of public discourse into regulatory design.

In terms of financial management, Habib et al. (2024) emphasise that sustainable investment practices are not only environmentally and ethically important but also enhance working capital efficiency. This operational angle suggests that when banking regulations incentivise sustainable practices, they may contribute to better financial discipline and resilience in firms, an attractive proposition for regulators in transition economies like Azerbaijan. Moreover, Korjonen-Kuusipuro et al. (2024) introduce the concept of an "inclusive sufficiency narrative", promoting sustainability through broader cultural and institutional change. While not directly about banking regulation, their work highlights the need for regulatory systems to align with evolving social narratives around environmental responsibility and equitable resource use.

Lastly, structural and technological transformations are highlighted by Vdovenko et al. (2025), who document Ukraine's financial market evolution in the era of meta-space technologies, hinting at the need for adaptive regulatory environments that embrace innovation while steering green investments.

The reviewed literature confirms that banking regulation is a critical enabler of green investment, particularly in upper-middle-income and transitional economies such as Azerbaijan and those in the ECA region. This influence is channelled through formal compliance structures, governance standards, financial incentives, and alignment with social and technological progress. As demonstrated by both financial and socio-cultural research, regulations that are integrated, adaptive, and sustainability-oriented can significantly shape the trajectory of green finance across diverse economic contexts.

AIMS AND OBJECTIVES

The aim of the study is to identify causal relationships between monetary instruments and green finance indicators in selected upper-middle-income countries within the formed clusters, depending on the characteristics of banking regulation. To achieve this, the following tasks were set and solved:

1. Identifying the role of banking regulation in the development of green investment in countries with above-middle income in the context of the current stage of global economic development.
2. To highlight existing trends in the harmonization of the regulation of banking activities and green finance in the countries under study.
3. Cluster analysis of Europe & central Asia upper-middle-income countries depending on banking regulation peculiarities.
4. Establishing the degree of dependence of green financing parameters on the level of perfection of banking regulation methods.

METHODS

Regulation of banking activities as a vehicle for green investment and finance to achieve the Sustainable Development Goals that concern them. Specifically, the change in adjusted savings rates is driven by energy depletion (as a percentage of GNI), renewable energy consumption, and CO2 emissions.

H1: The change in the volume of monetary sector credit to the private sector.

H2: Real interest rate.

H3: Interest rate spread.

H4: The indicator of broad money.

The information base consists of World Bank statistics for the last 15 years for which data have been made public for all investigated indicators, from 2006 to 2020, within the following indices:

1. Monetary sector credit to private sector (C) – the financial resources provided to the private sector through loans, trade credits, purchases of non-equity securities, receivables establishing a claim for repayment, etc., percentage of GDP.
2. Real interest rate (R) – the interest rate on loans, adjusted for inflation, %.
3. Interest rate spread (RS) – the interest rate charged by banks on loans to private sector customers, less the interest rate paid on demand deposits, time deposits, or savings deposits, %.
4. Broad money (M) – the amount of cash outside banks; demand deposits, time deposits, savings, bank, and traveller's checks; certificates of deposit and commercial papers, etc., percentage of GDP.
5. Adjusted savings: energy depletion (ED) – the ratio of the value of energy resources reserve (coal, crude oil, natural gas) to the remaining service life of the reserve (limited to 25 years), percentage of GNI.
6. Renewable energy consumption (RE) – the share of renewable energy in the total final energy consumption, percentage of total final energy consumption.
7. CO2 emissions (CE) – carbon dioxide, which is formed during the consumption of solid, liquid, and gaseous fuel, burning gas in flares, and during the production of cement, metric tons per capita.

Research sample includes countries which belong to the Europe & Central Asia region and to the upper middle-income group, as Azerbaijan (based on World Bank methodology of countries distribution), in particular 10 countries such as Albania, Azerbaijan, Bulgaria, Bosnia and Herzegovina, Belarus, Georgia, Moldova, North Macedonia, Montenegro, and Serbia. It should be emphasized that Armenia and the Russian Federation were excluded from the sample based on the author's beliefs and views. Kazakhstan, Kosovo, Türkiye, and Turkmenistan were not included in the research sample due to the lack of statistical data for these countries for certain investigated indicators.

Research methods include basic scientific methods such as comparison and abstraction, analysis, synthesis, modelling, etc. Also, special methods of scientific knowledge, such as statistical, mathematical, regression, and cross-country analysis, were applied.

Cluster analysis (Ward method, Sturges rule) made it possible to determine to which cluster Azerbaijan belongs based on previously normalized data for the research sample.

Cluster analysis is a statistical technique used to group objects into clusters that are similar within themselves but different from other clusters. The Ward method is one of the most commonly used hierarchical clustering methods, which minimizes the total within-cluster variance.

Pre-processing the data should be used to ensure all variables are on a comparable scale, typically through normalization or standardization. In our case, normalization was carried out according to the following formula:

$$nx = \frac{\mathrm{x} - \mathrm{x}_{min}}{\mathrm{x}_{max} - \mathrm{x}_{min}}, \quad (1)$$

Where: nx– normalized value of the indicator, x – a value of the indicator to be normalized, x_{min} and x_{max} – minimum and maximum values of the indicator to be normalized.

The most common distance metric used in the Ward method is the Euclidean distance, which calculates the straight-line distance between two points in a multidimensional space. In our case, the optimal number of clusters was determined by Sturges' rule using the following formula:

$$n = 1 + 3.322 \cdot \ln N, \quad (2)$$

Where: n – the number of clusters, N – the number of objects (countries).

Ward's method uses an agglomerative hierarchical clustering approach, where each observation starts in its own cluster, and pairs of clusters are merged step by step. The method merges clusters that result in the smallest possible increase in the total within-cluster variance (or error sum of squares). This is achieved by minimizing the following criterion at each step:

DOI: 10.55643/fcaptp.5.64.2025.4877

$$ESS = \sum_{i=1}^{n} \sum_{j=1}^{k} \left(x_{ij} - \bar{x}_j\right)^2, \quad (3)$$

Where: ESS is the error sum of squares, x_{ij} is the value of the i-th observation in the j-th cluster, $\bar{x}_j$ is the mean of the j-th cluster.

The hierarchical nature of the Ward method allows for the construction of a dendrogram, a tree-like diagram that shows the arrangement of the clusters formed at each step. Determination of the optimal number of clusters is provided by cutting the dendrogram at the level that maximizes the distinction between clusters, often where there is a significant jump in the distance metric. Calculating the silhouette coefficient measures how similar each point is to its cluster compared to others. Values close to +1 indicate that the point is well-matched to its cluster. Plotting the within-cluster sum of squares against the number of clusters helps to find the "elbow point," which indicates the optimal number of clusters.

The Vector Autoregressive (VAR) model is a statistical model used to capture the linear interdependencies among multiple time series. It extends the univariate autoregressive model by allowing for more than one evolving variable. Each variable in the system is modelled as a linear function of the past values of itself and the past values of all the other variables in the system.

In a VAR(p) model, each variable is a linear function of its own p lags and the p lags of the other variables in the system. The VAR(p) model is specified as:

$$Y_t = c + A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_p Y_{t-p} + \epsilon_t, \quad (4)$$

Where: Y_t is a vector of all endogenous variables at time t; c is a vector of constants (intercepts); A1, A2,…, Ap are matrices of coefficients to be estimated; ϵ_t is a vector of error terms (innovations) at time t.

Estimating the coefficients of the VAR model is provided by using Ordinary Least Squares (OLS). Each equation in the VAR model can be calculated independently using OLS because of the assumption that the error terms are uncorrelated across equations.

After estimation, diagnostic checks to assess the adequacy of the model should be performed. Also, we should check the stability of the estimated VAR model. The model is stable if all the eigenvalues of the companion matrix are less than one in modulus.

In the next stage, Granger causality should be conducted to determine whether one time series can predict another. In a VAR framework, this involves testing whether the coefficients on the lagged values of a variable are statistically significant in the equation for another variable. Granger causality tests are used to determine whether one time series can predict another. It is based on the principle that if a variable *X* Granger-causes another variable *Y*, then past values of *X* should contain information that helps predict *Y* beyond the information contained in past values of *Y* alone.

The Granger causality test is typically conducted within the framework of a Vector Autoregressive (VAR) model. For two time series, X_t and Y_t, the VAR model would include equations for both series:

$$Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i Y_{t-1} + \sum_{i=1}^{p} \beta_i X_{t-1} + \epsilon_{Y,t}, \quad (5)$$

$$X_t = \gamma_0 + \sum_{i=1}^{p} \gamma_i X_{t-1} + \sum_{i=1}^{p} \delta_i Y_{t-1} + \epsilon_{X,t}, \quad (6)$$

Where: p is the number of lags; $\epsilon_{Y,t}$ and $\epsilon_{X,t}$, are the error terms.

The coefficients β_i in the first equation and δ_i in the second equation are of primary interest for testing Granger causality.

The null hypothesis for the Granger causality test is that past values of *X* do not Granger-cause *Y*, i.e., $\beta_1=\beta_2=\cdots=\beta_p=0$. Similarly, the null hypothesis that *Y* does not Granger-cause *X* would be $\delta_1=\delta_2=\cdots=\delta_p=0$. The alternative hypothesis is that past values of *X* do Granger-cause *Y*, implying that at least one of the coefficients β_i is different from zero. Similarly, the alternative for the reverse causality is that at least one of the δi coefficients is different from zero.

We provide the p-value approach for the decision rule. If the p-value is less than the chosen significance level (e.g., 0.05), reject the null hypothesis, suggesting that X causes Y (or Y causes X). If the p-value is more significant than the significance level, fail to reject the null hypothesis, indicating no causality.

Based on the results, determine the direction of causality:

1. If X Granger-causes *Y* but *Y* does not Granger-cause *X*, there is unidirectional causality from *X* to *Y*.
2. If both tests reject the null hypotheses, there is bidirectional causality, meaning *X* and *Y* Granger-cause each other.
3. If neither test rejects the null hypotheses, there is no Granger causality between *X* and *Y*.

Results of regression analysis, especially VAR modelling, and the Granger test grounded causal relationships between the above indicators and confirmed/rejected the proposed hypothesis for a cluster of upper middle-income countries (European, Central Asian, and Azerbaijan), comparing them.

RESULTS

The Impact of Banking Regulation Peculiarities on Cluster Analysis of Upper Middle-Income Countries

As mentioned earlier, the research sample includes data for countries that belong to the Europe & Central Asia region and to the upper middle-income group, which also includes Azerbaijan. And in order to divide these countries into clusters, based on the peculiarities of banking regulation, the input data for the last year of investigation (2020) were first normalized, taking into account their different dimensions.

Calculations were made in the STATA 18 software package. The obtained results are shown in Table 1.

Table 1. Data normalization results.

Country name	Country number	nR	nC	nRS	nM	nED	nRE	nCE
Albania	1	0.27	0.22	0.81	0.90	0.05	1.00	0.00
Azerbaijan	2	1.00	0.03	1.00	0.10	1.00	0.00	0.36
Bulgaria	3	0.09	0.53	0.72	1.00	0.00	0.46	0.65
Bosnia and Herzegovina	4	0.19	0.56	0.58	0.79	0.00	0.84	0.92
Belarus	5	0.00	0.05	0.59	0.00	0.04	0.17	0.83
Georgia	6	0.23	1.00	0.54	0.46	0.00	0.51	0.23
Moldova	7	0.17	0.00	0.72	0.33	0.00	0.52	0.33
North Macedonia	8	0.16	0.57	0.68	0.52	0.00	0.44	0.34
Montenegro	9	0.30	0.69	0.80	0.42	0.00	0.88	0.49
Serbia	10	0.06	0.41	0.00	0.44	0.03	0.57	1.00

The optimal number of clusters was determined by Sturges' rule, and the resulting number of clusters is four.

Next, the Ward method and STATA 18 software toolkit were applied for cluster analysis. Built dendrogram also confirms the correctness of the selected number of clusters and visually demonstrates how observations are grouped at similarity/dissimilarity levels (Figure 1).

DOI: 10.55643/fcaptp.5.64.2025.4877

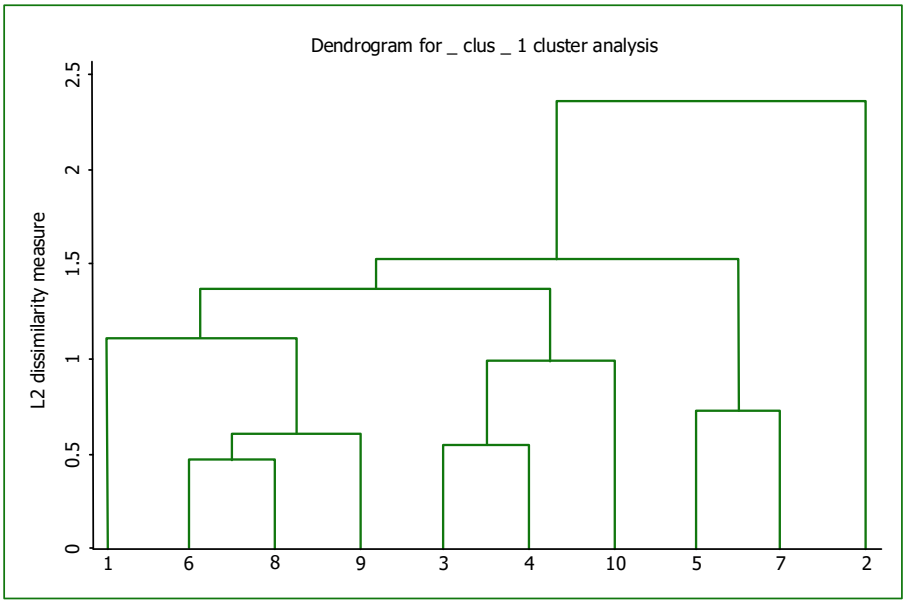

Figure 1. Dendrogram for Ward cluster analysis.

The horizontal axis of the dendrogram contains the research objects – countries, in order of their number. Vertical lines run from each research object and show the similarity/dissimilarity values, joining the lines of other research objects with a horizontal line until they are grouped together at the top of the dendrogram. At the same time, the longer the vertical lines, the clearer the clustering and division into groups.

So, the Ward method is a hierarchical one, based on group combination, of measuring dissimilarity and distance between them for function maximization. At each similarity/dissimilarity level, the mean value joins the clusters where the means are the closest.

Descriptive statistics for each indicator taken into account during clustering in terms of the formed clusters (groups) are provided in Table 2.

Table 2. Summary statistics (mean) by categories of groups within Ward's clustering.

Cluster	nR	nC	nRS	nM	nED	nRE	nCE
1	.2414381	.6196252	.7079209	.5753089	.0127093	.7089388	.2644137
2	.1122605	.5018664	.4350384	.7423165	.011292	.6236832	.8585776
3	.0861537	.0262644	.6584379	.1652973	.0200264	.3412918	.5823203
4	1	.0326867	1	.1040759	1	-4.40e-10	.3586676
Total	.2474842	.4069316	.6453675	.4962856	.1124766	.5389388	.5156696

Generalized information on the number of countries in each cluster and the percentage share is given in Table 3.

Table 3. Generalized information on countries belonging to the formed clusters.

Cluster	Frequency	Percent	Sum
1	4	40.00	40.00
2	3	30.00	70.00
3	2	20.00	90.00
4	1	10.00	100.00
Total	10	100.00	

The results of Ward's linkage determination and detailing countries' membership are shown in Table 4.

Table 4. Results of Ward's linkage definition.

Country name	_clus_1_id	_clus_1_ord	_clus_1_hgt	Cluster membership
Albania	1	1	1.1175934	1
Azerbaijan	2	6	.47838791	4
Bulgaria	3	8	.5996785	2
Bosnia and Herzegovina	4	9	1.3754369	2
Belarus	5	3	.54374862	3
Georgia	6	4	.98575234	1
Moldova	7	10	1.5234438	3
North Macedonia	8	5	.72936566	1
Montenegro	9	7	2.3583576	1
Serbia	10	2	1	2

Therefore, the first cluster consists of 4 countries (Albania, Georgia, North Macedonia, and Montenegro), the second – 3 countries (Bulgaria, Bosnia and Herzegovina, and Serbia), the third – 2 countries (Belarus and Moldova), and the fourth – 1 country (Azerbaijan).

Causal Links Between Instruments for Banking Activities Regulation and Green Investment Indicators

To determine causal links between banking regulation instruments and green investment indicators, the input time series data for 2006-2020 were normalized.

Then, for each sample's country, VAR modelling (vector autoregressive model as a direction of multivariate time series regression analysis) was applied using appropriate STATA 18 tools.

Table 5 shows the fragment of VAR modelling on the example of Azerbaijan, which alone represents the fourth cluster.

Table 5. The fragment of VAR modelling on the example of Azerbaijan. Note: * – the level of significance of z-criterion P>z is more than 0.05, so the obtained value of the coefficient is not statistically significant; L1, L2 – time lags of dependent variables.

			Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
nED	nR	L1.	-.1023676	.1417961	-0.72	0.470*	-.3802828	.1755476
		L2.	-1.766248	.1412057	-12.51	0.000	-2.043006	-1.48949
	nC	L1.	2.125486	.1871532	11.36	0.000	1.758673	2.4923
		L2.	-1.578322	.2625015	-6.01	0.000	-2.092816	-1.063828
	nRS	L1.	1.982417	.1474963	13.44	0.000	1.693329	2.271504
		L2.	-.7296976	.067654	-10.79	0.000	-.862297	-.5970981
	nM	L1.	-2.774514	.2839163	-9.77	0.000	-3.33098	-2.218049
		L2.	-.7915457	.2294601	-3.45	0.001	-1.241279	-.3418123
	_cons		3.320237	.2734502	12.14	0.000	2.784284	3.856189
	R-sq = 0.9917, chi2 = 1544.01, P>chi2 = 0.0000							
nRE	nR	L1.	.479748	.0361091	13.29	0.000	.4089754	.5505206
		L2.	.033202	.085162	0.39	0.697*	-.1337125	.2001164
	nC	L1.	.2435298	.0590665	4.12	0.000	.1277616	.3592981
		L2.	.0513551	.0920297	0.56	0.577*	-.1290198	.2317301
	nRS	L1.	.5042141	.0695724	7.25	0.000	.3678546	.6405736
		L2.	.2626384	.0680872	3.86	0.000	.12919	.3960868
	nM	L1.	-1.365161	.1021753	-13.36	0.000	-1.565421	-1.164901
		L2.	-.556832	.1927258	-2.89	0.004	-.9345676	-.1790964
	_cons		.9851732	.1064738	9.25	0.000	.7764883	1.193858
	R-sq = 0.9950, chi2 = 2565.525, P>chi2 = 0.0000							

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Table 5. Continued.

			Coef.	Std. Err.	z	P>z	[95% Conf. Interval]
nCE	nR	L1.	-2.504466	.3555763	-7.04	0.000	-3.201383 -1.80755
		L2.	-1.394264	.3913799	-3.56	0.000	-2.161355 -.6271736
	nC	L1.	1.640868	.4846305	3.39	0.001	.6910101 2.590727
		L2.	-2.031599	.29204	-6.96	0.000	-2.603986 -1.459211
	nRS	L1.	.2244368	.1983563	1.13	0.258*	-.1643345 .6132081
		L2.	-.9897749	.310991	-3.18	0.001	-1.599306 -.3802438
	nM	L1.	1.848326	.2550153	7.25	0.000	1.348505 2.348147
		L2.	1.230058	.3982741	3.09	0.002	.449455 2.010661
	_cons		1.678819	.3438318	4.88	0.000	1.004921 2.352717
	R-sq = 0.9665, chi2 = 375.3186, P>chi2 = 0.0000						

The obtained values of the coefficient of determination R-squared (it is very high), chi2-criterion, and p-value of significance P>chi2 (it is less than 0.05) mean the adequacy of the built models (regression equations for the above result indicators as nED, nRE, and nCE). For dependent variables (nC, nM, nR, and nRS), the level of significance of the z-criterion (P>z) that is less than 0.05 means that the probability of the hypothesis is not less than 95%, and the obtained values of coefficients are statistically significant.

The values of the obtained coefficients show how much the indicator's value will change when the dependent variable changes by 1%; respectively, the mathematical sign indicates the direction of change. At the same time, the influence can be not only in a certain direction, taking into account the possibility of the existence of bidirectional causality, which will be revealed by the Granger test.

Then, the pairwise Granger causality test was applied based on the above active VAR results.

Table 6 gives detailed results, also on the example of Azerbaijan.

Table 6. The results of the pairwise Granger causality test on the example of Azerbaijan. Note: * – the level of significance of chi2-criterion Prob > chi2 (Granger causality Wald test) is more than 0.05, so there is no causal link.

Indicator	Cause of the indicator	chi2	df	Prob > chi2
nED	nR	177.65	2	0.000
nED	nC	160.02	2	0.000
nED	nRS	186.88	2	0.000
nED	nM	310.34	2	0.000
nR	nED	82.958	2	0.000
nC	nED	2.055	2	0.358*
nRS	nED	24.503	2	0.000
nM	nED	27.766	2	0.000
nRE	nR	288.45	2	0.000
nRE	nC	23.616	2	0.000
nRE	nRS	72.681	2	0.000
nRE	nM	244.57	2	0.000
nR	nRE	32.158	2	0.000
nC	nRE	130.46	2	0.000
nRS	nRE	161.92	2	0.000
nM	nRE	87.254	2	0.000
nCE	nR	147.18	2	0.000
nCE	nC	50.037	2	0.000
nCE	nRS	12.473	2	0.002
nCE	nM	180.96	2	0.000
nR	nCE	121.34	2	0.000
nC	nCE	11.265	2	0.004
nRS	nCE	18.44	2	0.000
nM	nCE	15.739	2	0.000

In the case of Azerbaijan, all hypotheses are confirmed. At the same time, there is bidirectional causality in most observations.

A similar modelling and causality determination procedure was applied for each sample country and summarized by clusters. The summarized results are given in Table 7.

Table 7. Generalization results of the determination of causal links between instruments for regulating banking activities and green investment indicators. Note: * - the arrow shows the direction of causality or bidirectional Granger causality.

Country	The causal links* between C, R, RS, M, and			Country	The causal links* between C, R, RS, M, and		
	ED	RE	ED		ED	RE	ED
Cluster 1				**Cluster 2**			
Albania	C↔ED R↔ED RS↔ED M←ED	C↔RE R↔RE RS↔RE M↔RE	C↔CE R←CE RS↔CE M↔CE	Bulgaria	C↔ED R↔ED RS↔ED M↔ED	C↔RE R↔RE M↔RE	C↔CE R↔CE RS→CE M↔CE
Georgia	C↔ED R↔ED RS↔ED M↔ED	C→RE R↔RE RS→RE M↔RE	C↔CE R←CE RS→CE M↔CE	Bosnia and Herze-govina	C↔ED R→ED RS→ED M←ED	C→RE R↔RE RS↔RE M↔RE	C↔CE R→CE RS↔CE M→CE
North Macedonia	R↔ED RS←ED M←ED	C←RE R←RE RS←RE M↔RE	C→CE R↔CE RS↔CE M↔CE	Serbia	C→ED RS→ED M→ED	C↔RE R→RE RS→RE M↔RE	C→CE R→CE RS→CE M←CE
Montenegro	C→ED R→ED RS↔ED M↔ED	C→RE R↔RE RS←RE	C→CE R←CE RS↔CE M↔CE				
Cluster 3				**Cluster 4**			
Belarus	C↔ED R↔ED RS→ED M→ED	C←RE R↔RE RS←RE M←RE	C↔CE R↔CE RS↔CE M↔CE	Azerbaijan	C→ED R↔ED RS↔ED M↔ED	C↔RE R↔RE RS↔RE M↔RE	C↔CE R↔CE RS↔CE M↔CE
Moldova	C↔ED R←ED RS→ED M↔ED	C↔RE R↔RE RS↔RE M→RE	C↔CE R→CE RS↔CE M↔CE				

In many cases, bidirectional Granger causality takes place, which should be taken into account in future research during quantitative assessment of the impact and choosing model specification for achieving this purpose.

In many cases, bidirectional Granger causality takes place, which should be taken into account in future research during quantitative assessment of the impact and choosing model specification for achieving this purpose.

The change of the volume of monetary sector credit to the private sector is a cause of changes in adjusted savings: energy depletion (percentage of GNI) in 9 of 10 investigated countries, in renewable energy consumption – in 8 countries, in CO2 emissions – in 10 countries.

Real interest rate is a cause of changes in adjusted savings: energy depletion (percentage of GNI) in 8 countries, in renewable energy consumption – in 8 countries, in CO2 emissions – in 7 countries.

Interest rate spread affects changes in adjusted savings: energy depletion (percentage of GNI) in 9 countries, in renewable energy consumption – in 6 countries, in CO2 emissions – in 10 countries.

The indicator of broad money impacts on adjusted savings: energy depletion (percentage of GNI) in 7 countries, in renewable energy consumption – in 8 countries, in CO2 emissions – in 9 countries.

In general, all hypotheses were confirmed. Thus, banking regulation can be considered an important component of the process of "green" investment.

DOI: 10.55643/fcaptp.5.64.2025.4877

DISCUSSION

The aim of the study is to identify causal relationships between monetary instruments and green finance indicators in selected upper-middle-income countries within the formed clusters, depending on the characteristics of banking regulation.

As a result of the conducted research, 4 clusters were formed, while Azerbaijan entered the last of them individually. For Azerbaijan, all hypotheses were confirmed depending on all investigated indicators. At the same time, bidirectional causality was identified in most observations except for pairwise causality between the volume of monetary sector credit to the private sector, which is a cause of changes in adjusted savings: energy depletion (percentage of GNI). The greatest attention should be paid to this indicator. As for other indicators, in further studies, it is recommended to carry out a quantitative assessment of the impact of banking regulation instruments on green investment using a dynamic regression model, which will take into account the past values of both the resulting and factor variables, taking into account the two-way causality.

In general, according to the panel of countries in this sample, all hypotheses were confirmed. Therefore, banking regulation is a factor in green investment. It was also established that among the investigated indicators, the volume of monetary sector credit to the private sector and interest rate spread have the most influence on changes in CO2 emissions (in 10 of the 10 sample countries). For future research on the panel level, it would also be useful to carry out a quantitative assessment of the impact of banking regulation instruments on green investment using a dynamic panel regression model, which will take into account the past values of both the resulting and factor variables, taking into account the bidirectional causality.

Since this study has limitations regarding the sample of countries and the range of indicators of both banking regulation and green investment, it is also recommended to expand the sample of countries by representatives of the EU and other highly developed countries with a high level of income, and to expand the list of indicators in further studies.

CONCLUSIONS

The main conclusions and recommendations contained in this article can be used by government agencies in preparing materials and documents of a strategic nature regarding the problems of regulating banking activities as an important driver of sustainable development in general and the green economy in particular.

This study has some limitations regarding the sample of countries and the range of indicators of both banking regulation and green investment. So, in further studies, it is recommended to expand the sample of countries by representatives of the EU and other highly developed countries with a high level of income, and to expand the list of indicators. Increasing the time period of the study can also increase the quality of the obtained results.

The impact of economic and financial development on carbon emissions in small developing economies is substantiated, including the use of Granger causality in the extended VAR structure. Financial variables are shown to have played a role in reducing emissions only in the recent period, when there has been a greater degree of liberalization and development of the financial sector, which needs attention in developing economies where sufficient financial deepening and development have not yet occurred.

Multivariate causality analysis between CO2 emissions, electricity consumption, and economic growth using the VECM-based Granger causality test found that CO2 emissions, electricity consumption, and GDP are cointegrated, and there is a unidirectional causality between CO2 emissions and economic growth, but there is no directional causality between CO2 emissions and electricity consumption.

The results indicate that the effect of the lending rate on pollution depends on the prevailing economic and socio-political conditions.

According to our study, increased exposure to green assets contributes to an increase in intermediate financial spread. Given the identified bidirectional causality in most countries in the sample, we can argue that banks' default risk decreases when they consider environmental concerns when extending credit. These results correlate with the findings of earlier studies.

ADDITIONAL INFORMATION

FUNDING

The Author received no funding for this research.

CONFLICT OF INTEREST

The Author declares that there is no conflict of interest.

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DOI: 10.55643/fcaptp.5.64.2025.4877

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ЧИ Є БАНКІВСЬКЕ РЕГУЛЮВАННЯ ФАКТОРОМ ЗЕЛЕНИХ ІНВЕСТИЦІЙ В АЗЕРБАЙДЖАНІ ТА КРАЇНАХ ЄВРОПИ Й ЦЕНТРАЛЬНОЇ АЗІЇ З ДОХОДОМ, ВИЩИМ ЗА СЕРЕДНІЙ?

У статті розглянута гіпотеза про банківське регулювання як фактор зеленого інвестування в контексті пріоритетних тенденцій зеленого фінансування та зелених інвестицій для сталого розвитку. Метою дослідження є визначення причиново-наслідкових зв'язків між інструментами банківського регулювання та показниками зелених інвестицій в Азербайджані й інших країнах Європи та Центральної Азії з доходом, вищим за середній, у межах сформованих кластерів залежно від особливостей банківського регулювання. Вибірка дослідження включає дані для країн, що належать до регіону Європи та Центральної Азії, та групи країн із доходом, вищим за середній, до якої також належить Азербайджан, на основі статистики Світового банку та охоплює такі показники: кредити монетарного сектора приватному секторові, реальна процентна ставка, процентний спред, широка грошова маса, скориговані заощадження: енергетичне виснаження (у відсотках до ВНП), споживання відновлюваної енергії та викиди CO_2. Кластерний аналіз із використанням методу Ворда та інструментів STATA 18 дозволив визначити, до якого кластера належить Азербайджан. На наступному етапі завдяки VAR-моделюванню й тестові Ґрейнджера були визначені причи-

ново-наслідкові зв'язки між вищезазначеними показниками, що дозволило підтвердити або спростувати запропоновану гіпотезу для азербайджанського кластера та інших кластерів, порівнявши їх. Отримані результати можуть бути корисні для уряду та інших органів влади в процесі розробки політики та ухвалення стратегічних рішень.

Ключові слова: регулювання банківської діяльності, інструменти регулювання банківської діяльності, зелене фінансування, стале інвестування, країни із середнім рівнем доходу, Європа та Центральна Азія, Азербайджан

JEL Класифікація: E52, O13, Q56

DOI: 10.55643/fcaptp.5.64.2025.4877