

Green bonds as a perspective financial instrument for bank investment in Ukraine

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Abstract. Banks, as the main institutional participants in the securities market, play an important role in ensuring green investment processes, positioning themselves as socially and environmentally responsible financial institutions, which confirms the relevance of the research topic. The purpose of the study is to disclose the essence of green bonds as a new financial instrument on the international and Ukrainian stock market and to determine the prospects for their inclusion in the investment portfolio of the banks of Ukraine. The study uses general scientific and special methods of scientific cognition: analysis and synthesis, induction and deduction, horizontal analysis method, graphical method, comparative legal method, and analytic hierarchy process. The authors clarify the interpretation of the economic essence of the concept of "green bonds". The peculiarities of the formation of the global market for these financial instruments and trends in its formation in 2007-2022 are investigated. The legislative framework for regulating the national green bond market is elaborated. The advantages and disadvantages of including green bonds in the investment portfolio of Ukrainian banks are determined. The optimal tool for improving the formation of a bank investment portfolio based on such criteria as liquidity, profitability and riskiness, taking into account general banking goals, is determined and the role of green bonds as potential investment instruments for banks is characterised based on the data obtained. Barriers to the formation of green investment policy by banks and ways to overcome them are described. The practical significance of the obtained results lies in the fact that the implementation of the suggested recommendations for removing barriers to environmentally oriented investments by Ukrainian banks will help to revitalise the financing of environmental projects, and the developed proposals for enhancing the formation of investment portfolios by Ukrainian banks can be used by financial institutions to increase their financial stability and minimise the risk of investment transactions

Keywords: green financing; environmental projects; renewable energy; banks' investment portfolio; derivative financial instruments; stock market

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● INTRODUCTION

The unfolding of conflicts at the international level and the impact of external aggression have caused the destruction of production and non-production infrastructure, as well as the disruption of the ecosystem of Ukraine, which leads to the loss of environmental objects, significant emissions

of toxic substances into the atmosphere and hydrosphere, the energy crisis, etc. This stipulates the necessity to use new financial instruments of the stock market, in particular green bonds, to finance ecological projects to restore the Ukrainian economy and ecology after the upheavals

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mentioned above. The formation of the market for these debt securities is closely connected with the coordinated work of banking institutions as the main institutional participants of the capital markets that are able to accumulate temporarily free funds quickly and use them effectively, in particular, investing them in the implementation of environmental projects, which stipulates the relevance of the research topic.

The works of scientists from Ukraine, China and Sweden are devoted to the peculiarities of green bonds international and national market formation, as well as their role as an investment tool for banks. In particular, A Dubko (2022) in his work substantiates the need for the introduction and development of the market for these debt financial instruments in Ukraine during the legal regime of martial law, outlines their current legal status and reveals the meaning of the concept “green financing”. It is worth paying attention to the scientific work of N.V. Dunas (2021), where current global and national trends and initiatives in the formation of the market for these debt financial instruments in the context of COVID-19 have been analysed. N.O. Dugienko & M.K. Mikhailutsa (2020) consider potential opportunities for the implementation of environmental projects in Ukraine and their investment attractiveness, and also highlight an important problem of modern green financing – greenwashing. O.O. Liubic & A.O. Svystun (2020) focus on the ability of state-owned development banks, in particular the Public Joint-Stock Company of the Joint-Stock Bank “UkrGasbank” (PJSC AB “UkrGasbank”), to be leading financial institutions in the issuance of sustainable development bonds, including green ones, as they better identify the needs of the Ukrainian economy in monetary resources. A wide range of green banking tools is covered in the article by the well-known scientist V. Chala (2021), particularly: green banking lending, green mortgages, green bonds, green bank co-investment, green bank asset securitisation. I. Okhrymenko & K. Pyivoda (2021) suggest including new financial instruments, in particular green bonds and derivatives, in the investment portfolio of Ukrainian banks in order to hedge currency and interest rate risks.

Chinese scientists (Wang *et al.*, 2022) model the process of optimising Chinese enterprises operation by issuing green bonds from the perspective of choosing a sustainable development vector as it is done worldwide. While Swedish experts (Maltais & Nykvist, 2020) examine the development of the green bond market in Sweden and describe the impact of these securities on attracting market participants to sustainable development.

However, despite the large number of scientific developments, little attention is paid to the consideration of green bonds as a promising financial instrument of banking investment, as well as to the improvement in the investment portfolio formation by banks of Ukraine in the modern conditions of the destructive influence of endogenous and exogenous factors.

The goal of the study was to reveal the economic essence of green bonds as a new debt financial instrument on the global and national securities market and outline the prospects for their inclusion in the investment portfolio of Ukrainian banks.

In accordance with the set goal, the following tasks had to be solved in the process of scientific research:

1) to describe stages and characteristic features of the international and Ukrainian green bond market formation, indicating the dynamics in the volume of global issuance of these debt financial instruments for the period of 2007-2022;

2) to summarise advantages and disadvantages of including green bonds in the investment portfolio of Ukrainian banks;

3) to identify obstacles to the formation of an environmentally oriented investment policy by Ukrainian banking institutions and ways to overcome them.

The scientific novelty of this paper lies in the fact that the authors have developed proposals for improving the formation of the investment portfolio by banks of Ukraine taking into account the primary goals of the banking sector in modern destabilising conditions and have provided recommendations for levelling barriers on the way to the formation of an environmentally and socially oriented banking investment policy.

● MATERIALS AND METHODS

The research methodology is based on the application of general scientific and special scientific methods. Methods of analysis and synthesis have been applied to carry out a critical review of the literary sources of scientists of Ukraine, Belgium and the Philippines regarding the definition of the economic essence of “green bonds” term and to form our own interpretation of this scientific category. The application of induction and deduction methods made it possible to investigate the development of the green bond market at the international and Ukrainian levels. The method of horizontal (trend) analysis helped to determine the dynamics in the volume of the global emission of these debt financial instruments and the graphic method made it possible to visualise the obtained results. A critical review of the current legislation provisions on the regulation of processes related to the functioning of the green bond market has been carried out using the comparative legal method.

To make a decision regarding the choice of the optimal tool for improving the formation of the investment portfolio by banks of Ukraine and to determine the role of green bonds in this process, the hierarchy analysis method (hereinafter – HAM) has been applied. This method was developed by the American mathematician T. Saati (Usov, 2019) and is used throughout the world for decision-making in various areas: from management at the international level to solving sectoral and private problems in business. As a result, the relative importance of the investigated alternatives for all criteria in the hierarchy is determined and expressed numerically in the form of priority vectors. The vector values obtained in this way are estimates on a ratio scale, interpreted in the scientific work of V.A. Vovk & O.V. Havrylchenko (2022) (Table 1), and they correspond to the so-called hard estimates.

The system of paired evaluations of judgments leads to a result that can be presented in the form of an inverse-symmetric matrix.

The component of the matrix eigenvector and the priorities vector were calculated according to formulas (1-2):

$$w_i = \sqrt[n]{\prod_{j=1}^n a_{ij}}, \quad (1)$$

$$w_{norm} = w_i / \sum_{i=1}^n w_i, \quad (2)$$

Table 1. Ratio scale based on HAM

Stage	Definition	Explanation
1	Equal importance	Two factors contribute equally to achieving the goal
3	Moderate dominance of the i-th factor over the j-th	There are insufficiently convincing arguments in favour of the dominance of one of the factors
5	Significant advantage of the i-th factor over the j-th	There is evidence to prove the superiority of one factor over the other one
7	A significant advantage of the i-th factor over the j-th	Strong evidence in favour of one factor over the other one
9	The absolute advantage of the i-th factor over the j-th	The undeniable dominance of one factor over the other one
2, 4, 6, 8	Corresponding intermediate values	A situation where a compromise is needed

Source: developed by the authors based on V.A. Vovk & O.V. Havrylchenko (2022)

where w_i – is a component of the matrix eigenvector (the average value of the priority ratings); w_{norm} – is a normalised vector of the matrix of pairwise comparisons (vector of priorities); a_{ij} – is values of matrix elements.

Formulas (3-5) were used to check the consistency of experts' opinions with the determination of the matrix eigenvalue, consistency index and relative consistency:

$$\lambda = \sum_{i=1}^n a_{ij} \cdot w_{norm} \quad (3)$$

$$I_c = (\lambda - n) / (n - 1) \leq 0.2, \quad (4)$$

$$CR = I_c / I_{CR}, \quad (5)$$

where λ – is the matrix eigenvalue; I_c – consistency index; I_{CR} – is the average value of the consistency index (for a 3x3 matrix it makes 0.58); CR – consistency ratio; n – is the number of criteria (alternatives).

Then a pairwise comparison of alternatives was carried out according to each of the criteria; the overall priority for each option was determined and the best solution with the maximum value of the global priority was found.

During the research a group of 10 experts, being managers of JSC (Joint-Stock Company) "PRAVEX BANK", JSC "A-BANK", JSC "OTP BANK" and JSC "RAIFFEISEN BANK", was formed and anonymous individual survey based on the questionnaire method was carried out on February 21, 2023 by sending questionnaires to their e-mails. The respondents had to answer the following questions: do you believe that the optimal formation of the investment portfolio is one of the main ways to increase financial stability of a bank? Do you agree that the current state of investment portfolio formation by banking institutions of Ukraine needs improvement? Using a ratio scale, experts were asked to compare liquidity, riskiness and profitability as criteria for choosing the optimal direction of bank investments. Then they had an opportunity to match financial instruments based on each specified factor. Ethical norms were observed when working with managers of financial institutions during the survey (American Psychological..., 2017). The last stage was to compare the development goals of the banking sector and to match alternative investment objects to each general banking goal.

● RESULTS AND DISCUSSION

Current conditions of functioning of the Ukrainian economy under the influence of destabilising factors of exogenous and endogenous environment emphasise the importance of

smooth operation of the securities market. One of its priority goals is the accumulation of investment resources with the aim of directing them to the restoration of Ukrainian cities, the destroyed energy infrastructure after the abolition of the legal regime of martial law, ensuring the transition to a green economy and gaining energy independence given the accession of Ukraine to the UN Sustainable Development Goals (Resolution of the United Nations General Assembly..., 2015), and The Paris Agreement (2015), as well as the choice of a European development vector.

It is possible to achieve the specified goal through the use of a new debt financial instrument both on the international and on the national stock market – green bonds. One can find a large number of definitions of "green bonds" in scientific works of scientists from Ukraine, Belgium and the Philippines. In particular, O. Lyubich & A. Svistun (2020) in their scientific paper specify that green bonds are fixed-income securities that are placed to finance projects with specific environmental benefits. At the same time, O.V. Zayachkivska & O.V. Yakovchuk (2020) give a broader interpretation of this category, noting that green bonds are financial instruments through which the issuer receives a fixed amount of capital from investors and directs the raised funds to finance environmental projects, paying the nominal value to investors when the bonds are repaid, as well as the agreed amount of interest during their turnover period. Filipino experts in the banking sphere (Hyun *et al.*, 2021) have an opinion close to Ukrainian scientists and consider a new type of securities as debt instruments that finance exclusively projects with environmental benefits and therefore can reduce the negative impact of economic activity on climate change. In their interpretation of green bonds, a group of Belgian scientists (Ma *et al.*, 2020) additionally point out their differences compared to conventional debt securities, defining the studied concept as a type of fixed-income securities that attract funds for investment in pre-designed climate and environmental projects unlike conventional debt instruments, in which the use of proceeds is not stipulated in the terms. Thus, green bonds are a type of debt financial instruments of the stock market with a fixed interest rate, the funds raised from which are directed exclusively to the financing of new or existing projects with specific environmental effects, which emphasises the dual focus of such securities on the financial and social spheres.

Historically green bonds were issued for the first time by the European Investment Bank in 2007, and the funds

received from their placement were directed to financing projects to improve energy efficiency and the introduction of renewable energy sources (Gilchrist *et al.*, 2021). At that time these financial instruments were called “climate protection” bonds, then similar debt securities were called “climate” bonds and a year later they received the international name – “green”. Over the next 5 years other supranational financial institutions, in particular the International Bank for Reconstruction and Development (IBRD), the European Bank for Reconstruction and Development (EBRD),

the World Bank (WB) and the International Finance Corporation (IFC) began to issue them.

The general global trend in the development of the green bond market indicates a rather rapid and uneven dynamics of increasing the capitalisation of this segment of the international stock market. From the data shown in Figure 1 it can be concluded that over the past 15 years the volume of global green bond issuance has rapidly growing trends: from 0.86 billion US dollars in 2007 to 487.1 billion US dollars in 2022.

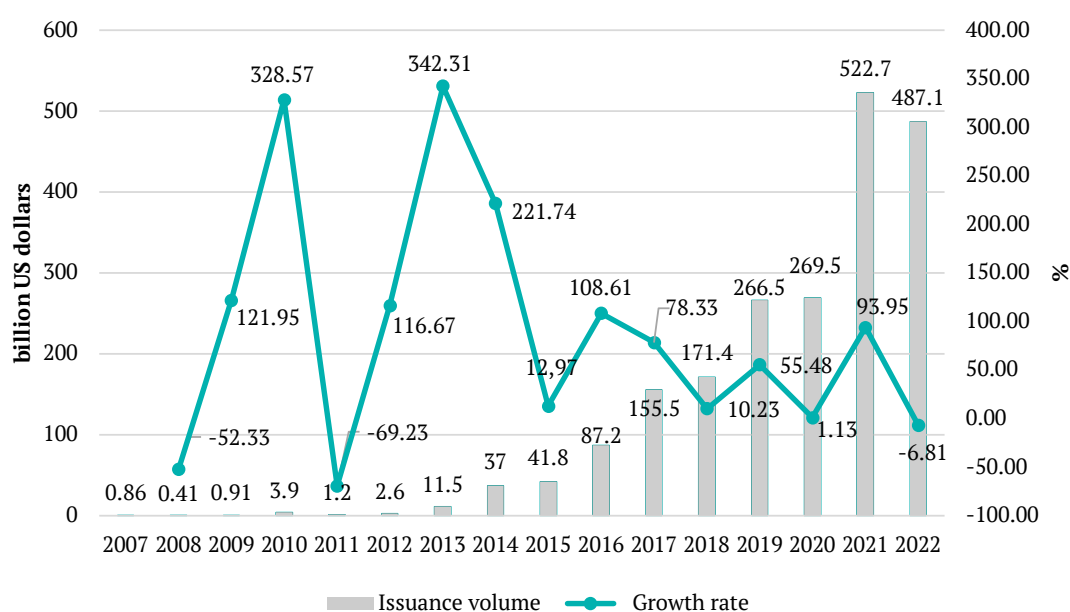


Figure 1. The volume of global issuance of green bonds during 2007-2022

Source: developed by the authors based on Official website of the Climate... (n.d.)

At the same time 2013 was the year of fundamental changes in the development of the market of these debt financial instruments, when companies and sovereign borrowers began to enter it and the growth rate of the issuance volume was 342.31% compared to 2012. The largest annual issuance of green bonds is observed in 2021 with a value of more than half a trillion – 522.7 billion US dollars. However, in 2022 this indicator decreased to 487.1 billion US dollars, i.e. by 35.6 billion US dollars or by 6.81%. This is explained by the fact that in the current conditions of the international stock market functioning macroeconomic trends are complicated by geopolitical instability (Marwan, 2022). At the same time the experts of the Climate Bonds Initiative (Official website of the Climate..., n.d.) (hereinafter – CBI) emphasise that there is a tendency in the global political space to believe that environmental considerations should occupy a central place in the recovery of economies after the crisis. In general, green bonds were placed in the amount of 2.06 trillion US dollars cumulatively for the period of 2007-2022.

It is worth noting that Ukraine is at the stage of strengthening both governmental and financial initiatives in the field of ensuring a safe environment for the population, which is outlined by the National Economic Strategy by the year 2030 (Resolution of the Cabinet of Ministers..., 2021) in accordance with world trends and European norms. In particular, it is envisaged to implement the principles of

sustainable development and a gradual transition to a green economy through the introduction of green bonds to attract investments in eco-modernisation and ecological projects.

The analysis of state policy principles in the sphere of creation and functioning of the Ukrainian market of these debt financial instruments demonstrates giving priority to the formation of the appropriate legislative framework. In particular, on July 1, 2021 the next edition of the Law of Ukraine “On Capital Markets and Organised Commodity Markets” (Law of Ukraine..., 2006) was published in the edition of the Law of Ukraine “On Amendments to Certain Legislative Acts of Ukraine on Simplifying Investment Attraction and Introducing New Financial instruments” No. 738-IX dated June 19, 2020 (Law of Ukraine..., 2020). It provides for the establishment of the legal basis for introducing green bonds into circulation as a separate class of securities and certain rules for professional participants of this market.

In order to ensure the development of the Ukrainian green bond market, on July 7, 2021, the National Commission on Securities and Stock Market (hereinafter – NSSMC) approved the recommendations on the implementation or financing of environmental projects through the issuance of green bonds, which were developed in accordance with the regulations of leading international market participants and specifically highlight environmental, social, and governance (ESG) standards adopted by the IFC. On February 23, 2022 the Cabinet of Ministers of Ukraine

(hereinafter – CMU) also approved the concept of the introduction and development of the green bond market in Ukraine for 2022-2023 (Order of the Cabinet of Ministers of Ukraine..., 2022) aimed to outline directions and tasks for the introduction of the market of these debt financial instruments.

The review and evaluation of potential environmental projects, which could receive financing due to the funds raised from the placement of green bonds began on July 5, 2021. In November 2021 the Private Joint-Stock Company “National Energy Company ‘UKRENERGO’” issued five-year green sustainable development Eurobonds under state guarantees in the amount of 825 million USD to repay the debt of the CMU to producers of electricity from renewable sources (Dubko, 2022). And a year later, in November 2022, despite the legal regime of martial law, the company made the first interest payment of 28.4 million USD on these bonds. However, it is worth noting that the first issue of these securities in Ukraine was carried out in 2019 by DTEK Limited Liability Company (DTEK LLC) to direct the received investment resources into renewable energy projects, as A. Dubko (2022) points out.

Prior to the unfolding of conflicts at the international level, the investment potential of financing multi-sectoral environmental projects of Ukraine, according to the IFC data, amounted to 73 billion US dollars until 2030, while it was expected that 36 billion US dollars could be attracted through the issuance of green bonds (Levandivskiyi *et al.*, 2022). Considering the development of the Ukrainian stock market based on the bank-centric model, ensuring

the growth of the green bond market largely depends on the bank performance in this segment of the securities market, in particular the investment sector, and its consistency with national strategic goals. Investing funds in the mentioned debt financial instruments provides banking institutions with a number of advantages, including: ability to diversify securities portfolio; creating additional opportunities for investing in environmental projects; providing green bonds with the full balance sheet of the issuer apart from cash flows from the implementation of green projects, which indicates the safety of investments; creating a positive image and reputation of the bank as a socially responsible financial institution; facilitating the implementation of strategic goals of the national environmental policy of Ukraine.

However, despite the listed advantages of including green bonds in the investment portfolio of banks, they are characterised by financial and operational risks not only on the Ukrainian securities market but also on the international market (Bedendo *et al.*, 2022), requiring timely regulation. Among them are: low liquidity, insignificant level of profitability, high revaluation in the stock market due to the excess of demand over supply, falling oil prices (Rublyk, 2020), as well as the spread of greenwashing.

Figure 2 presents a hierarchical structure of approaches to choosing the optimal tool for improving the formation of the investment portfolio by Ukrainian banks based on such criteria as liquidity, profitability and riskiness, taking into account the overall banking goals, developed by the authors independently.

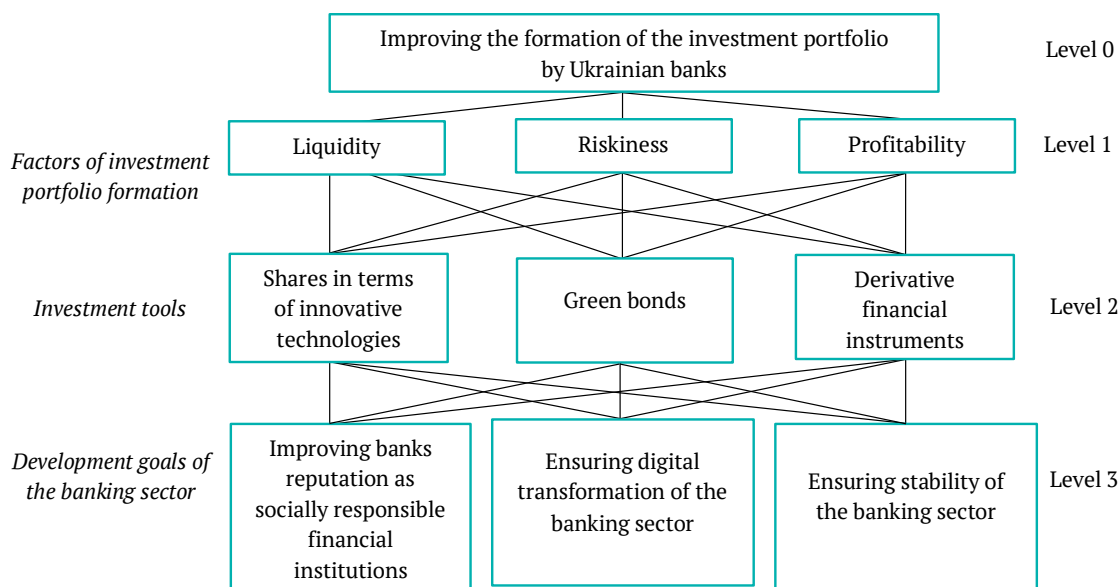


Figure 2. Three-level hierarchical model of approaches to choosing the optimal tool for improving the formation of the investment portfolio by Ukrainian banks

Note: The authors consider the criterion of riskiness regarding the smallest exhibit of this characteristic in the financial instrument
Source: developed by the authors

The next step is the construction of a matrix of paired judgments of experts on banks’ transactions with securities regarding the prioritisation of the factors of investment portfolio formation by banks (Table 2). According to the data calculated in Table 2, the most significant criterion for

choosing the optimal bank investment instrument is riskiness as its priority value equals 0.6466. Along with this, the least important factor is the liquidity of investments – 0.0732. Therefore, in the current destabilising conditions of the Ukrainian economy development it is expedient to

determine ways to reduce the degree of riskiness of securities, which, in turn, will encourage investments. The reliability of the obtained results is confirmed by the

consistency of experts' opinions, since the value of the consistency index does not exceed 0.2 and the relative consistency indicator is less than 0.1.

Table 2. Value of factors priority when choosing the optimal tool for improving the formation of the investment portfolio by banks of Ukraine

Factors of investment portfolio formation	Liquidity	Riskiness	Profitability	w_i	W_{norm}	λ
Liquidity	1	1/7	1/5	0.3094	0.0732	0.2216
Riskiness	7	1	3	2.7311	0.6466	1.9998
Profitability	5	1/3	1	1.1836	0.2802	0.8619
$S w_i$				4.2240		
$\lambda \max$				3.0834		
IC				0.0417		
CR				0.0719		

Source: developed by the authors

Next, it is necessary to determine the priority of financial instruments for each of the three factors of investment

portfolio formation by banks and calculate the global vector of priorities (Table 3-4).

Table 3. Priority value of tools for improving investment portfolio formation by banks of Ukraine for each factor

Investment tools	Shares in terms of innovative technologies	Green bonds	Derivative financial instruments	w_i	W_{norm}	λ
Liquidity						
Shares in terms of innovative technologies	1	7	2	2.3890	0.5897	1.7921
Green bonds	1/7	1	1/5	0.3094	0.0764	0.2274
Derivative financial instruments	1/2	5	1	1.3531	0.3340	1.0106
$S w_i$				4.0515		
$\lambda \max$				3.0301		
IC				0.0150		
CR				0.0259		
Riskiness						
Shares in terms of innovative technologies	1.00	0.25	0.33	0.4404	0.1222	0.3894
Green bonds	4.00	1.00	0.33	1.0996	0.3050	0.9847
Derivative financial instruments	3.00	3.00	1.00	2.0649	0.5728	1.8544
$S w_i$				3.6049		
$\lambda \max$				3.2284		
IC				0.1142		
CR				0.1969		
Profitability						
Shares in terms of innovative technologies	1	7	3	2.7311	0.6466	1.9998
Green bonds	1/7	1	1/5	0.3094	0.0732	0.2216
Derivative financial instruments	1/3	5	1	1.1836	0.2802	0.8619
$S w_i$				4.2240		
$\lambda \max$				3.0834		
IC				0.0417		
CR				0.0719		

Source: developed by the authors

Table 4. Calculation of the global priority of tools for improving the formation of the investment portfolio by banks of Ukraine considering the factors

Global priorities	Liquidity	Riskiness	Profitability	Global priorities
	0.0732	0.6466	0.2802	
Shares in terms of innovative technologies	0.5897	0.1222	0.6466	0.3033
Green bonds	0.0764	0.3050	0.0732	0.2233
Derivative financial instruments	0.3340	0.5728	0.2802	0.4733

Source: developed by the authors

Based on the results of the data analysis in Tables 3-4 it is possible to draw a general conclusion that according to the global vector of priorities the most appropriate alternative that would help improve the formation of the investment portfolio of Ukrainian banks is derivative financial instruments, since, compared to others, this direction of bank investments has the lowest riskiness, which was chosen as a priority factor, as well as the average level of liquidity and profitability after shares of innovative companies. Moving to the third level of the constructed hierarchy (Fig. 2), the

priority of the primary goals of the banking sector development should be established (Table 5). The most important goal of the Ukrainian banking sector in the conditions of the internal and external environmental instability is to ensure its stability. The priority value of this goal equals 0.7275. At the same time, according to the expert judgments improving the reputation of banks as socially responsible financial institutions in modern economic realities is not considered a priority task, which is proved by the indicator of the normalised vector of priorities being 0.0824.

Table 5. Priority values of the banking sector development goals, when choosing the optimal tool for improving the formation of the investment portfolio by the banks of Ukraine

Banking sector development goals	Improving the reputation of banks as socially responsible financial institutions	Ensuring digital transformation of the banking sector	Ensuring stability of the banking sector	w_i	W_{norm}	λ
Improving the reputation of banks as socially responsible financial institutions	1	1/3	1/7	0.3662	0.0824	0.2497
Ensuring digital transformation of the banking sector	3	1	1/5	0.8449	0.1901	0.5828
Ensuring stability of the banking sector	7	5	1	3.2325	0.7275	2.2549
$S w_i$				4.4436		
$\lambda \max$				3.0875		
IC				0.0437		
CR				0.0754		

Source: developed by the authors

Finally, it is worth determining the importance of the researched investment tools considering the overall banking goals and forming a global vector of priorities (Tables 6-7). Investing in derivative financial instruments is an optimal option for improving the formation of the investment portfolio by banks of Ukraine, taking into account the

realisation of goals of the banking sector. Unlike others, investments in these securities contribute most to sustainability, which is recognised as a priority goal. Derivatives play an important role in protecting against various kinds of financial risks and providing liquidity to other financial instruments.

Table 6. Priority value of tools for improving the formation of the investment portfolio by banks of Ukraine for each of the bank-wide goals

Investment tools	Shares in terms of innovative technologies	Green bonds	Derivative financial instruments	w_i	W_{norm}	λ
1	2	3	4	5	6	7
Improving the reputation of banks as socially responsible financial institutions						
Shares in terms of innovative technologies	1	1/7	3	0.7561	0.1507	0.4639
Green bonds	7	1	9	3.9245	0.7821	2.4415
Derivative financial instruments	1/3	1/9	1	0.3370	0.0672	0.2043

Table 6, Continued

1	2	3	4	5	6	7
Sw_i				5.0176		
$\lambda \max$				3.1097		
IC				0.0548		
CR				0.0945		
Ensuring digital transformation of the banking sector						
Shares in terms of innovative technologies	1	9	5	3.5120	0.7398	2.2992
Green bonds	1/9	1	1/4	0.3065	0.0646	0.1957
Derivative financial instruments	1/5	4	1	0.9290	0.1957	0.6019
Sw_i				4.7475		
$\lambda \max$				3.0967		
IC				0.0484		
CR				0.0834		
Ensuring stability of the banking sector						
Shares in terms of innovative technologies	1	1/4	1/6	0.3504	0.0866	0.2615
Green bonds	4	1	1/3	1.0996	0.2718	0.8321
Derivative financial instruments	6	3	1	2.5956	0.6416	1.9766
Sw_i				4.0456		
$\lambda \max$				3.0702		
IC				0.0351		
CR				0.0605		

Source: developed by the authors

Table 7. Calculation of the global priority of tools for improving the formation of the investment portfolio by banks of Ukraine considering the overall banking goals

Global priorities	Improving the reputation of banks as socially responsible financial institutions	Ensuring digital transformation of the banking sector	Ensuring stability of the banking sector	Global priorities
	0.0824	0.1901	0.7275	
Shares in terms of innovative technologies	0.1507	0.7398	0.0866	0.2161
Green bonds	0.7821	0.0646	0.2718	0.2744
Derivative financial instruments	0.0672	0.1957	0.6416	0.5095

Source: developed by the authors

The research suggests that the use of green bonds as an investment tool in Ukrainian banking institutions has not gained significant popularity compared to global trends and the market for these debt financial instruments is only at the initial stage of its development. The obtained results correlate with the findings of other scientists. In particular, O.S. Vavrychuk & A.A. Dovgan (2021) in their research emphasise the fact that the green bond market of Ukraine is at an early stage of forming and developing its ecosystem, is characterised by deformity, has a limited amount of resources and a narrow list of available financial instruments that can be used to attract investments in ecological projects. N.V. Dunas (2021) also adds the stakeholder identification processes, regulatory development, compliance and risk management standards to the above-stated features of

the initial stage of the Ukrainian green financing market formation. At the same time, the scientist states that the development and implementation of ecological projects in Ukraine are taking place at a rather slow pace, proving his conclusions with the following statistical data: the use of alternative energy sources, excluding hydropower, in the total volume of electricity production in Ukraine is 1.5%, while the value of this indicator in Germany exceeds 33%. At the same time, O.V. Zayachkivska & O.V. Yakovchuk (2020) emphasise the importance of developing this stock market segment, despite the initial steps for its formation, since the implementation of national strategic goals in the field of energy efficiency and renewable energy requires the accumulation of a significant amount of long-term financial resources. O.T. Levandivskyi *et al.* (2022) claim that in the

near future Ukraine has every opportunity to enter the international green bond market with its own debt financial instruments to finance national environmental projects.

It is worth paying attention to the fact that the further development of the Ukrainian green financing market will positively affect the key interests of stakeholders, namely: the country's population, public authorities, banking and non-banking financial institutions, joint investment institutions, private investors, etc. Financing environmental projects by investing in green bonds will have a beneficial effect on the quality of life of citizens, improve the state of the natural environment, serve as a driving force for the introduction of green technologies, as well as ensure the implementation of strategic provisions of economic, social and environmental policy and form a positive international image of the country. The obtained results correspond to the findings of other scientists.

Thus, O.V. Zayachkivska & O.V. Yakovchuk (2020) add opportunities to control cash flows directed to repay debts and to improve the investor rights protection, investing in environmental projects, to the above list of advantages of creating conditions for the issuance of green bonds in Ukraine. Y.V. Belinska (2021) emphasises the fact that economic benefits from developing the market of these debt financial instruments also consist in new jobs creation and increased revenues for budgets at all levels.

As for the participation of banking institutions in the further development of the green bond market in Ukraine and the achievement of sustainable development goals, O.O. Liubic & A.O. Svystun (2020) point out in their paper that the decisive factor in this issue is strengthening the role of state development banks as issuers of this type of securities. Compared to other second-tier banks and investment funds they have a greater risk-taking potential providing long-term financing. Moreover, M. Karlin & O. Ivashko (2020) suggest applying green investment lending in Ukrainian banking, which is a common practice abroad.

During the scientific research it was discovered that while carrying out investment transactions with green bonds Ukrainian banks bear a certain risk due to low liquidity, a small level of profitability and a significant revaluation on the stock market, since the demand for these securities is greater than the supply. I. Okhrymenko & K. Pyvoda (2021) approve of these findings. Thus, scientists recommend Ukrainian banks to invest in green bonds issued by foreign companies and emphasise that the investment process should be accompanied by highly trained professionals.

The main obstacles to the formation of an environmentally oriented investment policy of banks are: firstly, considering green financing mainly as unjustified expenses, which is confirmed by I. Tiazhkorob *et al.* (2020); secondly, high cost of green bonds compared to traditional financial instruments, which is also pointed out by M. Karlin & O. Ivashko (2020); thirdly, an uneven approach to the taxation of debt securities transactions, which is emphasised by A. Dubko (2022); fourthly, the high cost of environmental projects and their low investment attractiveness, which N.V. Dunas (2021) agrees with; fifth, a high risk of greenwashing in the green bond market, which is studied by N.O. Dugienko & M.K. Mikhailutsa (2020), as well as F. Baldi & A. Pandimiglio (2022); sixth, a significant share of banking institutions' investments in certificates of deposit

of the National Bank of Ukraine (NBU) and domestic government loan bonds (OVDP). O.S. Vavrychuk, & A.A. Dovgan, (2021) also add the lack of a clear strategy for the economic development in Ukraine based on the concept of "green growth" and mention the low level of coordination and mutual agreement in the actions of various authorities.

Moreover, according to the statistical data of the research agency Bloomberg (ClimateScope..., n.d.) Ukraine is in the 74th place among 136 world countries in terms of investment attractiveness in energy transition projects. Subject to stabilising a complex foreign and domestic political situation, providing financial assistance by partner international donor institutions and the elimination of the above-mentioned regulatory, institutional and financial-budgetary obstacles, the Ukrainian green bond market will become a fairly effective, liquid and safe segment for Ukrainian bank investments.

Therefore, the further development of the Ukrainian green bond market will contribute to the active accumulation of funds by investors of various categories and levels with the aim of financing environmental projects, creating conditions for improving the country's investment attractiveness and solving socio-economic and environmental problems, including those resulted from the COVID-19 pandemic and the unfolding of conflicts at the international level.

● CONCLUSION

The analysis of different points of view of researchers from Ukraine, Belgium and the Philippines regarding the interpretation of the economic meaning of the concept "green bonds" made it possible to formulate a universal definition of this term as a type of debt financial instruments of the stock market with a fixed interest rate, the funds raised from which are directed exclusively to the financing of new or existing projects with specific environmental effects, which emphasises the dual focus of such securities on financial and social spheres. As far as the peculiarities of the formation of the global and Ukrainian markets for these securities is concerned, it should be mentioned that green bonds were first issued at the international level in 2007, while the attempt to issue them in Ukraine took place in 2019 and they were introduced into circulation at the legislative level as a separate class of financial instruments in 2021. Thus, the national market of green bonds is at the initial stage of development. The study of the change in the volume of the global emission of these debt financial instruments during 2007-2022 suggests that it has a rather rapid and uneven dynamics with a distinctive reduction in 2022.

Taking into account the development of the Ukrainian stock market based on the bank-centric model, the importance of the banking sector in the development of the green bond market of Ukraine has been revealed. At the same time, applying the method of hierarchy analysis, we have discovered that derivatives are the optimal tool for improving the formation of the investment portfolio by Ukrainian banks among shares in terms of innovative technologies, green bonds and derivative financial instruments, as they are the least risky and ensure the stability of the banking system. The obtained results give evidence for insufficient awareness of green bonds potential as a new investment instrument by financial institutions in contrast to global trends. The subject of further research

is the substantiation of ways to improve the investment attractiveness of the Ukrainian green bond market and the development of methods for assessing the economic, environmental and social effects of banks investing in these debt financial instruments.

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● CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Зелені облигації як перспективний фінансовий інструмент банківського інвестування в Україні

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Анотація. Банки як основні інституційні учасники ринку цінних паперів відіграють важливу роль у забезпеченні процесів зеленого інвестування, позиціонуючи себе соціально та екологічно відповідальними фінансовими установами, що підтверджує актуальність теми дослідження. Метою роботи було розкриття сутності зелених облигацій як нового фінансового інструмента на міжнародному й українському фондовому ринках та визначення перспектив їх включення до інвестиційного портфеля банків України. У ході дослідження використано загальнонаукові та спеціальні методи наукового пізнання: аналіз і синтез, індукція і дедукція, метод горизонтального аналізу, графічний метод, порівняльно-правовий метод, метод аналізу ієрархій. Уточнено трактування економічної сутності поняття «зелені облигації». Досліджено особливості становлення світового ринку цих фінансових інструментів та тренди його формування у 2007-2022 роках. Опрацьовано законодавчу базу регулювання національного ринку зелених облигацій. Встановлено переваги та недоліки включення зелених облигацій в інвестиційний портфель банків України. Визначено оптимальний інструмент удосконалення формування банківського інвестиційного портфеля на основі таких критеріїв, як ліквідність, дохідність і ризикованість, з огляду на загальнобанківські цілі та на підставі отриманих даних охарактеризовано роль зелених облигацій як потенційних інвестиційних інструментів для банків. Описано бар'єри формування зеленої інвестиційної політики банками та напрями їх подолання. Практичне значення одержаних результатів полягає в тому, що реалізація запропонованих рекомендацій щодо усунення бар'єрів для здійснення банками України екологічно орієнтованих інвестицій сприятиме пошукванню фінансування проєктів екологічного спрямування, а розроблені пропозиції з удосконалення формування інвестиційного портфеля українськими банками можуть бути використані фінансовими установами з метою підвищення їх фінансової стійкості та мінімізації ризику вкладних операцій

Ключові слова: зелене фінансування; проєкти екологічного спрямування; відновлювана енергетика; інвестиційний портфель банків; похідні фінансові інструменти; фондовий ринок