

GREEN TREASURY BOND – TOOL OF SUSTAINABLE FINANCE

Judit Szemán 

associate professor, University of Miskolc, Institute of Accounting and Finance
3515 Miskolc-Egyetemváros, e-mail: judit.szeman@uni-miskolc.hu

Abstract

Green finance means financial solutions and investments that support environmentally friendly and sustainable economic development. Green finance includes financial activities, investments, business models enable economic growth, while minimizing environmental impacts and contributing to the fight against climate change. The rise of green financial products is motivated by several social, economic and market processes. This paper examines one tool of green financing, the Green Treasury Bond issues and its potential influencing factors in European Union comparison. The supposed influencing factors are the GDP/capita, CO2 emission/capita and market rate of long-term Treasury bond. Regression analysis was used to test the relationship of these variables in 2022. The model did not prove significant connections between the dependent and the input variables. However, filtering the database from outliers weak, positive connection was detected between the economic development and the intensity of green bond funding.

Keywords: green finance, green Treasury bonds, cluster analysis, regression analysis

1. Introduction

Environmental sustainability became one of the major challenges in current year. This includes various tools to reduce the emission of gas responsible for global warming or to adapt the unavoidable climate changes like sustainable use of water resources, transition to circular farming, prevention and reduction of environmental pollution, protection and restoration of biodiversity and ecosystems, decarbonization, reducing other greenhouse gas emissions. (Hrrváth et al., 2022). “Red signal for humanity” was the main conclusion of the latest IPCC (Intergovernmental Panel on Climate Change) report (IPCC report, 2022). According to a study of the United Nations Intergovernmental Panel on Climate Change (IPCC), less than 30 years left to have a chance to slow down the climate change to a relatively accepted by scientists (+1.5 °C warming) and to prevent a sixth wave of extinction. According to an unanimous opinion of scientists, a global sustainability revolution is needed to overcome this existential crisis, which is focused on achieving “climate neutrality”. Innovation is needed in three areas to promote decarbonization:

1. technology
2. law
3. finance.

This paper is devoted to deal with the special way of financial issues. How can the societies finance the struggle against global warming? The tools to achieve this are the parts of green finance. This paper focuses one particular financial tool, the green government bond issues and compares the major terms of these issues and links the terms to the characteristics of the national economies.

2. Literature overview

2.1. Legal framework

The major elements of legal framework in international, European and Hungarian levels are the following: Paris Agreement, European Green Deal and Hungarian Climate Law.

2.1.1. Paris Climate Agreement (Paris Agreement)

The Paris Agreement, officially the United Nations Framework Convention on Climate Change (UNFCCC), is one of the most important international tools for tackling climate change. This is an international treaty that stepped into force in 2016. The agreement aims to work together globally to reduce carbon emissions and thus prevents the global average temperature from rising. Within the framework of the agreement, it is important that countries work together to reduce global carbon emissions through the transition to renewable energy sources, to reduce the effects of climate change. Each country has committed to reducing their emissions and reviewing them every five years and update their climate action. (European Council, 2023a)

2.1.2. European Green Deal

The European Green Deal is an ambitious, long-term plan to put the European Union (EU) at the forefront of tackling climate change and environmental challenges. The agreement was launched in 2019 and has five main objectives:

1. Fight against climate change: The EU aims to be carbon neutral by 2050, i.e., to emit no more carbon-dioxide than what can be removed naturally.
2. Energy and resource efficiency: The EU aims to improve energy efficiency and the use of renewable energy sources and reduce the use of raw materials.
3. Sustainable agriculture: The EU aims to make food production and agriculture more sustainable and to ensure better access to healthy food.
4. Sustainable industry: The EU aims to achieve sustainable economic growth and greener industrial processes.
5. A protected and sustainable natural environment: The EU aims to protect and maintain natural resources, including biodiversity and ecosystems. (European Council, 2023b)

2.1.3. Hungarian Climate Law

The purpose of Hungarian Climate Law is to mitigate the effects of climate change and reduce the emission of greenhouse gases (Act on Climate Protection, 2020). According to the law, Hungary must reach net-zero carbon emissions (which is also included in the European Green Deal) by 2050. The Climate Law also stipulates that public procurement must give priority to products and services that are environmentally friendly and energy efficient. It also encourages citizens and businesses to adopt sustainable lifestyles and business practices.

This law ensures that Hungary contributes to the goals of the UN Paris Agreement and reduces the effects of climate change.

2.2. Green finance

After creating the legal framework, the next question is to set goals and finance their implementation. In next decades the clean technologies develop further and the development requires investments that can be financed by the financial sector. This is why innovative financing schemes with environmental awareness should be developed by both private and public institutions.

Let's make a brief look of these tools!

2.2.1. Green loans

Loans used by companies, local governments, or other organizations to raise funds for domestic and overseas green projects are called Green Loans.

The proportion of green loans is difficult to estimate. Due to the novelty of the products, the methodology of data collection and reporting is not standardized everywhere (Kántor, 2022). So the data about the amount of outstanding are not comparable. The 'greenness' of a loan is classified by its goal, and the green goals are obscure – energy saving investment, alternative and renewable energy power plants like solar panels, afforestation, emission reduction, water supply.

In Hungary, the Hungarian National Bank (MNB) launched a green financing facility called 'Green Capital Relief Programme' (MNB, 2022) The MNB introduced a preferential capital requirement programme for credit institutions to support the growth of green financial products and to improve the energy efficiency of the Hungarian building stock. The programme's preferential regulatory treatment will be available for green housing loans granted between 1 January 2020 and 31 December 2023. The allowance covers corporate and municipal loans, as well as bonds.

Figure 1 shows the evolution of green loans from December 2020 to December 2022. (MNB, 2023)

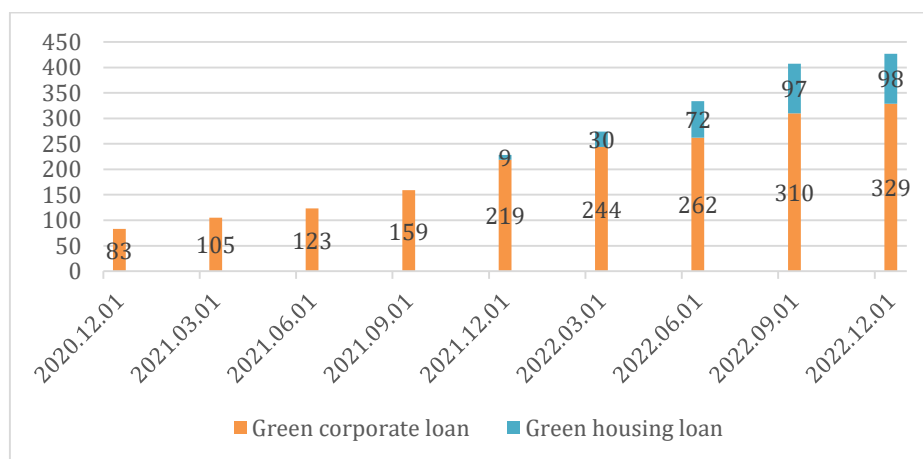


Figure 1. Development of green loans in Hungary (billion HUF)

2.2.2. Green shares

Shares are considered green if the company's core business serves environmental sustainability. There is no universal definition of these "cleantech" industries and there are many types of assessments and methodologies by which companies are evaluated (Kandrács, 2023).

2.2.3. Investment funds and private equity funds

European investment funds can be understood in three major (but not rigorous) frameworks:

1. traditional investment funds that have no sustainability purpose
2. ESG investment funds aimed at promoting environmental and social characteristics (“light green”)
3. sustainable investment funds that contribute to a social or environmental objective (“dark green”) (KPMG, 2020)

Globally, ESG (environmental, social and governance) and sustainable investment funds are growing rapidly. Almost two years have passed since the start of application of the Regulation on Sustainability-related Disclosures for investment service providers in the European Union (SFDR), which also covers green investment funds, however, investment funds’ commitment to sustainability has undergone a significant transformation recently (Magyar Közgazdasági Társaság, 2023).

In the European Union, the share of investment funds with sustainability objectives increased by 7.3% compared to the previous period.

The proportion of ESG investment funds in Hungary remains low in international comparison. The share of ESG investments within investment funds is small, only 1.6%, based on data from Q4 2022 (Böcskei et al., 2022) which is slightly decreasing compared to the previous year.

Green asset funds are also gaining ground in the supply of insurers. For these products, customers will have the opportunity to choose the asset base that suits them and thus express their sustainability preferences. The ESG ratio of insurance asset funds in Hungary stood at 8.8% in the fourth quarter of 2022. (MNB, 2023)

2.2.4. Green corporate bonds

Green corporate bonds are debt instruments whose issuers agree to use the funds raised through the securities to achieve green lending goals in accordance with international standards.

At international level, the first green bonds were issued in 2007 by the European Investment Bank and the World Bank. Green bond issues are characterized by dynamic growth in global capital markets between 2014 and 2021. The decline in 2022 is due to economic phenomena following Russia’s invasion of Ukraine, such as a surge in energy prices and inflation increase and interest rates rise. In 2022, there was a 24% year-on-year decline for theme-labelled bonds, which accounted for 5% of total debt, the same amount as in 2021. (Climate Bonds Initiative, 2023)

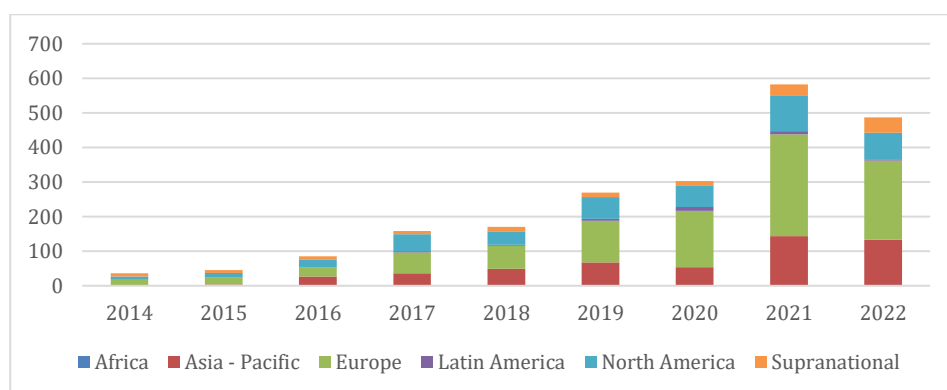


Figure 2. Green bond issuances in the world by region (billion \$)

The expansion of the green bond market in Hungary is still in its infancy compared to global markets, but its importance is growing. It is worth dividing green bond issues in Hungary into two parts: corporate green bonds and state-issued bonds.

The distribution of corporate green bond issues so far by economic sector shows a heterogeneous picture. In this way, issuers mainly raised funds to finance investment projects aimed at improving energy efficiency. Based on issue value, commercial real estate developers can be considered the most significant domestic green bond issuers, followed by companies engaged in renewable energy production and manufacturing (MNB, 2023).

The investments implemented from whole or in part from green bond issuance typically included the installation of solar panels, the construction of logistics parks with a low environmental impact, the installation of electric car charging stations, the installation of energy-saving paper production machines, the construction of an ecological waste plaque manufacturing plant, and the modernization of factory units (MNB, 2023).

Green mortgage bonds have become an important element of the market for environmentally sustainable financial instruments worldwide and in Hungary in recent years. By issuing these securities, mortgage banks undertake to hold green mortgage loans secured by energy-efficient real estate in the loan portfolio underlying the mortgage bonds for the entire life of the bond at least equal to the funds raised through the issuance (Kandrács, 2023).

3. Green government bond issues – analysis and results

Near the private green bond issue, the government green bond issue is growing rapidly in the European Union. The share of green government bonds (yellow) to total government bonds increased till 2017, but due to the Covid-crisis, the share of green government bond issues fell. 2021 saw a rapid growth, but now during the Russian aggression in Ukraine, the ratio fell again (European Environment Agency, 2023).

Table 1. The share of green bonds to total bonds issued in the EU and the share of green bonds of total bonds issued in the EU per issuer, such as corporates, governments, supranational and subnational in %

Year	Supranationals	Subnationals	Corporates	Sovereigns	All Issuers
2014	2.83	1.65	0.41	0.09	0.6
2015	1.86	2.29	0.79	0.12	0.81
2016	3.07	2.98	0.99	0.23	1.14
2017	1.73	4.14	1.98	3.98	2.7
2018	4.09	3.43	1.66	2.96	2.31
2019	3.17	10.39	4.07	1.94	4.04
2020	2.89	8.67	4.66	1.9	4.01
2021	9.16	10.76	8.31	5.32	7.8
2022	8.62	8.25	11.04	4.42	8.85

Most of the proceeds from green bond issues were spent by the state on clean transport expenditures, including the financing of rail transport costs. In addition to clean transport, the remainder of the proceeds was allocated to land use and living natural resource use, adaptation, energy efficiency, renewable energy, waste and water management.

Regarding the Hungarian government securities, Hungary announced its Green Bond Framework Program in May 2020, under which HUF 1640 billion of green bonds were issued by the end of 2022.

Most of the amount issued from 2020 to the end of 2022 was nominated in foreign currencies (more than half in euros), the HUF issues accounted for 20 percent. Green government bonds as a share of total government securities stood at 3.8 percent in Hungary at the end of 2022, only Ireland (4.55 percent) and the Netherlands (4.14 percent) achieved higher proportions in Europe (MNB, 2023).

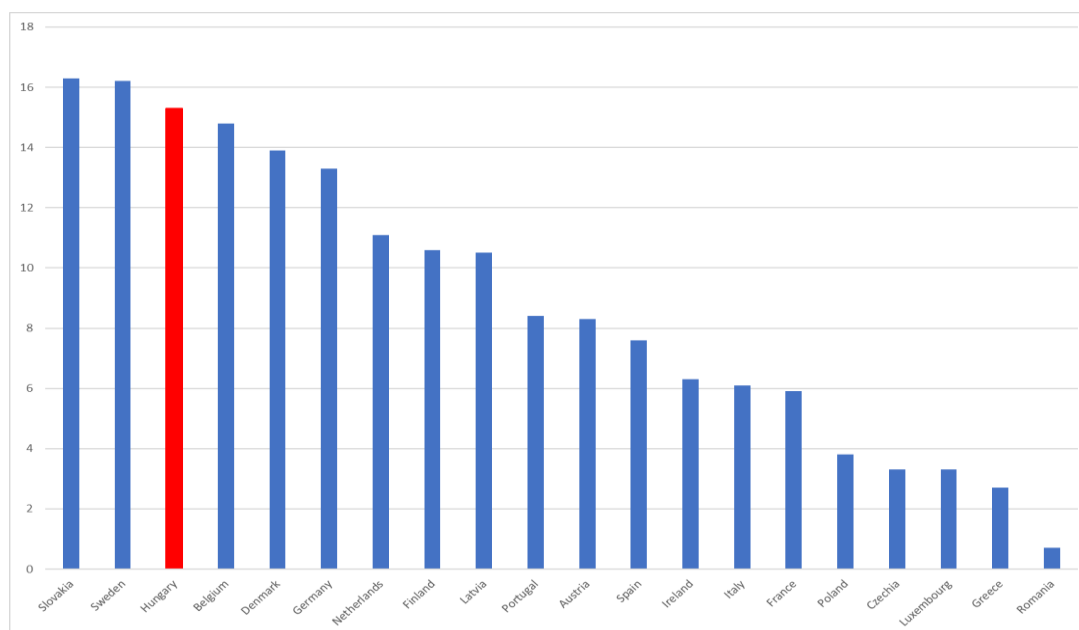


Figure 3. The share of green bonds to total bonds issued in the European Union countries in 2022 in %

Unfortunately, the figure represents only 20 countries. Lacking European Countries were Bulgaria, Croatia, Cyprus, Greece, Estonia, Lithuania, Malta, Slovenia. The number of countries is few to justify a significant relationship if the connection is weak or not linear one.

This paper focuses the potential influencing factors of the popularity of green Treasury bonds. Three hypotheses were tested with regression analysis.

H1: There is a significant and positive relationship between the GDP/capita and the share of green bonds.

The high GDP/capita indicates high development, the higher the development, the higher is the assertivity for environmental issues. Consequently, the government issues more green Treasury bonds.

H2: There is a significant and positive relationship between the yield of long-term Treasury bonds and the share of green bonds.

The green bonds are generally issued below the market rate, sometimes even at zero interest rate. The government trusts in the environmentally cautious buyers who is willing to buy the green bonds at lower expected return. The larger the market rate, the bigger is the yield advantage of the government.

H3: There is a significant and positive relationship between the CO2 emission/capita and the share of green bonds.

The input variables were collected from the website of Eurostat. The GDP/capita was measured at current market price in euro (table name: SDG_08_10). The date of long-term Treasury bond interest

rate (by Maastricht definition) was December of 2022 (table name: EI_MFIR_M). The emission was measured by tonne/capita of greenhouse gases in CO2 equivalent (table name: SDG_13_10).

3.1.1. Correlation matrix of variables

To exclude the multicollinearity among the variables, firstly the mutual independency should be tested. The correlation matrix of the input variables was the following.

Table 2. Correlation matrix of independent variables

	GDP/capita	Interest rate	emission/capita
GDP/capita	1.000		
Interest rate	-0.578	1.000	
emission/capita	0.610	-0.160	1.000

The interest rate and the emission can be considered as independent variables from each other. However, the GDP/capita negatively correlated with the interest rate and positively with the emission/capita. The strength of these relationship is weak. The macroeconomic explanation of these relationship is, that the higher the economic development, the more resistant is the economy to the inflation pressure (Bozsik, 2023). If the inflation pressure is lower, the expectation on future inflation is also lower, thus the government does not need to offer high yield for long term, risk-free investment.

The emission is high, if the economic development is high, since the developed economy is generally using more energy in absolute terms. However, the relationships are weak, so the multicollinearity is not significant.

3.1.2. Multivariate Regression of green bond funding with the GDP/capita, interest rate of long-term Treasury bond and emission/capita

Multivariate regression analysis was made to test the relationship between the share of green bond funding and the aforementioned variables. The more important figures are presented in Table 3.

Table 3. Regression statistics between share of green bond funding and the independent variables

Regression Statistics							
Multiple R	0.46	ANOVA	df	SS	MS	F	Sig. F
R Square	0.21	Regression	3	97.27	32.42	1.44	0.27
Adjusted R Square	0.06	Residual	16	361.50	22.59		
Standard Error	4.75	Total	19	458.77			
Observations	20.00						
	Coefficients	Standard Error	t Stat	P-value			
Intercept	15.28	4.48	3.41	0.00			
GDP/capita	0.00	0.00	0.32	0.75			
Interest rate	-0.79	0.77	-1.03	0.32			
emission/capita	-0.55	0.39	-1.41	0.18			

The variance of input variables explains the 21% of variance of target variables (R square), however due to the low number of observations, the real figure could be minimum 6%. This means that the explanation power of this model is weak.

The significance of ANOVA test also indicates that our model is not significant, since the significance of F probe is bigger than 0.05. Each element of the model is also not significant. The 0 value of the GDP/capita coefficient indicates that the economic development does not explain the share

of green Treasury bond finance. Note, that the relationship between the share of green funding and the interest rate and the carbon emission respectively is negative, however not significant. These ways of relationship are totally the opposite, what were the hypotheses.

What can be the reasons of the failure of this model?

The first reason can be, that not every green funding serves real green goals, the funds allocated from green Treasury bonds are used to finance the general deficit rather than spending on targeted green goals. This phenomenon is called green washing.

Greenwashing is a marketing practice in which a company, organization or product makes false or exaggerated claims about the environment, sustainability, or other positive social values to gain a better image (Szabó, 2021). The aim of such communication is usually to mislead consumers into creating a positive image of themselves and their products, when little or no real effort is made to promote sustainability. The word greenwashing comes in combination with the words “green” and “washing”, which means that companies look “green” but are “washing” their environmental efforts (Santos et al., 2023).

To prevent this, the European Union has put the most detailed and sophisticated regulation on the table. The EU’s continuously updated green taxonomy, which entered into force in July 2020, is a set of classification criteria that lists economic activities and their associated technical screening criteria, allowing to be quantified their ‘environmentally sustainable’ impact.

In addition to encouraging sustainable investment, the taxonomy focuses on preventing greenwashing, the increasingly common phenomenon of companies exaggerating their green performance or outright misrepresenting themselves.

The second reason can be the low number of cases, which makes the standard error of estimation high. However, the low figure of R square indicates that the relationship is not very strong among the variables.

The third reason can be the lack of more relevant input variables. To find them, further research is required.

Finally, the database should be filtered from the outliers. To detect the outliers, a hierarchical cluster analysis was run by the SPSS 25.0, where the clusters were created by the Euclidean distance between groups. The dendrogram of this hierarchical cluster analysis is presented in Figure 4.

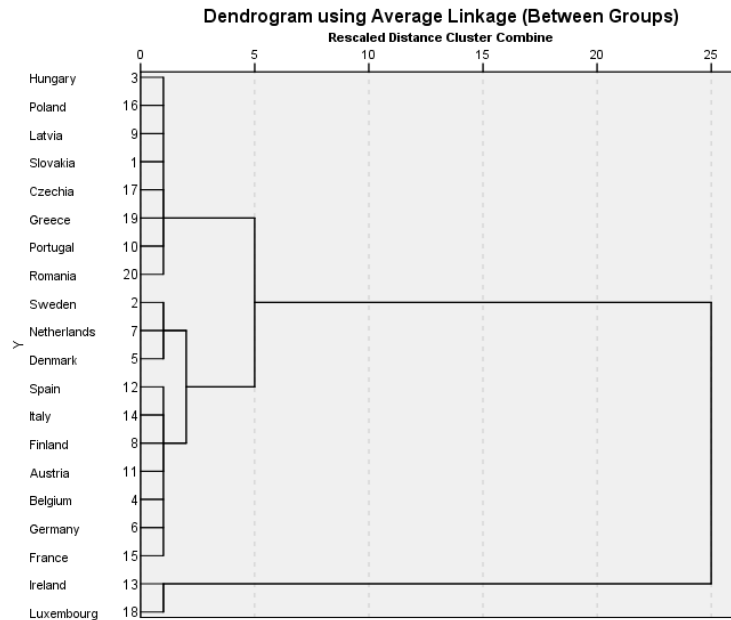


Figure 4. Dendrogram of hierarchical cluster analysis based on the analysed four variables

Based on the dendrogram, Ireland and Luxembourg were removed from the database. The scatter dot diagram between the GDP/capita and the share of green bond issue is presented in Figure 6.

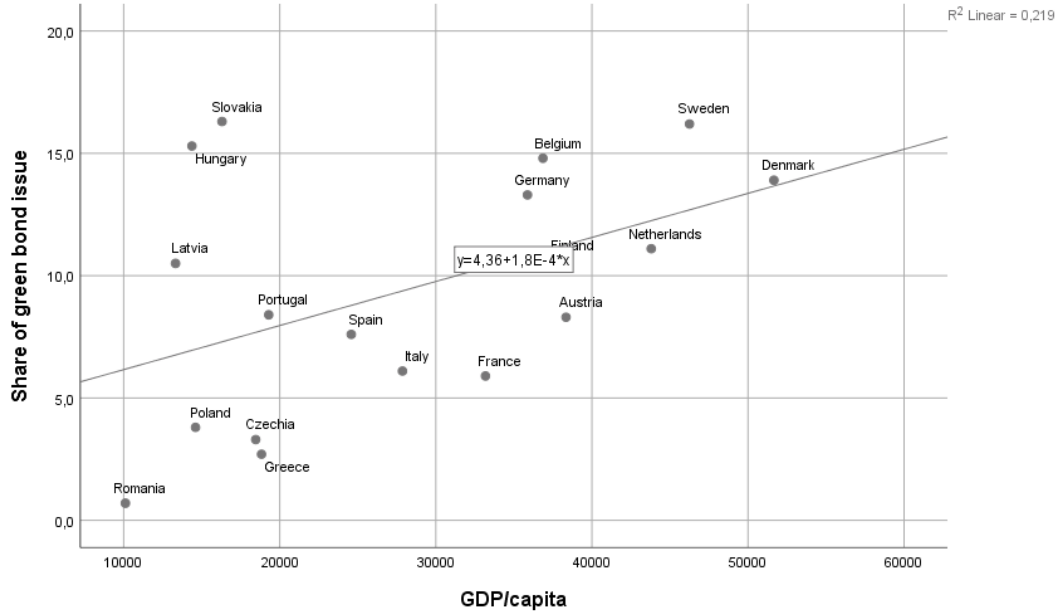


Figure 5. Graphical presentation of linkage between GDP/capita and share of green bond issue

The scatter dot diagrams in case of the remaining two variables (interest rate and emission) did not show any interpretable connection, but the linkage between economic development and intensity of green bond issue is obvious, but the connection is weak.

4. Summary

The paper tests a model, which tried to find connections between the intensity of green Treasury bond issue and some explanatory variables like GDP/capita, CO2 emission/capita and long term interest rate. Neither hypotheses can be accepted by the available 2022 data. The connections were not significant, and the way of connection was negative rather than positive in case of emission and interest rate.

However, after filtering the database from the outliers (Ireland and Luxembourg), weak connection can be detected between GDP/capita and the intensity of green funding. Thus, the economic development influences weakly the green funding.

References

- [1] Horváth, A., Takács Papp, A., Lipták, K., Molnar, L., Szűcs Markovics, K. Manafi, I., Musinszki, Z. (2022): Decarbonisation and financial performance of energy companies. *Amfiteatru Economic*, 24(61), pp. 701–719.
- [2] IPCC climate report 2022 summary: *The key findings* <https://climate.selectra.com/en/news/ipcc-report-2022>.
- [3] European Council, (2023a). *Paris Agreement on climate change*. <https://www.consilium.europa.eu/hu/policies/climate-change/paris-agreement/>.
- [4] European Council (2023b). *The European Green Deal*. <https://www.consilium.europa.eu/hu/policies/green-deal>.
- [5] Act on Climate Protection (2020). Act XLIV/20210, <https://net.jogtar.hu/jogszabaly?docid=A2000044.TV>.
- [6] Kántor, B. (2022). A könyvelés jövője, a jövő könyvelése (The future of accounting, the accounting of the future) In: Veresné, Somosi Mariann; Lipták, Katalin; Harangozó, Zsolt (szerk.) *“Mérleg és Kihívások – Fenntarthatóság” XII. Nemzetközi Tudományos Konferencia: Konferenciakötet* Miskolc-Egyetemváros, Magyarország: Miskolci Egyetem Gazdaságtudományi Kar 760 p., pp. 477–482.
- [7] MNB, (2022). *The Green Relief Programme of Hungarian National Bank* <https://www.mnb.hu/letoltes/az-mnb-zold-programja.pdf>.
- [8] MNB, (2023). Green financial report (April of 2023) <https://www.mnb.hu/letoltes/zold-penzugyi-jelentes-2022-2.pdf>.
- [9] Kandrács Cs., (2023). Financing of a sustainable economy in Hungary, opportunities and challenges: decarbonisation, green transition, sustainable finance, central bank *Pénzügyi Szemle*, 2023/1, 69(1), pp. 29–46.
- [10] KPMG, (2020). Green products in financial markets: are they worth? <https://kpmg.com/hu/hu/home/tanulmanyok/2020/06/zold-termekek-a-penzpiacon-megeri.html>.
- [11] Magyar Közgazdasági Társaság, (2023). *Sustainability in stock markets and in the corporate sector Online Conference*, 17/05/2023. <https://www.youtube.com/watch?v=UBZ-plE3mho&t=3894s>.
- [12] Böcskei E. –Vértesy L., (2022). Evaluability aspects of green investments and funds *Controller Info*, 10(3), <https://doi.org/10.24387/CI.2022.3.3>
- [13] Climate Bonds Initiative (2023). <https://www.climatebonds.net/market/data/>
- [14] European Environment Agency, (2023) https://www.eea.europa.eu/data-and-maps/daviz/percent-age-of-green-bond-issuances-1#tab-chart_5.

- [15] Bozsik, S., (2023). What are the reasons of the Hungarian inflation. In: Pál Zsolt: *Building up financial literacy*. Fintelligence, ISBN 978-615-01-8423-4.
- [16] Szabo, S., Webster, J., (2021). Perceived Greenwashing: The Effects of Green Marketing on Environmental and product perceptions. *Journal of Business Ethics*, 171(4), pp. 719–739.
- [17] Santos, C., Coelho, A., Marques, A. (2023). A systematic literature review on greenwashing and its relationship to stakeholders: state of art and future research agenda. *Management Review Quarterly*, <https://doi.org/10.1007/s11301-023-00337-5>