Sovereign Sustainable Bond Market – Positioning and Effects

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Abstract. **The sustainable bond market emerges in 2007-2008 but significantly impacts capital markets after 2015. It can be argued that one of the reasons for its development is due to the issuances from supranational financial institutions, governments, and other public sector organizations. This article focuses on sovereign bonds issued for sustainable development, covering four main themes: green bonds, social bonds, sustainability bonds, and sustainability-linked bonds. Using methods of descriptive statistics, analysis of variance and correlation-regression analysis, the article examines the position of sovereign bonds in the sustainable bond market and the achieved outcomes in the environmental and social spheres in issuing countries. The application of the methodology reveals an increasing share of sovereign bonds in the sustainable debt segment, along with a statistically significant relationship between thematic sovereign bond issues and the overall volume of thematic debt. Positive changes in the indices measuring the sustainable development of the countries suggest a policy of increasing the relative share of government securities with a thematic focus in the overall government debt market.**

Keywords: sustainable bond market; sovereign issues for sustainable development; green bonds; sustainability-linked bonds.

I. INTRODUCTION

The topic of sustainable development with the complex of environmental, social, and economic problems is increasingly entering every sphere of public life. This happens at the same time with digitalization, which expands the opportunities to achieve a greater level of stability by introducing 'smarter' processes [1]. In turn, financing the transition to sustainability is an integral part of policy agendas at national, regional and global levels over the past few years [2]. One of the mechanisms used in this context are debt securities. For their launch, a major role is played by international development banks, such as the European Investment Bank, which issued 'climate responsible bonds' (CABs) in 2007, and the World Bank with the green bonds issued in 2008 to meet the specific investment demand of Scandinavian pension funds [3]. The subsequent numerous initiatives and agreements lead to an exponential increase in the volumes of green bonds issued and the application of their model for the creation of other thematic financial instruments, such as social bonds, sustainability bonds, etc. Factors contributing to this development include the adoption of the Green Bond Principles in 2014, the late 2015 Paris Climate Agreement, and the UN Summit of September 2015, among others. The formation of the sustainable bond market is also related to the natural expansion of the issuer base to the private sector, local authorities, etc., to the extension of the geographical scope and to the diversification of the currency denomination of the newly issued bonds. Thus, by the end of the third quarter of 2023, the cumulative volume of the so-called GSS+ debt – comprising green bonds, social bonds, sustainability bonds, sustainability-linked bonds (SLBs) and transition bonds, has reached 4,2 trillion USD, and new issuance is now stabilizing at 5% of total debt issuance [4]. Sovereign thematic bonds have a relatively late appearance on the market – towards the end of 2016 with the green issue of Poland, but subsequently their share has seen a significant growth [5], which is an indicator of increasing commitment of the public sector to financing environmental and social problems.

Recently, in business and scientific circles, there has been a growing research interest in the sustainable debt market and the role and place of green and other thematic supranational, sovereign, and sub-sovereign securities. Studies on sovereign debt for sustainability are scarcer and more recent due to shorter dynamic data series. However, highlighting the emergence of sovereign green issues in the European Union and the subsequent rapid growth of the segment, some authors investigate the impact of sovereign green bonds in member countries on mitigating country risk and developing local green debt markets [6] - [7]. In IMF working papers, with the emphasis on the recent start of the market, the presence of so-called sovereign *greenium* is sought – i.e., the positive green premium or lower yield compared to similar

conventional bonds [8]. In World Bank reports, with the presumption of the role of states through regulatory frameworks and bond issues for the realization of green goals and channelling the financing of sustainable activities, a strong correlation is demonstrated between GDP per capita, on the one hand, and the share of green and social bonds in total public debt, on the other [9].

From the review of publications on the topic, it is found that the research is primarily directed towards green bonds, leaving the impact of sovereign GSS+ bonds as a whole on certain aggregate indicators insufficiently studied and quantified.

The current work focuses on the study of the correlation between the volume of sovereign GSS+ bonds and the volume of the total sustainable debt market. It also aims to initiate analyses regarding the presence of a statistically significant dependence between sovereign issues and changes in macro indicators and indices related to the sustainable development of countries.

II. MATERIALS AND METHODS

The study uses data from the annual and interim reports of the Climate Bonds Initiative [10] on the state of the sustainable debt market, and especially the systematized information by year from the 2022 report [11]. Separate analyses also incorporate data from the World Bank on GDP by country [12], as well as data from the UN's SDS Network for the SDG indices [13]. The calculations are performed using the capabilities of the statistical toolbox in MS Excel™.

Data for new issue thematic bonds (GSS+ bonds) are presented by year from 2016 (the start of the sovereign segment) to 2022, due to the lack of data for the entire year 2023 at the time of the study. Sovereign bonds are separated from all themes and their relative share is calculated. Only central government issues are included, excluding sub-sovereign issues, as well as issues by other public-private sector institutions and state-owned enterprises. The working algorithm is as follows:

1) The dynamics of the thematic debt market and the dynamics of sovereign issues, both in general and by individual themes, are investigated.

2) Regression and correlation analysis are applied to establish the existence of a dependence between the dynamics of sovereign issues and the dynamics of the entire sustainable debt market.

3) In order to establish the presence of a statistically significant influence of thematic sovereign bonds on the sustainable development of countries, a macroeconomic indicator measuring comprehensive improvement in environmental, social, and economic development is chosen. As such, the preferred indicator is the Sustainable Development Goals (SDG) index. Since the effect of financing through bonds occurs after a certain time lag, only thematic sovereign issues until the end of 2021 are taken into account, and their relative volume compared to the country's GDP for 2021 is calculated. The correlation between this indicator and the change in the country's SDG index for 2022 compared to 2015 is studied, first applying the analysis of variance (ANOVA) to establish a statistically significant influence, and then making more precise conclusions through the correlation-regression method. Specifically, for the application of the ANOVA,

four groups of countries are formed – randomly selected countries without GSS+ bond issues, countries with such issues up to 1% of GDP, countries with sovereign issues of thematic bonds from 1 to 3% of GDP, and countries with issues over 3% of GDP.

III. RESULTS AND DISCUSSION

Firstly, the dynamic analysis of the sustainability debt market as a whole and in particular the sovereign segment shows ascending trends with a certain decrease in the volume of total issues and retention of growth in the sovereigns in 2022, as a result of geopolitical catalysts (Fig. 1 (a)). At the same time, for the period, an increase in the number of issuer countries (a total of 43 by the end of 2022) and diversification of individual thematic instruments is established (Fig. 1 (b)). In 2019, the issuance of social bonds and sustainability bonds begins (with the allocation of funds for both environmental and social purposes), and in 2022, Chile and Uruguay initiate the sovereign SLBs bonds, where coupon payments are tied to the achievement of pre-set sustainability goals. At the end of the period, the cumulative volume of issued sovereign bonds reaches 324,2 billion USD from a total of 43 countries, 25 of which have more than one issue. Therefore, regardless of the later appearance of sovereign thematic debt, its stable growth is evident and, in parallel with this – a substantial increase in the volumes of the entire sustainable debt market. From here, the hypothesis can be set for the presence of a catalytic effect of the sovereign GSS+ bonds on the GSS+ debt market as a whole.
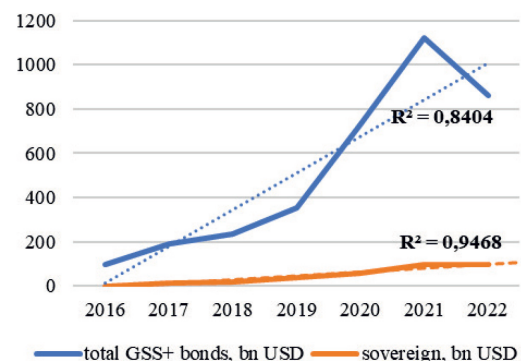

Fig. 1. (a) Dynamics of issues of GSS+ bonds in general and sovereign GSS+ bonds for the period 2016 – 2022
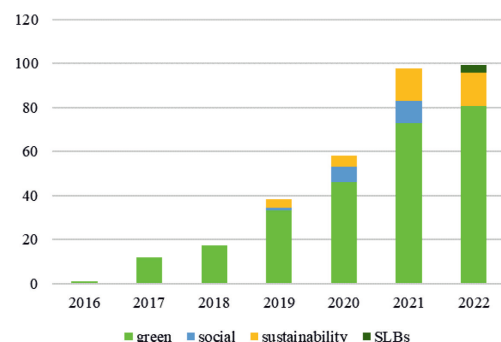

Fig. 1. (b) Dynamics of sovereign GSS + issues by individual themes for the period 2016 – 2022 in billion USD

Secondly, to establish the influence of sovereign issues on the entire thematic debt market, a regression and correlation analysis is applied, the results of which are presented in Table 1.

TABLE 1 RESULTS FROM REGRESSION-CORRELATION ANALYSIS FOR THE INFLUENCE OF THE TOTAL VOLUME OF ISSUED GSS+ SOVEREIGN BONDS ON THE ENTIRE GSS+ BOND MARKET

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0,9678					
R Square	0,9367					
Adj. R Square	0,9240					
Standard Error	107,8176					
Observations	7					
ANOVA						
	df	*SS*	*MS*	*F*	*Signif. F*	
Regression	1,0000	859535,20	859535,20	73,9409	0,0004	
Residual	5,0000	58123,13	11624,63			
Total	6,0000	917658,34				
	Coefficients	*Stand. Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	76,3662	64,9954	1,1749	0,2929	-90,7098	243,4422
X Variable 1	9,4240	1,0960	8,5989	0,0004	6,6068	12,2413

The coefficient for X Variable 1 (the volume of sovereign GSS+ bond issues) is 9,42. This means that for every unit increase in the volume of sovereign GSS+ bond issues, the total volume of GSS+ bond issues increases by 9,42 units, assuming all other factors remain constant. The P-value for X Variable 1 is almost zero, indicating a significant relationship between the volume of sovereign GSS+ bond issues and the total volume of GSS+ bond issues. The R-squared value is 0,9367, or about 93,67% of the variation in the total volume of GSS+ bond issues can be explained by the volume of sovereign GSS+ bond issues. The F statistic is 73,94 and the Significance F is very small (0,00035086), i.e., the model is statistically significant. Therefore, there is sufficient evidence that the volume of sovereign GSS+ bond issues has a significant impact on the total volume of issued GSS+ bonds.

The last and most important study is based on specific country data (Table 2). The general overview shows that there is a considerable differentiation in the absolute size and relative share of sovereign thematic debt. For example, by the end of 2021, the cumulative size of issues is under 100 million USD in Lithuania, Nigeria, and Ghana, and over 30 billion USD in France, Germany, the United Kingdom, the USA, and Chile. The lowest relative share to GDP is in Nigeria and Ghana (respectively about 0,02% and 0,05% of GDP for 2021), and the highest in Chile (10,5%) and Benin (almost 4%).

TABLE 2 SOVEREIGN GSS+ BONDS ISSUERS TILL 2021 (ANDORRA AND SEYCHELLES EXCLUDED DUE TO MISSING SDG INDEX DATA)

Country	cumulative volume of sovereign bond issuances up to 2021 in bn USD	GDP 2021 in bn USD	share of sov. GSS+ bonds issued until 2021 relative to GDP 2021	SDG index 2015	SDG index 2022	change of SDG index
Chile	33,4	316,58	10,55%	76,05	78,22	2,85%
Benin	0,7	17,69	3,96%	47,78	55,12	15,36%
Belgium	17,1	600,75	2,85%	77,94	79,46	1,95%
Hong Kong	9,8	369,2	2,65%	68,92	72,01	4,48%
Hungary	4,8	182,09	2,64%	78	79,39	1,78%
Slovenia	1,4	61,83	2,26%	79,12	81,01	2,39%
Luxemburg	1,8	85,58	2,10%	76,13	77,65	2,00%
France	58,8	2960	1,99%	79,84	82,05	2,77%
Guatemala	1,7	86,05	1,98%	58,01	59,38	2,36%
Peru	4,4	223,72	1,97%	69,33	71,66	3,36%
Serbia	1,2	63,1	1,90%	73,61	77,34	5,07%
Latvia	0,7	39,44	1,77%	78,47	80,68	2,82%
Netherland	17,3	1030	1,68%	78,48	79,42	1,20%
Thailand	7,7	505,57	1,52%	72,39	74,74	3,25%
Ireland	7,8	513,39	1,52%	79,28	80,15	1,10%
Fiji	0,05	4,296	1,16%	69,41	72,88	5,00%
Italy	24,4	2160	1,13%	76,88	78,79	2,48%
United Kingdom	33,7	3140	1,07%	80,43	81,65	1,52%
Germany	42,7	4280	1,00%	81,92	83,36	1,76%
Spain	9,3	1450	0,64%	77,88	80,43	3,27%
Poland	4,3	681,35	0,63%	79,02	81,8	3,52%
Mexico	7,1	1310	0,54%	66,85	69,71	4,28%
Indonesia	6,1	1190	0,51%	64,7	70,16	8,44%
Ecuador	0,4	106,17	0,38%	69,93	70,43	0,72%
Uzbekistan	0,2	69,6	0,29%	66,31	71,15	7,30%
Malaysia	0,8	373,83	0,21%	67,78	69,85	3,05%
Egypt	0,8	424,67	0,19%	66,39	69,62	4,87%
Colombia	0,5	318,51	0,16%	68,79	70,05	1,83%
Lithuania	0,1	66,8	0,15%	74,91	76,81	2,54%
USA	33,7	23320	0,14%	73,99	75,91	2,59%
South Korea	2,6	1820	0,14%	76,95	78,06	1,44%
Ghana	0,042	77,59	0,05%	60,06	61,08	1,70%
Nigeria	0,1	440,84	0,02%	52,46	54,27	3,45%

The application of the ANOVA for the influence of the scales of the thematic government debt on the changes in the SDG Index leads to the results presented in Table 3. From them, it can be seen that the F-statistic is 5,60 with F-crit. equal to 2,87, and the p-value is 0,003, from which it follows that the hypothesis of equality of SDG index between the groups is rejected. Therefore, there are statistically significant differences between the groups of countries according to the share of GSS+ bonds to GDP.

TABLE 3 RESULTS FROM THE ANOVA FOR THE INFLUENCE OF THE SHARE OF ISSUED GSS+ BONDS UP TO 2021 BY COUNTRIES ON THE CHANGE IN THE SDG INDEX FOR THE PERIOD 2015-2022

Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
no sovereign GSS+	6	0,1214	0,0202	0,0002		
GSS+ debt up to 1% of GDP	14	0,4900	0,0350	0,0005		
GSS+ debt from 1% to 3% of GDP	17	0,4527	0,0266	0,0002		
GSS+ debt over 3% of GDP	2	0,1822	0,0911	0,0078		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,0084	3	0,0028	5,6005	0,0030	2,8742
Within Groups	0,0176	35	0,0005			
Total	0,0260	38				

The ANOVA is based on the grouping of countries by intervals of thematic debt to GDP. Through regression-

correlation analysis, the strength and closeness of the dependence between the relative share of GSS+ bonds and changes in the sustainable development index by individual countries can be specified. The results of the applied one-factor regression and correlation are presented in Table 4 and Fig. 3.

TABLE 4 RESULTS FROM REGRESSION-CORRELATION ANALYSIS FOR THE INFLUENCE OF THE SHARE OF ISSUED GSS+ BONDS UP TO 2021 BY COUNTRIES ON THE CHANGE IN THE SDG INDEX FOR THE PERIOD 2015-2022

| SUMMARY OUTPUT							
Regression Statistics							
Multiple R	0,1756						
R Square	0,0308						
Adj. R Square	0,0047						
Stand. Error	0,0261						
Observations	39						
ANOVA							
	df	*SS*	*MS*	*F*	*Signif. F*		
Regression	1	0,0008	0,0008	1,1777	0,2848		
Residual	37	0,0252	0,0007				
Total	38	0,0260					
	Coefficients	*Stand. Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 68%*	*Upper 68%*
Intercept	0,0288	0,0051	5,6246	0,0000	0,0184	0,0391	0,0236	0,0339
X Variable 1	0,2507	0,2310	1,0852	0,2848	-0,2173	0,7186	0,0178	0,4835
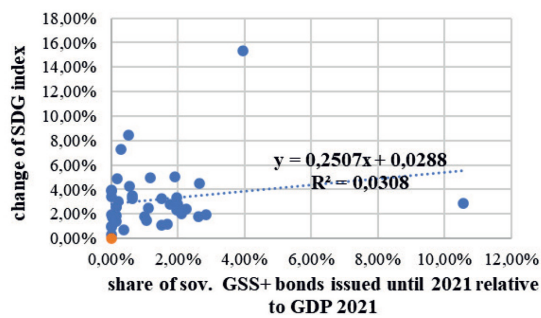
Fig. 3. Distribution of the countries included in the model according to the relative share of issued sovereign GSS+ bonds and change in the SDG index for 2022 compared to 2015

The value of the correlation coefficient R is 0,18, which indicates a weak positive correlation. The coefficient of determination (R Square) is 0,0308, i.e., 3% of the variation in the sustainable development index can be explained by the issues of sovereign GSS+ bonds. The adjusted coefficient of determination (Adjusted R Square) is 0,0047, which means that after adjusting for the number of independent variables, the influence of sovereign bonds (GSS+ bonds) on the sustainable development index is only 0,5%. Other factors, beyond sovereign issues, likely have a stronger influence on the index. An important circumstance in studying the factor influence of sovereign GSS+ bonds is their longer maturity, the need for time to absorb the financing, and for the effects to manifest, including through changes in the sustainability indices.

The complex linking of the results of the applied analyses gives reason to draw a conclusion about the catalytic role of government debt for sustainable development as an incentive for increasing the scale and relative share of the issued GSS+ bonds in each individual country, and hence the realization of the goals for sustainable development. Given the still insignificant share of thematic compared to conventional government debt, there are substantial reserves for increasing the relative share of GSS+ bonds at the expense of reducing government securities for general financing without increasing the total debt burden.

IV. CONCLUSIONS

The conducted studies have shown that financing the transition to sustainability and comprehensive integration of economic development with ecological balance and social prosperity is becoming a priority in the debt policy of more and more countries. Following the debut of the Republic of Poland, over 40 other countries have issued bonds, the proceeds of which are specifically intended for environmental, social, or mixed projects, contributing to the achievement of sustainable development goals. The application of the methodology also proved the significant influence of sovereign thematic bonds on the development of the GSS+ debt market and the presence of a weak but positive influence on the sustainable development index. Research on the topic remains open in connection with the increase in the share of government debt for sustainability, due to the reflection of the effects of its absorption further in time and the necessity to encompass the influence of other factors, such as: GSS+ bonds of local authorities, GSS+ bonds of other issuers – banks and non-financial companies, the actual allocation and use of proceeds, control exercised, normative changes and regulations, etc.

REFERENCES

[1] D. Serafimova, A. Andreeva, and V.Banabakova, "Digitalization of Business and Public Organizations—Communication Problems with IT Companies and Possible Solutions," in *Education, Research and Business Technologies. Smart Innovation, Systems and Technologies*, vol. 276, Ciurea, C., Boja, C., Pocatilu, P. and Doinea, M., Eds., Springer, Singapore, 2022, p. 352.

[2] V. Tsonkova, "Sustainable Finance or (R)evolution of Finance in the Context of Sustainability," *Socio-Economic Analyses,* vol. 15, no. 2, pp. 173-187, 2022.

[3] International Bank for Reconstruction and Development / The World Bank, "What are Green Bonds," 2015. [Online]. Available: https://documents1.worldbank.org/curated/en/400251468187810398/pdf/99662-REVISED-WB-Green-Bond-Box393208B-PUBLIC.pdf. [Accessed 4 February 2024].

[4] C. Harrison, "Sustainable Debt Market Summary Q3 2023," November 2023. [Online]. Available: https://www.climatebonds.net/files/reports/cbi_susdebtsum_q32023_01e.pdf. [Accessed 4 February 2024].

[5] V. Tsonkova, "The Sovereign Green Bond Market in the European Union: Analysis and Good Practices," *Knowledge International Journal,* vol. 30, no. 1, pp. 165-172, 2019.

[6] S. Dell'Atti, C. Di Tomasso and V. Pacelli, "Sovereign Green Bond and Country Value and Risk: Evidence from European Union Countries," *Journal of International Financial Management & Accounting,* vol. 33, no. 3, pp. 505-521, January 2022.

[7] W. Lewandowski and A. Smoleńska, "Member States Sovereign Green Bond Issuance and the Development of Local Green Bond Markets in the EU," in *Greening the Bond Market . EBI Studies in Banking and Capital Markets Law*, D. Ramos Muñoz, and A. Smoleńska,, Eds., Palgrave Macmillan, Cham., 2023, pp. 51-77.

[8] S. Ando, C. Fu, F. Roch and U. Wiriadinata, "How Large is the Sovereign Grenium?," *IMF Working Papers,* vol. 2023, no. 080, 7 April 2023.

[9] World Bank, "Spotlight 5.1: Greening capital markets: Sovereign sustainable bonds," in *World Development Report 2022: Finance for an Equitable Recovery*, World Bank, 2022, pp. 241-248.

[10] "Climate Bonds Initiative," 2024. [Online]. Available: https://www.climatebonds.net/resources/reports. [Accessed 4 February 2024].

[11] C. Michett, N. Chouhan, C. Harrison and M. MacGeoch,

"Sustainable Debt. Global State of the Market 2022," April 2023. [Online]. Available: https://www.climatebonds.net/files/reports/cbi_sotm_2022_03e.p df. [Accessed 4 February 2024].

[12] The World Bank, "https://data.worldbank.org/," [Online]. Available: https://data.worldbank.org/. [Accessed 4 February 2024].

[13] Sustainable Development Goals Transformation Center, "https://sdgtransformationcenter.org/," [Online]. Available: https://sdgtransformationcenter.org/. [Accessed 4 February 2024].

[14] V. Tsonkova, „Sustainable Finance or (R)Evolution of Finance in the Contex of Sustainability," *Socio-Economic Analyses,* том 15, № 2, pp. 173-187, 2022.