AN ANALYSIS OF THE IMPACT OF SUSTAINABILITY EFFORTS ON THE GOVERNMENT BOND MARKET

Regina Bodó[1]

ABSTRACT

Sustainable development, the ESG framework (environmental, social and governance factors) and green finance are of growing importance in light of the increasing risks and costs stemming from climate change. This study examines how countries' ESG performance influences the yields on their government bonds. Although ESG factors are often examined at the corporate level, they are also relevant at the country level, though less frequently researched. Due to their better ESG performance, the government bonds of more developed countries may appear safer, thus requiring a lower risk premium from investors. According to the hypothesis of the study, the higher ESG performance of the OECD countries is associated with lower bond yields. Based on a panel regression analysis covering the period 2002–2020, certain ESG factors had a significant negative impact on yields, with the environmental factor having a particularly significant effect. Although macroeconomic factors continue to have the greatest impact on yields, it is also important to take ESG factors into account during the risk analysis.

1   INTRODUCTION

One of the greatest problems of our time is air pollution, which poses a cross-border challenge for both developing and developed countries. The deterioration of the environment and the rise in average temperatures can be attributed to the increasing volume of greenhouse gases released into the atmosphere, particularly carbon dioxide emissions. Air pollution in many European cities frequently exceeds levels considered safe for human health (Németh–Durkó, 2020). People have always faced droughts and floods, as well as unknown epidemics, mass mi-

---
1   *Regina Bodó* Assistant Lecturer, University of Szeged, Faculty of Economics and Business Administration. E-mail: bodo.regina@szte.hu.

gration, food shortages and state bankruptcy; however, the frequency and intensity of these events are increasing to an unprecedented extent. Although sustainability is most often examined from an environmental perspective, social risks, such as growing inequalities, may also become central issues, as these exacerbate poverty and social tensions, thereby hindering sustainable development (Semet, 2020). As a result of the crises mentioned above, an increasing number of people are addressing the issue of sustainability, which has now become an integral part of economic thinking. The situation may also be described as unsustainability, which encompasses all previous considerations (Deák–Sárvári, 2023).

The UN World Commission on Environment and Development published its report `Our Common Future' as early as 1987, in which it called for a new era of growth that is environmentally sustainable. The 1987 Brundtland Report explains that sustainable development is important because we have a responsibility to future generations; we must live today in such a way that future generations can live in conditions at least as good as our own. However, this would mean that we can only meet our needs within the limits set by the environment. At present, however, we do not satisfy our needs based on these limits, but rather adapt them to our capabilities. This practice, however, may become unsustainable in the long term. For this reason, a UN committee has likened sustainable development to a three-legged stool. The three legs represent the economy, the environment and society. One of the most widely used indicator systems for measuring this is ESG, which covers Environmental, Social and Governance aspects (Dudás–Naffa, 2020). ESG rating is a scoring framework in which the performance of companies, industries or countries in relation to ESG factors is measured and assessed, and a combined ESG score is then assigned. Market participants use these ESG indices to assess the expected financial and capital market impacts of the market, and then make decisions based on their investment appetite and ESG risk exposures (Hajdu et al., 2023).

The ESG approach, sustainable development and sustainable finance have recently received increasing and growing attention in financial decision-making (Drempetic et al., 2020; Dudás - Naffa, 2020; Hajdu et al., 2023; Szepesi, 2020). The reason for this is the link between pollutant emissions and economic growth, namely the role of financial development in stimulating the economy (Németh–Durkó, 2020). Improving energy efficiency is crucial, as it not only supports the achievement of international climate neutrality targets but also directly contributes to improving countries' international competitiveness. Increased competitiveness leads to a more stable economic position, which in turn results in lower risk premiums (Holczinger–Sárvári, 2025). Environmental, social-ethical and (corporate) governance considerations are collectively referred to as non-financial performance (Tóth et al., 2021).

The problem, however, is that today more than 1,000 ESG indices are published by various financial service providers, investment, research and rating firms, and individual stock exchanges, among which consolidation has not yet taken place. This, however, complicates comparability and decision-making processes. For this reason, since 2010, the ERM Sustainability Institute has published a `Rate the Raters' report, which assesses the quality of ESG data providers (Hajdu et al., 2023).

The significance of this research lies in the fact that, whilst the majority of the literature has so far focused solely on corporate-level sustainability, these indicators are equally relevant at the country level. Naturally, at the country level, each dimension seeks to emphasise something entirely different. By assessing ESG factors, a comprehensive overview can be gained of a country's sustainability efforts, including its strengths and weaknesses (Dudás–Naffa, 2020). This study seeks to answer the question of whether there is a significant relationship between a country's ESG performance and government bond yields. Numerous studies have already examined government bonds; however, the majority of these studies have focused solely on macroeconomic relationships. It was already apparent at that time that it is not always advisable to rely solely on factual data (for example, in the case of the crisis in the southern Eurozone countries)[2]. Whilst it was previously sufficient to examine public debt and the budget deficit when pricing government bonds (Ardagna et al., 2007), since the global financial crisis, it has become apparent that the relationship between yield spreads and macroeconomic factors has been steadily weakening (Capelle–Blancard et al., 2019). It was then that the importance of government indicators in the management of sovereign bonds came to the fore, particularly following the case of Greece (Drut, 2010). It is not enough to focus solely on fundamental macroeconomic factors; the importance of risk, creditworthiness and quality has also come to the fore (Attinasi et al., 2009). This research aims to highlight the importance of these factors; thus, one of the main questions is what factors that determine the yield on a country's government bonds, i.e. whether the country's environmental, social and governance performance influence the yield on government bonds.

---

2   https://www.weforum.org/agenda/2015/03/what-caused-the-big-spreads-on-eurozone-bonds/.

2. THEORETICAL BACKGROUND

2.1   Sustainability

The past two decades demonstrate why it is important to discuss sustainability at both the economic and national levels. Kocziszky (2023) points out that we live in a world that is far more unpredictable than before, where markets are unable to manage the turbulence caused by crises, pandemics and wars on their own, or can only do so with a delay. Therefore, a new, sustainable market economy is needed, with a value system based on faith, family, integrity, justice, social sensitivity and work. In a sustainable market economy, this value system is at the centre, supported by four pillars: a sustainable institutional framework, economic sustainability, resource sustainability and social sustainability. Sustainability cannot be achieved through market mechanisms alone; it requires the state to play a proactive role and perform a monitoring function. Matolcsy (2022) also listed the four aspects of sustainability: economic, social, financial and environmental sustainability. Furthermore, in the developed countries of the global economy, total factor productivity may be the main driver of growth, in which institutional, policy and cultural factors play an important role alongside the level of technology (Halmai, 2023).

The best-known methodology for measuring contributions to sustainability is the ESG framework. In the case of countries, the environmental factor reflects how successfully countries manage their natural resources (such as access to water, biodiversity, nature conservation measures, etc.), the social factor measures the country's level of social development (literacy rates, school enrolment rates, life expectancy), whilst the governance factor includes factors such as government efficiency, regulatory quality, corruption, etc. (Margaretic–Pouget, 2018).

Criticisms aimed at the ESG framework relate primarily to its definition, regulation and methodology. There is no universally accepted definition of the ESG framework, either in the Hungarian or international literature, or in practice. The European Union and its Member States have only begun to develop regulations in this area over the past few years. There is no widely accepted, uniform methodology for the production and disclosure of sustainability-related data, nor for their market valuation. Currently, there are a number of sustainability rating agencies operating, which publish various sustainability indices and ESG ratings; however, their methods differ, and their widely divergent results point to a lack of standardisation (Deák et al., 2022; Olmedo et al., 2010), resulting in heterogeneous reports and information content (T. Vőneki–Lamanda, 2020). According to Hajdu et al. (2023), the biggest problem in measuring ESG performance is not a lack of data, but rather an oversupply of tools and frameworks.

2.2 Government bonds

Perhaps one of the best financial indicators for measuring a country's financial stability is the interest rate paid on government bonds. The interest rate is influenced, among other things, by the risk of default. A country in a critical situation may have to weigh up whether it is better for it to repay the debt or to declare bankruptcy. In many cases, countries declare bankruptcy not because they are unable to repay the debt, but because they do not wish to (Alichi, 2008; Crifo et al., 2017). According to Alichi (2008), the main motive behind debt repayment is to maintain access to capital markets. However, in a democracy, one generation may choose to declare bankruptcy, regardless of the consequences this may have for future generations. Governments may borrow from capital markets for fiscal smoothing purposes. Consequently, continued access to capital markets can serve as a safeguard for countries against future shocks. With this type of debt, however, investors cannot compel the debtor to repay the debt, as is the case with traditional household or corporate loans.

Based on the literature (Attinasi et al., 2009; Crifo et al., 2017; Haugh et al., 2009), it can be stated that countries' willingness to repay debt, which can be measured by the yield spread, is influenced by three factors: the country's creditworthiness, which is reflected in its fiscal and macroeconomic positions; liquidity risk, i.e. the size and depth of the government bond market; and, finally, international risk aversion. Trends point towards a comprehensive risk assessment, in which investors also take ESG factors into account. In practice, credit rating agencies are also placing increasing emphasis on ESG considerations in their sovereign ratings. ESG risks are now explicitly included in the methodologies of Fitch Ratings, Moody's Investor Service, S&P Global Ratings, Kroll Bond Rating Agency (KBRA), DBRS Morningstar, Scope Ratings GmbH and HR Ratings[3] . ESG factors can influence a country's credit rating and, consequently, the yields on government bonds.

Sovereign debt managers are engaging in increasingly structured ESG communication, which is partly aligned with EU regulations and partly with investor demands. The Finnish debt manager, for example, directly supports institutional investors' SFDR reporting by publishing `Principal Adverse Impact' (PAI) indicators. In Hungary, the Government Debt Management Agency publishes its own ESG profile on the country's sustainability indicators and international standing, whilst the Austrian OeBFA's website provides access to sovereign ESG ratings.

---

3   https://documents1.worldbank.org/curated/en/812471642603970256/pdf/Credit-Worthy-ESG-Factors-and-Sovereign-Credit-Ratings.pdf.

In parallel, several Western European countries – Germany, France, the Netherlands, Ireland, Sweden and the United Kingdom – provide detailed, comparable information on the management of ESG risks and the environmental impact of issuances through sustainability frameworks linked to green government bond programmes, as well as regular allocation and impact reports.

2.3   Investors

A prerequisite for the successful transition of the economy is that financial markets take into account and assess the risks associated with climate change. Barberis and Thaler (2003) pointed out that financial markets had previously been described using models that assumed rational behaviour on the part of agents; however, the results made it clear that aggregate capital markets, yield trends and individual investment decisions do not reflect these characteristics. Consequently, a new approach emerged: behavioural finance, which does not assume the perfect rationality of market participants. Investors and other market participants must analyse and evaluate sustainability considerations, and the associated risks must be incorporated into risk models, return expectations and the pricing of financial products. Furthermore, experts predict a rise in the popularity of sustainable investments, particularly as Generation Y enters the investment market and in the period following the coronavirus crisis (Szepesi, 2020). The proportion of investors and investments that take ESG criteria into account is steadily increasing, which determines the long-term returns on capital investments (Hajdu et al., 2023).

On the investor side, too, a number of international initiatives have been launched with the aim of integrating sustainability goals. Examples include the Net Zero Asset Managers Initiative, the Net-Zero Asset Owner Alliance, Climate Action 100+, the Glasgow Financial Alliance for Net Zero, the Sustainable Markets Initiative, and the Principles for Responsible Investment (PRI). These initiatives indicate that global capital market participants are increasingly making their investment decisions based on long-term climate and sustainability considerations.

When assessing countries' creditworthiness, investors are increasingly taking into account their ESG performance (*Figure 1*). It is clear that most developing African countries and Asian countries do not have high ratings. In contrast, developed countries such as Canada, Australia, Japan, France, Germany and the Scandinavian countries have particularly high ESG scores. It is clear from the above that countries with developed economies also achieve better results in terms of ESG indicators. However, due to their level of development and reliability, these countries also have lower government bond yields. Based on this, it can

be assumed that the better a country's ESG performance, the lower the yield on its government bonds.

Figure 1
Map of the Global Sustainable Competitiveness Index (2025)
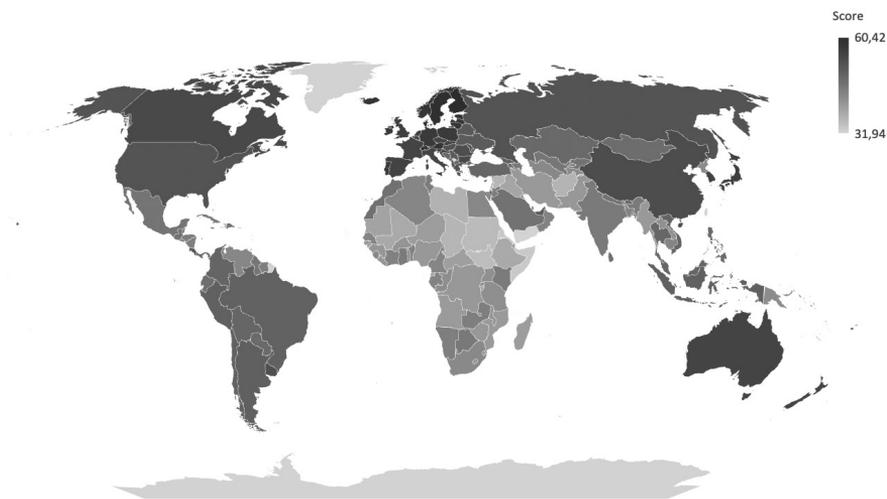
Source: edited by the author based on data from the SolAbility rating agency

2.4   Previous research in the literature

The literature contains numerous theories regarding the relationship between government bonds and ESG performance; however, these theories do not agree, and the findings are contradictory. Some authors support the view that a country's ESG factors can have a significant impact on whether that country is able to repay its debt, meaning that borrowing costs are not explained solely by traditional macroeconomic data (Crifo et al., 2017). In other words, a country with good ESG performance is also viewed more favourably by investors. In contrast, other authors argue that yield spreads depend primarily on the fundamental performance of the economy, with extra financial performance being taken into account at most as a supplementary factor (Crifo et al., 2017; Halbritter–Dorfleitner, 2015). At the same time, a country's economic performance cannot be separated from its governance factors, i.e. the 'G' pillar of ESG. Four reasons can be identified in the literature to explain the relationship between government bonds and ESG performance.

The first reason is *investors' preferences and values.* The number of investors interested in ESG performance is growing steadily. Social responsibility is also becoming increasingly important in capital markets, and investors are demanding more and more information on these topics. This may be driven by ethical or moral considerations (Capelle-Blancard et al., 2016; Olmedo et al., 2010). Consequently, investors are willing to accept a lower risk premium from countries with high ESG performance (Crifo et al., 2017). Furthermore, investors may even view a country's natural and social resources as an additional safeguard against losses when lending to a country (Capelle-Blancard et al., 2016; Margaretic–Pouget, 2018). These investors, who consider not only financial returns but also the presence of values important to them, are referred to as value-driven investors (Lippai-Makra–Kovács, 2021).

The second reason is the *link between financial and non-financial performance.* Sustainability can enhance financial performance by taking non-financial, qualitative criteria into account. This offers numerous benefits in terms of both profitability and risk management. For example, Japan has one of the highest levels of public debt relative to GDP (2026: 226.8%[4]), yet it pays lower interest rates on government bonds than the southern states with developing industries (Greece, Portugal and Italy). The quality of institutions can significantly determine how a government responds to public debt (Capelle-Blancard et al., 2016). A country's ESG score helps to capture a form of structural default risk. This is because a country's access to natural resources and the management of these resources influences the country's risk profile. This also includes the government's economic policy and whether it can generate sufficient revenue to service its debt. These factors can influence the country's ability to repay its debt in both the short and long term (Crifo et al., 2017). Attinasi et al. (2009) demonstrated that governments with relatively sound public finances can access credit on more favourable terms during a crisis, which can help them maintain the stability of the financial system, for example by managing the costs arising from bank bailouts. The 2008 crisis also highlighted how important public confidence in public finances is, and that countries must strive for fiscal balance even during good economic times. Furthermore, according to Wang and Zhao (2023), a country's regulatory framework can have a significant impact on the activities of companies operating there. One such example is the Clean Air Act, which had a significant impact on a company's reputation and financial performance. According to their findings, as regulations are tightened, companies reduce their pollutant emissions. Kandrács (2023) highlighted the importance of decarbonisation, as it improves the country's energy se-

---

4   https://www.imf.org/external/datamapper/GGXWDG_NGDP@WEO/JPN Downloaded: 11. 02. 2026.

curity and strengthens the macroeconomic structure, since the savings resulting from reduced energy imports improve the balance of payments and reduce the inflationary pressure generated by energy prices. Furthermore, reducing harmful emissions improves air quality and people's health. Industrial solutions promote innovation.

The third reason is the 'i*ndicator*' phenomenon, as a country's ESG performance can serve as an indicator of the state of its economy. According to Scholtens (2017), financial institutions should also take ecological considerations into account. Through these considerations, institutions and investors gain a more comprehensive picture of their social and economic roles. Gervich (2011) argued that environmental factors can provide an early warning, potentially foreshadowing a financial collapse in an economy even before traditional economic indicators detect it. Examples include oil consumption or per capita CO_2 emissions. According to Margaretic and Pouget (2018), good ESG performance can indicate a country's long-term sustainability, meaning that it is highly likely to be able to repay its debt in the future. A country's environmental and social resources can even act as a buffer against negative economic shocks, whilst also having a positive impact on economic growth. According to Capelle et al. (2019), countries with good ESG performance are less likely to find themselves in a near-default situation, and consequently, the yield spread on their government bonds is lower. Furthermore, they also found that the economic impact of ESG factors tends to manifest itself in the long term.

The fourth reason is the reduction of *information asymmetry.* According to Margaretic and Pouget (2018), the utilisation of natural resources and social development require cooperation with external organisations, whether other countries or private organisations. During such cooperation, ESG issues could be discussed and deliberated upon, which in turn could reduce information asymmetry even in other areas, thereby increasing trust between investors and the country. This is driven not only by shared interests but also by the alignment of objectives, thereby potentially reducing monitoring costs for both parties (Crifo et al., 2017).

Research in the literature has yielded the following findings regarding the relationship between government bond performance and ESG ratings: Kohlscheen (2007) found that countries with a presidential system are five times more likely to default than those with a parliamentary system. In his research, the author examined countries from 1976 to 2000; in other words, governance factors had already been given greater emphasis in theoretical research, but little attention had been paid to natural and social factors until now due to a lack of reliable data. According to Margaretic and Pouget (2018), there is an overall correlation between ESG indicators and the yield spread; within this, social and administrative factors are negatively correlated with the yield spread, whilst there is no correlation with the

environmental dimension. According to Capelle et al. (2019), there is a correlation overall, but the governance sector has a stronger correlation than the social and environmental sectors. Furthermore, they found that the correlation between the two variables is stronger in the eurozone than in other developed countries. In an earlier study, they argued that the environmental dimension has no impact on financial performance, whilst the governance dimension is more significant than the social factor (Capelle-Blancard et al., 2016). Crifo and colleagues (2017) concluded that ESG performance is associated with lower borrowing costs. However, the impact of ESG ratings on sovereign debt costs is only one-third of that of financial ratings. According to the work of Dudás and Naffa (2020), however, governance factors are no more significant for forecasting credit risk premiums than social or environmental factors. However, the importance of ESG indicators is not constant; in some years, different factors may be more important. According to some authors (Attinasi et al., 2009; Crifo et al., 2017; Haugh et al., 2009), however, the weight of country-specific factors is always greater than that of environmental or social factors.

Based on this, it can therefore be assumed that there is a negative correlation between a country's government bond yield and its ESG performance (Capelle-Blancard et al., 2016; Crifo et al., 2017; Margaretic–Pouget, 2018).

3   DATA AND METHODOLOGY

The study covers OECD countries. In 2022, there were 38 OECD member states; however, Costa Rica joined on 25 May 2021, so it was not included in the study. The data cover the period from 2002 to 2020, as the literature also supports the view that ESG impacts tend to materialise over the long term. Furthermore, reliable data are only available from 2002 onwards, and the data are analysed up to 2020 after filtering out anomalies caused by the coronavirus crisis.

For the analysis, primarily the yields on countries' 10-year government bonds are required. They were downloaded for each country from the LSEG (formerly Refinitiv Eikon)[5] database. Furthermore, based on the relevant literature, 13 ESG-related indicators were included in the study (*Table 1*). When selecting the indicators, those were selected that were almost universally available for most countries, whilst closely approximating the weightings used by Dudás and Naffa (2020) and Robeco (2021) {environmental factors: 20 per cent, social factors: 30 per cent, governance factors: 50 per cent}. As the literature suggests, environmental factors

---

5   https://www.lseg.com/en.

play a significant role in measuring sustainability; therefore, in our research, their weighting was increased whilst reducing that of governance factors (the weighting of social factors remains approximately the same). The source of these indicators is the World Bank's World Development Indicators (WDI) database[6].

Table 1
ESG indicators

Dimension	Indicator	Abbreviation
Environmental	Forest area (as a percentage of total land area)	Forest
	Renewable energy use (as a percentage of total final energy consumption)	Energy
	Population using safely managed drinking water services (as a percentage of the total population)	Water
Social	Ratio of female to male labour force participation (%) (data modelled based on ILO estimates)	Labour
	Primary school enrolment rate (% gross)	School
	Unemployment rate, total (as a percentage of the total labour force) (data modelled based on ILO estimates)	Unemployment
	Primary and secondary school enrolment (gross), gender parity index (GPI)	GPI
Governance	Expression of opinion and accountability: estimate	Voice
	Quality of regulation: estimate	Regulatory
	Rule of law: estimate	Law
	Government effectiveness: estimate	Effectiveness
	Control of corruption: estimate	Corruption
	Political stability and absence of violence/terrorism: estimate	Stability

Source: Source: edited by the author based on WDI (2022)

Panel regression was used to test the hypothesis, as the data form a panel data set. When analysing panel databases, the value of the dependent variable (10-year government bond yields) is estimated using explanatory variables (various ESG-related indicators) for which both cross-sectional and time-series data are available; however, the cross-sectional samples must contain the same units in every period (Wooldridge, 2010). In this case, the time-series dimension refers to the

---

6   https://databank.worldbank.org/source/world-development-indicators.

years, and the units refer to the countries, of which there are 37. In panel regression analyses, either a fixed-effects model or a random-effects model can be used.

The differences between fixed-effects and random-effects models are presented based on Wooldridge's (2018) book. In the fixed-effects model, it is assumed that the groups, i.e. the countries, have time-invariant, unobserved effects (a_i) that are related to the explanatory variables ($Cov(x_i,a_i)!=0$), so the aim is to eliminate these. Let us consider a two-variable model for each time point i:

$$y_{it} = \beta_1 x_{it} + a_i + u_{it}, t = 1,2,\dots,T \tag{1}$$

For each i, this equation is averaged over time:

$$\bar{y}_i = \beta_1 \bar{x}_i + a_i + \bar{u}_i \tag{2}$$

Since a_i is fixed and appears in equations (1) and (2), these effects can be filtered out by subtracting the period averages from each value, thus yielding a model that has been cleansed of country-specific effects:

$$\ddot{y}_{it} = \beta_1 \ddot{x}_{it} + \ddot{\mu}_{it}, \qquad t = 1,2,\dots,T \tag{3}$$

where

$$\ddot{y}_{it} = y_{it} - \bar{y}_i, \ \ddot{x}_{it} = x_{it} - \bar{x}_i, \ \ddot{\mu}_{it} = \mu_{it} - \bar{\mu}_i \tag{4}$$

In the case of multiple explanatory variables, the equation is written similarly:

$$\ddot{y}_{it} = \beta_1 \ddot{x}_{it1} + \beta_2 \ddot{x}_{it2} + \dots + \beta_k \ddot{x}_{itk} + \ddot{\mu}_{it}, t = 1,2,\dots,T \tag{5}$$

The basis for the random-effects model:

$$y_{it} = \beta_0 + \beta_1 x_{it1} + \dots + \beta_k x_{itk} + a_i + u_{it} \tag{6}$$

In the random effects model, the country-specific factor (a_i) is uncorrelated with any of the explanatory variables ($Cov(x_{itt},a_i)=0$). Estimation of β_j provided that a_i is uncorrelated with the explanatory variables, then β_j can be consistently estimated using a single cross-section: there is no need for panel data at all; however, in this case, a great deal of useful information from the other periods is ignored. The equation is solved using the generalised least squares (GLS) method.

A commonly used test for selecting the appropriate model is the Hausman test (Clark–Linzer, 2015), which compares the results of fixed-effect and random-effect models. The idea is to use random-effect estimates unless the Hausman test rejects them (Wooldridge, 2018). Based on the Hausman test, at a 5 per cent

significance level, the null hypothesis is rejected (H=105.291, p-value=0.000), so a fixed-effects model is applied.

Subsequently, by fitting a regression based on an OLS estimate to these data, our panel regression can be obtained (Wooldridge, 2010). During the regression process, two options may arise: the backward and the forward methods. Both models aim to achieve the greatest possible explanatory power; however, the backward method begins by removing the variable with the smallest effect from the full model (decomposing model), whilst the forward method begins by including the variable with the largest effect when constructing the model (constructing model) /Chung–Yeung, 2021/.

4. RESULTS

As a first step for the panel data set, the period average for each value was calculated; then analysed this data set was analysed as a linear regression using an OLS estimate. The dependent variable is 10-year government bond yields (10Y), whilst the explanatory variables are the indicators listed in *Table 1.* In this procedure, both the forward and backward methods yield the same model; thus, in this case, the analysis is independent of the method used (the same three explanatory variables were included in the model). It is important to note that the two variable selection procedures examine the effects of the variables solely from a statistical perspective; consequently, it may happen that variables which are economically justified are not included in the final model because their statistical effect is not significant. Before constructing the model, it is necessary to examine multicollinearity and autocorrelation. Based on the results of the first run, it can be concluded that whilst there is no issue with multicollinearity (Variance Inflation Factor /VIF/ values are all below 5), meaning that analysing the partial effects of the explanatory variables on the dependent variable is meaningful. However, autocorrelation is present in the data set (Durbin–Watson=1.203), meaning that the dependent variable is a time-dependent variable and explains itself. To eliminate this, the one-year lagged version of the dependent variable ($10Y_{t-1}$) has been included among the explanatory variables of the model. The one-year lagged value of the dependent variable resolved the autocorrelation problem (Durbin–Watson=1.986), meaning there is no autocorrelation in the model. Multicollinearity still causes no problem. By including the lagged dependent variable, the model becomes a dynamic panel specification, which could theoretically justify the use of GMM-based estimation. At the same time, the time dimension examined results in a relatively long panel, which mitigates the distortion of fixed-effects OLS. This study therefore employs a fixed-effects specification for the sake of methodo-

logical simplicity and comparability, whilst taking into account the limitations of the dynamic panel when interpreting the results.

Only three significant ESG factors were included in the final model: Labour, i.e. the labour force participation rate of women and men; Regulatory, i.e. the estimate of regulatory quality; and Energy, which is the share of renewable energy consumption in total final energy consumption (*Table 2*). The standardised beta indicates which variable has the strongest effect on the target variable.

Table 2
Model statistics

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics		Correlation	Variance decomposition (%)
	B	Std. Error	Beta			Tolerance	VIF	Zero–order	
constant	0.081	0.079		1.023	0.307				
Labor	−0.086	0.036	−0.109	−2.417	**0.016**	0.669	1.495	−0.324	3.531
Regulatory	−1.752	0.575	−0.120	−3.049	**0.002**	0.880	1.136	−0.184	2.209
Energy	−0.097	0.026	−0.168	−3.692	**0.000**	0.657	1.522	−0.327	5.491
$10Y_{t-1}$	0.470	0.040	0.475	11.734	**0.000**	0.826	1.211	0.576	27.367

Source: edited by the author

Of course, the model also includes the lagged value of the dependent variable. Based on this, our model can be written as follows:

$$10Y = 0,081 - 0,086 * L - 1,752 * R - 0,097 * E + 0,470 * 10Y_{t-1} \qquad (7)$$

Where 10Y denotes 10-year government bond yields, L denotes Labour, R denotes Regulatory and E denotes Energy.

All in all, it can be said that ESG factors have a significant, negative impact on the development of government bond yields; in other words, the research hypothesis has been accepted. It is important to note, however, as some authors (Crifo et al., 2017; Halbritter–Dorfleitner, 2015) have pointed out, that fundamental macroeconomic factors still have the greatest influence on the development of government bond yields; nonetheless, these ESG factors should not be overlooked either. The model's explanatory power is 38.6 per cent, meaning that 38.6 per cent of the variation in yields can be explained by the combination of the model's explanatory variables. This can be broken down using a variance decomposition procedure, in which the standardised betas and the linear correlation coefficient between each explanatory variable and the outcome variable (zero-order correlation) are multiplied. As a result, it can be seen that the largest proportion, 27.37 per cent, is

attributable to the lagged value of the outcome variable, and only 11.23 per cent is attributable to the three indicators selected by the model; of this, Labour explains 3.5 per cent, Regulatory 2.2 per cent, and Energy 5.4 per cent. These values may have a significant impact on the development of yield volatility.

5   SUMMARY AND OUTLOOK

In our research, we sought to answer the question of whether the yields on a country's government bonds are significantly correlated with their ESG ratings; in other words, whether qualitative criteria influence a country's ability to repay its debt. Literature reviews have shown that there is no consensus in this area. Many researchers argue that qualitative criteria do have an impact, whilst others contend that, for the most part, fundamental macroeconomic factors remain the most important. However, based on the literature, a negative relationship can be assumed between government bond yields and sustainability efforts. Four reasons can be put forward to explain this: investors' values and preferences, the relationship between financial and qualitative factors, the `signalling mechanism', and the reduction of information asymmetry. In our research, we have empirically demonstrated that certain environmental, social and governance factors have a significant, negative relationship with government bond yields. In other words, if a country has a higher ESG score, it is viewed as more reliable by investors, who are therefore willing to accept a lower risk premium. Although the weight and significance of these effects are still low, they should not be ignored when valuing/pricing government bonds, as, when used in conjunction with macroeconomic factors, they may be more effective in reducing the volatility of government bond yields. A further novelty of the research is that, whilst the environmental dimension has so far appeared negligible in most studies, in this case it has a significant, non-negligible impact on the valuation of government bonds. It is important to note, however, that a significant negative correlation does not necessarily imply a causal relationship in reality; it is rather a correlation.

The lack of reliable, verifiable data and the lack of regulation of the ESG framework are among the limitations of the research. The former was also highlighted by Matolcsy (2022), as one which may undermine the building of investor confidence and increase the potential for greenwashing. The latter is linked to rating agencies; a significant drawback from an analytical perspective is that each agency interprets the various dimensions differently. No two ratings are identical, so agencies often rank countries in completely different orders, and there are also discrepancies in the magnitude of their ratings. This makes it difficult to compare and evaluate countries. Last but not least, the assessments and results of most

rating agencies are not freely available; a subscription or purchase is required to access the data, which also hinders their use. In line with the research by Dudás and Naffa (2020), this study highlighted that ESG factors are not part of traditional sovereign risk ratings, but applying them in conjunction with credit ratings could effectively improve the risk analysis of government bonds. Consequently, the value-based and economic factors underlying long-term risks could be better understood. The weighting of ESG dimensions is based on considerations from the literature; thus, applying different weightings might lead to different results, which could form the basis for future research. Further objectives include extending the period under review, as the economic turbulence of recent years may have had a significant impact on the rise of sustainability goals to the fore.

REFERENCES

Alichi, A. (2008): A Model of Sovereign Debt in Democracies *SSRN Scholarly Paper* 1154328. https://papers.ssrn.com/abstract=1154328.

Ardagna, S. – Caselli, F. – Lane, T. (2007): Fiscal Discipline and the Cost of Public Debt Service: Some Estimates for OECD Countries. *The B.E. Journal of Macroeconomics*, 7(1), 1-33. https://doi.org/10.2202/1935-1690.1417.

Attinasi, M. G. – Checherita-Westphal, C. D. – Nickel, C. (2009): What Explains the Surge in Euro Area Sovereign Spreads During the Financial Crisis of 2007-09? *SSRN Scholarly Paper* 1520351. https://doi.org/10.2139/ssrn.1520351.

Brundtland, G. H. (1987): Our Common Future – Call for Action. *Environmental Conservation*, 14(4), 291–294. https://doi.org/10.1017/S0376892900016805.

Capelle-Blancard, G. – Crifo, P. – Diaye, M. – Scholtens, B. – Oueghlissi, R. (2016): Environmental, Social and Governance (ESG) Performance and Sovereign Bond Spreads: An Empirical Analysis of OECD Countries. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2874262.

Capelle-Blancard, G. – Crifo, P. – Diaye, M.-A. – Oueghlissi, R. – Scholtens, B. (2019): Sovereign bond yield spreads and sustainability: An empirical analysis of OECD countries. *Journal of Banking & Finance*, 98, 156–169. https://doi.org/10.1016/j.jbankfin.2018.11.011.

Chung, W. – Yeung, I. M. H. (2021): A two-stage regression-based benchmarking approach to evaluate school's energy efficiency in different tariff regions. *Energy for Sustainable Development*, 61, 15–27. https://doi.org/10.1016/j.esd.2021.01.003.

Clark, T. S. – Linzer, D. A. (2015): Should I Use Fixed or Random Effects? *Political Science Research and Methods*, 3(2), 399–408. https://doi.org/10.1017/psrm.2014.32.

Crifo, P. – Diaye, M.-A. – Oueghlissi, R. (2017): The effect of countries' ESG ratings on their sovereign borrowing costs. *The Quarterly Review of Economics and Finance*, 66, 13–20. https://doi.org/10.1016/j.qref.2017.04.011.

Deák, V. – Sárvári, B. (2023): A jegybanki zöld mandátum elméleti és gyakorlati aspektusai. [*Theoretical and Practical Aspects of the Central Bank's Green Mandate*] *Polgári Szemle*, 19 (4-6), 48-61. DOI: 10.24307/psz2023.1205 https://polgariszemle.hu/images/content/pdf/PSZ_191205.pdf.

Deák, V. – Tőrös-Barczel, N. – Holczinger, N. – Szebelédi, F. (2022): Fenntartható befektetések a biztosítási szektorban. [Sustainable investments in the insurance sector] *Hitelintézeti Szemle [Financial and Economic Review]*, 21(4), 103–128. https://doi.org/10.33893/FER.21.4.103.

Drempetic, S. – Klein, C. – Zwergel, B. (2020): The Influence of Firm Size on the ESG Score: Corporate Sustainability Ratings Under Review. *Journal of Business Ethics*, 167(2), 333–360. https://doi.org/10.1007/s10551-019-04164-1.

Drut, B. (2010): Sovereign Bonds and Socially Responsible Investment. *Journal of Business Ethics,* 92(1), 131–145. https://doi.org/10.1007/s10551-010-0638-3.

Dudás, F. – Naffa, H. (2020): Országszintű ESG-indikátorok szerepe a pénzügyi döntéshozatalban [*The role of country-level ESG indicators in financial decision-making*]. *Gazdaság és Pénzügy,* [*Economy and Finance*] 7(4), 450–464. https://doi.org/10.33926/GP.2020.4.5.

Gervich, C. D. (2011): Precarious Economies: Exploring the Use of Environmental Indicators to Predict Economic Instability. *S.A.P.I.EN.S. Surveys and Perspectives Integrating Environment and Society*, 4(1), 1-9. https://journals.openedition.org/sapiens/1204.

Hajdu, T. – Lukács, J. – Reizingerné Ducsai, A. (2023): A kör négyszögesítése, avagy az ESG-jelentések számszerű minősítése [*Squaring the Circle, or the Quantitative Assessment of ESG Reports*] *Pénzügyi Szemle [Public Finance Quarterly]*, 69(2), 103-122. https://doi.org/10.35551/PFQ_2023_2_6.

Halbritter, G. – Dorfleitner, G. (2015): The wages of social responsibility — where are they? A critical review of ESG investing. *Review of Financial Economics*, 26, 25–35. https://doi.org/10.1016/j.rfe.2015.03.004.

Halmai, P. (2023): Fenntartható növekedés, növekedési potenciál. A potenciális növekedés irányzatai az Európai Unióban. [*Sustainable growth, growth potential. Trends in potential growth in the European Union] Pénzügyi Szemle [Public Finance Quarterly]*, 69(1), 47-64 https://doi.org/10.35551/PFQ_2023_1_3.

Haugh, D. – Ollivaud, P. – Turner, D. (2009): What Drives Sovereign Risk Premiums? An Analysis of Recent Evidence from the Euro Area. *OECD*. https://doi.org/10.1787/222675756166.

Holczinger, N. – Sárvári, B. (2025): A zöld átmenet szerepe a Visegrádi országokban a KAYA-azonosság alapján. [*The role of the green transition in the Visegrád countries based on the KAYA identity.] Észak-magyarországi Stratégiai Füzetek [Strategic Issues of Northern Hungary]*. 22(1) 5-16. https://doi.org/10.32976/stratfuz.2025.1.

Kandrács, Cs. (2023): A fenntartható gazdaság finanszírozása Magyarországon, lehetőségek és kihívások: Dekarbonizáció, zöld átállás, fenntartható pénzügyek, központi bank. [*Financing the sustainable economy in Hungary: opportunities and challenges: Decarbonisation, green transition, sustainable finance, central bank] Pénzügyi Szemle [Public Finance Quarterly]*, 69(1), 29-45. https://doi.org/10.35551/PFQ_2023_1_2.

Kocziszky, Gy. (2023): Quo vadis, piacgazdaság? Fenntarthatósági és értékrendi kihívások, lehetséges válaszok. [*Quo vaids, Market Economy? Challenges of Sustainability and Values, Possible Responses.*] *Pénzügyi Szemle [Public Finance Quarterly]*, 69(1), 9-28. https://doi.org/10.35551/PFQ_2023_1_1.

Kohlscheen, E. (2007): Why Are There Serial Defaulters? Evidence from Constitutions. *The Journal of Law and Economics,* 50(4), 713–730. https://doi.org/10.1086/519814.

Lippai-Makra, E. – Kovács, Zs. (2021): Motivációk a nem pénzügyi információk közzététele mögött – interjús kutatás a közérdeklődésre számot tartó szervezetek kommunikációjáról. [*Motivations behind the disclosure of non-financial information - interview-based research on the communication of organisations of public interest.*] *Marketing & Menedzsment,* [*Marketing & Management*] 55(1), 55-65. https://doi.org/10.15170/MM.2021.55.01.05.

Margaretic, P., – Pouget, S. (2018): Sovereign bond spreads and extra-financial performance: An empirical analysis of emerging markets. *International Review of Economics & Finance*, 58, 340–355. https://doi.org/10.1016/j.iref.2018.04.005.

Matolcsy, Gy. (2022): A gazdasági, a társadalmi, a pénzügyi és a környezeti fenntarthatósági szempontok megjelenése a Magyar Nemzeti Bank gyakorlatában. [*The emergence of economic, social, financial and environmental sustainability considerations in the practice of the Magyar Nem-*

zeti Bank.] *Pénzügyi Szemle [Public Finance Quarterly]*, 67(3), 319-337. https://doi.org/10.35551/PFQ_2022_3_1.

Németh-Durkó, E. (2020): Környezet és pénzügyek: A pénzügyi fejlettség emissziót befolyásoló szerepe. [*Environment and finance: The role of financial development in influencing emissions.*] *Gazdaság és Pénzügy [Economy and Finance]*, 7(4), 434–449. https://doi.org/10.33926/GP.2020.4.4.

Olmedo, E. E. – Torres, M. J. M. – Izquierdo, M. A. F. (2010): Socially responsible investing: Sustainability indices, ESG rating and information provider agencies. *International Journal of Sustainable Economy*, 2(4), 442–461. https://doi.org/10.1504/IJSE.2010.035490.

Robeco (2021): Country Sustainability Ranking Update - Summer 2021: Country sustainability visibly harmed by Covid-19. Robeco Institutional Asset Management B.V. https://elitequality.org/wp-content/uploads/2022/09/325dd63882d778324dd13ad2122d8ecb_202108-country-sustainability-ranking_tcm17-31263.pdf.

Scholtens, B. (2017): Why Finance Should Care about Ecology. *Trends in Ecology & Evolution*, 32(7), 500–505. https://doi.org/10.1016/j.tree.2017.03.013.

Semet, R. (2020) The Social Issue of ESG Analysis. *SSRN Scholarly Paper* 3838372. https://doi.org/10.2139/ssrn.3838372.

Szepesi, N. J. (2020): Válságálló-e a fenntartható befektetés? ESG-részvényportfóliók válságidőszaki teljesítményének vizsgálata. [*Is sustainable investing crisis-proof? An analysis of the performance of ESG equity portfolios during times of crisis.*] *Gazdaság és Pénzügy [Economy and Finance]*, 7(4), 500-520. https://doi.org/10.33926/GP.2020.4.8

Vőneki, T. Zs. – Lamanda, G. (2020): Az ESG-kockázatokkal kapcsolatos banki közzétételek tartalomelemzése: Pillanatkép a hazai nagybankok közzétételi gyakorlatáról. [*Content analysis of bank disclosures relating to ESG risks: A snapshot of disclosure practices among major domestic banks.*] *Gazdaság és Pénzügy [Economy and Finance]* 7(4), 420–433. https://doi.org/10.33926/GP.2020.4.3.

Tóth, B. – Lippai-Makra, E. – Szládek, D. – Kis, G. D. (2021): Az ESG-információk hozzájárulása az európai bankok pénzügyi stabilitásához. [*The contribution of ESG information to the financial stability of European banks.*] *Pénzügyi Szemle [Public Finance Quarterly]*, 66(3), 440-461.

https://journals.lib.uni-corvinus.hu/index.php/penzugyiszemle/article/view/1233.

Wang, X. – Zhao, J. (2023): The green reputation: Corporate culture and environmental reputation risk. *Finance Research Letters,* 58, 104247. https://doi.org/10.1016/j.frl.2023.104247.

Wooldridge, J. M., (2010): *Econometric Analysis of Cross Section and Panel Data*, second edition. MIT Press.

Wooldridge, J. M. (2018): *Introductory Econometrics: a modern approach*. 7th. CENGAGE Learning, USA.