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# GOVERNANCE EFFECTIVENESS AND GREEN BONDS. AN EMPIRICAL EVALUATION

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ABSTRACT: The study aims to assess the relationship between governance effectiveness, measured by the Worldwide Governance Indicators, and the use of green bonds worldwide. We apply panel data models with random effects and a robust linear regression model that allows us to identify the impact of the family of variables on green bonds. We found a statistically significant correlation between the quality of a government, measured as government effectiveness, and the value of green bond issuances. Thus, it is advised under New Public Governance to increase the effectiveness of their functioning, which may contribute to greater investor interest in environmental projects.

KEYWORDS: world governance indicator, green bonds, government effectiveness, green financing

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## Introduction

The study aims to assess the relationship between the quality of public management and the use of “green financing” instruments, thus enriching the extensive research trend on this instrument. The research relates to the growing concern of negative climate change, which will cause a deterioration in nations’ quality of life and loss of material and intangible resources. Therefore, it is necessary to develop financial instruments to help reduce the adverse effects of climate change. Both public and private entities are involved in solving environmental challenges. They are looking for greener technological solutions that can help reduce global warming. To meet the ecological target of limiting global warming to 2°C, it has been estimated that almost US$ 6.9 trillion has to be spent on improving infrastructure over the next 15 years (OECD, 2017). The appearance of green bonds (GBs) in 2007 (the climate bond category) as an essential source of financing for such initiatives was a critical event in the global bond markets.

Green bonds are innovative debt instruments of sustainable financing that companies and governments use to finance environmentally friendly investments. Green bonds are issued to raise capital for financing projects that contribute to a low-emission and climate-resilient economy (Inderst et al., 2012). Green bonds differ from standard bonds because capital is only used to finance “green” projects (OECD, 2015). The allocation process includes obtaining financing, selling a financial instrument, selecting a project, and allocating funds (The World Bank). The rules for issuing green debt are the leading global standard in the green bond market. It defines green bonds as “any type of bond instrument, the proceeds of which will be used exclusively to finance or refinance part of or fully new and/or existing eligible green projects” (ICMA, 2022). These projects include renewable energy development, energy efficiency, pollution prevention and control, sustainable management of living natural resources, protection of land and aquatic biodiversity, clean transport, sustainable water management, eco-efficient products, and production technologies and processes (ICMA, 2022). Common examples of funding include low-carbon transport, recycling, energy-efficient buildings, and hydropower (Climate Bonds Initiative, 2022). Importantly, these applications cover both mitigation measures (e.g., building solar and wind installations) and measures to adapt to climate change (e.g., reforestation) (The World Bank, 2021). The Climate Bond Initiative has created a green bond taxonomy to facilitate market convergence (Climate Bonds Initiative, 2022). In addition to financing new projects, issuers can use green bonds to refinance existing debt to lower the cost of capital or raise additional financing. Green bonds are similar in structure to regular bonds, mean-

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ing that investors have direct recourse to the issuer if the issuer cannot pay the interest or par value (OECD, Green Bonds, 2015). Green bond issuers include corporations, municipalities, government entities, and international institutions. The European Investment Bank issued the first green bond in 2007 to finance renewable energy and energy efficiency projects, while Poland first issued a green state bond in December 2016 (Durand, 2016). Since then green bonds have become increasingly popular and this trend is often referred to as the "green bond boom".

The present paper aims to answer the following research question (RQ): Is there a relationship between the effectiveness of governments and the value of GB issuances? This study begins with a literature review on "impact investing" and GBs, followed by empirical analyses showing a statistical relationship between the effectiveness of governments and the value of GB issuances. It concludes with a scientific discussion based on the obtained results and research conducted so far in the area in question.

## An overview of the literature

The significant increase in recent years of "impact investments" which positively impact the community and the environment, has become a key trend among the forms of implementation by public and private entities. The Global Impact Investing Network estimates that the impact investing sector grew from US$4.3 billion in 2011 to US$502 billion in 2018 (GIIN, 2019). Positive environmental changes are inextricably linked with the quality of public management. A measure of this, among others, is the World Governance Indicator (WGI). This indicator covers six key areas of governance: accountability, political stability and non-terrorism, governance performance, regulatory quality, rule of law, and the control of corruption. It is part of the wider concept of New Public Governance (NPG), which is associated with maintaining the security of the pillars of the public economy while, at the same time, increasing social welfare (Osborne, 2010). NPG has taken shape as a "self-regulating network" of stakeholders operating with or without the involvement of local governments to deliver public goods and maintain a decent quality of life (Kickert, 1993) (Rhodes, 1997). Compared to many examples of socially responsible investment projects that have been extensively researched for reputation/branding and consumption theory (McWilliams & Siegel, 2000; Lee, 2008; Campbell, 2007), little research has dealt with the relationship between NPG public management quality and the value and profitability of green bond issues as an instrument for financing impact investment projects. The growing interest in green bond issues has translated into a growing number of government initiatives in the bond market,

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both on the demand and supply side. Examples of such initiatives are not only voluntary standardization in EU countries, but also various types of subsidies or grants to cover the costs of certification as seen – for example – in Singapore. To summarise, the justification of the present research is the existence of a gap concerning the quality of public management of NPG for using “impact investing” instruments to generate positive environmental effects.

The incentives for issuing green bonds are varied and include improving market image by investing in green technologies/initiatives (Turban & Greening, 1997), improving financial performance (Nilsson, 2008; Bauer & Smeets, 2015; Hartzmark & Sussman, 2018), and risk reduction (Krüger, 2015). The value of green bond issues increased over ten times between 2014 and 2020 – from €28 billion to €230 billion (Climate Bond Initiative, 2020). Developing “green financing” instruments is necessary to achieve climate goals communicated at Glasgow’s 2021 COP26 climate summit. COP26 adopted declarations that developed countries will achieve annual green investment financing at US$100 billion from 2023 (ukcop26.org).

Adverse effects related to production, consumption, and population growth have seriously impacted climate change and environmental degradation. However, developed countries can better cope with the effects of environmental change caused by industrial development (Tara et al., 2015). Ecological crises in developed countries are also perpetuated by non-compliance in developing countries. Environmental problems are much more significant in developing countries due to non-compliance with business rules that aim to protect the environment (Tu et al., 2015). As a result, the importance of green finance for developing countries has also increased. To increase the issuance of green financial instruments aimed at protecting the environment, governments must promote and regulate green financial instruments by creating incentives for introducing green technologies. Green finance is, therefore, an essential element of sustainable economic growth. Poor quality of state governance will not be conducive to the green industry and, as a result, green instruments will disappear from the market. This could contribute to the failure of economies designed to prevent climate change. Governments should strive to promote green growth by developing new technologies and environmentally friendly industries. Green bonds are one of the instruments for financing environmentally friendly projects, and government authorities should pay special attention to climate-friendly projects. Low-carbon financing fosters a low-carbon economy (Jiguang & Zhiqun, 2011) by raising capital for projects involving low-carbon production (Zhang et al., 2019). Green bonds are one of the instruments used to finance environmentally friendly projects.

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The present research aims to verify the relationship between the quality of public management and the value and profitability of global issues of the above-mentioned types of bonds. Moreover, we present a systematic review of impact investing instruments such as social impact bonds, green bonds, and sustainability bonds. We highlight this market's potential and the role of governments in developing financial instruments that increase social welfare, including environmental welfare. Assessing the relationship between the quality of government and the value and profitability of green bonds may contribute to further development of green financing instruments to better match them to the specificity of individual countries and create greater social welfare. Moreover, it may constitute a justification for specific government interventions and the use of subsidy/grant tools to stimulate the development of a green economy properly. As climate change goals are global, verifying the planned dependence may also directly support raising the level of public management under the NPG to the appropriate areas.

Previous studies linking green bonds and public management have not indicated any direct relationship between the quality of government and the value of bond issues. Nevertheless, attention should be paid to the reports of, among others, Yamahaki et al. (2020). Their research indicated the importance of structural and legislative barriers, including unstable environments, for developing GBs. In a broader context, i.e., impact investing, the vital role of governments and public institutions in coordinating relations with investors is emphasised to induce them toward making socially beneficial investments. These analyses mainly concerned the real estate market and broadly understood investments with positive social effects (Wood et al., 2013). Another analysis, this time based on a case study in Sweden, did not directly indicate the importance of the role of governments for issuers and investors in the long-term planning of a favourable climate policy. The respondents' replies were inconsistent; some considered the importance of, for example, GB government emissions for the development of the market, while others showed scepticism about the importance of public involvement in the development of the GB market (Maltais & Nykvist, 2020). It is also worth paying attention to the factors of growth of the GB market based on the experience of China (Escalante et al., 2020; Lin & Hong, 2022). The authors emphasised that one of the key determinants of the development of GB emissions was a more substantial commitment of governments to introduce standardised frameworks for reporting the environmental impact of these emissions. This would ensure a uniform methodology and provide indicators for issuers to report environmental impacts, enable the market to understand better, communicate the benefits of GBs and attract environmentally conscious investors.

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When considering green finance as a broader subject of analysis, instead of focusing solely on GBs, research on the importance of the quality of power and green finance may also be vital in answering our research question. Thus, the reports of Bhatnagar and Sharma (2022) deserve attention. The authors point out the critical importance of, among others, political stability, the development of regulatory structures of the GB market, legal regulations, and institutional involvement in the market of green instruments. In conclusion, they directly emphasised the importance of government actions in this market.

The evidence of government quality and the rule of law set the frameworks for issuance. It should be clear and publicly visible (Cheng et al., 2022). Moreover, these frameworks must require that the environmental impact is measured in both qualitative and quantitative ways (ICMA, 2022). This is in line with the assumptions of New Public Governance. Improvement in management quality should occur through the absorption of market mechanisms into the public sector, as well as management methods and techniques widely used in the private sector. Moreover, the administration should be focused on efficiency, economic efficiency, quality, and result orientation (Lapuente & Van de Walle, 2020). In this case, there is an actual translation of the investment into the quality of the natural environment.

## Research methods

To answer the RQ: Is there a relationship between the effectiveness of governments and the value of GB emissions, we analysed values of GBs for 94 countries from 2014 to 2022 (thomsonreuters.com; accessed 2022) and World Governance Index (WGI) values for 169 countries (values are provided for the period 1996–2020, but since we analysed GB values from 2014, we take WGI index values from the same year, worldbank.org accessed 2021), taking common parts of these two datasets to find a relationship between both variables. We aimed to answer the RQ "Is there any significant influence of WGI on (yearly total) GB values with respect to both country and year?".

It is worth noting where the possibility of comparison between such different countries lies. We made cross-country analyses using the WGI (government effectiveness) index. It is independent of the economy's structure, geographical specificity and demographics. Efficiency is an independent factor in this case. For example, the structure of the economies of Germany and Andorra is irrelevant if we compare the effectiveness of governments in these countries and the existence of its relationship with the value of the described green finance instrument. The WGI is calculated for each of these countries according to a uniform methodology, independent of the structural specificities of the surveyed economies.

To investigate the existence of monotonic relationships between two variables, Spearman's correlation coefficient was used. This coefficient takes values from -1 to 1. A statistically significant result from Spearman's correlation coefficient substantiates the existence of monotonic dependencies between the variables. If the coefficient is positive, it means that, as one variable grows, the value of the other variable grows as well. However, if the correlation is negative, it means that, as one parameter's value increases, the other parameter's value decreases. The correlation can be low, moderate, high, or very high. It may also not be present. The following classification of the correlation strength was used (Guilford, 1965):

$|r|=0$ – no correlation,
$0<|r|\leq 0.3$ – very weak correlation,
$0.3<|r|\leq 0.5$ – weak correlation,
$0.5<|r|\leq 0.7$ – moderate correlation,
$0.7<|r|\leq 0.9$ – high correlation,
$0.9<|r|<1.0$ – very high correlation,
$|r|=1$ – full correlation.

Where applicable, a linear regression model was used to examine the relationship between the dependent and explanatory variables. Coefficient values in linear models estimate the size of the effect the independent variables have on the dependent variable. An intercept is the value the dependent variable is predicted to have, when all the independent variables are equal to zero. We also provide 95% confidence intervals for estimated coefficients. Where the assumptions of the classical linear regression model were not met, we used a robust regression model. The idea of robust regression is to weight the observations differently based on how well-behaved the observations are. Roughly speaking, it is a form of weighted and reweighted least squares regression (UCLA).

As there were too few values of total GB for an individual country in most of the cases (due to the presence of missing values), we abandoned time series models (VAR or VECM) in favour of panel data models that allowed us to identify the impact of the family of variables on GB. Despite the lack of time series models, standard approaches also have drawbacks – a pooled linear regression model does not consider heterogeneity across countries. In contrast, individual models are based on a few observations and do not consider common features of the countries (they all interact and experience the same influence of progress). Figures 1 and 2 present the phenomenon of heterogeneity across countries and across years, respectively. In the figures, dots

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represent means values for GB across countries (Figure 1) and years (Figure 2), while whiskers denote 95% confidence intervals for these means.

To allow for the country effect, we used a fixed effects model. The fixed effect assumption is that the individual-specific effects are correlated with independent variables. We introduced a dummy variable, "*Di = country*" and included it in the model along with an interaction term. Our model had the following form:

$$GB \sim A\,WGI\ + B\ Country\ + C\ WGI * Country, \tag{1}$$

where symbol * denotes the interaction term and *A, B, and C* are the estimated parameters.

We characterised statistically significant results in bold. The unique effect of the WGI is represented by everything that is multiplied by it in the model – it is equal to $A + C * Country$, where $A$ is a coefficient corresponding to the WGI and $C$ is a coefficient corresponding to the interaction term. Panel data models provide information on individual behaviour across individuals and over time. The basic linear panel models used in econometrics can be described through suitable restrictions of the following general model:

$$y_{it} = \alpha_{it} + \beta_{it}x_{it} + u_{it}, \tag{2}$$

where $i$=1,...,$n$ is the individual (country) index, $t$=1,...,T is the time index, and $u_{it}$ is a random disturbance term of mean 0.

Naturally $u_{it}$ is not estimable with N=$n$×T data points. The appropriate estimation method for this model depends on the properties of the two error components. The idiosyncratic error $\epsilon it$ is usually considered well-behaved and independent of both the $x_{it}$ of the regressors and the individual error component $\mu i$. The individual component may, in turn, either be independent of the regressors or correlated. If it is correlated, the ordinary least squares (OLS) estimator of $\beta$ would be inconsistent, so it is customary to treat the $\mu i$ as a further set of $n$ parameters to be estimated, as if in the general model $\alpha_{it} = \alpha_i$ for all values of $t$. This is called the fixed effects model, usually estimated by OLS on transformed data, and gives consistent estimates for $\beta_{it}$.

Nevertheless, the common error component over individuals induces correlation across the composite error terms, making OLS estimation inefficient, so one has to resort to some feasible generalised least squares (GLS) estimators. This is based on an estimation of the variance of the two error components, for which several different procedures are available. If the individual component is missing, pooled OLS is the best estimator for $\beta$. This set of assumptions is usually labelled as a “pooling model”, although this refers to the errors’ properties and the appropriate estimation method rather than the model itself. If one relaxes the usual hypotheses of well-behaved, white noise errors and allows the idiosyncratic error to be arbitrarily heteroskedastic and serially correlated over time, a more general kind of feasible GLS is needed (called the “unrestricted” or “general” GLS). This specification can also be augmented with individual-specific error components possibly correlated with the regressors, termed “fixed effects” GLS.

Another way of estimating unobserved effects models by removing time-invariant individual components is by first differencing the data, i.e., by lagging the model and subtracting, the time-invariant components (the intercept and the individual error component) are eliminated, and the model:

$$\Delta y_{it}=\beta\top\Delta x_{it}\mathrm{t}+\Delta u_{it}, \tag{3}$$

where $_{it}-y_{it-1}$, $\Delta x_{it}=x_{it}-x_{it-1}$ and $\Delta u_{it}=u_{it}-u_{it-1}=\Delta\epsilon_{it}$ for t=2,...,T) can be consistently estimated by pooled OLS.

This is called the “first-difference” or “FD” estimator. Its relative efficiency, and hence the reason for choosing it against other consistent alternatives, depends on the properties of the error term. The FD estimator is usually preferred, if the errors are strongly persistent over time, because the $\Delta u_{it}$ will tend to be serially uncorrelated. Finally, the “between” model, which is computed on time (group) averages of the data, discards all the information due to intragroup variability, but is consistent in some settings where the others are not (e.g., non-stationarity) and are often preferred to estimate long-run relationships. Variable coefficient model relax the assumption that $\beta_{it} = \beta$ for all values of *i* and *t*. Fixed coefficients models allow the coefficients to vary along one dimension, e.g $\beta_{it} = \beta$ for all values of *t*. Random coefficients models instead assume that coefficients vary randomly around a common average, as $\beta_{it} = \beta+n_i$ for all values of *t*, where $n_{it}$ is a group (time) specific effect with a mean of zero.

In the case of this analysis, the level of statistical significance was set to $p$=0.05. However, we also separately highlighted significant results for the levels of $p$=0.01 and $p$=0.001. P-values indicating a statistically significant result are shown in bold. In cases where $P$<0.001, the notation “$P$<0.001” was used. All calculations were done in R (version 4.02).

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## Research results

First, we investigated the relationship between WGI and GB for each year from 2014 to 2020. As we can treat both variables as continuous variables and hence suitable to calculate Spearman's correlation coefficient, Table 1 below presents the results of calculating Spearman's correlation between these two variables for each consecutive year. In each case, there was an average positive (statistically significant) monotonic correlation between WGI and GB. We note that the results here were very similar across the years, i.e. a high consistency of mutual correlations for all successive years characterises the results. Based on the significance test of the correlation coefficient ($p$-value < 0.001), we reject the null hypothesis stating that there is no significant correlation between these variables each year.

**Table 1**. Spearman's correlation coefficients between GB and WGI (2014-2020)

| Year | Correlation coefficient | p-value |
|---|---|---|
| 2014 | 0.5 | <0.001 |
| 2015 | 0.528 | <0.001 |
| 2016 | 0.505 | <0.001 |
| 2017 | 0.511 | <0.001 |
| 2018 | 0.608 | <0.001 |
| 2019 | 0.607 | <0.001 |
| 2020 | 0.486 | <0.001 |

Since correlation does not mean causation, we modelled the influence of WGI level on the total amount of Green Bonds (bln $) with a linear regression model. Still, as its assumptions could not be satisfied (i.e., heteroscedasticity and lack of normality of residuals), we applied a robust linear regression model, suitable when such basic assumptions are not fulfilled. Diagnostic plots verifying individual assumptions of the linear regression model for the models in each year have been included in the supplementary material (Appendix 1). Scale-Location is a type of graph used to check the homogeneity of variance of the residuals (homoscedasticity). A horizontal line with equally spread points is a good indication of homoscedasticity. We can see clearly that it does not occur in our case. Hence, we use a robust model. The results are presented in Table 2. We note that, in each case, WGI was statistically significant ($p$-value < 0.001). The results imply that, with an increase of WGI by one unit, the value of GB increases on average by the value of the coefficient corresponding to WGI. Every year, an increase in the value of WGI caused a simultaneous increase in the value of GB. The increasing values of

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the regression coefficients indicate that this trend has been strengthening in subsequent years. An example illustrating this situation is the increase in the value of GB by an average of 0.09 billion USD, with a one-point increase in the WGI index in 2014, whereas, in 2020, it is already an average of 1.63 billion USD. We also added the values of the coefficient of determination $R^2$, indicating the model's fit as the percentage of variance in GB explained by the model.

Table 2. Robust linear regression model determining the relationship between GB and WGI (2014-2020)

| Year | Variable | Coefficient | 2.5% | 97.5% | *p*-value | $R^2$ |
|---|---|---|---|---|---|---|
| 2014 | Intercept | 0.043 | -0.012 | 0.098 | 0.128 | 0.119 |
| | WGI | 0.09 | 0.042 | 0.139 | **<0.001** | |
| 2015 | Intercept | 0.046 | -0.018 | 0.111 | 0.165 | 0.124 |
| | WGI | 0.112 | 0.055 | 0.169 | **<0.001** | |
| 2016 | Intercept | 0.183 | 0.001 | 0.365 | 0.053 | 0.143 |
| | WGI | 0.334 | 0.171 | 0.5 | **<0.001** | |
| 2017 | Intercept | 0.29 | 0.033 | 0.546 | 0.031 | 0.023 |
| | WGI | 0.439 | 0.211 | 0.667 | **<0.001** | |
| 2018 | Intercept | 0.2 | -0.01 | 0.411 | 0.066 | 0.21 |
| | WGI | 0.444 | 0.255 | 0.633 | **<0.001** | |
| 2019 | Intercept | 0.666 | -0.025 | 1.357 | 0.064 | 0.156 |
| | WGI | 1.515 | 0.887 | 2.142 | **<0.001** | |
| 2020 | Intercept | 1.103 | 0.295 | 1.911 | **0.001** | 0.085 |
| | WGI | 1.626 | 0.88 | 2.371 | <0.001 | |

Figure 1 below presents the phenomenon of heterogeneity across countries. Here, dots represent mean values for GB across countries, and whiskers denote 95% confidence intervals for these means.

Similarly, we can present heterogeneity across years, as depicted in Figure 2 below.

Table 3 presents the results for the fixed model described in detail by Equation 1. We denoted statistically significant results in bold. The unique effect of WGI is represented by everything that is multiplied by it in the model – it is equal to A + C*Country, where A is a coefficient corresponding to WGI and C is a coefficient corresponding to the interaction term.

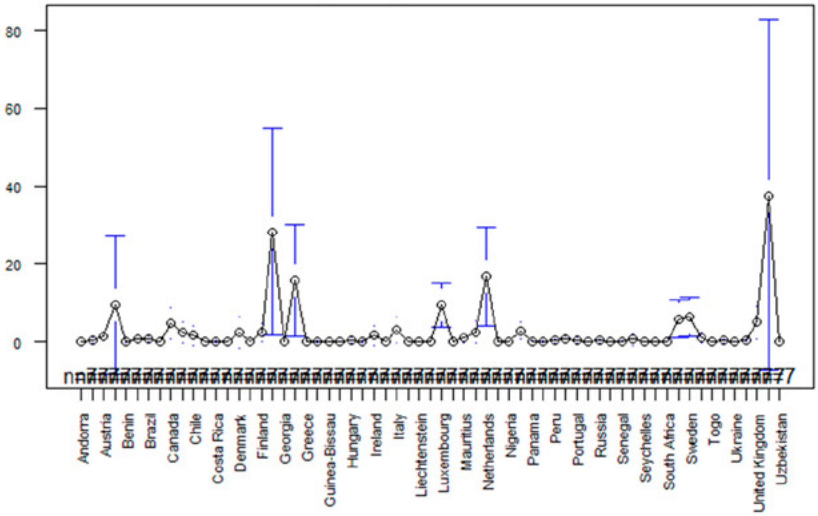
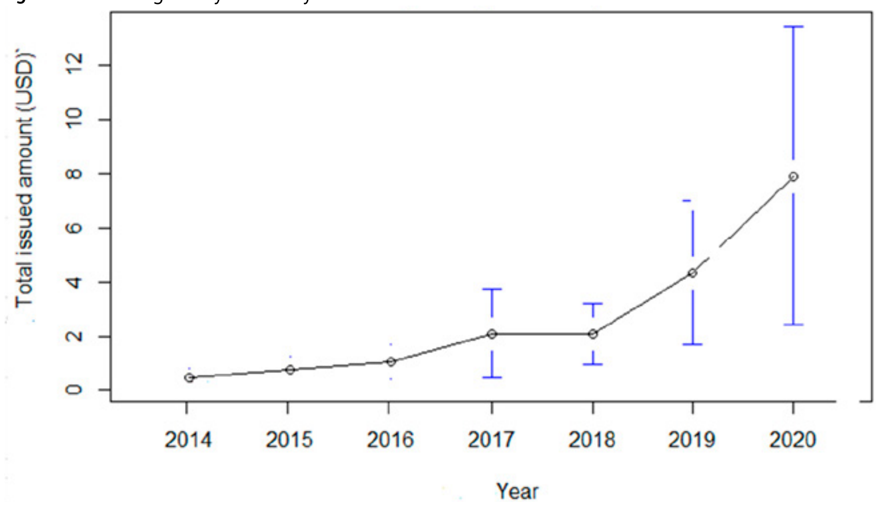



**Figure 1.** Heterogeneity across countries for GB (2014-2020)

**Figure 2.** Heterogeneity across years for GB




For example, the unique effect of WGI on GB for Austria is equal to 14.391, which means it is 14.391 stronger than the effect for Andorra. As observed here, we primarily speak of a statistically significant relationship in the case of wealthy countries with a high GDP, especially when compared to the tiny reference country of Andorra. These countries were significant factors influencing the value of GB itself and statistically significant moderators of the relationship between GB and WGI.

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**Table 3.** Fixed effects model for the relationship between GB and WGI across countries

| Variable | Coefficient | 2.5% | 97.5% | *p*-value |
|---|---|---|---|---|
| Argentina | 0.032 | -2.152 | 2.216 | 0.977 |
| Austria | -20.907 | -24.275 | -17.540 | **<0.001** |
| Belgium | 23.180 | 20.870 | 25.489 | <0.001 |
| Benin | 0.500 | -1.717 | 2.717 | 0.659 |
| Bermuda | -1.325 | -3.585 | 0.935 | 0.251 |
| Brazil | 1.365 | -0.827 | 3.558 | 0.223 |
| Burkina Faso | -0.089 | -2.439 | 2.260 | 0.941 |
| Canada | 125.709 | 122.273 | 129.144 | **<0.001** |
| Cayman Islands | 67.159 | 62.817 | 71.501 | **<0.001** |
| Chile | 7.276 | 4.510 | 10.042 | **<0.001** |
| Colombia | 0.031 | -2.153 | 2.216 | 0.977 |
| Costa Rica | 0.085 | -2.321 | 2.491 | 0.945 |
| Czech Republic | 0.000 | -3.003 | 3.003 | 1.000 |
| Denmark | -30.933 | -35.399 | -26.466 | **<0.001** |
| Dominican Republic | 0.000 | -2.281 | 2.281 | 1.000 |
| Finland | 17.533 | 14.118 | 20.949 | **<0.001** |
| France | 543.365 | 540.485 | 546.245 | **<0.001** |
| Georgia | -0.081 | -2.298 | 2.136 | 0.943 |
| Germany | 212.836 | 210.294 | 215.377 | <0.001 |
| Greece | -0.234 | -2.437 | 1.968 | 0.835 |
| Guatemala | -0.058 | -2.765 | 2.649 | 0.966 |
| Guinea-Bissau | 0.132 | -2.457 | 2.721 | 0.920 |
| Honduras | 0.087 | -2.167 | 2.342 | 0.940 |
| Hungary | -0.278 | -2.799 | 2.243 | 0.829 |
| Iceland | -0.613 | -4.388 | 3.161 | 0.750 |
| Ireland | 6.260 | 3.781 | 8.739 | **<0.001** |
| Israel | 0.000 | -2.464 | 2.464 | 1.000 |
| Italy | 22.697 | 20.365 | 25.029 | **<0.001** |
| Latvia | -0.154 | -2.616 | 2.308 | 0.903 |
| Liechtenstein | -0.726 | -4.845 | 3.393 | 0.730 |
| Lithuania | 0.420 | -2.208 | 3.048 | 0.754 |
| Luxembourg | -64.754 | -68.227 | -61.282 | **<0.001** |
| Mali | -0.542 | -3.038 | 1.954 | 0.671 |

| Variable | Coefficient | 2.5% | 97.5% | *p*-value |
|---|---|---|---|---|
| Mauritius | 10.615 | 8.151 | 13.079 | **<0.001** |
| Mexico | 0.772 | -1.412 | 2.956 | 0.489 |
| Netherlands | 880.355 | 870.750 | 889.959 | **<0.001** |
| Niger | 0.273 | -2.135 | 2.681 | 0.824 |
| Nigeria | 0.075 | -2.523 | 2.674 | 0.955 |
| Norway | -19.457 | -23.570 | -15.343 | <0.001 |
| Panama | 0.033 | -2.153 | 2.219 | 0.976 |
| Paraguay | 0.115 | -2.097 | 2.326 | 0.919 |
| Peru | 0.488 | -1.710 | 2.687 | 0.664 |
| Poland | 0.563 | -1.669 | 2.795 | 0.622 |
| Portugal | 0.298 | -2.091 | 2.688 | 0.807 |
| Romania | 0.000 | -2.184 | 2.184 | 1.000 |
| Russia | 0.022 | -2.163 | 2.206 | 0.984 |
| Saudi Arabia | 0.000 | -2.218 | 2.218 | 1.000 |
| Senegal | 0.100 | -2.089 | 2.289 | 0.929 |
| Serbia | 0.135 | -2.063 | 2.332 | 0.904 |
| Seychelles | -0.013 | -2.289 | 2.264 | 0.991 |
| Slovenia | -0.349 | -2.934 | 2.237 | 0.792 |
| South Africa | -0.377 | -2.811 | 2.057 | 0.762 |
| Spain | 60.534 | 58.143 | 62.925 | **<0.001** |
| Sweden | -390.759 | -405.954 | -375.564 | **<0.001** |
| Switzerland | 31.418 | 26.906 | 35.929 | <0.001 |
| Togo | 0.569 | -1.683 | 2.820 | 0.621 |
| Turkey | 0.304 | -1.881 | 2.489 | 0.785 |
| Ukraine | 0.000 | -2.230 | 2.230 | 1.000 |
| United Arab Emirates | -1.776 | -5.082 | 1.530 | 0.293 |
| United Kingdom | 52.598 | 50.135 | 55.061 | **<0.001** |
| United States | 824.504 | 821.704 | 827.304 | **<0.001** |
| Uzbekistan | 0.000 | -2.376 | 2.376 | 1.000 |
| Government Effectiveness | 0.000 | -1.175 | 1.175 | 1.000 |
| Argentina: Government Effectiveness | -0.026 | -1.382 | 1.330 | 0.970 |
| Austria: Government Effectiveness | 14.391 | 12.348 | 16.435 | **<0.001** |
| Belgium: Government Effectiveness | -15.200 | -16.504 | -13.897 | **<0.001** |
| Benin: Government Effectiveness | 0.866 | -0.527 | 2.258 | 0.224 |

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| Variable | Coefficient | 2.5% | 97.5% | *p*-value |
|---|---|---|---|---|
| Bermuda: Government Effectiveness | 1.332 | 0.072 | 2.592 | **0.039** |
| Brazil: Government Effectiveness | 1.768 | 0.375 | 3.160 | **0.013** |
| Burkina Faso: Government Effectiveness | -0.168 | -1.992 | 1.657 | 0.857 |
| Canada: Government Effectiveness | -69.467 | -71.384 | -67.549 | <0.001 |
| Cayman Islands: Government Effectiveness | -54.785 | -58.176 | -51.394 | **<0.001** |
| Chile: Government Effectiveness | -6.319 | -8.313 | -4.326 | **<0.001** |
| Colombia: Government Effectiveness | -0.200 | -2.079 | 1.679 | 0.835 |
| Costa Rica: Government Effectiveness | -0.191 | -3.160 | 2.777 | 0.900 |
| Czech Republic: Government Effectiveness | 0.000 | -2.343 | 2.343 | 1.000 |
| Denmark: Government Effectiveness | 17.269 | 14.852 | 19.686 | **<0.001** |
| Dominican Republic: Government Effectiveness | 0.000 | -2.178 | 2.178 | 1.000 |
| Finland: Government Effectiveness | -7.992 | -9.767 | -6.217 | <0.001 |
| France: Government Effectiveness | -369.428 | -371.221 | -367.636 | **<0.001** |
| Georgia: Government Effectiveness | 0.166 | -1.170 | 1.501 | 0.808 |
| Germany: Government Effectiveness | -122.158 | -123.588 | -120.728 | **<0.001** |
| Greece: Government Effectiveness | 1.068 | -0.479 | 2.614 | 0.177 |
| Guatemala: Government Effectiveness | -0.106 | -2.748 | 2.536 | 0.937 |
| Guinea-Bissau: Government Effectiveness | 0.080 | -1.390 | 1.550 | 0.915 |
| Honduras: Government Effectiveness | 0.081 | -1.362 | 1.523 | 0.913 |
| Hungary: Government Effectiveness | 0.553 | -2.082 | 3.187 | 0.681 |
| Iceland: Government Effectiveness | 0.427 | -1.968 | 2.822 | 0.727 |
| Ireland: Government Effectiveness | -3.905 | -5.338 | -2.472 | **<0.001** |
| Israel: Government Effectiveness | 0.000 | -1.475 | 1.475 | 1.000 |
| Italy: Government Effectiveness | -38.615 | -40.659 | -36.572 | <0.001 |
| Latvia: Government Effectiveness | 0.177 | -1.459 | 1.812 | 0.833 |
| Liechtenstein: Government Effectiveness | 0.435 | -1.898 | 2.769 | 0.715 |
| Lithuania: Government Effectiveness | -0.363 | -2.182 | 1.456 | 0.696 |
| Luxembourg: Government Effectiveness | 42.479 | 40.525 | 44.433 | <0.001 |
| Mali: Government Effectiveness | -0.554 | -2.219 | 1.112 | 0.515 |
| Mauritius: Government Effectiveness | -10.068 | -11.756 | -8.380 | **<0.001** |
| Mexico: Government Effectiveness | 1.244 | -0.066 | 2.555 | 0.064 |
| Netherlands: Government Effectiveness | -468.090 | -473.292 | -462.888 | <0.001 |
| Nigeria: Government Effectiveness | 0.043 | -1.507 | 2.240 | 0.962 |
| Norway: Government Effectiveness | 11.680 | -1.736 | 1.823 | **<0.001** |

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| Variable | Coefficient | 2.5% | 97.5% | *p*-value |
|---|---|---|---|---|
| Panama: Government Effectiveness | -0.093 | 9.493 | 13.867 | 0.898 |
| Paraguay: Government Effectiveness | 0.134 | -1.521 | 1.335 | 0.836 |
| Peru: Government Effectiveness | 1.649 | -1.139 | 1.408 | 0.061 |
| Poland: Government Effectiveness | -0.696 | -0.073 | 3.371 | 0.333 |
| Portugal: Government Effectiveness | -0.225 | -2.103 | 0.710 | 0.760 |
| Romania: Government Effectiveness | 0.000 | -1.669 | 1.219 | 1.000 |
| Russia: Government Effectiveness | 0.106 | -1.368 | 1.368 | 0.883 |
| Nigeria: Government Effectiveness | 0.043 | -1.298 | 1.510 | 0.962 |
| Saudi Arabia: Government Effectiveness` | 0.000 | -1.972 | 1.972 | 1.000 |
| Senegal: Government Effectiveness` | 0.266 | -1.027 | 1.558 | 0.687 |
| Serbia: Government Effectiveness` | -1.286 | -4.365 | 1.794 | 0.414 |
| Seychelles: Government Effectiveness` | 0.033 | -1.837 | 1.904 | 0.972 |
| Slovenia: Government Effectiveness` | 0.348 | -1.380 | 2.075 | 0.694 |
| South Africa: Government Effectiveness | 1.422 | -2.153 | 4.996 | 0.436 |
| Spain: Government Effectiveness | -50.403 | -51.894 | -48.913 | **<0.001** |
| Sweden: Government Effectiveness | 232.310 | 223.430 | 241.191 | **<0.001** |
| Switzerland: Government Effectiveness | -14.883 | -17.158 | -12.609 | **<0.001** |
| Togo: Government Effectiveness | 0.502 | -0.786 | 1.789 | 0.446 |
| Turkey: Government Effectiveness | -0.976 | -2.342 | 0.389 | 0.162 |
| Ukraine: Government Effectiveness | 0.000 | -1.573 | 1.573 | 1.000 |
| United Arab Emirates: Government Effectiveness | 1.388 | -0.723 | 3.498 | 0.198 |
| United Kingdom: Government Effectiveness` | -31.823 | -33.214 | -30.431 | <0.001 |
| United States: Government Effectiveness | -524.478 | -526.147 | -522.809 | **<0.001** |
| Uzbekistan: Government Effectiveness | 0.000 | -2.016 | 2.016 | 1.000 |

Reference country value: Andorra

We must emphasise that, statistically, there is no reason why the results (ratios) should not be negative. An increase in WGI may negatively impact the value of GB, especially in rich countries. However, the overall model should be taken into account here. First, the situation in the qualitative models is that we compare country results to something which is (relatively) wealthy, Andorra in this case. Second, looking at a specific country, we can see that its impact on the size of GB (the sum of the coefficients for the country and the interaction component [B + C]) is positive in the largest economies. That is,

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not so much the WGI itself, but the influence of the WGI on GB is heavily moderated by the country, in which it is tested.

To use a more systematic approach, we shall apply the panel data model with random effects (as p-value < 0.001 in Hausman's tests and p-value < -0.001 in Lagrange multiplier test imply that random effects model is better than both Ordinary Least Squares (OLS) model and fixed effects model). The parameter *index* tells us to use fixed effects based on country and year variables.

The following table presents the results of such estimation. We see that WGI is a statistically significant variable (p=0.02). The coefficient 1.908 (next to WGI) represents the average effect of WGI over GB total value, when WGI changes across time and between countries by one unit.

Table 4. Panel model for the relationship between GB and WGI (2014-2020)

| Variable | Coefficient | 2,5% | 97,5% | *p*-value |
|---|---|---|---|---|
| Intercept | 1.544 | -0.259 | 3.346 | 0.093 |
| WGI | 1.908 | 0.307 | 3.509 | 0.02 |

## Discussion, limitations, and future research

The essence of new public governance focuses on financial markets, including capital market instruments, partnership and understanding, and even co-management with private investors, instigating the measurable impact of implemented investment projects. Our results have shown that investors should consider incorporating the level of governance effectiveness indicator before issuing bonds. That is a background for creating a trade-off between public partners' aims and private investors' expectations. Such cooperation depends on the level of effectiveness of governments. If the government improves the effectiveness of its management, it can count on investors' interest in the green finance instruments market. It is typically crucial for environmental investments and financing with GB, where the investment return period is extended. Time is necessary to obtain measurable ecological effects. The effects of the investment environment financed with such instruments are usually visible within a few years from the completion of the investment. All the more so, the quality of government, public policy, and, thus, government effectiveness is crucial to ensuring the long-term stability of the financial market and economic situation. A government's effectiveness over the long term gives the creditability of stable market conditions to conduct investments. At the same time, there is a trade-off between public and

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private partners' (investors') expectations. Stable market conditions based on a credible assessment of the effectiveness of governments contribute to the achievement of the goals of investors and public authorities. Furthermore, the public partner cannot only require or commission public tasks to be performed by the private partner. "Steer not row" under NPM (Osborne, 2006) means, in our case, not only demanding specific tasks from the project's private partner, but also the appropriate efficiency level in public partner activities.

Our research widen the results from Tara (2015), confirming that developed countries with a high WGI government effectiveness index use green instruments to a greater extent, here in the example of the GB. The established relationship between the increase in WGI and the increase in GB may be a trigger for developing countries. According to Tu's (2015) studies, if these countries manage to improve the efficiency of their governments, they will be able to attract investors for environmentally friendly investments. Moreover, it is not only the promotion of green instruments by the government, as stated by the cited authors of Jiguang and Zhiqun (2011), that is important. Due to our results on the part of governments, measures are necessary to increase the efficiency of public management. Yamahaki et al. (2020) state that economic and legislative barriers affect investors' interest in using green finance instruments. The quality of governance is directly related to the transparency and stability of legislative principles. What we have proven translates directly into the value of the issued bonds.

One could argue further that there are ratings of countries' economies. They enable investors in the financial markets to assess the stability of their potential investments. However, our study points to a narrower view of the effectiveness of governments translating into a limited group of financial instruments, such as GB. Thus, such a relationship is gaining importance for a specific green finance sector. Regardless of the type of economy, the WGI efficiency index is calculated according to the same methodology. This makes it possible to analyse the impact irrespective of the broader context of the state of economies or the stage of development of financial systems.

## Conclusions

These research results indicate a statistically significant correlation between the quality of a government, measured as governance effectiveness, and the value of green bond issuances. Thus, from a scientific perspective, it is recommended for developing countries under New Public Governance to increase the effectiveness of their functioning. From a practical standpoint, the presented results may contribute to greater investor interest in environmental projects and a better assessment of the quality of a government and thus promote broader access to green finance instruments, including GB.

In light of these results, public actors should take care of the quality of public management, as it may contribute to increasing interest in green finance instruments for implementing pro-ecological investments. It has rarely been highlighted that the effectiveness of governance influences green investments. Here, the concept of governance effectiveness was measured using the WGI indicator, which considers the quality of public services, public service capacity and its independence from political pressures, as well as the quality of policymaking. Thus, public entities and local authorities should be aware of the WGI Index and use this to increase the interest of green finance investors.

It is necessary to further develop science in assessing the impact on the environment of investments implemented with the use of green bonds. The implementation of this type of investment alone cannot be considered a success. It is necessary to find the right measure, the actual impact on the environment, in the shortest possible time. It is essential, e.g. for capital recipients, to obtain more favourable financial conditions for implementing projects with a positive environmental effect. Kociemska (2021) writes about indicating a simple way of assessing the impact of the investment on the local community by using social impact bonds as an incentive-compatible mechanism of *"profit write-off"* for social purposes. Here, too, the governments of individual countries should play a key role in stimulating the development of financial markets and, at the same time, developing their public management effectiveness, including the reliable assessment of the effects of this management.

Considering the limitations of this study and developing trends in the GB market, we aim to deepen our research in the future. We want to determine whether there is a relationship between GB issuances and the Human Development Index in low- and middle-income countries. We can observe that these countries are struggling with ecological stratification (Obeng-Odoom, 2020). Considering that a government's effectiveness may tempt green-finance investors, as was suggested by the results of our study, there is a need to measure if a real impact of GB issuance exists and influences social welfare, particularly in low- and middle-income countries.

## The contribution of the authors

Conception, H.K.; interpretation of data, H.K. and R.P.; literature review, E.F., E.S.-P. and M.R.; analysis, R.K., P.R., R.P., K.B. and B.P.; acquisition of data, E.F., M.R. and R.P.; editing, K.B. and B.P.; presenting impications, H.K.; concluding, H.K. and E.S.-P.

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