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Bachelor Thesis Economics & Business

THE LINK BETWEEN ESG FACTORS AND GDP GROWTH DECLINE: A GLOBAL STUDY

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Abstract

In this thesis, I examine the relationship between a country's ESG rating and its economic performance. The World Bank dataset on various ESG factors was used to study this relationship. The studied panel data spanning 20 years and 124 countries was analyzed using the fixed effects model. I find that sovereign ESG limitedly relates to GDP growth of a nation. By accounting for year-specific effects, I demonstrate the complex influence of a myriad of multivariate factors on GDP growth. While the relationship between sovereign ESG and GDP growth is faint, its presence emphasizes the need to acknowledge this connection and research it further.

Keywords: ESG, GDP growth, panel data analysis

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1. Introduction

ESG, which stands for environmental, social, and governance - is a framework for evaluating how well an entity performs in its operations based on several ethical and sustainability aspects (Mathis, 2023). This thesis focuses on analyzing the relationship between the ESG index scores of different countries and their economic performance. According to Gourinchas (2022), in the wake of the global crisis, which was COVID-19 and amidst the war in Ukraine, many of the world's economies are struggling with declining GDP growth as well as lurking inflation. Thus, nations are seeking different ways of combating these issues. Some are counting on ESG strategies, which have a solid theoretical background and a proven track record in the business world (Friede et al., 2015).

Previous studies have looked at the effect of ESG-versed countries from a different angle – one of the relationships between the ESG ratings of 23 OECD countries and their sovereign borrowing costs (Crifo et al., 2017). Through the use of a panel regression, the researchers found statistically significant evidence that a higher ESG score of a country, on average, translates to lower borrowing costs. However, they also found that the effect that ESG ratings have on sovereign borrowing costs is actually three times weaker than that of financial ratings, which indicates that focusing on ESG might not be as fruitful as expected. Furthermore, a study by Karaman Lheureux (2022) analyzing the relationship between country ESG ratings and 5-year credit default swap premiums also finds a significant negative association between the two variables. As before, the researchers found this relationship to be feeble as well.

In this analysis of the relationship between countries' ESG scores and their economic performance, I replicated the study by Crifo et al., which was conducted in 23 OECD countries. Their study focused on the effect of ESG factors on sovereign borrowing, which is remotely connected to the country's GDP (growth). Thus, it is essential to keep their findings in mind as we dive into my research of country ESG performance effects on GDP growth, which is a much less researched topic. Furthermore, the study by Crifo and colleagues analyzed the relationship for 23 OECD countries, which raises concerns as the number of observations is not so extensive that we could draw generalized conclusions for every country in the world. In my study, I aim to study the relationship between the variables for approximately 130 different countries of the world. Therefore, my research question is, "How does a country's ESG rating relate to its GDP growth?".

Firstly, to study the relationship in my research question, I will gather the required time series data from The World Bank database, a collection of a wide range of information on global economic and development indicators. Using the database, I will extract data on annual GDP growth for N=124 countries spanning the most recent 20 years (~2000–2020) for which data is available. Similarly, I will also acquire time series data on a number of proxy variables for each of the three pillars of conventional ESG scoring. Secondly, using the E, S, and G proxies, a unique new variable will be constructed to represent the overall ESG performance of a country. To decide on which specific proxy variables will be used, I will consider the availability of data and the related studies, such as the one by Jiang et al. (2022), which looks at ways of measuring sovereign ESG. The new variable will be constructed using the weighted average method, where the weights of each of the three ESG pillars will be equal (this is a common practice in distributing the importance of E, S, and G factors). Thirdly, due to the nature of my panel data having a country and a time dimension, I will conduct a fixed effects model concerning the newly constructed country ESG performance index and their GDP growth (annual %) over time. A fixed effects model is a statistical method used to analyze data containing observations spanning multiple time periods. The fixed effects approach is designed to control for unobserved heterogeneity. This research method is advantageous when comparing changes over time between various entities.

From my research, I expect to arrive at similar conclusions as the study looking at the ESG effects on sovereign borrowing costs. That is, I believe that the relationship between the ESG score and the GDP growth of a country will be positive. However, regarding the strength of the relationship, it will be interesting to see whether the effect is as weak as the findings of other studies. Based on this, I hypothesize that GDP growth will be positively weakly related to the ESG performance of a country since GDP growth magnitude depends on an extent of different factors apart from ESG ones. Although our data will include the most recent metrics, my research will serve as a reasonable basis for further analysis of the topic in the future when ESG factors will most likely only grow in importance.

2. Theoretical Framework

2.1 Sovereign ESG

To conduct my study, it is crucial that I define the core predictor variable of my analysis – country ESG performance. Traditionally, the three pillars of ESG (Environmental, Social, and Governance) are used to measure firm performance in these aspects. However, in my study, I aim to apply this same framework on a sovereign level. However, sovereign ESG differs both in terms of methodology and data from corporate ESG (Gratcheva et al., 2021). According to Zhang et al. (2022), a commonly considered definition, a country's ESG score gives us an overall assessment of a nation's financial situation and commercial environment.

The term ESG was first coined in a 2004 publication, *Who Cares Wins,* by 20 different financial institutions in response to the request by the United Nations (Origin of ESG, 2023). The core purpose of the report was to establish unique guidelines for all the actors of the financial industry to give more consideration to the environment, society, and governance in their activities. With the published article, the endorsing institutions wanted to signal a crucial finding that they uncovered: corporations that tackle the issues stemming from these three dimensions can increase their financial value (Who Cares Wins, 2004).

The approach to evaluating corporate ESG varies among analytics firms as they vastly disagree on the definition of ESG, but the underlying concept remains consistent across the board (Berg et al., 2022). Firstly, an ESG ratings firm examines multiple metrics associated with the three core pillars–Environmental (e.g., air and water pollution, carbon footprint), Social (e.g., human rights, data privacy), and Governance (e.g., shareholder rights, compensation)–and assigns weights to these metrics based on their relative importance within each pillar (What Is ESG Performance?, 2021). This weight reflects the significance of specific factors within the broader ESG framework. Secondly, the firm calculates a unique score for the company in each of the three ESG pillars by combining the value of each metric with its corresponding weight. This process ensures that the resulting scores reflect the emphasis placed on different aspects of ESG for that particular firm. Lastly, the firm determines the overall corporate ESG score by aggregating the scores from the three pillars. To accomplish this, the analytics companies multiply individual scores for each pillar by their respective weights, determined by their relative importance in the overall ESG assessment. The products of the weights and scores for each pillar are then summed together, producing a comprehensive ESG score.

However, researchers and financial institutions have recently started to consider applying the ESG framework on a sovereign level to evaluate the ESG performance of nations and analyze its importance. As countries are operated differently than firms due to their unique, diverse composition and different objectives that they strive for, the ESG evaluating process also differs. The differences are most noticeable in the sub-composition of the score, i.e., in the individual metrics that comprise the score. Furthermore, according to Berg et al. (2022), the correlation of sovereign ESG scores between different providers is much greater than that of corporate ESG scores, which potentially indicates that there is more agreement in ways of measuring sovereign ESG. In contrast, there have been findings that disagreement is highest amongst analyst firms regarding the E

(Environmental) pillar of ESG, which generally also had minor importance in the overall score (Gratcheva et al., 2021).

2.2 Economic Performance

The economic performance of a country is an indicator that tells us how healthy and prosperous its economy is. Generally, measuring economic success is a standardized process so that the measures can be compared among different nations. The most common way of measuring this metric amongst countries is GDP growth. However, due to the limited resources that the planet we live on provides us with, GDP growth and its limits could potentially obstruct the attainment of environmental goals. Thus, research surrounding the United Nations' Sustainable Development Goals (SDGs) often considers other performance indicators, such as the Human Development Index and the unemployment rate (Coscieme et al., 2020).

Measurements of the economic performance of nations date back to ancient civilizations when wealth was simply defined by the amount of gold, silver, or precious stones one held. This way of wealth measurement for countries started to decay in the 17th century when Sir William Petty proposed that a country's wealth equals its real resources (Lely & Fuller, n.d.). Sir William Petty tried estimating the real wealth and income of England through the use of the expenditure method: he first calculated the average amount spent by a person and then multiplied it by the estimated population. Although Sir Petty's methods were lacking in numerous aspects, such as not accounting for investment expenditures on capital, his ideas gave a crucial foundation to the systems of measurement of sovereign performance used nowadays.

It was not until much later, in the 20th century, that standardized measuring systems for economic performance started developing. In the wake of the 1929 stock market crash, economists around the world lacked one crucial piece of information required to tackle the issue–a metric of how serious the damage was. In consequence, in the 1930s, Simon Kuznets' development of the standardized Gross National Product (GNP) and Gross Domestic Product (GDP) systems allowed countries to have insight into how many goods and services they produced during a specific period (Vanham, 2021). Calculating GDP was quite straightforward, according to Kuznets: add up the total value of all finished goods and services produced within a country in a year and subtract any costs of intermediary products. Another way of arriving at the same value of the GDP is to sum all the salaries, investment incomes, and profits within a nation for a specific year. The ingenuity of Kuznets' GDP invention was confirmed as many nations around the world started implementing it, and it finally reached the status of the main tool for measuring economies around the world at the 1944 Bretton Woods conference.

However, more recently, and especially in light of the primary explanatory variable of my research–sovereign, ESG, researchers have started to emphasize the importance of traditional country performance indicators such as ESG and ESG growth (Coscieme et al., 2020). That is due to the contradiction of the economic theory of infinite growth with the limitation of resources that our planet provides us with. Thus, these researchers resort to other measures of a country's financial performance, such as *The Genuine Progress Indicator* (GPI) or *The Index of Sustainable Economic Welfare* (ISEW). Unlike GDP, which measures only the production and income of a country, these indexes look at the sustainable financial and societal welfare of a country which is in line with Sustainable Development Goals (SDGs) coined by the UN (Talberth et al., 2006). The most noteworthy factors these alternative measures consider are income distribution, environmental costs, and individual leisure time.

2.3 The Relationship: Sovereign ESG Score and Economic Performance

The relationship between sovereign ESG scores and economic performance is a relatively new topic in economic research and has thus been studied only a number of times. One example of such an analysis of this relationship is a 2021 study based on 29 OECD countries' GDP per capita in relation to their ESG performance (Diaye et al., 2022). Their study looked at two main panel datasets ranging from 1996 to 2014 to conduct their study. More specifically, the first dataset, a base for their independent variable, included ESG indexes for each of the countries through time. The second dataset, their response variable (inflation-adjusted) GDP per capita, was chosen to fill the need for comparability of results among other studies in the field. The researchers conclude their study with two crucial findings regarding the relationship's short-run and long-run aspects. Firstly, they find that, on average, ESG performance does not significantly affect a country's GDP per capita figures in the short run. Secondly, however, they find that the connection between the two factors is positive and statistically significant in the long run. Given that the GDP per capita metric is closely connected to GDP growth, it is reasonable to assume that the same positive relationship would be identified when analyzing the changes in this measure in relation to the ESG performance of countries.

Further, more studies examined the relationship between a country's ESG performance and financial prosperity. In their research, Capelle-Blancard et al. (2019) and Crifo et al. (2017) studied whether there is a connection between sovereign ESG factors and borrowing costs in international capital markets. The findings of Capelle-Blancard and his colleagues lead them to conclude that countries with a good ESG score generally pose a lower risk of defaulting and have lower sovereign bond yield spreads. Furthermore, both research papers found that the social and governance components of ESG significantly negatively correlated with sovereign bond yields. Contrastingly, Capelle-Blancard et al. found that the environmental dimension's correlation in this case was not statistically significant. Moreover, Crifo et al. find that the effect of ESG ratings on sovereign borrowing costs is "about three times weaker (in absolute value)than the effect of financial ratings" Capelle-Blancard et al. (2019). Observing these findings helps us better understand the relationship I am studying. Specifically, since the independent variables in the two studies and my study are closely related, GDP growth and sovereign borrowing costs indicate the overall health of a nation's economy. These variables are also linked through core macroeconomic principles. Thus, based on these research results and his colleagues, we can expect that for a similar sample, a good ESG score of a country with a lesser chance of default would also reflect on average higher GDP growth figures.

What's more, Zhang et al. (2022) analyze the relationship between sovereign ESG factors and corporate investment. The findings based on balance sheet data of UK firms lead the researchers to conclude that how the country governs significantly positively affects firm investment. They also found that uncertainty in migration and climate policies leads to a reduction in corporate investment. These findings might not be relevant to my research as they primarily focus on the corporate impact of sovereign ESG. However, as there is an undeniable connection between the average economic success of a country's firms and its economic performance, I can expect to find some similarities in my findings. More concretely, based on this, I expect that sovereign ESG and economic performance are similarly related.

In my research, I aim to replicate the study by Diaye et al. (2022) developed to determine how important ESG factors are when it comes to the GDP per capita of 29 OECD countries. As part of my research, I apply a similar approach to analyzing the importance of ESG variables on economic performance (as depicted by GDP growth) of various countries worldwide. As the determinants of GDP are essentially identical to those of GDP growth, parallels can be drawn between the findings of the study by Diaye and colleagues and the predicted outcome of my analysis. The main conclusion of the 2022 study is that *a higher sovereign ESG score leads to higher GDP per capita, while in the short run, the relationship is not statistically significant*. This finding importantly helps shape the core prediction for my research. As my analysis will also include poorer countries that are not a part of the OECD, my expectations for findings differ somewhat from those of Diaye et al. I expect to find that the sovereign ESG score has a weak but positive role in determining economic performance. This conclusion stems from research such as (DiPasquantonio et al., 2021), which, although in the corporate world, points out that environmental sustainability actions are a luxury of the players that can afford it. Ergo, it would be naïve to expect a mix of all kinds of economic performers to be able to dedicate their various budgets to environmental sustainability.

3. Data

3.1 Sample Description

To conduct my research, I collected 12 ESG-related metrics from various countries worldwide (later used to compose unique sovereign ESG performance scores) and one metric related to the nation's economic performance. All of the data was collected from the World Bank database, which is available online and publicly accessible to everyone. My sample consists of 124 countries spanning six different continents (see Appendix A for the list of all countries used in the analysis). Furthermore, the sample observations begin in 2002 and end in 2021. Of the 12 individual metrics related to sovereign ESG, I have selected three groups of four to represent each core ESG branch.

3.2 Economic Performance

GDP growth is defined as the "Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2015 prices, expressed in U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products." (Sovereign ESG Data Portal). I have obtained the *GDP growth* data from the World Bank ESG database. In total, there were 2479 observations and one data point with a blank value. I have synthesized the missing value with IDW extrapolation to proceed calmly with my analysis. Observing the unanalyzed data points makes it hard to distinguish any noticeable anomalies of interest.

3.3 Environmental Variables

CO2 emissions are defined as the average amount of carbon dioxide (CO_2) emitted by each individual within a specific country, measured in metric tons (Sovereign ESG Data Portal). I have collected the *CO2 emissions* data from the World Bank Sovereign ESG database for N=124 countries and t=18 years (2002-2019). However, due to not yet having access to this metric for the years 2020 and 2021, I was missing 124 observations for each of these two years. Having these 248 observations is crucial for my research, as missing data points would cause problems in calculating the sovereign ESG score. To make up for this and to be able to perform my analysis fully, I have implemented inverse distance weighted (IDW) extrapolation to extrapolate these values. I discuss this technique in greater detail below. The final number of periods, countries, and, thus, data points is the same for all variables: N=124 countries and t=20 (2002-2021), resulting in a total of 2480 data points. Not so shockingly, the countries scoring the highest on this metric (e.g., Kuwait, Brunei, and Luxemburg) are all characterized by a relatively small population, very energy-intensive industries, and limited renewable energy sources.

The *Renewable energy use* metric is defined as the share of energy derived from renewable sources out of the total energy consumed and generally signifies how much a nation cares about the sustainable production of the energy it consumes(Sovereign ESG Data Portal). Thus, it is measured in % terms. I have collected the metric data from the World Bank Sovereign ESG database for N=124 countries (see Appendix **Error! Reference source not found.**) and t=18 years (2002-2019). However, similar to the *CO2 emissions*, due to not yet having access to this metric for the years 2020 and 2021, I resorted to the IDW extrapolation technique to make up for the missing values. Surprisingly, the values for the various data points are quite higher than I expected, especially considering how far back the data dates.

Energy intensity indicates "how much energy is used to produce one unit of economic output" (Sovereign ESG Data Portal). In other words, a higher value indicates that more energy is consumed to produce a unit of output. Thus, this variable is calculated via the following formula:

$$Energy\ intensity_{i,t} = \frac{Total\ primary\ energy\ supply_{i,t}}{2017\ US\$\ PPP\ adjusted\ GDP_{i,t}} \qquad (1)$$

where *i* indicates the given country and *t* a specific year for which we are trying to calculate the metric. *Total primary energy supply*$_{i,t}$ is measured in MJ. While a close proxy to the energy efficiency indicator, the *Energy intensity* ratio has flaws, like not accounting for countries' climate differences. I have gathered the World Bank Sovereign ESG database data for N=124 countries and t=18 years (2002-2019). As with the previous two values, this variable also initially suffered from missing the most recent data points. I have performed the identical extrapolation technique as with the *Renewable energy use* and *CO2 emissions* variables to make up for the 248 not yet available observations. The data shows that the geographies with the highest ratio values either belong to one of the colder parts of the world or have a less developed economy. On the other side of the spectrum, mostly only economically rich nations such as Switzerland and Austria can be found.

Natural resource depletion is defined as "the sum of net forest depletion, energy depletion, and mineral depletion" (Sovereign ESG Data Portal) and is measured as a (%) share of gross national income (GNI). I have obtained the data from the World Bank Sovereign ESG dataset. The observations span t=20 years and include N=124 countries. However, due to some countries having minor gaps in their data, the initial dataset was missing 19 observations, which I have accounted for through IDW interpolation and extrapolation. The country that stands at the top in terms of this measure in my data is the Democratic Republic of Congo (DRC). Due to its vast natural wealth combined with a heavy colonial history, DRC is one of the biggest exporters of cobalt ore, diamonds, and copper ("Democratic Republic of the Congo", 2023).

3.4 Social Variables

Life expectancy is defined as "the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life" (Sovereign ESG Data Portal).In other words, *Life expectancy* very well indicates the overall health of a country's population and its health system. I have obtained the data from the World Bank Sovereign ESG database for t=19 years (2002-2020) and N=124 countries. Since the observations for 2021 are not yet available at the time of writing this research, I have again applied IDW extrapolation to produce 124 missing data points. Looking at the data, it is interesting to observe the persistent positive trend in this variable as time progresses. The mean value over all countries increases by roughly 0.3 annually for the entire sample time span.

School enrolment is defined as "the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of (primary) education." and is thus measured in gross % terms (Sovereign ESG Data Portal). As primary education provides people with essential reading, writing, and computing skills needed for life, this is a good indicator of the capacity of the primary education system. Since the data includes all the people in primary education, we can also observe countries where many overage individuals still pursue primary education. This can be approximately interpreted as the closer the metric is to 100%, the more appropriately balanced the primary education system of a country is. I have obtained the data for t=20 years and N=124 countries from the World Bank Sovereign ESG dataset. While the data was complete for some countries, many were missing the most recent 2021 observations. Additionally, some countries had small gaps in their data in the middle of the sample timeframe. Thus, I used IDW interpolation and extrapolation to create the 199 missing data points. Regarding the above explanation of the optimal metric value, it is interesting to see how many countries have an abundance of nationals participating in primary education even though they are too old for it (e.g., Togo, Peru, and Mozambique).

The *Labor force* ratio indicates what portion of the population aged between 15 and 64 years is involved in producing goods or services and is therefore expressed in percentage terms (Sovereign ESG Data Portal). This metric is closely linked to how well a nation's human capital is developed. I have extracted the data from the World Bank Sovereign ESG dataset. The data encompasses the same time and geographical sample specifications as every other variable in my research. There was one observation that was blank in the original dataset. I have addressed this shortcoming by synthesizing the data point through IDW extrapolation. Interestingly at the top of the *Labor force* metric, we can find first-world countries such as Switzerland and third-world countries, e.g., Madagascar.

The *F/M labor participation* variable is defined as the ratio of female to male labor force (Sovereign ESG Data Portal). The ratio is expressed in % terms and is calculated via the following formula:

$$F/M\ labor\ participation_{i,t} = 100 \times \frac{Female\ labor\ force_{i,t}}{Male\ labor\ force_{i,t}} \tag{2}$$

where *i* indicates the given country and *t* a specific year for which we are trying to calculate the metric. Thus, a higher value implies more equality in the labor force regarding biological sex. I have obtained 2479 observations from the World Bank Sovereign ESG database. Evidently, there was one observation missing in the dataset. Similarly to other issues with missing variables in my dataset, I have again applied IDW to extrapolate the missing data point. Astonishingly, this time around, the metric is not topped by first-world countries. The top spots are taken by Rwanda, Guinea, and Mozambique's *F/M labor participation* mean values are the closest to 100%. Conversely, at the bottom of the *F/M labor participation* scale are Yemen, Iran, and Egypt.

3.5 Governance Variables

Political stability aims to measure the estimate of "the likelihood of political instability and/or politically-motivated violence, including terrorism" (Sovereign ESG Data Portal). As the estimate gives a country's position on the aggregate scale, it is shown in units of standard normal distribution (approximately between -2.5 and 2.5). I have obtained data for t=20 years and N=124 countries from the World Bank Sovereign ESG database. One observation (0.04% of all observations) was missing in the original dataset. Thus, I used the IDW technique to address this and synthesize the missing data point. While the data differs greatly around the world, an observation can be made that countries with less developed political systems and economies are on the lower end of the scale. Countries scoring the highest here are the ones that are either very small or remote (having a lesser likelihood of terrorism) or are very developed.

Control of corruption aims to estimate how much public authority is used for private benefit, encompassing both small-scale and large-scale corruption (Sovereign ESG Data Portal). The estimate provides a score for the nation on the overall indication that ranges from around -2.5 to 2.5 in units of a typical normal distribution. I have gathered the data from the World Bank Sovereign ESG dataset. The range of information is the same as for the other variables. I have synthesized the four missing observations using IDW extrapolation for this variable. As expected, the countries with the highest estimates are located in central, North-West, and North Europe, while the country with the lowest estimate is again DRC.

Government effectiveness denotes the "perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies" (Sovereign ESG Data Portal). Similarly to the *Political stability* estimate, the values for this variable also roughly range between -2.5 and 2.5. I have extracted the information from the World Bank Sovereign ESG dataset. The amount of data points matches the other variables. Again, the initial dataset was missing some (six) observations. I tackled this with IDW extrapolation. North European countries dominate the top of this metric. Contrastingly, the bottom of the metric is filled with countries located on the African continent.

The *Voice and accountability* variable estimates the extent to which nationals of a nation are permitted to take part in electing their government officials and of freedom of expression, association, and media (Sovereign ESG Data Portal). Conversely, *Voice and accountability* is a good indicator of how much freedom individuals have in a country to voice their opinions. Once more, as this is an estimate, this variable takes values ranging from roughly -2.5 to 2.5, as it follows a standard normal distribution. Moreover, I have also extracted the usual amount (for my research) of data points for this variable from the World Bank Sovereign ESG database. All 2,480 data points were available for this variable; thus, no imputation was needed. The distribution of countries along the *Voice and accountability* metric is very similar to that of other metrics that fall under the Governance branch of the ESG metrics.

3.6 Missing Values

As I was working with a relatively large periodical and geographical range in my data, it was no surprise that there were a number of missing observations in my panel data. As I needed all of the observations to be present in order to construct the sovereign ESG metric, I have resorted to inverse distance weighted (IDW) interpolation (for missing variables within the range of the observed data points) and extrapolation (for missing variables outside the range of the existing observations). IDW interpolation and extrapolation are spatial analysis methods used to estimate unmeasured values. These techniques assign the weights to neighboring data points based on their distance from the target point. The weights are inversely proportional to distance, meaning closer points have a stronger influence on the estimated value. The formula I have used to estimate the missing values in my data can be expressed as follows:

$$Z_p = \frac{\sum_{i=1}^{n}\left(\frac{1}{d_i^2}\right)\times Z_i}{\sum_{i=1}^{n}\left(\frac{1}{d_i^2}\right)} \tag{3}$$

where Z_p is the estimated value at the target point, Z_i is the known value at the data point *i,* and d_i represents the distance between the target point and data point *i*. Apart from being simple and intuitive to use, the IDW model for estimating missing values suits the needs of our research, as we cannot make strong assumptions about the underlying data distribution.

3.7 Environmental Performance Variable

To compose *E*, the environmental component of sovereign ESG, I first transformed the four relevant variables to follow a linear scale between 0 and 1. I did this so that figures of different metrics could be more easily compared, visualized, and interpreted. Specifically for the *CO2 emissions* and *Energy intensity* variables, which can, in theory, take any non-negative integer, I subtracted the minimum value and divided by the range to transform the variables to fit on a scale between 0 and 1. Since the *Renewable energy use* and *Natural resource depletion* variables are already expressed in percentage terms, no further transformation was needed.

Afterwards, I further transformed the values of the transformed *CO2* emissions, *Energy intensity*, and *Natural resource depletion* variables so that a higher value would correspond to a higher overall ESG score for every variable. I achieved this by simply inverting these variables' 0-1 scale. Next, I assigned weights to individual metrics within each of the three ESG pillars based on their importance (the variable weights can be found in Appendix B). Subsequently, I calculated the country scores for the *E* component of sovereign ESG. The transformations and computations that I applied to form the *E* variable are observable in the following formula:

$$E_{i,t} = \left(1 - \frac{CO2\ emissions_{i,t} - \min(CO2\ emissions)}{\max(CO2\ emissions) - \min(CO2\ emissions)}\right) \times w_{CO2\ emissions} + Renewable\ energy\ use_{i,t} \times w_{Renewable\ energy\ use} + \left(1 - \frac{Energy\ intensity_{i,t} - \min(Energy\ intensity)}{\max(Energy\ intensity) - \min(Energy\ intensity)}\right) \times w_{Energy\ intensity} + \left(1 - Natural\ resource\ depletion_{i,t}\right) \times w_{Natural\ resource\ depletion} \tag{4}$$

where $E_{i,t}$ represents a country *i*'s score in the environmental aspect of ESG in year *t*. Moreover, the $Variable_{i,t}$ indicates the value of *Variable* in year *t* and country *i.* Furthermore, the *min(Variable)* and *max(Variable)* variables represent the dataset minimum and maximum values for a variable *Variable*, and $w_{Variable}$ represents the weight attributed to the variable *Variable* within the environmental branch of ESG.

3.8 Social Performance Variable

Similarly to the sub-variables of the *E* metric, I have first transformed the sub-variables composing *S* (the sovereign social performance) to fit a 0-1 scale. Most notably, for the *School enrolment* variable, I expressed it as an absolute difference from 1, as that is the optimal score. Then, like with the *E* component, I have inverted the relevant variables' scales so that a higher score would correspond to a better ESG score. Lastly, I applied the weights to individual metrics and added them to form a unique *S* metric. All of the transformations and computations that I used to construct the *S* variable can be seen in the equation below.

$$S_{i,t} = \frac{Life\ expectancy_{i,t} - min(Life\ expectancy)}{max(Life\ expectancy) - min(Life\ expectancy)} \times w_{Life\ expectancy} + \left(1 - \left|1 - \frac{School\ enrolment_{i,t}}{100}\right|\right) \times w_{School\ enrolment} + Labor\ force_{i,t} \times w_{Labor\ force} + F/M\ \ labor\ participation_{i,t} \times w_{F/M\ labor\ participation} \quad (5)$$

3.9 Governance Performance Variable

As with the other two ESG pillars, I first transformed the governance-related variables to fit a 0-1 scale. As the four relevant variables here, in theory, take values approximately between -2.5 and 2.5, I have first shifted each measurement by adding 2.5 and then divided that by 5 to fit each observation to my desired scale. I have proceeded with the composition of the *G* (sovereign governance performance) variable, mirroring the process from the previous two ESG components. Equation (6) represents all of the computations and transformations that are needed for the composition of *G*.

$$G_{i,t} = \frac{Political\ stability_{i,t} + 2.5}{5} \times w_{Political\ stability} + \frac{Control\ of\ corruption_{i,t} + 2.5}{5} \times w_{Control\ of\ corruption} + \frac{Government\ effectiveness_{i,t} + 2.5}{5} \times w_{Government\ effectiveness} + \frac{Voice\ and\ accountability_{i,t} + 2.5}{5} \times w_{Voice\ and\ accountability} \quad (6)$$

3.10 Sovereign ESG Variable

To compose the core independent variable of my studied relationship, *Sovereign ESG*, I have, based on importance and similar research on the topic (Robeco, MSCI, ISS), assigned weights (see Appendix B for specific pillar weights), w_x, to the individual ESG pillars and multiplied it with the correlating ESG pillar score, $X_{i,t}$. Lastly, I have added the three products between the sovereign ESG pillar score and its designated weight to obtain the *Sovereign* $ESG_{i,t}$ metric for country *i* and year *t*.

$$Sovereign\ ESG_{i,t} = E_{i,t} \times w_E + S_{i,t} \times w_S + G_{i,t}\ \times w_G \quad (7).$$

The country mean values for the Sovereign *ESG* variable can be found in Appendix C.

3.11 Summary Statistics

Table 1: Descriptive statistics of GDP growth and sovereign ESG variables across 20 Years (2002−2021) and 124 Countries

Variable	Mean	Std. dev.	Min.	Max.
GDP growth (%)	3.646	4.297	-33.493	41.745
CO2 emissions (t/cap)	4.295	4.733	0.030	31.273
Renewable energy use (%)	32.665	27.940	0.000	98.270
Energy intensity (MJ/$2017 PPP GDP)	4.958	2.708	1.270	27.270
Natural resource depletion (%)	3.524	5.282	0.000	33.501
Life expectancy (years)	71.022	8.655	42.125	83.905
School enrolment (%)	103.770	12.337	39.539	149.957
Labor force (%)	66.890	9.754	38.058	89.450
F/M labor participation	70.922	17.701	17.339	105.659
Political stability	-0.025	0.874	-2.810	1.753
Control of corruption	0.058	0.957	-1.673	2.459
Government effectiveness	0.103	0.900	-1.841	2.346
Voice and accountability	0.045	0.960	-2.233	1.801
E	0.668	0.142	0.256	0.946
S	0.727	0.120	0.382	0.945
G	0.511	0.170	0.156	0.911
ESG	0.615	0.094	0.407	0.864

Looking at the summary statistics (Table 1), a few interesting aspects can be pointed out. Firstly, it is very interesting to see the considerable range in the *GDP growth* data, as the minimum value reaches -33.493%, indicating a significant decline, while the maximum value shows a substantial growth of 41.745%. After further inspection of the data, I have found the outlier data points to belong to the Maldives in the years 2020 and 2021. This anomaly is most likely a consequence of the decline in tourism due to the Covid-19 pandemic. Secondly, looking at the summary statistics for *CO2* emissions, especially the standard deviation of 4.733 and the big range between the minimum and maximum values, suggests significant differences in environmental impact across countries. Lastly, focusing on the *F/M labor participation*, we can see that the mean value, 70.922, indicates that in our sample, on average, women are still less represented in the labor force than men. Conversely, the max value of 105.659 indicates that in some cases, women actually make up a bigger part of the labor force than men, a finding which goes against the traditional patriarchal values.

Table 2: Correlations between GDP growth, 12 ESG-related metrics, three sovereign ESG pillars' scores, and sovereign ESG

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) GDP growth (%)	1.000																
(2) CO2 emissions (t/cap)	-0.161	1.000															
(3) Renewable energy use (%)	0.165	-0.596	1.000														
(4) Energy intensity (MJ/$2017 PPP GDP)	0.179	0.015	0.298	1.000													
(5) Natural resource depletion (%)	0.186	0.075	0.114	0.377	1.000												
(6) Life expectancy (years)	-0.229	0.559	-0.692	-0.442	-0.317	1.000											
(7) School enrolment (%)	-0.008	-0.093	0.040	-0.007	0.026	0.023	1.000										
(8) Labor force (%)	-0.048	0.225	0.079	0.084	-0.090	0.184	-0.019	1.000									
(9) F/M labor participation	-0.004	0.011	0.296	0.210	-0.066	-0.115	0.059	0.760	1.000								
(10) Political stability	-0.182	0.436	-0.346	-0.243	-0.282	0.494	0.094	0.337	0.290	1.000							
(11) Control of corruption	-0.242	0.527	-0.331	-0.291	-0.350	0.628	0.019	0.362	0.215	0.730	1.000						
(12) Government effectiveness	-0.231	0.597	-0.478	-0.323	-0.361	0.729	-0.024	0.355	0.183	0.691	0.916	1.000					
(13) Voice and accountability	-0.246	0.310	-0.264	-0.361	-0.487	0.531	0.033	0.373	0.284	0.640	0.778	0.766	1.000				
(14) E	0.154	-0.799	0.951	0.128	-0.036	-0.669	0.060	-0.009	0.220	-0.374	-0.383	-0.518	-0.245	1.000			
(15) S	-0.211	0.551	-0.538	-0.306	-0.318	0.893	0.004	0.529	0.330	0.590	0.683	0.772	0.619	-0.556	1.000		
(16) G	-0.253	0.522	-0.391	-0.340	-0.414	0.670	0.022	0.393	0.255	0.801	0.961	0.950	0.887	-0.421	0.742	1.000	
(17) ESG	-0.229	0.336	-0.168	-0.347	-0.473	0.637	0.043	0.520	0.418	0.739	0.902	0.876	0.869	-0.179	0.780	0.942	1.000

A number of observations can be made by looking at the table of correlations between variables used in my research. Firstly, looking at the correlations between individual ESG pillar variables and the metrics that compose them, most of the coefficient signs are correct (positive for variables that needed to be. The exception to this is the coefficient between *E* and *Energy intensity* (where a higher *Energy intensity* should reflect in a lower *E*). The most likely explanation for this deviation from expectation is that the significance of *Energy intensity* is relatively small and is thus outweighed by the influence of other variables determining *E*. Secondly, the correlation coefficient between *E* and *ESG* is -0.179. To my knowledge, there are two possible explanations for this unexpected outcome: the relatively low weight of *E* (0.25) in determining *ESG* and a lack of determining factors (e.g. external economic conditions, policy implementation information). Lastly, the correlation coefficient between *GDP growth* and *ESG* is -0.229, which is a good sign that my expectation of a positive relationship between the two variables might not hold.

4. Methodology

$$GDP\ growth_{i,t} = \beta_1 \times ESG_{i,t} + \alpha_i + u_{i,t} \tag{8}$$

In order to determine what approach is best to analyze my data, I used the Hausman test. The Hausman statistical test is used in econometrics to determine the appropriate choice between a fixed effects model and a random effects model. The test compares the coefficients estimated under both models and assesses whether their differences are statistically significant. If the test indicates a significant difference, it suggests that the fixed effects model is more suitable due to the presence of endogeneity or correlation between the individual-specific effects and the explanatory variables.

After running the Hausman test on my dataset, I have determined that the fixed effects (FE) model is more appropriate for analyzing my data. The FE model is a statistical approach commonly used in panel data analysis. It aims to control for unobserved heterogeneity or individual-specific effects that might be present in the data. By including individual fixed effects, the model accounts for time-invariant characteristics of each entity within the panel, allowing researchers to focus on the within-group variation over time. In the panel regression equation (8), α_i represents country fixed effects, capturing unobserved country-specific characteristics that are constant over time. Furthermore, $u_{i,t}$ is the error term, and β_1 represents the impact of a change in $ESG_{i,t}$ on $GDP\ growth_{i,t}$. This approach helps mitigate potential biases caused by unobserved factors and enables estimating causal relationships between variables within the panel data set.

5. Results and Discussion

5.1 Results

Our panel regression model was estimated using the fixed effects method, accounting for country-specific fixed effects, and is represented by formula (8). The model explores the relationship between the sovereign ESG score $(ESG_{i,t})$ and $GDP\ growth_{i,t}$, while accounting for unobserved country-specific heterogeneity that remains constant over time. The β_1 coefficient represents the estimated effect of a one-unit change in the ESG score on GDP growth. In other words, when $ESG_{i,t}$ changes by 1 unit, the $GDP\ growth_{i,t}$ will, on average, change by β_1 percentage points.

Table 3: Panel regression results for the relationship between GDP growth (%) and sovereign ESG for 124 countries: models (1) and (2) capture 20 years, while models (3) and (4) each capture 10 years of data

Variable	(1) GDP growth (%)	(2) GDP growth (%)	(3) GDP growth (%)	(4) GDP growth (%)
Constant	20.570***	2.056	-1.506	-1.474
	(4.900)	(4.934)	(5.180)	(9.415)
Sovereign ESG	-27.500***	2.723	8.615	7.760
	(7.964)	(8.105)	(8.492)	(15.32)
Year				
2003		1.278***	1.278***	
		(0.384)	(0.384)	
2004		2.036***	2.046***	
		(0.403)	(0.407)	
2005		1.518***	1.523***	
		(0.421)	(0.422)	
2006		2.542***	2.537***	
		(0.422)	(0.423)	
2007		2.167***	2.154***	
		(0.386)	(0.382)	
2008		0.395	0.374	
		(0.429)	(0.429)	
2009		-3.738***	-3.770***	
		(0.543)	(0.541)	
2010		0.682	0.641	
		(0.428)	(0.425)	
2011		0.329	0.278	
		(0.432)	(0.433)	
2012		-0.430		
		(0.412)		
2013		-0.402		0.0130
		(0.402)		(0.220)
2014		-0.0558		0.339
		(0.381)		(0.316)
2015		-0.313		0.0758
		(0.422)		(0.383)
2016r		-0.600		-0.219
		(0.422)		(0.398)
2017		-0.142		0.235
		(0.412)		(0.392)
2018		-0.0979		0.275
		(0.377)		(0.342)

Variable	(1) GDP growth (%)	(2) GDP growth (%)	(3) GDP growth (%)	(4) GDP growth (%)
2019		-0.588		-0.224
		(0.370)		(0.375)
2020		-7.720***		-7.338***
		(0.571)		(0.566)
2021		1.445**		1.826***
		(0.610)		(0.621)
Observations	2,480	2,480	1,240	1,240
R-squared	0.014	0.315	0.232	0.392
Number of countries	124	124	124	124

Note. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

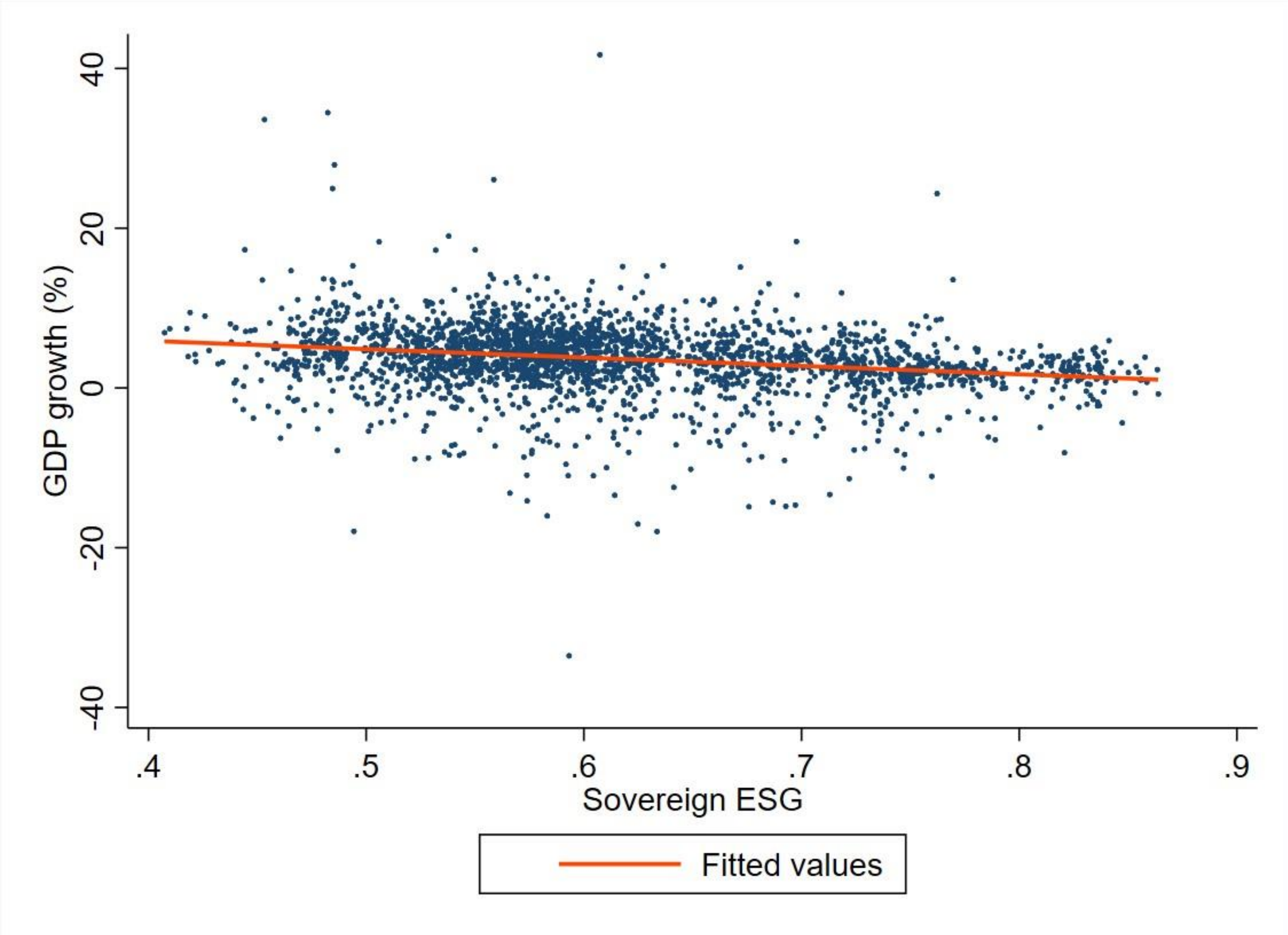

Figure 1: Scatter plot of model (1): fixed effect panel regression between GDP growth (%) and sovereign ESG score including all observations for 124 countries and 20 years (2002-2021) and a fitted trend line

The model (1)'s R-squared is about 0.014, which means that 1.4% of the variance in the overall GDP growth of countries in my sample can be explained by the independent variable in the model. The results from this model's (1) table can be interpreted as follows: a one-unit increase in the sovereign ESG score, on average, leads to a change in a country's GDP growth by -27.500%. This relationship can also be observed in Figure 1's Fitted values line in red. Some examples of this relationship for individual countries can be found in Appendix D. The corresponding p-value of this effect is smaller than 1%, meaning that it is statistically significant.

$$GDP\ growth_{i,t} = \beta_0 + \beta_1 \times ESG_{i,t} + \delta_t + \alpha_i + u_{i,t} \tag{9}$$

I have further considered the presence of random shocks in the financial markets that likely disrupt the relationship between sovereign ESG and GDP growth in certain years. Thus, I have also included a model controlling for year-specific effects on the relationship (model (2) in Table 3) as a robustness test of the primary model. This model is represented by the formula (9), where δ_t dummy variable captures the year-specific influence on the dependent variable. Model (2), including year-fixed effects, yielded an R-squared of approximately 31.5%, meaning that it explains more of the variation in the dependent variable than the primary model. Moreover, including year-specific effects causes the sovereign ESG variable to lose significance. This indicates that the year-specific effects relate to GDP growth more than sovereign ESG scores. More closely observing the coefficients of the individual year effects, we can first identify a strong positive trend for years between 2003 and 2011 and, second, a negative trend from 2012 onwards. Firstly, the positive trend in year dummy variables' coefficients before 2011 indicates that the average GDP growth rate during these years was higher compared to the reference year 2002. Secondly, the negative trend of the coefficients from 2012 to 2021 indicates that, on average, the GDP growth rate was lower than the reference year.

Due to two distinct trends in the year dummy variables, I have formed two models, (3) and (4), separately capturing these two time frames symbolized by the different trends. Model (3) captures panel regression formula (9) in years from 2003 up to 2011, while model (4) captures the same formula, however, in years 2012-2021. Comparing the regression results of these models with those of model (2), we can notice that the R-squared statistic falls to 23.2% with model (3) but rises to 39.2% with model (4). The most noticeable variable coefficient in model (3) is -3.770 for the year 2009, which stems from the immense downturn in GDP growth following the 2008 recession. We can interpret this coefficient as follows: in 2009, keeping all other variables constant, the average GDP growth was 3.770% lower than in the reference year. For model (4), the most significant dummy variable coefficients are the ones for 2020 and 2021 dummies. These can be explained by the extreme decline in GDP growth in 2020 following the outbreak of COVID-19 and a fast economic rebound in 2021, which caused the GDP growth figures to rise. As all three of these economic events shaping the coefficients of models (3) and (4) had a global influence, their coefficients are statistically significant at the 1% level. We can interpret the coefficients here similarly to the 2009 dummy coefficient in model (3).

An additional robustness test is provided in Appendix E. The model, same as the model (2), was estimated, omitting years 2020 and 2021 as they seem to stand out noticeably from other years. The reported results remained robust against these alternative specifications.

5.2 Discussion

With this variety of results, I find a lot of support for my expectations: sovereign ESG has little effect on GDP growth as there are likely many other variables influencing it. While model (1) already confirms this idea through its low R-squared score, models (2) through (4) confirm this further by showing the importance of year-specific influence on the dependent variable. Furthermore, I have predicted that the relationship between sovereign ESG score and GDP growth will be positive, which is rejected by the model (1) results. The coefficients of sovereign ESG's effect on GDP growth in models (2), (3), and (4) have a positive sign, which matches my prediction. However, in none of these models is the positive coefficient statistically significant.

With this outcome in mind, it is essential to point out that as compared to the Diaye et al. (2022) study, my findings differ from theirs. These differences in findings possibly stem from the different approaches to studying the relationship. On the one side, Diaye et al. (2022) examined the relationship between sovereign ESG and GDP per capita in two different time specifications (in the long run and short run). At the same time, I considered GDP growth as my dependent variable and focused on the immediate connection between factors. Another differentiating factor that causes the difference in results could be using different samples.

Moreover, as compared to the Capelle-Blancard et al. (2019) study of the similar relationship between ESG performance and financial prosperity, my results differ here again. Capelle-Blancard et al. (2019) found that a higher sovereign ESG score reflects a healthier national economy (i.e. lower risk of defaulting and lower sovereign bond yield spreads). Based on my findings, it is hard to determine whether they reflect those of Capelle-Blancard et al. (2019).

6. Conclusion

In this thesis, I sought to explore the intricate relationship between a country's Environmental, Social, and Governance (ESG) index scores and its economic performance, specifically focusing on the impact of ESG metrics on GDP growth. As global economies grapple with challenges like the aftermath of the COVID-19 pandemic and geopolitical uncertainties, there is increasing recognition of the potential of ESG strategies to address these issues. While prior research has examined ESG's influence on various financial aspects, including sovereign borrowing costs and credit default swap premiums, this study contributes by shedding light on the connection between ESG ratings and GDP growth - a topic with limited exploration. Consequently, this investigation's central question was: "How does a country's ESG rating relate to its GDP growth?"

To address this research question, I have gathered time series data encompassing 124 countries over a two-decade time period (2002-2021). I have collected proxy variables for the three ESG pillars and composed a novel composite sovereign ESG metric. The analysis of the time series data using the fixed effects model showed that the effect of a country's ESG performance on GDP growth is minimal.

This research thus concludes that while there exists a discernible relationship between ESG metrics and GDP growth, this connection is nuanced and intertwined with myriad factors that influence economic performance. This finding echoes previous research that has explored the impact of ESG on various financial dimensions. Indeed, the identified nuances in the sovereign ESG-GDP growth relationship align with the broader discourse surrounding the multifaceted nature of economic drivers, emphasizing the pivotal role played by a spectrum of factors.

A potential limitation of this study is that certain unobserved variables were omitted from this research due to their difficult quantification (e.g., changes in government policies, geopolitical events, and cultural differences). Potentially, future researchers will find a way to enumerate these factors and thus better distinguish the influence of sovereign ESG on economic performance.

Another limitation I have encountered while conducting this research is cross-country variability. More specifically, some composite factors of ESG countries might have little influence on them. For example, the climate of countries most likely strongly influences the *Energy intensity* figures for that country.

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Appendix A: Countries used in analysis

The countries included in my research are: Albania, Argentina, Armenia, Australia, Austria, Azerbaijan, Belgium, Benin, Burkina Faso, Bulgaria, Belarus, Belize, Bolivia, Brazil, Barbados, Brunei, Bhutan, Canada, Switzerland, Chile, China, Ivory Coast, Cameroon, Democratic Republic of the Congo, Colombia, Cape Verde, Costa Rica, Cuba, Cyprus, Czechia, Germany, Denmark, Dominican Republic, Algeria, Ecuador, Egypt, Spain, Estonia, Finland, Fiji, France, United Kingdom, Georgia, Ghana, Guinea, Gambia, Greece, Guatemala, Croatia, Hungary, Indonesia, India, Ireland, Iran, Israel, Italy, Jordan, Kazakhstan, Kenya, Kyrgyzstan, South Korea, Kuwait, Laos, Sri Lanka, Lesotho, Lithuania, Luxembourg, Latvia, Morocco, Madagascar, Maldives, Mexico, North Macedonia, Mali, Myanmar, Mongolia, Mozambique, Mauritania, Malawi, Malaysia, Namibia, Niger, Nigeria, Netherlands, Norway, Nepal, New Zealand, Oman, Pakistan, Panama, Peru, Philippines, Poland, Portugal, Romania, Russia, Rwanda, Saudi Arabia, Senegal, Solomon Islands, El Salvador, Serbia, Sao Tome and Principe, Suriname, Slovakia, Slovenia, Sweden, Eswatini, Chad, Togo, Thailand, Tajikistan, Tonga, Tunisia, Turkey, Tanzania, Uganda, Uruguay, Uzbekistan, Saint Vincent and the Grenadines, Vietnam, Samoa, South Africa, and Zambia.

Appendix B: ESG variable weights

Table 4: The distribution of weights of each metric within individual ESG pillars

Variable	E component weight	S component weight	G component weight
CO2 emissions	0.30		
Renewable energy use	0.40		
Energy intensity	0.10		
Natural resource depletion	0.20		
Life expectancy		0.50	
School enrollment		0.15	
Labor force		0.10	
F/M labor participation		0.25	
Political stability			0.15
Control of corruption			0.30
Government effectiveness			0.30
Voice and accountability			0.25

Note. The weights of individual metrics were picked based on other sovereign ESG research and estimated importance and relevance.

Table 5: The distribution of weights of the three ESG pillars

ESG component	Weight
Environment	0.25
Sustainability	0.30
Governance	0.45

Note. The weights of ESG components were picked based on other sovereign ESG research and estimated importance and relevance.

Appendix C: Mean ESG values

Table 6: Country mean values of ESG variable

Country	Mean ESG
Albania	0.630
Argentina	0.598
Armenia	0.579
Australia	0.749
Austria	0.787
Azerbaijan	0.505
Belgium	0.738
Benin	0.581
Burkina Faso	0.575
Bulgaria	0.615
Belarus	0.527
Belize	0.614
Bolivia	0.545
Brazil	0.630
Barbados	0.727
Brunei	0.599
Bhutan	0.717
Canada	0.771
Switzerland	0.818
Chile	0.723
China	0.571
Ivory Coast	0.513
Cameroon	0.547
Democratic Republic of the Congo	0.486
Colombia	0.593
Cape Verde	0.674
Costa Rica	0.700
Cuba	0.592
Cyprus	0.712
Czechia	0.680
Germany	0.759
Denmark	0.813
Dominican Republic	0.567
Algeria	0.473
Ecuador	0.563
Egypt	0.480
Spain	0.719
Estonia	0.707
Finland	0.825
Fiji	0.590
France	0.750
United Kingdom	0.753
Georgia	0.634
Ghana	0.622
Guinea	0.514

Country	Mean ESG
Gambia	0.555
Greece	0.660
Guatemala	0.580
Croatia	0.672
Hungary	0.663
Indonesia	0.567
India	0.565
Ireland	0.749
Iran	0.453
Israel	0.684
Italy	0.676
Jordan	0.538
Kazakhstan	0.506
Kenya	0.582
Kyrgyzstan	0.526
South Korea	0.665
Kuwait	0.534
Laos	0.547
Sri Lanka	0.610
Lesotho	0.535
Lithuania	0.694
Luxembourg	0.749
Latvia	0.696
Morocco	0.533
Madagascar	0.597
Maldives	0.571
Mexico	0.566
North Macedonia	0.589
Mali	0.553
Myanmar	0.510
Mongolia	0.562
Mozambique	0.591
Mauritania	0.503
Malawi	0.580
Malaysia	0.608
Namibia	0.605
Niger	0.558
Nigeria	0.505
Netherlands	0.772
Norway	0.846
Nepal	0.549
New Zealand	0.816
Oman	0.531
Pakistan	0.478
Panama	0.630
Peru	0.612
Philippines	0.581
Poland	0.663

Country	Mean ESG
Portugal	0.740
Romania	0.616
Russia	0.495
Rwanda	0.600
Saudi Arabia	0.487
Senegal	0.573
Solomon Islands	0.629
El Salvador	0.587
Serbia	0.590
Sao Tome and Principe	0.581
Suriname	0.582
Slovakia	0.668
Slovenia	0.723
Sweden	0.837
Eswatini	0.528
Chad	0.458
Togo	0.532
Thailand	0.607
Tajikistan	0.509
Tonga	0.575
Tunisia	0.567
Turkey	0.565
Tanzania	0.618
Uganda	0.565
Uruguay	0.748
Uzbekistan	0.448
Saint Vincent and the Grenadines	0.673
Vietnam	0.598
Samoa	0.670
South Africa	0.566
Zambia	0.584

Appendix D: Model (1) scatter plots for individual countries

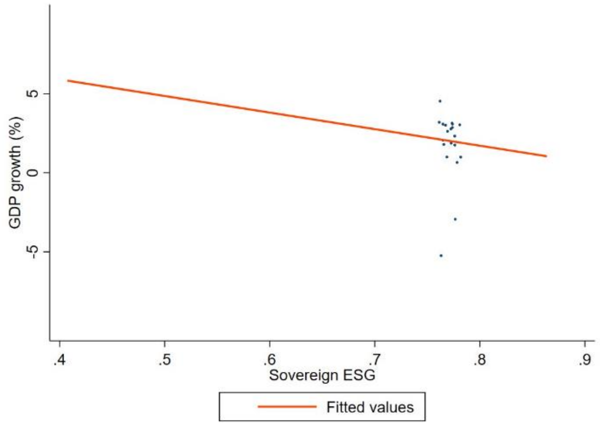

Figure 6: Scatter plot of model (1): fixed effect panel regression for Canada with a fitted trend line

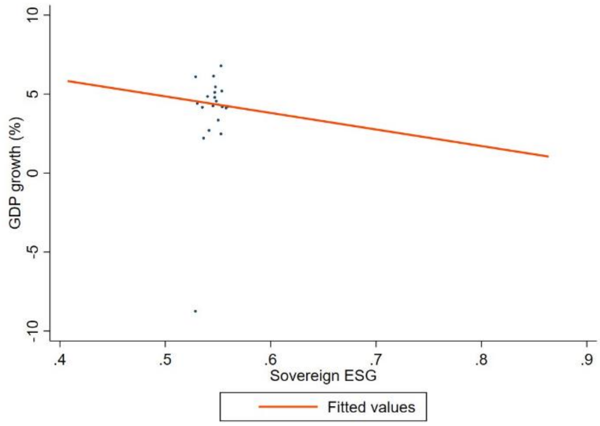

Figure 7: Scatter plot of model (1): fixed effect panel regression for Bolivia with a fitted trend line

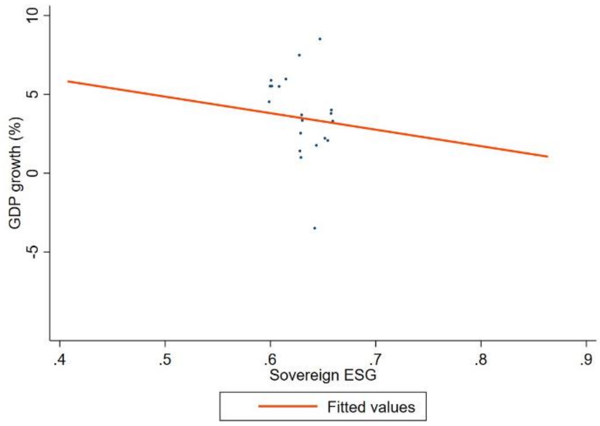

Figure 5: Scatter plot of model (1): fixed effect panel regression for Albania with a fitted trend line

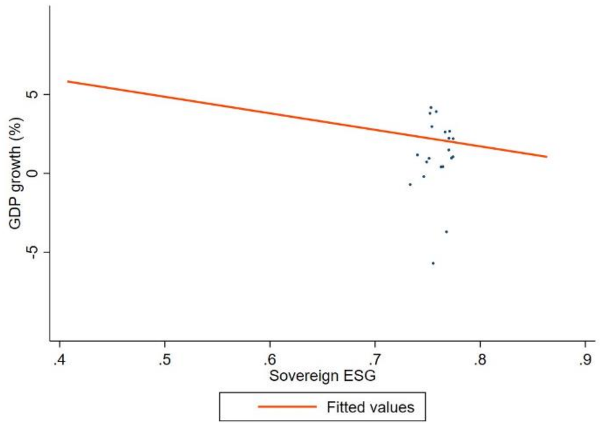

Figure 4: Scatter plot of model (1): fixed effect panel regression for Germany with a fitted trend line

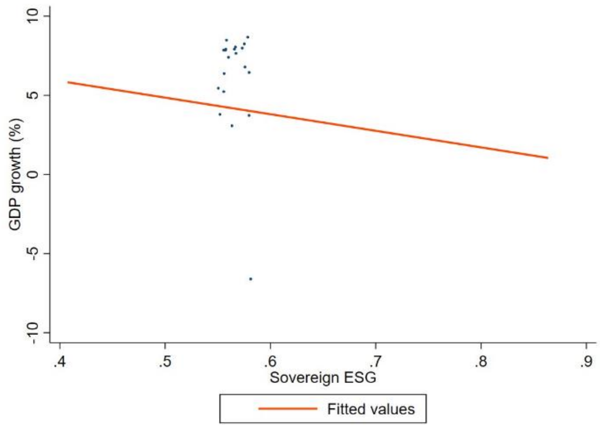

Figure 3: Scatter plot of model (1): fixed effect panel regression for India with a fitted trend line

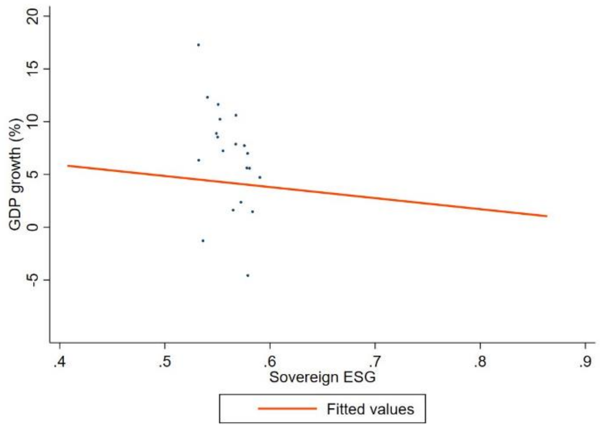

Figure 2: Scatter plot of model (1): fixed effect panel regression for Mongolia with a fitted trend line

While looking at the model (1) scatter plots of six randomly selected countries, several observations can be made. Firstly, the fitted line depicting the general relationship between sovereign ESG and GDP growth is negatively sloping in all cases, indicating that the relationship between the two variables is negative. Secondly, from looking at the plots, we can determine that the distributions of data points on the X and Y axis are approximately similar for all countries, indicating that no country (visually) significantly deviates from the rest in its distributions of sovereign ESG scores and GDP growth figures. Lastly, looking at the six figures, the differences between sovereign ESG scores between countries are apparent. For example, Mongolia and Bolivia fall comparably lower on the sovereign ESG scale than Germany and Canada.

Appendix E: Further robustness check of model (2)

Table 7: Robustness check of model (2): excluding years 2020 and 2021 from the model due to apparent extremity

Variable	(5) GDP growth (%)
Constant	3.833
	(5.275)
Sovereign ESG	-0.216
	(8.677)
Year	
2003	1.278***
	(0.384)
2004	2.031***
	(0.402)
2005	1.516***
	(0.421)
2006	2.544***
	(0.422)
2007	2.174***
	(0.387)
2008	0.405
	(0.429)
2009	-3.723***
	(0.541)
2010	0.703
	(0.424)
2011	0.354
	(0.432)
2012	-0.398
	(0.411)
2013	-0.362
	(0.401)
2014	-0.00404
	(0.380)
2015	-0.257
	(0.421)
2016	-0.540
	(0.424)
2017	-0.0801
	(0.411)
2018	-0.0333
	(0.382)
2019	-0.518
	(0.378)
Observations	2,232
Number of countries	124
R-squared	0.183

Note. Robust standard errors in parentheses;
*** p<0.01, ** p<0.05, * p<0.1

This robustness check in the form of the modified model (2), excluding years 2020 and 2021 from the analysis, was done to determine whether it would be sensible to omit these years from the analysis together due to their extremity. As model (5) declines in the R-squared statistic in comparison to model (2) and none of the coefficients change drastically, I concluded that omitting the years 2020 and 2021 is unnecessary.