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A Green Sensibility?

Examining the Issuance of Green Bonds in the Nordic Region

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Abstract

Green Bonds are debt instruments issued by companies whose proceeds are used to finance projects that promote sustainability. Consequently, they act as measures of a company's contribution towards the environment. However, they are often criticised as virtue-signalling. This paper explores the issuance of green bonds on two levels: the corporate level and the role of the region, here the Nordic Region, in promoting sustainability. Using the least square methods, I find that while company scores may increase, it is the previous year's score that has a larger impact than green bond issuance. I also find evidence that the environmental component of a region minutely affects the outcomes on the score of a company.

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1. Introduction

The following essay aims to contribute to the literature on corporate sustainability in two ways - in expanding the analysis of corporate green bonds to include those green bonds issued in the Nordic regions and examining the effects of the region on corporate sustainability. As per the Paris Climate Agreement which was signed in 2015, the need to recognise and tackle the consequences of global warming is pertinent. Several financial incentives (such as the carbon tax) have been proposed as a manner of tackling the carbon-emission heavy industries. Consequently, sustainability in companies has been a growing concern since the late 2000s. Increasingly, institutional investors have been using a company's environmental, social and governance (referred to as ESG) scores as a measure of responsibility and ethicality. ESG investing allows individuals to promote certain ethical concepts through their investments and thus, diversify their portfolios.

Green bonds are one such measure of diversification. Green bonds are debt instruments. These can be issued by companies, municipalities, states and sovereign governments in order to finance projects related to long-term environmental projects (Orlov et al., 2017). Bonds have often been used to fund large-scale projects and green bonds are an extension of this idea. Green Bond issuance soared to as much as USD 80 billion in 2016 (Bigger, 2017). Examining the relationship between corporate entities and regional entities given the size of the market for the same is pertinent. However, green bonds need to be viewed with respect to social disclosures.

Social disclosures are defined as the information that a firm makes public, whether alongside its annual reports or standalone accounts, that relate to its performance, standards or activities under the umbrella of corporate social responsibility (CSR) (Brooks and Oikonomou, 2018). These are often referred to as sustainability reports. These disclosures, which may be mandatory depending on the region the firm is in, more often than not tend to rely on self-reported accountability (Brooks and Oikonomou, 2018). In the 1970s, reporting was geared towards reporting on social issues pertaining to the conditions of workers. However, by the 1990s environmental information was released alongside other financial reports.

Now why provide these disclosures? Often, the rationale between reporting these disclosures and issuing green bonds is the same. Possible explanations include a sense of social contract, to enhance legitimacy and affect their financial valuations (Mathews, 1997), the latter which I elaborate on here. In terms of financial valuations, Ashforth and Gibbs (1990) identify the key reasons behind why firms choose to provide their social and environmental disclosures:

1) The substantiative approach states that disclosures reveal the ESG changes firms have made in their activities.
2) The symbolic approach states that they portray the firm's behavior to be consistent with social norms.

Sceptics often believe that due to financial motives, CSR should be viewed as less than sincere as this improvement is purely for presentation and not to improve on sustainability (Brooks and Oikonomou, 2018) - a practice known as green washing. Green bonds fall into this same category of skepticism and are seen as instruments of practice for the same.

However popular green bonds may be, there is no standard definition for “green-ness”. Environmental standards often vary widely across jurisdictions and thus the risk associated with the green bonds isn’t uniform. By and large, a bond can be aligned to five primary standards as per the criteria obtained from the Climate Bond Initiative - a system that depends primarily on the transparency and rigour from the firm. The most wide-spread baseline standard is that as produced by the Green Bond Principles, which is controlled by the International Capital Markets Association (Bigger, 2017). Further, many market service providers create their own green bond indices. Some of these include Bloomberg, Nasdaq and Standard & Poor. Each standard creates its own requirements for ex-ante and ex-post reporting of green credentials (Bigger, 2017). Thus, the greenwashing concerns arise due to the aforementioned lack of certificable and consistent, public standards.

Additionally, green bonds also face another issue which goes hand-in-hand with green washing: that if investors trade financial returns for societal benefits, then companies issue green bonds in order to obtain cheaper financing. Even if prior literature has disproved this notion (Flammer, 2018; Larcker and Watts, 2019) and that both non-green bonds and green bonds are often priced at the same and yield no difference, the sentiment persists.

When examining the European Markets, ESG tends to be a symbolic approach that aims to pull costs down. There is a difference between ESG performance and ESG disclosure with the former being what firms actually do versus what they symbolically do in a similar vein as aforementioned (Eliwa et al., 2019). Lending institutions take a note of scores, particularly, environmental scores when deciding to lend. Further, scores also demonstrate its relationship to the institution or region. Stakeholders in companies that have low scores for ESG criteria are believed to be less interested in CSR related matters. Conversely, if firms deviated from the social norm then they tend to have higher costs of debt (Tinker and Neimark, 1987).

There is a difference across firms. Larger the firm, greater their environmental footprint. Further, companies in certain industries have sector specific standards of reporting. However, the Nordic countries - Denmark, Sweden, Norway, Finland and Iceland and the firms in those regions which constitute the ambit of this paper face strict mandatory sustainability requirements and thus, report on environmental effects (Brooks and Oikonomou, 2018). Exploring if companies care about their ESG Scores, under these requirements can provide insight into their behaviour with respect to the market. As the Thomson Reuters data is based on reported data, we can conclude that higher reporting scores should mean that companies care more about their CSR perspective and that the data reported back has led to verifiable change (Eliwa et al., 2019).

It is in this existing framework that I examine the issuance of green bonds in the Nordic regions. To my knowledge, this is the first paper that examines issuance for this region. In order to do so, I draw and construct mainly from the regression as illustrated in Flammer (2020). I extend this to include an Environmental Component - which represents the Nordic Region's role in promoting environmental sustainability - which is obtained by performing a principal component analysis on World Bank Indicator data, as stated in Capelle-Blancard et al. (2019). I contribute to the literature on ESG and Corporate Sustainability in three ways. First, I select the Nordic countries as studies regarding issuance of Green Bonds have not been done yet for this region. Second, I run a panel regression specification with the same control variables as mentioned in Flammer (2018). Third, I use the method of constructing a sustainability index as mentioned in Capelle-Blancard and obtain the environmental component before applying it to the data on corporate bonds.

I find that Green Bond Issuance does not have a prominent effect on scores - but the preceding year's scores do, suggesting a pattern of cyclical improvement. I also find that the environmental component of a region has a minute effect on green bond issuance and the scores of the companies in the region - as long as there is no prior information regarding sustainability available to the company.

This essay is arranged as follows. Section 1 outlined the scope of the thesis. Section 2 goes over relevant aspects of the literature while going over the key resources that lead to building the research model. Section 3 details the methodology including the research model. Section 4 details the analysis. Section 5 discusses the results and the limitations of this essay. Section 6 concludes. This essay also contains an appendix that details how the environmental component was constructed.

2. Literature Review

The following section details the literature review. I begin by examining the literature on corporate sustainability and green bonds before going over some studies that have linked the two. I then examine some studies that have been done that link the benefits of green bonds to CSR, and more specifically their disclosures. I also talk about the role of a region in promoting sustainability. I then conclude with our hypothesis for the same.

2.1 Green Bond Issuance and Corporate Social Responsibility

There is a vast amount of literature on the relevance of CSR (what is referred to as sustainability in this paper) and its effect on financial performance. Given that the domain for 'green' activities is not consistent across regions, definitions, hypothesis and methodologies tend to vary. This is important to note because there are often differing perspectives to consider when examining the literature on the effects of CSR (Brooks and Oikonomou, 2018). Brooks and Oikonomou (2018), detail that particularly, for environmental discourses, good environmental performance is a signal of status which separates strong performers from weak performers and hence, weak performers are unable to imitate this (Brooks and Oikonomou, 2018). In order to distinguish between performers, green bonds is one such instrument. However, the literature exploring green bonds is limited due to large scale growth only occurring around 2013 (Gianfrate and Peri, 2019).

Flammer (2018) in 'Corporate Bonds' amongst other results finds that stock markets respond positively to green bonds including that the Cumulative Abnormal Return is 0.49%. In order to ascertain signalling, namely the response for certified green bonds versus first-time issuers, she examines issuance at the firm level via a matching approach. By constructing a matching approach, she finds that green bond issuers improve their environmental performance post issuance. She also finds that companies that issue green bonds attract investor bases that are mindful of the long term and natural environment. Flammer (2020) examines the effects of issuance of green bonds by municipalities on environmental and financial performance. She finds that financial performance increases significantly and environmental emissions fall when green bonds are issued. Wang et al. (2020) while examining the market reaction to issuance of green bonds for China found that green bond investors perceive green bonds favourably and accept a higher price for these sort of bonds. Further, they also find that green property has a stronger pricing effect for issuers with good social reputation i.e. higher CSR rating scores. This is supported by Ge and Liu (2015) who analyse firm performance in several CSR dimensions and find that environment, community and governance are associated with lower bond yield spreads. In the same vein, Gianfrate and Peri (2019) find that there is a statistically significant advantage for issuers when bonds are marked as 'green'. Inclusive of the extra-cost that is required to obtain a certification, green bonds are more convenient for issuers.

2.2 The Impact of Countries on Sustainability

A subsection of the literature also examines macroeconomic sustainability with reference to sovereign bonds. As an example, Capelle-Blancard et al. (2019) elaborates on how that in terms of risk management, investors look at ESG to ascertain the level of riskiness when lending money. He specifically states that knowing the ESG performance and the level of a country's ESG metrics allows it to determine its sovereign yield and debt. Hence, governments with poor ESG are more risky and thus require a higher rate of interest to fund debt i.e. if the ESG performance of a country is bad not only does it look like it will default on loans but it could also spell ecological damage. Thus, ESG signals the long term behaviour of a country. To test the hypothesis that better the ESG performance, lower the cost of debt, the authors construct their own performance index from different ESG indicators for (the subject of their choice) 20 OECD Countries. This is characteristically quite different from other papers (Hoepner et al. (2016), (Ge and Liu, 2015) that use third party rating systems (which are generally unverifiable) in order to assess these differences. While exploring the relation between ESG and sovereign bond spread and decomposing the impact along these individual factors, they find that good ESG practices are associated with lower default risk and lower bond spreads. Further, these indexes also demonstrate that the government has the strongest impact while the environment has no significant impact for sovereign bonds. This is also supported by Presbitero et al. (2016). By examining how sovereign bonds are issued in developing countries as opposed to those issued by developed countries, it is found that larger sovereign issuers have higher GDP and more effective governments than occasional issuers.

Often, countries which are more stake-holder oriented have a higher cost of debt. Variations in benefits of ESG are largely attributable to country characteristics (Eliwa et al., 2019). Country level characteristics such as the legal framework and cultural systems affect firm ESG disclosure (Bennani et al., 2018). Rewarding of ESG performance by the state and the community is driven through social constituents and mandatory requirements. These vary across states.

In this framework, the question arises if ESG performance is studied in relation to corporate bonds. Hoepner et al. (2016) examines the effect of CSR on the cost of debt through external financing i.e. the bank's lending perspective, for corporate bonds. They find that a sustainability framework is negatively related to corporate borrowing costs. An increase in overall country sustainability metric results in a 52 % average corporate loan spread over LIBOR. An improved overall performance in sustainability is not associated with the cost of bank loans. The environmental components of country sustainability are more financially impactful than the social component (Hoepner et al., 2016). However, for this study, the country sustainability measure is determined by the data provided by the Oekom Research Group (Hoepner et al., 2016). While rating firms can incorporate CSR into credit ratings, its valuation from the market may not be entirely captured (Ge and Liu, 2015).

In this purview, the following are our hypotheses:

Hypothesis 1: Green Bond Issuance is a clear driver for ESG scores. Hence, an increase in issuance should have a significant effect on ESG scores.

Hypothesis 2: Companies with a higher score are influenced by the environmental effects of the countries they reside in.

3. Methodology

The following section describes the mannerisms of the data, how it was collected and what was done to the data in order to achieve our final form. This section is divided into three sub-sections. I begin with the Research Approach subsection that presents an overview of what methods were used. This is then followed by the Data section which elaborates on the sources of data and covers some key summary statistics. The third sub section on Research Design covers the manner of implementation of the data. Methodology is subsequently followed by the fourth section of the essay, the Analysis section.

3.1 Research Approach

This section goes over the theory behind the empirical work - mainly touching on panel data and Principal Component Analysis. In addition, the section covers the fixed effects models, the pooled OLS models and the theory of principal component analysis.

3.1.1 Overview on Panel Data Methods

This paper utilises optimal least square regressions with fixed effects and pooled ordinary least squares on panel data. A key aspect of pooled cross section data is that they consist of independently sampled observations. A benefit of this method is that it rules out correlation in the error terms across various observations. However, observations do not tend to be identically and independently distributed (as is the standard assumption) as they are samples from the population at different points of time. (Wooldridge, 2013). For the pooling method, the relationship between the dependent variable and independent variables remain constant over time. White noise tends to be more relaxed for this model.

In order to capture unobserved effects or an error that is constant over time, I run the fixed effects model. This is also referred to as unobserved heterogeneity - in terms of our regression specifications, this is firm heterogeneity (Wooldridge, 2013). I assume that the errors are independent of our main regressor. I also assume that errors are independent of the individual error component that is time specific. Thus, under fixed effects including lagged dependent variables is meaningless as the lagged dependent variables are no longer correlated with the individual error (Stewart, 2020).

There are potential drawbacks to the pooled OLS method. The pooled OLS is built on the assumption that there is no correlation between the variables. If there is an unobserved effect then correlation possibly exists between the variables. Hence, the obtained estimator will be biased and inconsistent. This bias may also be due to omittance of a time constant variable. A potential manner of overcoming this is to run a first difference equation and then running the standard OLS model. However, running this model for our data set results in highly correlated matrices (based on the results from MATLAB, the statistical tool used) that do not provide tangible results and hence, I omit this model. However, I alleviate potential causes of endogeneity through our choice of data as by construction, the ESG scores do not take into account green bond issuance.

3.1.2 An overview on Principal Component Analysis and Factor Analysis

Principal Component Analysis (PCA henceforth), a statistical technique that is primarily used for dimensionality reduction, reveals variables in the dataset which are relatively independent of each other (Capelle-Blancard et al., 2019). For this essay, PCA has been used to ascertain how much of variation the Environment Component captures. Having observed the variable over time, multiple sample units allow us to identify the components that capture the most variation amongst the data. PCA thus, is a linear transformation method that 'transforms' data from n-dimensional space to another space with n-dimensions in such a manner that the resultant transformation is mutually perpendicular to each other (Capelle-Blancard et al., 2019). The first component captures the most variation, with each succeeding component capturing lesser and lesser variance - referred to as factor loadings. PCA is often followed by factor extraction. This is because PCA does not discriminate between shared and unique variance (Costello and Osborne, 2005). However, during factor extraction, the shared variance of a variable is isolated from its unique variance and error variance to obtain the factor structure (Costello and Osborne, 2005). The factors are then rotated so that the variance is uncorrelated. It is pertinent to note that rotation does not determine how much variance is originally extracted (Costello and Osborne, 2005) but only allows the dissemination of variance across the component in order to provide a simplified explanation. Thus, pre-rotation variance and post-rotation variance are mathematically equivalent (Capelle-Blancard et al., 2019). The factor loadings that are obtained are squared. These squared factor loadings represent the proportion of the total unit variance of each indicator, which is explained by its respective factor (Capelle-Blancard et al., 2019). Thus, the estimates obtained from the factor loadings allows us to determine the distribution of weights across the indicators that make up the environmental, social and governance components.

3.2 Data Collection Method

The data for this paper were collected from three sets of sources.:

The data on companies and their scores were collected from Data-Stream and the ASSET4 ESG database. ASSET4 ESG data provides comprehensive environmental, social, governance information based on 250+ key performance indicators and is accessed through the Datastream software, as provided by Thomson Reuters (2017). Thomson Reuters ESG scores objectively measure a company’s ESG performance across ten themes including emissions, environmental innovation, human rights etc. based on self-reported company data (Thomson Reuters, 2017).

Data on Green Bond issuance years was collected from Bloomberg. It should be noted that ASSET4 ESG, while exhaustive, does not contain data for all companies, unlike Bloomberg. The data spans the 5 Nordic countries: Denmark, Iceland, Norway, Sweden and Finland over a stretch of 25 years. Due to the small sample size of Icelandic companies and missing variables of interest, firms from Iceland are virtually non-existent and hence, our scope of analysis is limited only to the remaining 4 Nordic countries. Once missing values were removed, I obtained a smaller panel of 47 companies. 98 Bonds were issued between 2002 to 2020 of which 48 were green. Some firms issued more than one green bond over 25 years. Of these, Sweden has issued the greatest number of bonds and consequently, the greatest number of green bonds with Denmark being the least. Among industries, financial industries are the largest issuers of green bonds. Due to a small sample size, we examine the region as a whole. However, I vary the dependent variables of interest in order to understand the effect that green bond issuance has across various subdivisions of CSR scores.

The 4 scores of our interest are as follows.

- ESG Score: This is the overall company score based on self reported information provided by the company. It is an accumulation of the environmental, social and corporate governance pillars (Thomson Reuters, 2017).
- Emission Score: a subdivision of the Environmental pillar score, it measures a company's commitment and effectiveness towards reducing environmental emission in the production and operation process (Thomson Reuters, 2017).
- Resource Use score refers to the company's performance and capacity to reduce the use of materials, energy or water, and to find more "eco-efficient" solutions that improve the existing supply chain management. It is a subdivision of the Environmental pillar score (Thomson Reuters, 2017).
- Environmental Innovation score reflects a company's capacity to reduce the environmental costs and burdens by creating new market opportunities through new environmental technologies, processes or eco-designed products. It is a subdivision of the Environmental Pillar Score (Thomson Reuters, 2017).

The Generalised ESG Score consists of over 400 indicators which are grouped into ten categories for ESG dimensions. Emission makes up 12 percent, Resource Use makes up 11 percent and Environmental Innovation makes up 11 percent of the total generalised ESG Score.

Table 3.2: Descriptive Statistics at the Firm Level.

	Mean	*Median*	*Minimum*	*Maximum*	*Standard Deviation*
Dependent Variables					
Generalised ESG Score	58.94	62.91	5.93	91.28	19.07
Emissions Score	62.02	72.07	0	99.74	29.43
Resource Score	61.91	70.29	0	99.66	30.78
Environmental Innovation Score	44.43	50	0	99.09	34.79
Control Variables					
Size	7.63	7.57	4.59	9.80	0.99
Leverage	35.78	34.1	0	99.67	18.28
Return on Assets (RoA)	4.77	4.93	-157.16	45.18	9.09
Market to Book Value	2.03	1.43	-2.54	89.81	3.46
Research & Development to Total Assets (R&D to T.A.)	0.01	0	0	0.19	0.03

Notes: Table 3.2 represents firm level data for the 47 firms present in our sample. All scores are measured in percentage with higher scores representing better firm responsibility. Size, Leverage, RoA, Market to Book Value, and R&D to T.A are control variables included in the main panel specification.

Information used to construct components of sustainability are obtained from the Sovereign ESG Data Portal and from the World Development Indicators established by the World Bank Group. This portal is supported by the Global Program on Sustainability and incorporates data relevant to the 17 Sustainable Development Goals. The original list of 67 indicators is exhaustive. Thus, in order to capture an overview for the Nordic Regions, I examine 18 indicators that represent the environment, social and governance landscape respectively. I perform principal component analysis on the data to identify the Environment component, before incorporating it into the regression (refer Appendix A).

3.3 Research Design

As aforementioned, I build my research design primarily based on the methodology in two papers. Flammer (2020), in order to avoid endogeneity, constructs a matching approach to match green bonds and non-green bonds and does so for 225 companies. However, due to a smaller sample size of 47 firms, the matching process was opted out of and a panel regression was run. I run 3 pooled OLS models and 2 Fixed Effects models, built on the general model specifications given below.

The specifications for the pooled OLS Model is as follows:

$$Y_{ix} = \alpha + \beta_1 \text{BondIssuance}_{ix} + \beta_2 \text{Greenbond}_{ix} + \square_3 Y_{i(x-1)} + \beta_4 \gamma_{country} + \beta_5 \gamma_{industry} + \sum_{k=1}^{K} C_k \gamma_{kix}$$

Where, Y is the dependent variable and varies across 4 scores - the generalised ESG Score and the components that make up the environment score: the Emission score, the Resource Use score and the Environmental Innovation score. Bond Issuance is a dummy variable that provides a value of 1 when a bond is issued by a company in a year, regardless of the date and the frequency of issuance, and a value of 0 when a bond is not issued. Green Bond is a dummy variable which provides a value of 1 when, if a bond is issued, the proceeds from that bond go towards 'green' activities and a value of 0 otherwise. $Y_{i(x-1)}$ is the lagged dependent variable. $\gamma_{country}$ is a matrix of country dummy variables, for the 4 countries. $\gamma_{industry}$ is a matrix of industry dummy variables that represents the 5 categories of industries, namely Bank Savings, Industrial, Transportation, Utility and Other Financial Services. $C_k \gamma_{kix}$ is a matrix of firm specific control variables consisting of size, leverage, return on assets, market to book value and R&D to T.A. The equation is indexed for 'i' firms and 'x' years.

When incorporating the environmental component for the Nordic Region in order to test the secondary hypothesis, I test the following pooled OLS specification:

$$Y_{ix} = \alpha + \beta_1 \text{BondIssuance}_{ix} + \beta_2 \text{Greenbond}_{ix} + \square_3 Y_{i(x-1)} + \beta_4 \gamma_{environment} + \beta_5 \gamma_{industry} + \sum_{k=1}^{K} C_k \gamma_{kix}$$

Where, the independent variables are as listed above. $\gamma_{environment}$ represents the principal component corresponding to the environmental dimension. In order to avoid multicollinearity, country dummy variables are eliminated prior to running the regression models based on the above specification. As above, the panel equation is indexed for ‘i’ firms and ‘x’ years.

The fixed effects specification is only run for the primary hypothesis and its specification is as follows:

$$Y_{ix} = \alpha + \beta_1 BondIssuance_{ix} + \beta_2 Greenbond_{ix} + \beta_3 \gamma_{company} + \sum_{k=1}^{K} C_k \gamma_{kix}$$

Where I include the same independent variables as above but drop the country dummy variables and the industry dummy variables. Instead, I incorporate $\gamma_{company}$, which is a matrix of company dummy variables. Similar to the pooled OLS, the above equation is indexed for ‘i’ firms and ‘x’ years.

A true panel would use an instrumental variable in order to account for any possible sources of endogeneity. However, I cannot do so as issuance tends to be non-random and finding an accurate substitute is virtually impossible (Flammer, 2018). However, it is pertinent to note that the issuance of green bonds is not taken into account when issuing the rating. Thus, this independence is taken into account when constructing the panel format i.e. there is no direct relationship between green bond issuance and higher environmental ratings (Flammer, 2018). The green bond dummy variable acts as an interaction dummy as it is conditional on a bond being issued. Further, green bond dummies for the pre-issue year and post-issue years have not been included due to them being found insignificant in prior studies (Flammer 2018). However, I do introduce the lagged dependent variables into the pooled OLS model in order to avoid serial correlation. Prior studies such as Waddock and Graves (1997) have demonstrated that lagged CSR has an effect on factors such as RoA (Return on Assets) and RoE (Return on Equity). Establishing the return on sales as the dependent value, they found that a one-year lagged value has significant explanatory power for RoA (Brooks and Oikonomou, 2018).

With the secondary hypothesis, I aim to construct and capture the environmental aspect of the Nordic Region as a whole. In a similar manner to Capelle-Blancard (2019), I use World Bank ESG indicators to understand the variation across the environmental, social and governance components respectively. While the subdomain indicators used to build the ESG global index are the governance quality index, the social development index and the environment quality index, I isolate the environmental component through principal component analysis and analyse its effects on scores. A key reason for capturing the variation and isolating the environmental component is to ensure that the environmental component captures the cross variation across all dimensions. This is why I did not directly isolate the environmental indicators, obtain the first principal component and run the estimation equation. As PCA measures the eigenvectors of the covariance matrix, isolating its relation with respect to the overall space was important in order to obtain a picture of how the environmental dimension specifically acts in the whole purview (refer Appendix A). This component is incorporated when the pooled OLS model is run.

The procedure for constructing the principal component analysis is as follows. As aforementioned, for factor analysis, the variables in the data have to be related to each other. The lower the correlation among our variables in the dataset, the more unlikely that they share common factors. The principal component analysis is done in order to identify the first 3 components that capture the largest variation. Factor analysis is then done for the obtained components followed by squaring the resultant factor loadings- these represent the proportion of total unit variance of the indicator. Thus, these allow us to identify which components explain the most variation for our environment, social and governance categories respectively. Thus, the correspondent component that explains the most variation is the second component, ceteris paribus (refer Appendix A). This essay relies on the fact that rotation of the factors allows us to isolate variation to particular components but mathematically, variation across components, pre and post-rotation is the same.

While running the pooled OLS model specifications to test the secondary hypothesis, I run two variations for the environmental component. The environmental component is lagged because lagging these measures helps reduce any persistent endogeneity problems (Capelle-Blancard, et al., 2019). Further, rating agencies often put together ESG data at the end of each year. Thus, the lagged environmental component acts as publicly available knowledge that is available to firms when they price and issue bonds (Capelle-Blancard et al., 2019). While the lagged component has been given precedence, the unlagged component was run to demonstrate the difference between obtained results, conditional on the results being significant.

3.4 Model Selection

In the previous section, I stated three main regression models from which I build and run the remaining models. I now run 5 models based on the above generalised specifications. A larger emphasis has been given to the pooled OLS Model due to the independent variable being static and not measuring a change in score. Models are built sequentially, to potentially isolate the change in effects.

For the primary hypothesis, I run the following models:

1) A pooled OLS model, without the lagged ESG score with the Bond Issuance dummy variable and the Green Bond dummy variable (M1), namely:

$$Y_{ix} = \alpha + \beta_1 \text{BondIssuance}_{ix} + \beta_2 \text{Greenbond}_{ix} + \beta_3 \gamma_{country} + \beta_4 \gamma_{industry} + \sum_{k=1}^{K} C_k \gamma_{kix}$$

This is run to check if the issuance dummy and the green bond dummy have varying effects on the score in question. Our estimators of interest are β_1 and β_2.

2) The pooled OLS model without the lagged ESG score with a Green Bond dummy variable only (M2):

$$Y_{ix} = \alpha + \beta_1 \text{Greenbond}_{ix} + \beta_2 \gamma_{country} + \beta_3 \gamma_{industry} + \sum_{k=1}^{K} C_k \gamma_{kix}$$

By dropping the dummy for issuance, I want to see the additional effect of green bond issuance on the score in question. This model helps assess the difference in green bond issuance versus no issuance at all.

3) The pooled OLS Model with the lagged dependent variable with the Green Bond dummy variable only (M3):

$$Y_{ix} = \alpha + \beta_1 \text{Greenbond}_{ix} + \beta_2 Y_{i(x-1)} + \beta_3 \gamma_{country} + \beta_4 \gamma_{industry} + \sum_{k=1}^{K} C_k \gamma_{kix}$$

The introduction of the lagged variable checks for an additional effect of the estimator on the green bond dummy variable. While the lagged dependent variable has been used in prior studies and does have an effect on the variable in question, its presence can lead to endogeneity or heteroskedasticity.

In addition to the above models, I also run 2 fixed effects models without the lagged dependent variables as fixed effects models, by nature assume that error in the sample is independent over time. These are:

1) The fixed effects model with the Green Bond dummy variable only (M4 in the tables):

$$Y_{ix} = \alpha + \beta_1 \text{Greenbond}_{ix} + \beta_2 \gamma_{company} + \sum_{k=1}^{K} C_k \gamma_{kix}$$

2) The fixed effects model with the Bond Issuance dummy and Green Bond dummy variable (M5):

$$Y_{ix} = \alpha + \beta_1 \text{BondIssuance}_{ix} + \beta_2 \text{Greenbond}_{ix} + \beta_3 \gamma_{company} + \sum_{k=1}^{K} C_k \gamma_{kix}$$

For our secondary hypothesis, I run the same variations of the pooled OLS models as listed above. Only here, I incorporate the environmental principal component in place of the country dummy variables. As mentioned above, the specifications are run for both lagged and unlagged components. Specifically, the models are:

M1: $Y_{ix} = \alpha + \beta_1 \text{BondIssuance}_{ix} + \beta_2 \text{Greenbond}_{ix} + \beta_3 \gamma_{environment} + \beta_4 \gamma_{industry} + \sum_{k=1}^{K} C_k \gamma_{kix}$

M2: $Y_{ix} = \alpha + \beta_1 \text{Greenbond}_{ix} + \beta_2 \gamma_{environment} + \beta_3 \gamma_{industry} + \sum_{k=1}^{K} C_k \gamma_{kix}$

M3: $Y_{ix} = \alpha + \beta_1 \text{Greenbond}_{ix} + \beta_2 Y_{i(x-1)} + \beta_3 \gamma_{environment} + \beta_4 \gamma_{industry} + \sum_{k=1}^{K} C_k \gamma_{kix}$

4. Analysis

I test the models as mentioned in Section 3.4 for each of our hypotheses. In order to attain a comprehensive picture, results are grouped according to their scores. Although there may be certain similar results across models, the scores are considered independent of each other (apart from the ESG score). Section 4.1 explores the primary hypothesis of issuance on scores. Section 4.2 explores the secondary hypothesis of regional effects on scores. This leads to section Section 5, which discusses the results further.

4.1 The Effect of Issuance on CSR

Table 4.1.1 shows that the results for M1- the pooled OLS Model (I) yields no significant results. However, under M2 when a bond that is issued is green (as compared to no bond issuance at all) then the generalized ESG score goes up by 9.65 percentage points resulting in the average generalised ESG score, across industries increasing to 68.59. The introduction of the lagged variable in M3, proves significant implying that the ESG score from the previous year results in a marginal increase of 0.82 percentage points for the general ESG score in the current year. However the lagged variable may be endogenous and hence, what I see could be effects of multicollinearity. If I assume that the lag is non-endogenous, then the green bond indicator for M3 is insignificant which can imply that activities outside the environmental umbrella i.e. activities under social and governance, are accounting for the positive incremental percentage change.

Table 4.1.2 displays the effects of the independent variables on Emission Scores. By and large, the green bond issuance is insignificant across all models. However in M3, the lagged independent variable is significant. If not endogenous, it could imply that companies that have begun demonstrating a commitment towards reducing emissions will do so in the following year and see an average increase of 0.73 percentage points. The Fixed Effects models (M4 and M5) return insignificant results.

Table 4.1.1 Variation in Generalized ESG Score.

	Pooled OLS I (M1)	*Pooled OLS II (M2)*	*Pooled OLS III (M3)*	*Fixed Effects I (M4)*	*Fixed Effects II (M5)*
ESG Score					
Bond Issued	4.17				3.89
	(3.10)				(2.56)
Green Bond	5.69	9.65***	0.97	3.04	-0.61
	(4.75)	(3.73)	(1.71)	(3.17)	(3.97)
Lagged Score			0.82***		
			(0.02)		
Firm Controls	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	No	No
Industry Dummies	Yes	Yes	Yes	No	No
Company Dummies	No	No	No	Yes	Yes

Standard errors in parentheses
**p<.1, **p<.05, ***p<.01*

Notes: The dependent variable for all regressions in the above table is the Generalised ESG Score. Generalised ESG is the overall company score based-off of self-reported information provided by the firm and is an accumulation of the ESG pillars (Thomson Reuters, 2017). M1 refers to Pooled OLS I, M2 refers to Pooled OLS II, M3 refers to Pooled OLS III, M4 refers to Fixed Effects I, M5 refers to Fixed Effects II. All regressions contain a constant. Results are reported in percentage. Standard errors are reported at the firm level.

Table 4.1.2 Variation in Emissions Score.

	Pooled OLS I (M1)	*Pooled OLS II (M2)*	*Pooled OLS III (M3)*	*Fixed Effects I (M4)*	*Fixed Effects II (M5)*
Emissions Score					
Bond Issued	5.27				2.22
	(4.89)				(4.22)
Green Bond	2.50	7.51	3.93	3.84	1.77
	(7.49)	(5.87)	(3.27)	(5.23)	(6.56)
Lagged Score			0.73***		
			(0.03)		
Firm Controls	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	No	No
Industry Dummies	Yes	Yes	Yes	No	No
Company Dummies	No	No	No	Yes	Yes

Standard errors in parentheses
**p*<.1, ***p*<.05, ****p*<.01

Notes: The dependent variable for all regressions in the above table is the Emissions Score. Emissions Score measures a company's commitment and its effectiveness towards reducing environmental emissions in the production and operation process (Thomson Reuters, 2017). It is a sub-division of the Environmental Pillar Score. M1 refers to Pooled OLS I, M2 refers to Pooled OLS II, M3 refers to Pooled OLS III, M4 refers to Fixed Effects I, M5 refers to Fixed Effects II. All regressions contain a constant. Results are reported in percentage. Standard errors are reported at the firm level.

Table 4.1.3 shows the effects of the variables on the Resource Use score. Here, Green Bond issuance has a significant effect on the Resource Use score (M1) (albeit at the 10 percent significance level). Thus, green bond issuance can see an increase in their Resource Use score by 15.07 percentage points. This significance increases when the bond issuance dummy is removed and could reflect that firms that issue non-green and green bonds in the same year, lose some signalling power as opposed to just releasing green bonds that year. The additional effect of being green is a 4.16 percentage increase. In M3, I see that the green bond dummy once again loses its significance. The Fixed Effect models (M4 and M5), yield insignificant results.

Table 4.1.3 Variation in Resource Use Score.

	Pooled OLS I (M1)	*Pooled OLS II (M2)*	*Pooled OLS III (M3)*	*Fixed Effects I (M4)*	*Fixed Effects II (M5)*
Resource Use Score					
Bond Issued	4.37				3.89
	(8.14)				(2.56)
Green Bond	15.07*	19.23***	2.28	3.93	-2.40
	(0.13)	(6.38)	(3.29)	(5.55)	(6.95)
Lagged Score			0.80***		
			(0.02)		
Firm Controls	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	No	No
Industry Dummies	Yes	Yes	Yes	No	No
Company Dummies	No	No	No	Yes	Yes

Standard errors in parentheses
**p<.1, **p<.05, ***p<.01*

Notes: The dependent variable for all regressions in the above table is the Resource Use Score. A subdivision of the Environmental Pillar score, Resource Use Score refers to the company's performance and capacity to reduce the use of materials, energy or water and to find more 'eco-efficient' solutions that improve existing supply chain management (Thomson Reuters, 2017). M1 refers to Pooled OLS I, M2 refers to Pooled OLS II, M3 refers to Pooled OLS III, M4 refers to Fixed Effects I, M5 refers to Fixed Effects II. All regressions contain a constant. Results are reported in percentage. Standard errors are reported at the firm level.

Table 4.1.4 shows the variation in the Environmental Innovation score. For M1, bond issuance for the Environmental Innovation score is significant at the 5 percent level and results in an increase of 14.99 percentage points. However, the green bond indicator itself is insignificant. Similar to the Resource Use Score, removing the bond issuance dummy variable, results in the green bond dummy being significant and leading to an increase of the mean score by 21.93 percentage points. As before, the lagged independent variable captures any endogeneity (M3). For the fixed effects models, bond issuance is significant at the 1 percent level for the category of Environmental Innovation (M5) i.e. when a bond is issued by a firm, irrespective of the country or industry it is from, there is a 15.14 percentage point increase in the Environmental Innovation score. Given the high level of significance, an increase in scores may be due to "green-ish" activities i.e. for activities that are not clearly categorised as green but indirectly affect the environment positively.

Table 4.1.4. Variation in Environmental Innovation Score.

	Pooled OLS I (M1)	*Pooled OLS II (M2)*	*Pooled OLS III (M3)*	*Fixed Effects I (M4)*	*Fixed Effects II (M5)*
Environmental Innovation Score					
Bond Issued	14.99**				15.14***
	(6.07)				(5.54)
Green Bond	7.67	21.93***	-0.39	9.57	-4.61
	(9.29)	(7.32)	(4.59)	(6.92)	(8.62)
Lagged Score			0.76***		
			(0.03)		
Firm Controls	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	No	No
Industry Dummies	Yes	Yes	Yes	No	No
Company Dummies	No	No	No	Yes	Yes

Standard errors in parentheses
**p<.1, **p<.05, ***p<.01*

Notes: The dependent variable for all regressions in the above table is the Environmental Innovation Score. A subdivision of the Environmental pillar, Environmental Innovation score reflects a company's capacity to reduce the environmental costs and burdens by creating new market opportunities through new environmental technologies, processes or eco-designed products. (Thomson Reuters, 2017). M1 refers to Pooled OLS I, M2 refers to Pooled OLS II, M3 refers to Pooled OLS III, M4 refers to Fixed Effects I, M5 refers to Fixed Effects II. All regressions contain a constant. Results are reported in percentage. Standard errors are reported at the firm level.

In order to check if the presence of the environmental component of a region has a role to play on company scores, I now re-examine the pooled OLS models to check for the secondary hypothesis.

4.2 The Effect of Regional Environmental Sustainability on Scores

The following set of regressions tests the secondary hypothesis i.e. companies that issue green bonds are influenced by the environmental effects of the region they reside in. This is done by running the pooled OLS specification again, including the environmental component that was obtained via PCA. Specifically, I run a total of 6 models - 3 for the unlagged environmental component and 3 for the lagged environmental component.

Table 4.2.1. Generalized ESG Scores: Variation in the Environmental Component.

	Unlagged Environmental Component			*Lagged Environmental Component*		
	Pooled OLS I (M1)	*Pooled OLS II (M2)*	*Pooled OLS III (M3)*	*Pooled OLS I (M1)*	*Pooled OLS II (M2)*	*Pooled OLS III (M3)*
Bond Issued	3.01			0.59		
	(3.37)			(3.37)		
Green Bond	7.34	10.06**	0.88	7.47	8.00**	0.76
	(5.07)	(4.06)	(1.76)	(5.01)	(4.00)	(1.76)
Lagged Score			0.85***			0.85***
			(0.02)			(0.02)
Environmental Component	-0.27	-0.46	0.09	-2.48***	-2.51***	-0.07
	(1.05)	(1.03)	(0.45)	(0.79)	(0.77)	(0.44)

Standard errors in parentheses
*p<.1, **p<.05, ***p<.01

Notes: The dependent variable for all regressions in the above table is the Generalised ESG Score. Generalised ESG is the overall company score based-off of self-reported information provided by the firm and is an accumulation of the ESG pillars (Thomson Reuters, 2017). M1 refers to Pooled OLS I, M2 refers to Pooled OLS II and M3 refers to Pooled OLS III. All regressions contain a constant. Results are reported in percentage. Standard errors are reported at the regional level.

In table 4.2.1, M2 with an unlagged Environmental Component demonstrates that just the green bond issuance is significant i.e. leading to a 10.06 percentage increase. However, as the lagged score (M3) is significant at the highest level it's more plausible that the preceding year's score influences the current year's generalised ESG Score. Lagging the environmental component has a significant effect on the score of a company - which is in line with the literature on its inclusion of the same.

Table 4.2.2 Emission Scores: Variation in Environmental Component

	Unlagged Environmental Component			*Lagged Environmental Component*		
	Pooled OLS I (M1)	*Pooled OLS II (M2)*	*Pooled OLS III (M3)*	*Pooled OLS I (M1)*	*Pooled OLS II (M2)*	*Pooled OLS III (M3)*
Bond Issued	5.51			1.16		
	(5.35)			(5.37)		
Green Bond	4.03	9.00	3.55	4.03	5.07	3.26
	(8.05)	(6.44)	(3.40)	(7.98)	(6.37)	(3.41)
Lagged Score			0.77***			0.77***
			(0.02)			(0.02)
Environmental Component	0.90	0.55	-0.34	-3.60***	-3.66***	-0.66
	(1.67)	(1.64)	(0.88)	(1.26)	(1.22)	(0.86)

Standard errors in parentheses
*p<.1, **p<.05, ***p<.01

Notes: The dependent variable for all regressions in the above table is the Emissions Score. Emissions Score measures a company's commitment and its effectiveness towards reducing environmental emissions in the production and operation process (Thomson Reuters, 2017). It is a sub-division of the Environmental Pillar Score. M1 refers to Pooled OLS I, M2 refers to Pooled OLS II and M3 refers to Pooled OLS III. All regressions contain a constant. Results are reported in percentage. Standard errors are reported at the regional level.

In table 4.2.2, the Green Bond variable across all models is insignificant, with the scores of the preceding year having a larger effect - a 0.77 percentage increase. This is followed by the lagged environmental component, demonstrating potential information effects.

In table 4.2.3 for M1 with an unlagged environmental component, bond issuance dummy and green bond dummy are significant at the 10 percent level. In M2 for the same unlagged environmental component, the green bond dummy is highly significant i.e. not accounting for the previous year's score, an issuance of a green bond in the current year results in the Resource Use for companies in the region increasing by 18.63 percent. For the lagged environmental component, the increase is smaller i.e. 16.41 percent. Again, this is probably due to endogeneity due to the presence of the lagged variables.

Table 4.2.3 Resource Scores: Variation in Environmental Component.

	Unlagged Environmental Component			*Lagged Environmental Component*		
	Pooled OLS I (M1)	*Pooled OLS II (M2)*	*Pooled OLS III (M3)*	*Pooled OLS I (M4)*	*Pooled OLS II (M5)*	*Pooled OLS III (M6)*
Bond Issued	2.90*			0.05		
	(5.80)			(5.82)		
Green Bond	16.02*	18.63***	1.51	16.36*	16.41**	1.41
	(8.72)	(6.98)	(3.39)	(8.66)	(6.92)	(3.40)
Lagged Score			0.83***			0.83***
			(0.02)			(0.02)
Environmental index	-1.38	-1.57	-0.16	-3.57***	-3.57***	-0.27
	(1.81)	(1.77)	(0.87)	(1.37)	(1.33)	(0.85)

Standard errors in parentheses
**p<.1, **p<.05, ***p<.01*

Notes: The dependent variable for all regressions in the above table is the Resource Use Score. A subdivision of the Environmental Pillar score, Resource Use Score refers to the company's performance and capacity to reduce the use of materials, energy or water and to find more 'eco-efficient' solutions that improves existing supply chain management (Thomson Reuters, 2017). It is a sub-division of the Environmental Pillar Score. M1 refers to Pooled OLS I, M2 refers to Pooled OLS II and M3 refers to Pooled OLS III. All regressions contain a constant. Results are reported in percentage. Standard errors are reported at the regional level.

In table 4.2.4, the regression analysis is largely similar to the previous mentioned scores. However, M2 for both the lagged and unlagged components leads to some variation at the 10 percent significance level. The presence of current region level sustainability decreases the Environmental Innovation score of the companies in the region by 3.32 percent and while having obtained information regarding the component from the previous year results in a decrease of -6.05 percent.

Summarising, the key takeaways are as follows:

1) Green Bond Issuance has an effect on the indicators that make up the environment pillar, albeit minute. This only holds true for M2 models (across tables 4.1.1 to 4.1.4) implying that only issuing green bonds in a particular year is much more effective than not issuing bonds at all. Further, the previous year's score has a larger impact on the current year's score. This can result in a situation where companies either attempt to improve their scores every year: either by signalling or tangible impact.
2) Regional level environmental indicators have little effect in the measurement of corporate sustainability. However, having obtained information either via last year's released reports or from published public information (representing the environmental component) allows companies to best project an ESG front for themselves.

Table 4.2.4 Environmental Innovation Scores: Variation in Environmental Component.

	Unlagged Environmental Component			*Lagged Environmental Component*		
	Pooled OLS I	*Pooled OLS II*	*Pooled OLS III*	*Pooled OLS I*	*Pooled OLS II*	*Pooled OLS III*
Bond Issued	11.70*			7.45		
	(6.50)			(6.50)		
Green Bond	10.02	20.58***	-1.45	10.70	17.36**	-1.46
	(9.78)	(7.85)	(4.70)	(9.66)	(7.72)	(4.71)
Lagged Score			0.78***			0.78***
			(0.03)			(0.03)
Environmental Component	-2.58	-3.32*	-0.90	-5.61***	-6.05***	-0.83
	(2.04)	(2.00)	(1.21)	(1.54)	(1.49)	(1.18)

Standard errors in parentheses
$*p<.1$, $**p<.05$, $***p<.01$

Notes: The dependent variable for all regressions in the above table is the Environmental Innovation Score. A subdivision of the Environmental pillar, Environmental Innovation score reflects a company's capacity to reduce the environmental costs and burdens by creating new market opportunities through new environmental technologies, processes or eco-designed products. (Thomson Reuters, 2017). It is a sub-division of the Environmental Pillar Score. M1 refers to Pooled OLS I, M2 refers to Pooled OLS II and M3 refers to Pooled OLS III. All regressions contain a constant. Results are reported in percentage. Standard errors are reported at the regional level.

5. Discussion and Limitations

A limitation of the results is that they are not robust to potential endogeneity. Data stream and ASSET4 often do not have data on scores and hence, had to be removed from the original collected data. Further, I am unable to chart out a longer span of time in order to see the evolution of the scores as ASSET4 scores are recent. Even so while I have referenced a section of the literature that views disclosures positively, scepticism still remains. Research has shown that for voluntary disclosures, firms will often release data that highlights them in a positive manner as opposed to providing a complete picture (Brooks and Oikonomou, 2018). There is a vast section of literature that argues that environmental disclosures should only be viewed as a mechanism for perception and not actual tangible change. Further, As ASSET4 data depends on self-reported company data, a large number of unavailable observations indicates that data was not reported. Even though it is mandatory to report sustainability measures taken by a company and assuming that most companies in the region do so, ASSET4 data is still limited.

There's a two fold support to the results. Green bonds do signal a credible commitment of the firm towards the environment and thus, one finds significant improvements in environmental performance (Flammer, 2018). Further, an improvement of these scores also denotes that greenwashing does not exhibit a large effect i.e. if these bonds were issued only to portray the firm as environmentally conscious but with no intention to deliver, then I wouldn't see any improvements in environmental scores, post issuance (Flammer, 2018). However, given that green bonds issuance is small, more realistically, the results could be evidence that green bonds are a credible commitment towards the environment and while not all projects are financed by these proceeds, some of these improvements are (Flammer, 2018). In fact, it is only green bond issuance that has an effect on these scores. However, in order for effective implementation to occur, green bonds need to be used along with other financial instruments such as carbon tax in order to facilitate a transition into a low carbon economy (Orlov et al., 2017).

An increase in the number of components that address the variation in order to pinpoint the effect on the scores could be done. However, most studies use a 10:1 ratio of indicators to components and hence, there is a limit on how much variation a technique such as principal component analysis could attain. Hence, a further limitation to this study is to only use the eighteen selected indicators. There is very little literature that has been done in highlighting the effects of environmental components of global sustainability on corporate sustainability. Further studies could be done in assessing what indicators are necessary.

6. Conclusion

The rise in the green bond market leads to multiple questions, including those pertaining to the implications of such issuance. There is limited research in this field particularly to do with issuance of corporate bonds although the effects of sovereign green bonds have been analysed in far more detail. This study examined the Nordic regions and questioned if firms only care about issuance for the purpose of signalling or if it does lead to actual change? This paper aimed to explore this by examining a region that hasn't been studied before, yet has strict disclosure laws and a consistent ESG component in investing. This essay also analysed various scores to explore if issuance had an effect on the variation of green bonds. The key takeaways were that while issuance is significant, preceding year's scores may have a causal effect on the current year score. This can lead to a cycle of improvement over time. A drawback to the obtained results is that they do not hold for robustness tests and are not conclusive.

Future studies could build on a comparative group of variation of green bonds. While there is also a vast body of literature that deals with yields and sovereign bonds, examining the influence of scores in relation to other aspects of stability is required and examining the exact purview on these bonds will be required.

At the corporate level, green signalling and green washing are aspects that ESG Investing will continue to struggle against as the demand for a more conscious form of investing grows. Policy changes will need to be rigorously implemented in order to obtain a form of standardisation in order to make green bonds more palatable to investors. Only then, will estimating effective change be possible.

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Appendix A: Principal Component Analysis.

The following tables present the steps for the Principal Component Analysis that was done to obtain the Environmental Component. Tables A.1.1 to Table A.1.3 show the descriptive statistics for the Data used to construct the Sustainability Components. Data was obtained from the Sovereign ESG Portal and World Bank Indicators websites. I also reference Kaufmann et al. (2010) to construct the data dimensions on governance.

Table A.1.1 : Descriptive Statistics – World Bank Development Indicators: Environment Dimension

Dimension	*Indicators*	*Mean*	*Median*	*Minimum*	*Maximum*	*Standard Deviation*
Air Quality	PM2.5 air pollution, mean annual exposure	3.22	0	5.86	12.67	3.89
Water and Sanitation	Safely managed sanitation services (% of population)	61.56	92.15	72.97	99.21	41.76
Forests	Forest area (% of land area)	45.49	68.41	13,14	73.69	27.54
Renewable Energy - 1	Combustible renewables (% of total energy)	11.46	13.17	3.13	24.09	6.45
Renewable Energy - 2	Renewable electricity output (% of total electricity output)	47.33	48.28	3.88	99.72	33.76
Renewable Energy – 3	Renewable energy consumption (% of total energy consumption)	33.80	35.82	7.26	60.19	20.48

Notes: In Table A.1.1 The Environmental Dimension uses 6 indicators to capture how well countries manage their natural resources and their degree of concern for their environment (Capelle-Blancard et al., 2019). Air Quality is a weighted average value that identifies the average level of exposure of a nation's population to particles lesser than 2.5 microns that are harmful. Low values indicate better air quality. Water and Sanitation measure sanitation facilities that are not shared with other households. Higher values indicate larger proportions of the population use sanitation services. Forest area refers to natural or planted trees, excluding trees in gardens and plantations. Higher values indicate larger percentage of trees in the region. Renewable energy is measured by 3 components. Combustible renewables includes biomass, biowaste and industrial waste all measured as a percentage of energy use. Renewable electricity is the electricity generated by renewable power plants. Renewable energy consumption measures the share of renewable energy consumption in final energy consumption. Higher percentages for renewable indicate a higher quality of energy efficiency.

Table A.1.2 : Descriptive Statistics – World Bank Development Indicators: Social Dimension

Dimensions	*Indicators*	*Mean*	*Median*	*Minimum*	*Maximum*	*Standard Deviation*
Human Capital	School enrolment, secondary (% gross)	117.10	116.23	96.98	156.55	29.46
Demography	Life expectancy at birth, total (years)	70.77	79.84	75.21	82.51	25.62
Health	Domestic government health expenditure (% of current health expenditure)	77.91	83.02	74.26	85.51	18.56
Gender Equality -1	Ratio of female to male labour force participation rate (%) (modelled ILO estimate)	84.05	87.75	79.34	90.53	16.95
Gender Equality - 2	School enrolment, primary and secondary (gross), gender parity index (GPI)	0.91	1.01	0.97	1.15	0.34
Employment	Wage and salaried workers, total (% of total employment) (modelled ILO estimate)	86.39	89.60	83.40	93.54	17.42

Notes: In, Table A.1.2 the Social dimension captures a country's effort in terms of Human development and is a measure of social welfare for a country. 6 indicators have been used to capture its effects. School enrolment is the ration of total enrolment to the population of the age group that corresponds to that level of education. Higher scores, capture higher ratios. Life expectancy at birth is the number of years a new-born infant would live if pre-existing patterns of morality at birth were constant throughout its life. Higher values indicate a better quality of life. Domestic government health expenditure refers to the heath expenditure funded from domestic public sources for health. Greater values of expenditure correspond to higher quality of life. Higher rates of ratio of female to male labour force participation (where the labour force participation rate is the proportion of the population greater than 15 years that is economically active) indicates higher a quality of gender equality. GPI measures the gross enrolment ratio of girls to boys enrolled at primary and secondary levels in public and private schools. Higher GPI indicates a greater proportion of enrolled girls. Wage and salaried workers are the proportion of those workers that have paid employment jobs that provide them with a basic renumeration that is not dependent direct revenue of the unit they work in. Higher values correspond to a greater proportion of non-vulnerable employment.

Table A.1.3 : Descriptive Statistics – World Bank Development Indicators: Governance Dimension

Dimensions	*Indicators*	*Mean*	*Median*	*Minimum*	*Maximum*	*Standard Deviation*
Democratic Institution - 1	Control of Corruption	1.62	2.19	1.91	2.47	0.99
Democratic Institution - 2	Government Effectiveness	1.44	1.88	1.72	2.35	0.88
Democratic Institution - 3	Political Stability and Absence of Violence/Terrorism	0.92	1.14	0.86	1.75	0.58
Safety Policy - 1	Regulatory Quality	1.20	1.55	1.16	1.92	0.75
Safety Policy - 2	Rule of Law	1.42	1.91	1.79	2.10	0.86
Safety Policy -3	Voice and Accountability	1.15	1.54	1.46	1.80	0.70

Notes: In Table A.1.3, the Governance dimension captures the regulatory effectiveness of a country and includes 6 dimensions. Control of Corruption covers the extent to which public power is exercised for private gain, including petty and grand forms of corruption. Government Effectiveness covers a range of measures including the perceptions of quality of public services, freedom from political pressure and the credibility of a government to formulate and implement good quality policy. Political Stability reflects likelihood of politically motivated violence including terrorism. Regulatory quality reflects the ability of the government to implement policies that promote the private sector. Rule of Law reflects the extent to which the agents have confidence in and abide by the rules of a society including areas like property rights, the police, the courts and the likelihood of crime and violence. Voice and Accountability captures the extent to which a country's citizens can participate in selecting their government, including freedom of expression and a free media. For all of the above listed estimators, higher scores reflect higher quality and stronger levels of governance.

I then take the above eighteen indicators and perform the principal component analysis on it in order to obtain the three ESG dimensions and the variation among them. I examine the eigenvectors for the first 3 factors in order to obtain the variation in the data. According to the eigenvalues in table A.2, the indicators are correlated with 3 main factors which account for 77 percent of variation in the data. With each additional component, variation in the data is captured. Thus the first factor captures 54 percent of the variation among the factors, the second factor captures 14.68 percent of the variation, the third factor explains 8 percent of the variation in the data.

Table A.2 : Variance explained by the eigenvalue of the extracted components.

Components	*Eigenvalue*	*Difference*	*Proportion of variation*	*Cumulative variation*
1	9.81	7.63	0.54	0.54483
2	2.64	2.18	0.1468	0.69166
3	1.47	0.47	0.08141	0.77

Table A3 shows the results of the principal component analysis.

Table A.3: PCA Results

Dimension	*Component 1*	*Component 2*	*Component 3*
Air Quality	0.13	-0.01	0.20
Water and Sanitation	0.29	0.03	-0.01
Forests	-0.02	0.41	-0.39
Renewable Energy - 1	0.02	0.34	-0.43
Renewable Energy - 2	-0.07	0.30	0.16
Renewable Energy – 3	-0.05	0.37	0.01
Human Capital	0.03	0.35	0.02
Demography	0.07	0.35	0.04
Health	0.29	0.02	0.08
Gender Equality -1	-0.03	0.22	0.51
Gender Equality - 2	0.04	0.38	-0.01
Employment	-0.04	0.22	0.56
Democratic Institution - 1	0.37	-0.01	0.00
Democratic Institution - 2	0.37	0.00	-0.01
Democratic Institution- 3	0.34	0.02	-0.03
Safety Policy - 1	0.38	-0.02	-0.01
Safety Policy - 2	0.37	-0.01	0.02

Table A.4: Squared Factor Matrix

Dimension	*Component 1*	*Component 2*	*Component 3*
Air Quality	0.02	**0.00**	0.04
Water and Sanitation	0.09	**0.00**	0.00
Forests	0.00	**0.17**	0.15
Renewable Energy - 1	0.00	**0.11**	0.19
Renewable Energy - 2	0.00	**0.09**	0.03
Renewable Energy – 3	0.00	**0.14**	0.00
Human Capital	0.00	0.12	**0.00**
Demography	0.01	0.12	**0.00**
Health	0.08	0.00	**0.01**
Gender Equality -1	0.00	0.05	**0.26**
Gender Equality - 2	0.00	0.15	**0.00**
Employment	0.00	0.05	**0.32**
Democratic Institution - 1	**0.14**	0.00	0.00
Democratic Institution - 2	**0.13**	0.00	0.00
Democratic Institution- 3	**0.12**	0.00	0.00
Safety Policy - 1	**0.14**	0.00	0.00
Safety Policy - 2	**0.13**	0.00	0.00
Safety Policy -3	**0.13**	0.00	0.00

The factors are then rotated and squared. This is so as to obtain the factor loadings: the weight that each indicator brings to the requisite component. Across factors, the variance is summed in order to identify which set of indicators corresponds to which representative component (Table A4). The indicators that capture the most variance for the environment correspond to component 2 which I incorporate into the panel regression.