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ESG FACTORS AND SOVEREIGN CREDIT RATINGS

Bachelor's thesis

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I hereby declare that I have compiled the thesis independently
and all works, important standpoints and data by other authors
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The document length is 9060 words from the introduction to the end of the conclusion.

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ABSTRACT

Dealing with environmental and social responsibility is increasingly important topic in corporate world, but additionally among the national economies. Expectations towards governments' financial ecosystems are no longer limited to maximizing wealth and growth, but governments should also incorporate considerations regarding Environmental, Social, and Governance (ESG) factors.

This thesis aims to examine how the ESG performance of world governments impact the sovereign credit rating performance. The study is conducted by quantitative research, considering 130 governments' credit rating history between the years 2011 and 2021. Most common explanatory macroeconomic factors and ESG factors from the same time period are included in the multivariate linear regression analysis to study their relationship to the credit rating performance of sovereigns.

The results from regression analysis indicate that regarding the ESG performance, there seems to be potential for ESG to have an effect on the sovereign credit rating performance. Nevertheless, this study suggests that among the three ESG pillars, only governance aspects of ESG significantly affect the sovereign credit rating performance.

Keywords: Sovereign credit ratings, ESG factors, Sustainability

INTRODUCTION

Sovereign credit rating is an assessment of a country's creditworthiness when a country borrows on international markets. In consequence, it is an important factor in predicting and deciding under what conditions a country has access to international financial markets. Credit rating of a country plays a significant role on the effects on sovereign economy, the financial industry and acts as a vanguard of the creditworthiness of domestic companies. Most importantly, sovereign credit rating influences the overall borrowing cost of a specific country (Härmälä, Laakkonen, & Lahtinen, 2014). The global credit rating industry is highly concentrated on three largest rating agencies: Fitch Group, Moody's, and Standard & Poor's (S&P's) Global Ratings (Afonso, Gomes, & Rother, 2007). The analysis presented in this thesis considers ratings provided by these three agencies.

Environmental responsibility is nowadays at forefront of financial industry and especially in the focus for companies. Nevertheless, also governments should incorporate considerations regarding Environmental, Social, and Governance (ESG) factors. In spite of ESG factors referring to non-financial information, these factors are superior compliment to the financial ratings, as these dimensions allow investors to come up with conclusions of the country's long-term stability and considerations regarding environmental, social, and governmental responsibility (ISS Governance, 2023). From credit ratings point of view, ESG factors refer to key types of factors affecting the credit profile of government and as a whole, these factors speak for long-term sustainability of a country (GFOA, 2020). Nowadays, ESG factors are recognized as a part of a country's credit rating assessment process, however it is not straightforwardly quantified by the assessment providers that to what extent are these factors considered in credit ratings (Pineau, Le, & Estran, 2021).

The aim of this thesis is to investigate the association between ESG responsibility aspects and sovereign credit rating. The thesis aims to understand the importance of ESG performance in relation to the sovereign credit rating performance by conducting a multivariate cross-sectional regression analysis on sovereign credit ratings as a dependant variable and macroeconomic factors related to the ratings and ESG factor performance of governments as explanatory variables.

This study aims to answer on the following research questions:

1. Does ESG performance influence the sovereign credit rating performance?
2. Is ESG performance significant determinant of credit ratings in the presence of standard macroeconomic control variables?

The hypothesis proposed in this study suggests that ESG factors have an effect on the credit rating performance. Contrarily, null hypothesis suggests that countries performance in ESG environment does not affect the sovereign credit ratings. The development of this hypothesis is provided in subchapter 1.3. discussing previous studies regarding the topic.

The study makes a contribution to the credit rating and ESG streams of literature. Findings of the study contribute to the implementation process of ESG principles in financial environment. Since ESG principles are altogether contemporary and increasingly more significant theme in the world and in finance in general (CFA Institute, 2023), this type of research is important in order to understand and to improve the enforcement of ESG aspects in credit rating assessments of world governments.

The structure of the thesis is divided into four sections. The first chapter provides theoretical foundations about the topic, including discussion of sovereign credit ratings, ESG factors and relevant previous studies conducted related to these two topics. Also, more detailed hypothesis formation is provided in this chapter. Second chapter introduces the research methodology and utilized data sources concerning the research. In the second chapter there are regression analysis related considerations included, such as testing variables for multicollinearity and standardization of variables introduced. Third section covers the analysis and discussion on the data and findings of the regression analysis, as well as the limitations of the research. On last chapter, there is conclusion provided about the study as a whole.

1. LITERATURE REVIEW

1.1. Sovereign credit ratings

Sovereign credit rating is an assessment of a country's creditworthiness and ability to meet its financial debt obligations. These kinds of ratings can be used by investors to estimate the risk of investing in a particular country's government bonds and other debt securities, but most importantly from sovereign point of view, credit ratings influence the borrowing costs of a given country. Overall, sovereign credit rating has a special status in the economy. When government has problems with creditworthiness, the whole economy of a country suffers. The falling of a credit rating is not only reflected in availability of financing, but also the price of base value for risk yields of companies in this specific country (Härmälä, Laakkonen, & Lahtinen, 2014). Fundamentally, high sovereign credit rating indicates that country is considered to be lower risk borrower and more likely to receive favourable terms and interest rates on its debt. Contrarily, low credit rating indicates that country is higher-risk borrower and might face higher costs to its borrowings (Takawira & Muteba Mwamba, 2020).

When it comes to credit ratings, relative nature of the rating is essential. In this context, relativity refers to the comparability of different ratings at given time. To put differently, certain rating does not imply a specific absolute probability of default (Pekkala, 2015). S&P, Moody's, and Fitch do not use same qualitative codes for their ratings, but S&P and Fitch use similar letter rating from AAA to CCC-. Moody's ratings descend from Aaa to Caa3. S&P and Fitch mark default as D and Moody's marks it as C (Afonso, Gomes, & Rother, 2007).

The assessment process of sovereign credit ratings is not standardized in association with credit rating agencies. In preference, each distinct rating agency uses their own diverse set factors to determine sovereign credit ratings and constantly aim to correspond on changing conditions in the world (Nuzzo & Dubost, 2023). Credit rating agencies do not provide much instruction either regarding the weights they consider each variable on their rating assessment process (Elkhoury,

2008). Despite the fact, rating systems are moderately similar and comparable between separate rating providers and always focus only on assessment of the credit risk (Nuzzo & Dubost, 2023).

According to Cantor and Packer (1996), Moody's as well as S&P's rating assignments for long-term debt can be mostly explained by a small number of explanatory macroeconomic variables. These variables are per capita income, GDP growth, inflation, fiscal balance, external balance, external debt, economic development, and a country's default history (Cantor & Packer, 1996). In addition to listed variables, there are set of other quantitative and qualitative variables to assign the credit rating (Mellios & Paget-Blanc, 2006).

Cantor and Packer (1996) provide explanation for the most explanatory and influential macroeconomic variables as following: Per capita income, which is often observed as GDP per capita, is related to the potential tax base received by a government, which has straight-line effect on country's ability to pay its debt. It can also function as a proxy to indicate the level of political stability in the country. GDP growth acts as a proxy for overcoming the existing debt. The higher the GDP growth is in the country, the easier the existing debt burden is to serve over time. High inflation can reveal problems in government's finances since it can result in country's inability to pay for current expenses and got to finance its expenses by inflationary money. Fiscal balance points out if a country lacks the capacity to tax its citizens to cover current expenses. External balance refers to the information if public and private sectors together depend on funding from overseas. External debt rate considers the fact that higher debt rate corresponds to higher default risk. Economic development is measured also in GDP per capita, but it is important to consider also separately, since there is a connection among economic development and risk. Lastly, default history is an important proxy, as other macroeconomic factors being equal, country having defaulted previously is extensively recognized as high credit risk (Cantor & Packer, 1996).

Upon closer inspection, the concept of credit rating agencies is not very simple. Even though the credit ratings are considered as an influential assistance for lenders for understanding the risks associated with financial instruments, over-reliance on the ratings might lead to failing in appreciating the risks (European Commission, 2023). Especially global financial crisis from 2007 to 2009, followed by sovereign debt crisis in Europe, has been subject to significant attention towards the role of credit rating agencies in financial systems. The ratings have significant influence on financial markets and the agencies receive criticism from failing to evaluate risks appropriately (Sahibzada, Rizwan, & Qureshi, 2022).

In recent times, ESG performance variables have been acknowledged as a set of new drivers for financial ratings (Pineau, Le, & Estran, 2021). To underline the transparency about the impact of ESG factors in their credit ratings, Moody's, Fitch, and S&P all have generated ESG scoring systems for communicating the impact of these factors on the ratings. Moody's and S&P systems indicate the effect of ESG factors on ratings, while Fitch model emphasizes the ESG significance on the ratings provided (Nuzzo & Dubost, 2023). As an example, Moody's states that it seeks to integrate all possible aspects affecting their ratings, which is why their analysts use also ESG ratings in their assessments. Nevertheless, similar to Fitch, Moody's use impact scoring for indicating the extent to which the ESG factors impact the rating (Moody's, 2023).

1.2. ESG Principles

In the year 2015, the United Nations formalized 17 Sustainable Development Goals (SDGs) which were acquired by 193 governments. This was a universal call for action to protect the planet, end poverty and increase peace and prosperity in the world by 2030 (UNDP, 2023). These Sustainable Develpoment Goals provide also an approach to foster Environmental, Social and Governance (ESG) improvements and raising awareness when it comes to capital markets with ESG risks (Hübel, 2020).

Nowadays, ESG is a key standard in assessing especially the overall enterprise performance and is also an essential element in adoption of green finance. ESG has gained high recognition from society and is seen as crucial application in evaluation of the issuer's impact on environment, society and governance. Therefore, ESG has appeared as powerful competitive tool, having impact on the decision-making of issuers (Wan, Dawod, Chanaim, & Ramasamy, 2023). The primary objective for ESG ratings is to create a comprehensive overlook about how well a specific company is able to confront critical tasks and crucial challenges, as well as primary responsibilities when it comes to sustainability. While the adoption of ESG principles in research and investment decision-making has been particularly popular in Europe, the popularity of these matters is rapidly increasing in elsewhere in the world as well (International Trade Center, 2019).

For the most part, ESG ratings have been principally centered on corporate securities while sovereigns have been less in the focus of ESG rating sector. In such manner, when it comes to sovereign ESG performance, throughout the recent history, ESG ratings and factors have been

primarily focusing on corporate stocks and bonds rather than analyzing sovereigns as a whole. When ESG ratings related to stocks and bonds are quite familiar to responsible investors, sovereign ESG is not that well-known factor, even though it is increasingly more commonly used in assessing sovereign credit ratings, too. Sovereign issuers are systematically exposed to ESG risks, as such factors have an effect on sovereigns ability to repay its debts (Mirabaud, 2023). Sovereign ESG principles provide analysis of the sustainability of a government. Methodologies in assessing these principles call for proper understanding of contributors of ESG in financial ecosystem. The key actors in this ecosystem are for example issuers receiving ESG ratings, rating providers, leaders, and investors making use of these ratings (OECD, 2020).

Morgan Stanley Capital International (MSCI) is one of the many ESG rating providers in the world. MSCI provides ESG ratings for companies, securities, loans, mutual funds and also sovereigns (MSCI, 2023). According to the MSCI, the most common ESG factors used in determining the ESG ratings and providing broadest factual coverage are the following:

From “E pillar”: carbon emissions, water stress, toxic emissions and waste.
From “S pillar”: labour management, health and safety, human-capital management and data security.
From “G Pillar”: corporate governance, business ethics, corruption and instability and anticompetitive practices (Giese, Nagy, & Lee, 2020).

According to the PWC (2022), “S pillar” is increasingly more important in assessing ESG performance, having been lacking focus besides environmental and governance aspects for a while. For instance, supply chain and distribution, workforce risks, human rights and social reporting are listed as decriptive examples of important social considerations regarding ESG (PWC, 2022).

ESG has received increasing amount of academic as well as practical attention due to social responsibility problems for example in the manner of environmental pollution and fiancial fraud (Wan, Dawod, Chanaim, & Ramasamy, 2023). Nonetheless, there is no commonly agreed definition of ESG criteria, and at the moment, all ESG issuers have their own criteria to assess ESG scorings for sovereigns. The expression “ESG” can right now refer to numerous rating products and different rating providers assess their ratings based on different criteria (Nuzzo & Dubost, 2023). It is now noted that sovereign ESG scoring framework needs some serious

improvement (Gatcheva, et al., 2021). Sovereign ESG providers have come up with the foundation for the operationalization when it comes to good sovereign-level performance on Governance and Social issues. Nevertheless, there is less agreement regarding what contributes to good score on Environmental level, since there are a number of data-gaps and heterogenous reporting standards related to the environmental topics (Pesme & Caputo Silva, 2021). Other structural challenges related to ESG framework include for example lack of clarity and the ingrained income bias. To fix for example mentioned issues, World Bank suggest new, more transparent framework called *Sovereign ESG 2.0*. This framework includes five quiding principles for assessing ESG in future. Those principles are clarity on investment objectives, transparent scoring methodology, improved data sources, incorporation of forward-looking scenarios and accounting for the ingrainde income bias (Gatcheva, et al., 2021). As sustainability and ESG variables are just recently been getting more attention, these kinds of notations are important in the development movement towards more sustainable future in finance.

1.3. Prior studies and hypothesis development

Recently, literature has been investigating the ESG impact on business performance progressively more (Nirino, Santoro, Miglietta, & Quaglia, 2020). Credit rating industry suggests that only ESG factors that affect the creditworthiness, should be included in sovereign credit rating assessment. That being the case, credit rating agencies have started using impact scoring systems for indicating the extent to which the ESG factors impact the rating (FitchSolutions, 2023). Additionally, according to the World Bank, it is challenging to compare sovereign credit ratings to the sovereign ESG scores, as these are two different measures as the other focuses on creditworthiness and other on the issuer's sustainability (Gatcheva, Gurhy, Skarnulis, Stewart, & Wang, 2021).

The World Bank (2021) has found correlation between high-income countries' credit ratings and ESG scores. Nevertheless, for lower income countries there is no clear relationship found between these two, despite macroeconomic factors which often dictate sovereign creditworthiness. This is relevant information for lower-income countries assigned to the same rating on the scale of creditworthiness but, on the contrary, different ESG scoring (Gatcheva, et al., 2021).
Jiang, Feng & Yang (2022) evaluated the current status and evolution of sovereign ESG globally. They constructed ESG index based on the data of 171 countries worldwide, from 1990 to 2020. They concluded that lower-income countries tend to focus on their development as an economy

rather than focusing on ESG principles, whereas countries with higher economic growth tend to focus more on ESG development (Jiang, Feng, & Yang, 2022). Also, Pineau, Le, and Estran (2021) made similar types of findings in their research where they studied the importance of ESG factors in sovereign credit ratings. The research was based on data-driven methodology to explore relative importance of ESG and non-ESG factors in sovereign credit ratings. As a conclusion, they stated that ESG factors are more important for countries with higher economic growth and less important for developing economies (Pineau, Le, & Estran, 2021).

Crifo, Diaye, and Oueghlissi (2016) did research on impact of government ESG performance on public debt. As a conclusion for the research, they explained that higher ESG scores were associated with lower borrowing costs, which is connected to the better credit rating. Anyhow, they found out that the effect of ESG on sovereign borrowing cost is much weaker than the effect of financial ratings (Crifo, Diaye, & Oueghlissi, 2016).

As intersection between the sovereign credit ratings and ESG is comparatively new area of research and ESG has just recently considered as new components of financial analysis (Pineau, Le, & Estran, 2021). At the present time there is growing awareness of the influence and importance of ESG variables yet the same time there is still considerably limited research on how these factors influence the sovereign credit ratings. Based on theoretical review as well as previous studies conducted regarding the topic of this thesis, hypothesis of this study suggests that ESG factors have an effect on credit rating performance. To the contrary, null hypothesis suggests that ESG factors do not significantly affect the credit rating performance.

2. DATA AND METHODOLOGY

This chapter reviews the research method and data used in the research. Since the thesis investigates the effect of macroeconomic factors and ESG factors to the sovereign credit ratings, this study will be undertaken as quantitative empirical study. The study is conducted using multivariate linear regression to discover how the impact of the most acknowledged macroeconomic factors and ESG factors have changed over time.

2.1. Data

In this study, the dependant variable is the average credit rating performance of a government during the time period defined on each sample. Independent explanatory variables used for the analysis consist of macroeconomic most common variables contributing to the credit ratings and most recognized ESG variables. Time periods considered in this study are 2011-2014, 2015-2018 and 2019-2021. Also, a sample of country averages from the whole considered time period of 2011-2021 is formed and evaluated to provide the overview of the time period as a whole.

Data for the study is gathered mainly from The Global Economy database, which compiles business and economic datasets from sources such as the World Bank, the International Monetary Fund, the United Nations, and the World Economic Forum (The Global Economy, 2023). However, data regarding the debt is gathered from the International Monetary Fund database and water-stress data is retrieved from the World Bank ESG databank.

To compile the determinant sovereign credit rating variable for regression analysis, credit ratings provided by Fitch, Moody's, and Standard & Poor's must be numerically standardized, so that it is possible to calculate an average numerical rating value for each country per year. There is maximum 24 different outcomes in ratings, which is why the scores received vary from 1 to 24. Scoring scale is compiled in a way that the best possible, highest quality, outcome on this scale would be 24 and the worst possible outcome would be 1, typical default. Since different countries have contractual credit ratings from different providers, and received unsolicited credit ratings

vary from year to year, all the ratings available by Moody's, S&P and Fitch for each country that year were combined to calculate the average score. In case same provider had provided multiple ratings for the same year for a specific country, only the latest rating for this country from each year from each provider was taken into account to simplify the standardizing process.

Table 1. Author's standardization of credit ratings provided by different agencies

Moody's	**S&P**	**FitchRatings**	**Scoring scale**
Aaa	AAA	AAA	**24**
Aa1	AA+	AA+	**23**
Aa2	AA	AA	**22**
Aa3	AA−	AA−	**21**
A1	A+	A+	**20**
A2	A	A	**19**
A3	A−	A−	**18**
Baa1	BBB+	BBB+	**17**
Baa2	BBB	BBB	**16**
Baa3	BBB−	BBB−	**15**
Ba1	BB+	BB+	**14**
Ba2	BB	BB	**13**
Ba3	BB−	BB−	**12**
B1	B+	B+	**11**
B2	B	B	**10**
B3	B−	B−	**9**
Caa1	CCC+	CCC+	**8**
Caa2	CCC	CCC	**7**
Caa3	CCC−	CCC−	**6**
Ca	CC	CC	**5**
	C	C	**4**
C	RD	RD	**3**
	SD	D	**2**
	D		**1**

Source: Rating scales of Moody's, S&P and Fitch (2023) and author's calculations

As stated earlier in this thesis, most common macroeconomic factors affecting credit rating performance of governments are GDP per capita, GDP growth, inflation, fiscal balance, external balance, external debt, economic development, and a country's default history (Cantor & Packer, 1996). Even though occurred default and default history in general is a major influencer in credit ratings (Cantor & Packer, 1996), it would not add significant value for this research, as it is already comprehensible that default affects the ratings substantially.

Considering this information, the macroeconomic explanatory variables chosen for model used in this study are capita income, GDP growth, inflation, fiscal balance, external balance, external debt, and economic development. Definitions of the chosen variables are provided in the table below. Also coding for the variables used in further inspection is presented on the table.

Table 2. Coding and definitions of macroeconomic variables

Code	Macroeconomic independent variable	Definition
Growth	Economic growth	Measured as annual percentage growth rate of gross domestic product at market prices based on constant local currency.
GDP	GDP per capita	Measured as GDP divided by the population in the midyear. Expressed in USD.
Inflation	Inflation	Measured as percent change of Consumer Price Index
Trade	Trade balance	External balance regarding goods and services. Measured as percent of Gross Domestic Product.
Debt	Debt	General government gross debt as percent of gross domestic product
Fiscal	Fiscal balance	Difference between government revenue and expenditure. Measured as a percent of gross domestic product

Sources: The Global Economy database and IMF indicators' definitions

Independent ESG variables utilized in this study are based on the most common macroeconomic ESG factor affecting ESG scoring. Since ESG scoring procedures vary substantially between the providers, this analysis will be done by using the most common ESG variables utilized in ESG score assessments. In the database utilized there was not a complete match to all intended ESG variables available therefore chosen ESG variables for regression analysis are based on MSCI study about the most common ESG variables as well as PWC information about social variables

affecting ESG scoring. The chosen explanatory ESG variables for analysis are carbon dioxide emissions and level of water stress from the E pillar, labour freedom index and human rights and rule of law index from the S pillar and rule of law index and freedom from corruption rate from the G pillar. Definitions of the independent explanatory ESG variables used in the regression model, as well as the coding of the variables is provided in the table below.

Table 3. Coding, definitions, and original scales of ESG variables

Pillar	Code	ESG Variable	Definition	Presented in scale
E	Carbon	Carbon dioxide emissions	Measured in tons of emissions per capita on each country that specific year	Measured in …
	Water	Level of water stress	Measured in a freshwater withdrawal as a proportion of available resources within the country	Measured in …
S	Labour	Labour freedom index	Composed from six distinct factors based on World Bank's Doing Business study. The index includes ratio of minimum wage to the average value added per worker, hindrance to hiring additional workers, rigidity of hours, difficulty of firing redundant employees, legally mandated notice period, and mandatory severance pay.	0 to 100
	Human rights	Human rights and rule of law index	Examines the link between the state and population and if fundamental human rights are protected and freedom is observed.	0 (high) to 10 (low)
G	Corruption	Freedom from corruption index	Derived mainly from Transparency International's Corruption Perceptions Index but have minor additional inputs for countries which scores are not determined in that index.	0 to 100
	Law	Rule of law index	Indicates perceptions of the amount to which a country follows the society rules, quality of contract enforcement, property rights and likelihood of crime and violence in the country.	-2,5 (weak) to 2,5 (strong)

Source: The Global Economy database indicators' definitions

To compile the dataset for regression analysis, average credit performance, macroeconomic factors and ESG factors are combined to one dataset. In this research, credit rating performance score acts as a dependant variable and macroeconomic and ESG variables function as explanatory independent variables.

The compiled primary dataset consists of 1358 observations between the years 2011 and 2021 including 150 separate countries in the dataset. Table 4 below provides descriptive statistics from the primary dataset, where all the observations are presented separately.

Table 4. Descriptive statistics, the primary dataset

	Variable	Mean	St.dev	Min	Max
Dependant variable	Credit rating performance	15	5	2	24
Macroeconomic variable	Growth	2,56	4,92	-54,24	41,75
	GDP	19 089	22 412	429	165 642
	Inflation	4,25	10,45	-3,70	254,90
	Trade	-1,41	13,27	-67,93	52,65
	Debt	57,92	37,16	0,05	262,49
	Fiscal	-3,12	4,83	-31,00	33,83
E pillar variable	Carbon	5,39	5,35	0,03	37,80
	Water	83,27	380,80	0,03	4250,85
S pillar variable	Labour	61,99	14,63	20,00	99,00
	Human rights	5,04	2,45	0,50	10,00
G pillar variable	Corruption	47,62	21,09	7,00	97,00
	Law	0,22	0,95	-2,26	2,12

Source: Author's calculations

Since there is generally no considerable change in the regression variables over the time period from 2011 to 2021, regarding this study it is reasonable to focus the cross-section dimension of the data. The data is divided into three samples based on different time periods of country averages over the years of observation. The considered time periods are 2011-2014, 2015-2018 and 2019-2021. Also, a sample of country averages from the whole time period of 2011-2021 is formed to provide the overview of the considered time period as a whole.

Regression analysis is conducted for all of these data samples separately, to compare the application of ESG variables in relation to credit rating performance and also observe the evolution of these variables throughout the time period over 2011 to 2021. To present the variation and development within the variables between the separate datasets, the variable averages for each dataset is presented in the Table 5 below.

Table 5. Variable averages in each dataset

	2011-2021	2011-2014	2015-2018	2019-2021
Number of observations	150	131	139	144
Credit rating performance	14	15	15	14
Growth	2,18	3,01	3,20	1,04
GDP	18 258	19 316	18 715	17 874
Inflation	4,45	4,58	4,19	4,03
Trade	-2,09	-0,98	-2,11	-2,01
Debt	57,01	50,22	57,03	65,49
Fiscal	-3,14	-2,26	-2,64	-4,26
Carbon	4,99	5,51	5,06	4,59
Water	80,40	81,32	78,43	79,83
Labour	60,49	62,88	61,12	60,55
Human rights	5,26	5,19	5,12	5,08
Corruption	45,48	45,14	46,29	47,74
Law	0,13	0,20	0,19	0,13

Source: Author's calculations

2.2. Multivariate linear regression

Regression analysis is a technique to statistically explain the relationship between dependant variable and independent variables. Analysis predicts the value of dependent variable based on the independent variables. Regression analysis is versatile and flexible method for studying relationships between variables (Kaakinen & Ellonen, 2023). This study is conducted through multivariate regression analysis, which is an extension of the unitary linear regression analysis. Whereby multivariate linear regression analysis differs from the unitary linear regression is the approach that its goal is to determine how each independent variable contributes to the variance in the dependent variable. Multivariate regression analysis is commonly used in economics to explore the relationships between variables and to make predictions.

Model for multivariate regression model is formulated as following:

$$y = \beta_0 + \beta_1 x_1 + \cdots + \beta_n x_n + \varepsilon \quad (1)$$

Where:

y – dependent variable

x_i – independent variable

β_i – parameter

ε – error

Linear regression analysis is based on the set of assumptios, which must be met for the results to be reliable. It is important to notice that certain factors that are not directly related to the regression, can also have impact on the results of the model. Although, linear regression is in general relatively robust method even if the assumptions are not fully satisfied. Especially, when there are large number of observations in the dataset, linear regression tolerates some deviations from the assupmtions without compromising. In reality, the assumptions are rarely fully met in research. It is still important to be aware of the deviations from assumptions (Kaakinen & Ellonen, 2023).

2.3. Standardization of variables

Because this study aims to also compare the magnitude of ESG factors effect on the credit assessments to the magnitude effect of macroeconomic factors, it is necessary for all the independent variables to be comparable with each other. This allows us to draw conclusions about the independent variable impact on credit rating performance and compare the variables to each other in case these variables are significant regarding to the dependant variable. Different independent variable values do not express much as coefficient values if they are measured on their own scales. In this case, as definitions expressed in the Table 2 and different scales in the Table 3, almost all the variables fluctuate on their own scales and are expressed on different forms. Nevertheless, variables can be standardized, so that instead of varying on their own scales, they are deviating on similar extents and in such way, that they are comparable with each other (Abdi, 2007).

Independent variables' original values are standardized by calculating z-scores for each value. To produce the z-scores, mean of the variable values is subtracted from the original value, which

eliminates the mean and converts the original score as a deviation of the mean. Lastly, the score deviation is divided by standard deviation of the variable values, which eliminates the original unit of measurement. Followed by this procedure, mean of every variable equal to zero. Distribution of the values is not changing but is reconstructed in a way that it midpoints at value 0 (Abdi, 2007).

Formula for calculating z-score for each value is the following:

$$Z = \frac{Y - M_Y}{S_Y} \quad (2)$$

Where:

Y – original value

M_Y – mean of the original values within this variable

S_Y – standard deviation of original values within this variable

Z-scores were calculated for each table separately, as they always correspond to the variation within the variable in specific period. New data tables were formed correspondingly to the z-score calculations, so that it was possible to utilize z-scores in the regression analysis.

Table 6 below provides the overlook on independent variable z-scores used for the final regression analysis in the dataset over 2011-2021 to create the overview of where the values fluctuate within the dataset.

Table 6. Z-score descriptive statistics over the time period of 2011-2021

Variable	Average	St.dev	Min	Max
Credit rating performance	0	1	-1,98	1,78
Growth	0	1	-9,69	1,88
GDP	0	1	-0,82	4,33
Inflation	0	1	-0,91	7,25
Trade	0	1	-3,73	3,50
Debt	0	1	-1,41	4,95
Fiscal	0	1	-1,80	6,16
Carbon	0	1	-0,95	5,61
Water	0	1	-0,24	8,97
Labour	0	1	-2,62	2,04
Human rights	0	1	-1,80	2,04
Corruption	0	1	-1,22	2,26
Law	0	1	-2,08	1,88

Source: Author's calculations

2.4. Multicollinearity

Multicollinearity refers to straight-line relation between two or more independent variables. Concerning regression analysis where the explanatory variables should be independent, multicollinearity may cause difficulties in reliability of the model parameters and interpreting the results (Alin, 2010). If there is high correlation between some of the independent variables, it can cause the coefficients swing extensively based on other variables in the model. Multicollinnearity also weakens the statistical power of the regression model, as the p-values might not be trustworthy to indentify if independent variables are statistically significant (FroIndest, 2023).

To review the correlation of the variables, the correlation matrix was formed using Microsoft Excel DataAnalysis Correlation tool. Correlation matrix is presented in the Table 7 below.

Table 7. Correlation matrix for the variables

		1	2	3	4	5	6	7	8	9	10	11	12	13
1.	Rating	1												
2.	Growth	-0,04	1											
3.	GDP	0,77	-0,08	1										
4.	Inflation	-0,29	-0,11	-0,18	1									
5.	Trade	0,54	-0,14	0,56	-0,09	1								
6.	Debt	-0,08	-0,27	0,10	0,11	-0,16	1							
7.	Fiscal	0,43	-0,11	0,41	-0,26	0,42	-0,42	1						
8.	Carbon	0,57	-0,10	0,49	-0,09	0,52	-0,01	0,19	1					
9.	Water	0,20	-0,18	0,13	-0,02	0,31	-0,17	0,43	0,47	1				
10.	Labour	0,34	0,20	0,23	-0,23	0,11	0,00	0,09	0,26	0,03	1			
11.	Human rights	-0,59	0,03	-0,62	0,28	-0,15	-0,27	-0,15	-0,20	0,16	-0,20	1		
12.	Corruption	0,83	0,01	0,83	-0,30	0,36	0,19	0,23	0,46	0,03	0,39	-0,77	1	
13.	Law	0,83	-0,01	0,76	-0,37	0,37	0,19	0,25	0,43	0,02	0,41	-0,81	0,96	1

Source: Author's calculations

Generally, correlation between 0,5 and 1 is considered as strong correlation (Wilson, 2009). With respect to this information there is very strong correlation of 0,96 between the G pillar variables, Freedom from Corruption and Rule of Law. These same variables are also very correlative with the S pillar variable Human Rights and Rule of Law. Since, the correlation between these variables may influence the statistical power of the regression analysis, it would be important to create also a model where this kind of correlation is restricted wihtin the independent variables.

With respect to the interests of this study, it would still be important to include at least one variable from each of the pillars in the regression, Rule of law and Human Rights and Rule of law will be left out from the regression model, where multicollinearity is taken into account. In such sense, there will be variable from each pillar represented without correlation among the independent ESG variables. In accordance with the correlation matrix review, the ESG variables utilized in other regression model are carbon dioxide emissions and the level of water stress from the E pillar, labour freedom from the S pillar, and lastly, freedom from corruption from the G pillar. To enable the versatile picture of the performance of these variables, also alternative regression model where all the variables are included is run and the results overviewed in the following chapter.

3. FINDINGS AND DISCUSSION

This section presents the findings of the conducted quantitative study made by using multivariate cross-section regression analysis and discusses the key findings of the analysis. To start with, the results include the review of findings of regression analyses after which there is discussion provided about the obtained results of the study.

Multivariate linear regressions were run in Gretl, which is a software used for econometric analysis. Regression model in Gretl uses 95% confidence interval by default, making the alpha of the regression equal to 0,05. Gretl runs regression using the Ordinary Least Squares (OLS) method, which involves finding the best fitting line minimizing the sum of the squared distances between actual and predicted values. OLS produces estimates under certain conditions so that the errors in model are normally distributed and are uncorrelated with each other (Butekis, 2020). OLS conditions are usually referred as Gauss-Markov assumptions, according to which the coefficients in linear regression model is the most efficient of linear unbiased estimator (Taboga, 2021).

3.1. Empirical Findings

R squared is commonly used when reporting the linear regression. Nevertheless, it is acclaimed that R squared tends to overestimate the amount of variance within the population by always increasing the effect associated with the increase in number of effects included in the model. To correctly estimate the amount of variance in population, adjusted R squared is normally used, (Karch, 2019) which is the reason why it is more significant value for this specific research also. Adjusted R squared is corrected model accuracy measure, an unlike R squared, may decrease if some effect does not enhance the model. Value of 1 in adjusted R squared would express that the model perfectly predicts the values in the population, whereas 0 would indicate that the model is not able to predict values (IBM, 2023).

Regarding the regression results of this study, adjusted R squared fluctuating above 0,7 in every model. Values between 0,7 and 1 are generally considered as strong linear relationship through the regression line, so adjusted R squares regarding all of the models presented are generally considered as strong linear relationship between the credit rating performance and explanatory macroeconomic and ESG variables. Adjusted R squared values on other models fluctuate also in a way that the values are above 0,7, representing that all models present strong relationship between credit ratings and explanatory variables.

Standard error describes the accuracy of the estimator. Initially, the smaller the standard error appears the better, as it refers the data being more precise and less likely to be affected by sampling error or variation within the sample. Standard error generally stands for the average distance that observed values fall from the regression line. Significance is close to zero on all of the models, which is less than the alpha of 0,05 in regression, meaning that the results of the analysis are statistically significant.

P-values are notable tool in regression analysis when it comes to determinining if the relationships within the sample also exist in the larger population. To put in other words, P-values test the null hypothesis, which in regarding this research is that whether the variables would or would not have a significant effect on the credit ratings. P-values exceeding the alpha of 0,05, are suggesting that data is likely to be true with the null hypothesis and to not correspond to the initial hypothesis. What is especially interesting to review in respect to this study, is the evolution of p-values regarding the different time periods, as it communicates if the impact of ESG has evolved trough the observed time period. As was stated previously, both regression models were ran and will be analysed, keeping in mind the model where there is correlation between the variables may produce biased results.

Table 8 provides the p-values and variable coefficients over the periods of 2011-2014, 2015-2018, 2019-2021 and over the whole considered time period of 2011-2021 when ESG-variables are selected based on the multicollinearity review.

Table 8. Regression results, only non-correlated ESG variables included in models

	2011-2014			2015-2018			2019-2021			2011-2021		
Growth	0,028	(0,107)		-0,026	(0,045)		-0,052	(0,051)		0,001	(0,112)	
GDP	0,093	(0,108)		0,156	(0,103)		0,201	(0,083)	**	0,101	(0,105)	
Inflation	-0,071	(0,047)		-0,277	(0,181)		-0,073	(0,044)		-0,033	(0,041)	
Trade	0,081	(0,071)		0,129	(0,057)	**	0,069	(0,049)		0,121	(0,054)	**
Debt	-0,137	(0,059)	**	-0,197	(0,045)	***	-0,266	(0,055)	***	-0,147	(0,049)	***
Fiscal	0,084	(0,084)		0,051	(0,056)		-0,061	(0,046)		0,052	(0,059)	
Carbon	0,149	(0,073)	**	0,097	(0,064)		0,017	(0,055)		0,121	(0,061)	*
Water	-0,025	(0,068)		0,048	(0,048)		0,07	(0,046)		0,018	(0,050)	
Labour	0,016	(0,052)		0,001	(0,045)		0,001	(0,047)		-0,011	(0,047)	
Corruption	0,640	(0,093)	***	0,582	(0,077)	***	0,608	(0,080)	***	0,651	(0,082)	***
Adjusted R^2		0,773			0,799			0,802			0,810	
Standard error		0,477			0,446			0,434			0,432	
Significance		0,000			0,000			0,000			0,000	
Observations		111			119			121			125	

Source: Author's calculations

Notes:

1. *** - p-value < 0.01; ** - p-value < 0.05; * - p-value < 0.10

It can be derived from the table above that from the selection of ESG variables, mainly only G pillar variable, freedom from corruption, is significant regarding the credit rating performance every periods of time. Nevertheless, there is neither significant improvement nor decline in different time periods regarding this variable. Also carbon dioxide emissions seem to be significant regarding the time period of 2011-2014, however, on the contrary, not really on the environmental friendly point of view, as the higher amount of emissions would have positive effect on the rating performance according to this model. Nevertheless, considering the whole time period of 2011-2021, carbon dioxide is only significant at significance interval of 0,1, which makes it barely significant. Other ESG variables mainly have p-values over 0,05, which makes them to complement the null hypothesis of the study.

In addition to ESG variables review, the significant variables regarding sovereign credit rating performance are mostly GDP per capita, government debt and trade balance. Yet the p-values of these variables fluctuate in a way that all of the variables are not significant every year on this model, which makes it interesting to compare how much each of the significant value affect the ratings.

Statistically significant coefficients presented on the above table seem to stay comparatively similar throughout the observation years. What is interestin here is that the coefficients regarding the freedom from corruption are comparatively higher than the macroeconomic variables coefficients.

Table 9 indicates the p-values and coefficients over the periods of 2011-2014, 2015-2018 and 2019-2021 when all ESG-variables are included in the regression, despite the multicollinearity within G pillar variables. As well as in the table above, also p-values of the regression conducted on the cross-selection of whole considered time period is presented on the table. Despite multicollinearity within variables can cause biases in p-values, regarding the topic of this study it could be important to review these variables combined in a regression model. However, it would not add value to compare coefficients of these variables in the same terms that in the model where multicollinearity is considered, since this model has a risk of being biased due to the correlation among the ESG variables.

Table 9. Regression results, all ESG variables included in regression

	2011-2014			**2015-2018**			**2019-2021**			**2011-2021**		
Growth	0,036	(0,108)		-0,061	(0,045)		-0,012	(0,051)		0,018	(0,111)	
GDP	0,092	(0,103)		0,107	(0,100)		0,131	(0,082)		0,076	(0,100)	
Inflation	-0,023	(0,047)		-0,235	(0,179)		-0,043	(0,043)		0,027	(0,042)	
Trade	0,082	(0,068)		0,104	(0,055)	*	0,080	(0,048)	*	0,103	(0,052)	*
Debt	-0,154	(0,057)	***	-0,228	(0,044)	***	-0,268	(0,053)	***	-0,157	(0,047)	***
Fiscal	0,099	(0,081)		0,067	(0,057)		-0,028	(0,046)		0,103	(0,059)	*
Carbon	0,133	(0,070)	*	0,099	(0,062)		0,050	(0,055)		0,132	(0,059)	**
Water	-0,041	(0,066)		0,038	(0,047)		0,067	(0,044)		-0,005	(0,049)	
Labour	-0,021	(0,051)		-0,014	(0,045)		-0,006	(0,045)		-0,022	(0,046)	
Human rights	0,121	(0,092)		0,076	(0,080)		-0,052	(0,069)		0,036	(0,076)	
Corruption	0,219	(0,162)		0,213	(0,131)		0,252	(0,129)	*	0,164	(0,152)	
Law	0,591	(0,175)	***	0,516	(0,150)	***	0,405	(0,142)	***	0,582	(0,164)	***
Adjusted R^2		0,793			0,816			0,819			0,828	
Standard error		0,456			0,426			0,415			0,412	
Significance		0,000			0,000			0,000			0,000	
Observations		111			119			121			125	

Source: Author's calculations

Notes:

1. *** - p-value < 0.01; ** - p-value < 0.05; * - p-value < 0.10

Considering ESG variables in this model, as well as in the model where multicollinearity is considered, the G pillar variables freedom from corruption and rule of law seem to be mainly only variables affecting credit ratings among considered ESG variables. When it comes to p-values of freedom of corruption, the values fluctuate over the years and in the most recent years has started to affect the credit ratings. According to this model, rule of law on the other hand has been affecting the credit rating performance during all the years. As well as on the other model, carbon dioxide emissions seem to be significant regarding some time period samples also in this model. Here carbon dioxide emissions also seem to have positive effect on credit rating performance, which would not correspond to the environmental friendliness and thus, does not consider good ESG performance. Concerning this model, as well as the model where multicollinearity was considered, other ESG variables correspond to the null hypothesis of the study and do not affect the sovereign credit rating performance. In these models, macroeconomic variables usually significant for credit rating performance are government debt and trade balance.

3.2. Discussion

This subchapter discusses the findings of the regression analyses that were conducted to examine the relationship between the dependant variable credit rating performance and independent macroeconomic and ESG variables which are expected to have an effect on the sovereign credit rating performance.

As it was stated in the previous chapter, it is important to note that the regression model where correlating variables are included in the same regression (Table 9), the model may produce biased results. Still, to discuss the results of this model, according to the model only variables from governance pillar seem to be mostly statistically significant and correspond to the initial hypothesis that they have an effect on the ratings. G pillar variables seem to have rather high effect on the sovereign credit rating performance comparing to the macroeconomic variables, which usually mainly contribute and determine the rating. In this model, since there is multicollinearity noted within the variables, we should not value the coefficients too much, as they might be biased due to the behaviour of independent variables.

Due to noted multicollinearity within the variables, most reliable model regarding this study is the regression model where there was no rule of law index or human rights and rule of law index

included (Table 8) since these were the ones highly correlated with other variables. As well as the other regression model, this model also expressed that the only continiously significant ESG variable regarding the credit rating performance throughout the observation years is the G pillar variable, in this case, freedom from corruption. In this model, G pillar seems to have, again, rather high effect on sovereign credit rating performance compared to the most common determinants of credit ratings, for example debt. Same, relatively large effect was noted on the other model too, where all the variables were included in the model. There can be several reasons why the model produces coefficients this high for the G pillar, however for example errors in specification of variables can produce results like this. As this study considers only the most common variables affecting credit rating performance and ESG performance, there is a possibility that some important variables are left out from the model. As well as multicollinearity, specification error can also lead to biased coefficients for the variables remaining in the model. In case some relevant variable is left out from the model, it may be captured by other variables in the model, in this case G pillar variables on both of the models. In the models of this study, G pillar coefficients may appear misleading in a sense of their effect on credit rating performance and no conclusions should be made from the coefficients, since they are unexpectedly large.

In addition to G pillar being significant, sometimes carbon dioxide emissions appeared as significant variables for the models. Nevertheless, on both models, carbon dioxide always had a positive effect on the credit rating performance, meaning that higher carbon dioxide emission levels would lead to better ratings. This conclusion would not support the initial idea of sustainability wihtin ESG and most probably, this effect is a result of the most wealthiest countries also being the most polluting ones.

As an aswer to the first research question, it could be stated that ESG performance have an effect on the credit rating performance, on the other hand, it seems that they only effect the ratings from the G pillar aspect. Neither environmental nor social performance of governments influence the credit rating performance significantly, so when credit rating agencies address they consider ESG on their ratings, it seems that they mainly adopt the governance aspect. Regardless of the ESG not being fully implemented by itself, the parts of it utilized in credit rating assessments might be significant in addressing the rating performance. As credit ratings are indeed only supposed to underline the creditworthiness of a country and not significantly have a say on if country is functioning well from environmental, social or governance point of view, there wouldn’t be a

serious reason to include variables which are not contributing to the credit rating to the assessment processes.

To elaborate the G pillar coefficients appearing quite large compared to the other significant coefficients on the model, it seems that the G pillar would have relatively high effect compared to the macroeconomic varibales. Considering the economic significance of the findings regarding the freedom from corruption variable, according to the model it means that as the values of freedom from corruption coefficients are between 0,582 and 0,651, it means that one standard deviation increase in this variable would be associated with 0,582 to 0,651 increase in the dependant variable, credit rating performance. As an example, if the average credit rating performance of a country for the whole time period was 18, being a rating A- by Fitch and S&P. If the country's level of from corruption increases, and followed by this, freedom from corruption rate would decrease, according to this model, one standard deviation amount of decrease in the rate would end up decreasing the credit rating score by 5, which is the standard deviation of credit ratings. This would result in the situation where the country's rating would end up being BB due to the increase of corruption in the country. Nevertheless, as the coefficient of freedom of corruption is relatively high compared to the macroeconomic explanatory variables coefficients, it seems unusual that the freedom from corruption would explain more of the credit ratings than the other variables. Thus, no proper conclusions about the power of governance aspects or ESG as a whole regarding sovereign credit rating performance can be drawn from the models used in this study.

ESG has potential in being a part of the assessment process of sovereign credit ratings, after all as credit ratings are considering only the creditworthiness of a country as a borrower, ESG implemented as a whole would not really respond to the demand of credit rating agencies. As it was stated in the theoretical review, S&P, Fitch, and Moody's all use different scales to assess the extents that ESG assessments affect their ratings. Even though the rating agencies are reticent to unveil their exact procedure, it is quite certain that governance-related variables are significant, whereas environmental and social aspects are not that important determinants in the assessment process of the rating providers. As the need for standardization of ESG principles is noted recently, it is expected that changes in operations regarding ESG in sovereign credit rating assessments are implemented in future.

When it comes to the discussion of the findings, it is also important to understand the limitations of this research. This study focuses only the most common independent macroeconomic variables used in sovereign credit rating assessments and most commonly used ESG determinants in assessing the ESG performance of countries. As a result, the regression analyses do not use all the possible variables affecting the assessment of credit ratings or ESG ratings. This can affect for example the way that G pillar variables coefficients seem unexpectedly large. Since the information regarding either the credit rating assessment process or ESG or ESG effect on credit ratings is not standardized, with respect to this research, it was not possible to include all those possible variables in the regression. Along these lines, variation of credit rating performance assessments can be explained also by other factors outside of the factors used in regression. By using the most common macroeconomic and ESG variables, it is possible to illustrate the main outlines for ESG variables functioning with macroeconomic variables in credit rating assessments. As a consequence, there is potential for further research in this area.

CONCLUSION

This thesis aims to study the ESG performance effect on sovereign credit rating performance throughout the time period over 2011 to 2021. The study was conducted as cross-section regression analysis. All in all 130 countries average credit rating performance assessments provided by the three most significant credit rating agencies in the world, Fitch, Moody's and S&P, was treated as dependant variable. Macroeconomic variables, which are generally known for affecting the credit ratings the most were added in the regression model together with most common ESG variables, to study the relationship and effect between these independent variables regarding the dependant variable. Data for the study was collected mainly from The Global Economy database, despite some variable additions form the World Bank database and International Monetary Fund databank.

The main aim of the study was to state if ESG performance of governments have effect on the credit rating performance, which is a considerable influencer of a government's financial performance. The countries average performance regarding the regression variables were divided into three time periods based datasets to create cross-sectional datasets to study if the ESG effect has increased throughout the years. Also sample of the country averages from the whole observed time period was presented and observed in the study. Multicollinearity within the independent variables was considered in the study, which came to be limiting the ESG variable selection by leaving two of these variables out from the main regression model.

The study had limitations in such sense, that there is not much information available on which ESG variables are used in ESG performance assessments, and especially not about which ESG variables are used in credit rating assessments. This is why only the most common variables affecting ESG performance were included in regression models. Thus, there can be other ESG variables, that can have an effect on the regression results. ESG performance is relatively contemporarily introduced topic, and has been facing criticism on its unconsistensy, missing standardized protocols and ground rules. Yet ESG is widely studied topic, and research on this field adds value in implementing more ethical aspects and considerations in finance in future, as these are important factors contributing to the sustainability in the financial sector, too.

The findings of the study show that ESG performance indeed have an effect on sovereign credit ratings, nevertheless according to the regression result interpretations, it seems that ESG only affects the credit ratings from the governance pillar point of view. There was no improvement or variation of ESG implementation or effect pointed out troughout the considered time period. Instead, the variables which had an effect credit rating performance remained the same troughout the different samples, so no increase in implementation of ESG was spotted during the observation years. Even though it seems that governance aspects of ESG have some effect on the credit rating performance and assessments, there can not be proper conclusions drawn about the extents to which governance aspects affect the ratings, as the produced results may be biased due to the lack of explanatory variables in the regression models.

There has been some studies made from ESG and credit ratings made previously, however since this is quite a new topic in finance, there is not much former research to rely on. As the ESG variables were quite limited in this study, for future research it could be interesting to include multiple variables from each pillar in the research, to study this topic further and point out for example which governance variables affect the credit ratings the most, as in this study governance pillar appeared as the most important influencer regarding the rating performance.

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