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The relationship between ESG rating scores of a public company and its financial performance

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Abstract

ESG rankings were originally set up as a benchmark to help make investments and manage risks in accordance with sustainability principles. Yet ESG ranking remains an instrument that does not have a wide application in enhancing performance of the financial optimization and management. Issues understanding ESG - related activities in practice pose a problem in an objective implication of the ESG framework. There is no exact answer on whether investing in ESG - related activities pay off enough to increase internal financial indicators. There is a suggestion that if dependency exists, it is a non-linear one, because the rule of marginal productivity may apply: ESG actions can be considered a resource or an asset in a company. Showing curvilinear dependency has a practical implementation because it serves as a foundation for creating optimization models for internal company indicators and building more reliable and predictable portfolios. It can find a place in consulting, operational management, portfolio management purposes as well as overall input in the business ethics field.

The described model is based on open-source data, that is why any company can use our methodology to forecast the influence of sustainable actions on profits and revenues. Same comes to investors: when constructing a portfolio, ESG - scores from available rankings can help to predict trends for fundamental analysis coefficients, which is a subject of explicit research. Statistical analysis conducted with polynomial regression using data collected from Refinitiv Eikon for the companies of different sizes. There are models built for profit margins and revenues with the anticipated results of curvilinear dependency with ESG for revenues and non-U-shape dependency of ESG scores and profit margins.

Keywords: ESG investing, sustainable investment, resource optimization, business ethics, diminishing marginal utility, U-shape marginal product, neoclassical economy, sustainable operations, sustainable portfolio, risk management, impact investing, corporate financial performance

Introduction

Background. In the second half of the XIX century, people started to notice a relationship between their economic activities caused by the ongoing industrial revolution and negative tendencies in environmental and social balances. The 1970s were the years when the first sustainability - related concept was brought up - "social contract", which had shown the necessity for businesses to serve the society's demands and corporate social responsibility that served as the means to support social contract. Fundamental discussions occurred during the global UN conference on the environment in Stockholm in 1972 (Mensah, 2019), when the movement was officially defined as "sustainable development" mentioned for the first time in the Brundtland Report published by the United Nations in 1987 (United Nations, "Report of the World Commission on Environment and Development", 1987). There were several key milestone premises: Club of Rome Limits to Growth report in 1972 (Donovan, 2009), first hearnings by the MIT research group on sustainable development (U.S. Government Publishing Office, "Growth and its implications for the future", 1973) and five principles of conservation by the UN World Charter for Nature in 1982 (United Nations, "World charter for nature", 1982). Later on, the whole ESG framework was formulated as a universal instrument, which covered environmental, social and governance aspects of company's performance. Originally, ESG was linked to investment processes to ensure proper risk management, though these days it also finds an application in internal operations within companies.

Problem statement. With the attention to scarce resources and to the value of social needs within the organization, instruments began to appear for considering sustainability issues on a regular basis - ESG indexes and rankings. This research paper covers only ESG rankings implementation. The issue is that the dependency between financial indicators and non-material aspects of company activities is neither exactly defined nor explored in a non-linear aspect. The aim of the research is to explore the relationship between non - material aspects of a company's performance represented by ESG scores and its financial indicators, profit margin and revenue. Related objective is to analyze the significance of relationship between ESG ranking scores and a company's internal financial performance presented by profit margin and revenues. In addition to dependency confirmation, our research intends to confirm or refute U-shape of this dependency. For meeting the formulated objectives statistical method - regression analysis will be used. Data taken from Refinitiv Eikon covers 9861 observations (companies ESG scores for the last fiscal year evaluated by Refinitiv agency). As a possible extension of this research, analysis can be expanded to include external market indicators, like share prices and expected revenues. As long as we specified that ESG evolved as a concept initially for risk management, this analysis makes sense, even though a lot of similar research was

conducted: curvilinear relationship remains barely covered and industries factor is not always accounted for. Primary motivation of this research paper is explained through high practical relevance of the paper and scientific contribution. The core research question we came up with looks the following way: "*Is there statistical evidence confirming non-linear connection between the ESG scores presented by Refinitiv and the core financial metrics of a company - total revenue and profit margin?*"

Professional significance. *Practical relevance* of the research paper is based on extended modeling of the interconnection between sustainable actions and financial wellness for a particular company. A mathematical financial model assessing a company's core financial characteristic regarding environmental, social, and government issues is designed to simplify the process of building short – term, long – term strategies and develop new methods of market control. It helps to more efficiently utilize financial resources inside a wide range of companies bringing more available assets to use. So, the confirmed positive or negative dependency of any kind will be a sufficient statistical instrument for assessing the potential profits and revenues for the future cash flow management. The results may be used around companies from different industries. Especially when it comes to the huge ones, who deal with a greater number of factors in their operations, like social aspects, natural resources scarcity and other ethical issues. Moreover, non-linearity of the model makes it more flexible to be used and leads to more exact predictions. As for the *scientific contribution* that the current research paper makes, it brings additional value to the notions of total revenue and profit margin. Our evaluation shows the influence of ESG criteria on profit margins and total revenues, internal financial parameters of a company. It means that the accepted framework assessing non-material aspects of a company may not just bring additional reputation but also economically influence the performance. In addition to that, a fuller picture on internal parameters and internal risks makes operational optimization available giving a more precise control on capital. Moreover, profit margins and total revenues give a fuller picture for potential conservative investors, who tend to achieve growth in the long-term.

Delimitations of the Study. It is worth mentioning some limitations of this particular research. First of all, the methodology for the formation of ESG rankings is specific and its compilation requires several stages: the agency collects information about the various types of activities of the company, its internal and external processes. After that, the agency assigns points to each criterion that it uses to form the ESG ranking. This is followed by the calculation of the final result, its execution (general reporting) and publication. As long as the process involves a lot of agents, there can be informational bias. Also, any activity of the company cannot be assessed instantly, since some amount of time must

pass for the rating agencies to evaluate and take into account all past events. Typically, companies are assessed once or twice a year. Thus, under certain circumstances, it may take several financial quarters before the market receives information about the company's ESG ranking for the past period. What is more, scores on Refinitiv are updated on a weekly basis (Refinitiv, 2022).

As for the specific terms, the operating margin is advised to be used exclusively to compare companies that belong to the same industry, also having similar business models as well as annual sales. Different industries have very different operating margins, so comparing them is not significant (Hayes, 2022). However, we take the scores from the Refinitiv framework, where industries are already taken into account while computing the ESG score. So, in practice, we cannot really claim that the research will be interfered with by these profit and revenue level differences: they are taken into account in ESG scores in regression models. Net profit margin can be influenced by one-off items such as the sale of an asset, which would temporarily boost profits, which can be considered as outlier influence (Murphy, 2022). Finally, a better ranking data could be chosen. Limited financial availability for research did not allow us to get data on more companies with more advanced and precise methodologies.

Before getting deeper into methodology, it is essential to understand the background behind ESG rankings and internal, external financial performance of companies. Also, to trace the development of research relatively to connections between sustainable development actions and financial parameters

Literature Review

Before getting deeper into methodology, it is essential to understand the background behind ESG rankings and internal, external financial performance of companies. Also, to trace the development of research relatively to connections between sustainable development actions and financial parameters.

From CSR to ESG

Sustainable development concerns around the world got its roots a long time ago, in the XIX century since the times of industrial revolution. It started as ideas about sustainable forest management, proceeded with hearings for US Congress, a report by Meadows, discussion during the UN conference on the Human environment in Stockholm, and the chain of other events. Eventually, it emerged into the "official" definition - sustainable development mentioned for the first time in the Brundtland Report in 1987, also known as "Our Common Future" (Sustainable Development Commission, 1987).

Even before that companies noticed the necessity of being attentive towards society: corporate social responsibility appeared around the 1970s as the "social contract" between business and society: business should be operating because of public "consent" and serving demands of society (Association of Corporate Citizenship Professionals, 2021). Later, principles of sustainability started to be considered not only inside the companies but also on a global market. The story of ESG investing began in January 2004 when former UN Secretary General Kofi Annan invited more than 50 CEOs of major financial institutions to participate in a joint initiative under the UN Global Compact and International Finance Corporation. Initiative had a goal to find ways of integrating ESG into capital markets (Kell, 2021). The first reference to ESG issues appeared in the 2006 UN Principles for Responsible Investment report. It consisted of the Freshfield Report and "Who Cares Wins". ESG criteria were advised to be included in the financial evaluations of companies for the first time ever (Atkins, 2021).

ESG is a pillar of a company's CSR initiative that is why it was important to understand the evolution of the related concepts (YourCase, 2021). ESG framework quantitatively estimates influence of non-material factors (environmental, social, and governance) on performance. Environmental factors are the activities having negative impacts on ecosystems and human health: managing waste and pollution, lowering negative climate impact, and working towards environmental disclosure (Boffo, R., et al., 2020). Social factors are related to the interaction of company and society: providing various healthcare and training benefits, unemployment regulation and human rights protection (Krekel, et al., 2019). Governance factors address the running process of a company:

executive leadership, lobbying activities, consumer privacy, etc. (Blackbaud, Inc, 2017). Different from SRI consisting of ethical criteria and implies negative screens, such as not investing in sin assets (alcohol, tobacco, etc.), ESG investing focuses on the financial relevance of those principles (Kell, 2021). ESG is a wider notion related to the long-term perspective and financial performance optimization.

ESG Index and ESG Ranking

To give sustainability principles a quantitative approach, ESG indexes and rankings were created. It is essential to distinguish one instrument from another, so as not to develop theoretical misconceptions. The ESG index is an instrument which reflects the changes in valuation for a group of companies collected by specific characteristics. Segmentation in index is defined by the company size or the grouped ESG scores. Indexes are used as benchmarks against which to measure the performance of mutual funds. For instance, the situation with classical indexes: mutual funds compare their returns to the return in the S&P 500 Index to give investors a sense of how much more or less the managers earn on their investments than they would make by investing in an index fund (Chen , 2022). The S&P ESG Index Family shows investors exposure to companies according to their ESG profile in the context of regional indices. Based on S&P DJI ESG Scores, the index family is formed from the results of the annual S&P Global Corporate Sustainability report.

On the contrary, ESG ranking reflects a single company's performance on a stock exchange, not depending on whether it belongs to a particular market segment or not. ESG ratings cover a company's exposure to financially relevant sustainability risks. In the current research paper, ESG rankings specifically are going to be used. ESG criteria is a very simplified indicator that absolutely anyone can easily operate with. There are many rankings based on different methodologies to reflect ESG characteristics. MSCI, several other financial firms have developed their ESG scoring models, including Russell Investments, Standard & Poors (S&P), and Blackrock (Hayes, 2021). The scores from various ESG rankings are used within risk adjustment models by private investors. (Masari Arai, et al., 2018)

In the current research paper, ESG rankings specifically are going to be used. We choose to analyze the influence of a ranking on a specific company so that we make sure that the pool is representative. Representative in a sense that it includes all sorts of companies: different earnings and industries.

Important to mention, that ESG ranking corresponds to the category of intangible assets. A similar example is a company's reputation (Barnett, et al., 2006). Reputation is an essential factor influencing the performance of a company. In many ways, it determines demand and helps fight

competition in the market. A bad reputation can significantly hurt a company's meaningful valuation. Why does reputation have such a strong impact on a company?

A person without an economic education is unlikely to judge a company by its marginal profit. Thus, reputation is a very simplified indicator that absolutely anyone can easily operate with. Reputation might have huge number of errors as long as it does not take into account all the factors, and can often be formed by incompetent people, but its clarity and accessibility allow it to play a key role in the development of the company.

ESG criteria have an extremely similar model. The ESG ranking is a generalized indicator that has its limitations, but it is much easier to use and interpret than the set of numbers and facts that it consists of. If the ESG ranking becomes a publicly available way to evaluate companies, its impact will be hard to underestimate.

On the publicly available methodologies from agencies building ESG rankings and reviewers, we can see which criteria is implemented for giving scores.

First of all, it is essential to point out that there are no universally defined ways on how to evaluate company's actions in terms of sustainability. There are several briefs that have a systemic outline about existing ESG rankings by FRAMEWORKS, ACCF, SustainAbility, Morgan Stanley, academic articles on SSRN (FrameworkESG, 2022). These reports covered main aspects that are important for responsible investors to use for their portfolio analysis as well as for executives who position their entities. Based on FRAMEWORKS research that has been cited by Bloomberg and Harvard Business School professors, mostly all rankings are based on public disclosures and are annual. Also, they use individual methodologies for computations (some can account for 30 factors like MSCI or just for 10 as Refinitiv). Report from SustainAbility points out that for companies focus on material issues is essential, as well as credibility of data sources matters and quality of methodology matters when they choose which ranking to rely on (Wong, C., et al., 2019).

As for the criteria, there are certain categories that are commonly considered by the major raters, indicating that these are commonly accepted core ESG problems:

● Biodiversity;
● Employee Development;
● Energy;
● Green Products;
● Health and Safety;
● Labor Practices;
● Supply Chain;

- Water;

There is also evidence that far not all categories are covered by all ratings at the same time. This comes not only to categories that are rather specialized, such as Electromagnetic fields, but also for Taxes. There is a fundamental concern in the context of ESG. Refinitiv has an explicit amount of unclassified indicators which other rankings do not cover. Correlations between rankings also vary, that is why it is important to understand which methodology is more applicable to your company and for what purposes (Berg, et al., 2019).

ESG scores from Refinitiv are going to be used. Refinitiv is a huge financial data provider that resulted from the strategic partnership between Thomson Reuters and Blackstone in 2019 (Refinitiv, "Meet Refinitiv. Refinitiv Perspectives", 2019). We have chosen this data provider because it was available to us considering financial restrictions of the research and the number of companies covered. Moreover, the rankings by Thomson Reuters have been featured as top five in terms of quality for academic respondents by the research of SustainAbility (Wong, et al., 2019). In their framework Refinitiv covers 10 themes in total for environment, social and governance aspects and is based on publicly available data accounting for industry materiality and company size biases. Rating is available for over 9,500 companies around the world, with time series data up to 2002 (data up to 2002 available for approximately 1000 organizations). There are scores provided for individual E, S, G criteria as well as a combined score. Interesting feature is that it also has a separate controversy score. It addresses the market cap bias from that large-cap companies experience, due to the fact that they have a wider media coverage. Also, this score verifies companies' actions against commitments, so as to discount overall ESG score based on significant controversies and negative media stories. The results of evaluation are available in both percentages and letter grades from D- to A+.

Overall, the structure looks the following way:
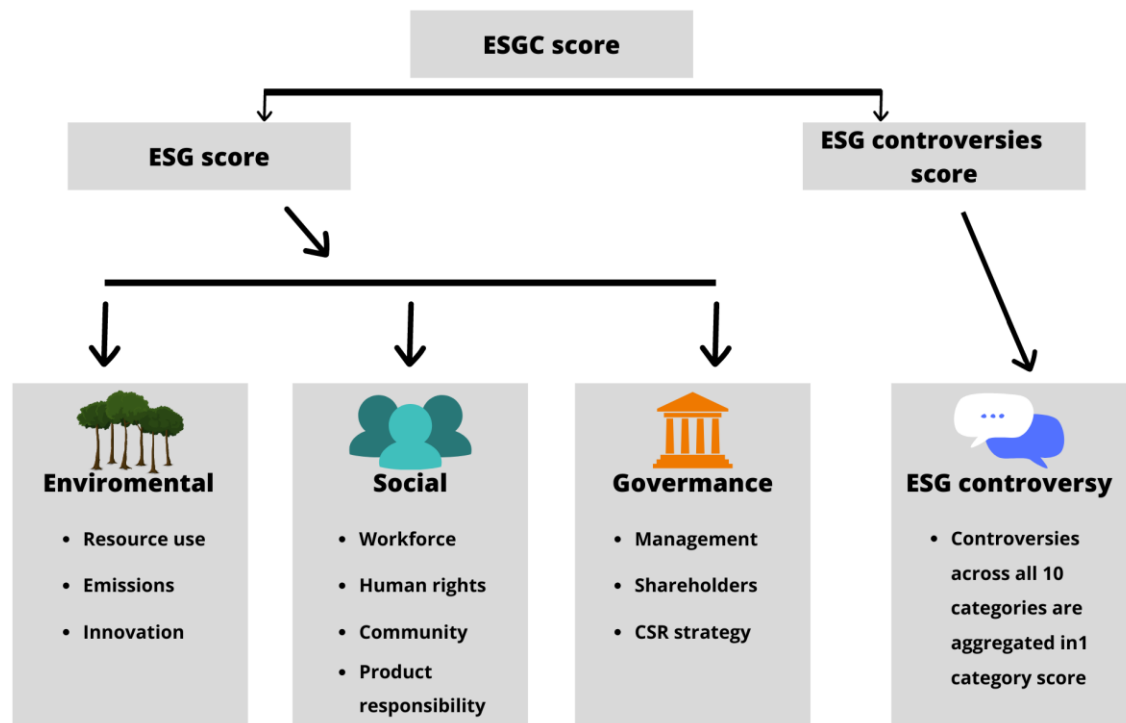
Picture 1, ESGC score

Data is obtained through:

- Annual reports;
- Company websites;
- NGO websites;
- Stock exchange filings;
- CSR reports;
- News sources;

- Calculation method includes category weights and materiality matrix, total ESG scores, ESG pillar scores, total ESGC score (Environmental, social and governance (ESG) scores from ... 2021).

- Category weights of an industry group = magnitude weights of all the categories for an industry group / sum of magnitudes for all categories. Magnitude weights are counted through industry medians and transparency weights;

- ESG scores are aggregated based on the 10 category weights, which are calculated based on the Refinitiv magnitude matrix.
- ESG pillar score - the relative sum of the category weights, which vary among industries for the E and S categories. For governance, the weights remain the same;
- ESGC score - average of the ESG score and ESG controversies score;

Having the general sense of ESG evaluation, we can now proceed to the analysis of primary theories which explain the relationships between ESG rankings and financial indicators of a company. Our paper aims to study the influence of ESG indicators both on internal operational financial performance and externally defined shares prices. Thus, it is essential to describe which financial indicators are theoretically justified to be used for building models.

Influence of ESG on Internal Financial Optimization

It makes sense to suggest the particular impact of sustainable actions for a company's internal financial health. Success in internal financial management influences the attractiveness of a company's shares: during the fundamental investing approach, such indicators as operating cash flows, total revenues and profit margins are considered (Segal, T. 2022). Capital gains or losses is a direct consequence of changing internal performance operations. For manufacturing, internal performance operations could include such actions as equipment utilization, set up times, work in progress levels, queues, etc. (Springer, 2000).

Which criteria can be a sufficient representation of internal financial performance, so we could allocate ESG principles with corresponding internal performance operations related to financial indicators?

It would be a profit margin that can be computed 3 different ways (Trending Accounting, 2022), 2 of which we are going to cover in the paper.

Firstly, a company's operating efficiency is one of the keys to its financial health. As an indicator of operating efficiency connected to gains - operating profit margin. This indicator covers a basic operational profit margin with the deduction of the production and marketing variable costs of both products and services. It shows the proportion of revenues that can cover non-operating costs (paying interest, for instance).

Operating profit margin (Return on sales) =
Operating earnings (operating income, EBIT) / Revenue

Secondly, profitability is essential as well as operating efficiency. It is measured by net margin: ratio of net profits to total revenues (Fidelity, 2022). Net profit margin ratio tells more information

than a simple profits number: a company showing a net profit figure of several hundred million dollars can have a net margin of only 1% or less. It would mean that the slightest increase in costs of operations or competition could drop the company significantly down (Duke University, 2022).

Net Profit Margin = Net Income (net profit) / Sales (revenue)

Higher net margin means a greater margin of financial stability, showing a stronger financial position to grow and expand (Maverick, J. B., 2022).

If you are working in a retailing segment, marketing strategy and marketing position the profit margin indirectly is impacted via revenues (Beers, 2021).

Operating margin differs from net margin in a way that operating margins refers to the profits earned from the core operations of the company, while the net profit margins point out the actual margin after considering interest payments on debt and tax outflows (Beers, 2021).

Also, connecting to the 2 terms analyzed, we can see that revenue also takes part in both of the notions, thus, it makes sense to look at it separately within our models.

According to T. Vashakmadze, classical financial statements allow investors to evaluate only around 30% or less of the total financial value of the enterprise. It happens so since on average no more than 1/3 of the market capitalization is formed at the expense of its physical capital, the rest is intangible assets. The investor needs non-financial reporting of the company, covering ESG factors and confirming the sustainability of the chosen business model. (Vashkamadze T., 2013). This non-financial reporting also can find its place in stock prices and create additional value

*Total Revenue = Number of Units Sold X Cost Per Unit*

One of the most common principles of financial analysis is to measure the overall level of cash flow going through the company. Total Revenue indicates the amount of money received by a company in the absolute value (Beers, 2021). Total revenue is an essential part of Price/Earnings Multiple (P/E) indicating the price of a share in comparison with the revenue generated by a company. P/E multiple is a tool of fundamental stock analysis which is essential for market stock analysis via ESG ranking.

Research Gap

Literature primarily covers positive linear dependency between earnings per share, stock prices and ESG scores. In 2006 Michael Barnett and Robert Salomon published a study describing a curvilinear relationship between social responsibility and stock prices. Selective investment could maximize the performance of the portfolio (Barnett, Salomon, 2006). At this point, there is a sufficient lack of research explaining non-linear patterns in connection of ESG with financial indicators of

companies, especially internal ones - revenues and profit margins. It can be considered *a literature gap* that our paper fills in.

ESG - the score should be considered as an asset. In this case, behavior can be described by a theory from the neoclassical economic model: the dependence of the use of an asset and the profit that the company receives using this resource. Most of the activities in production have the traditional reversed U-shape relationship between the amount of action and the amount of result. Initially, an increase in the amount of action leads to an increase in the result, but the marginal productivity at some point becomes equal to zero, and a further increase leads to a decrease in the result. For example, an increase in wages up to a point lead to an increase in the productivity of workers and an increase in profits, but then it has a negative impact on profits. A similar situation is possible if we consider the relationship between sustainable actions and financial performance. In our case, this will be the dependence of the financial performance and the total cost of investments in ESG.
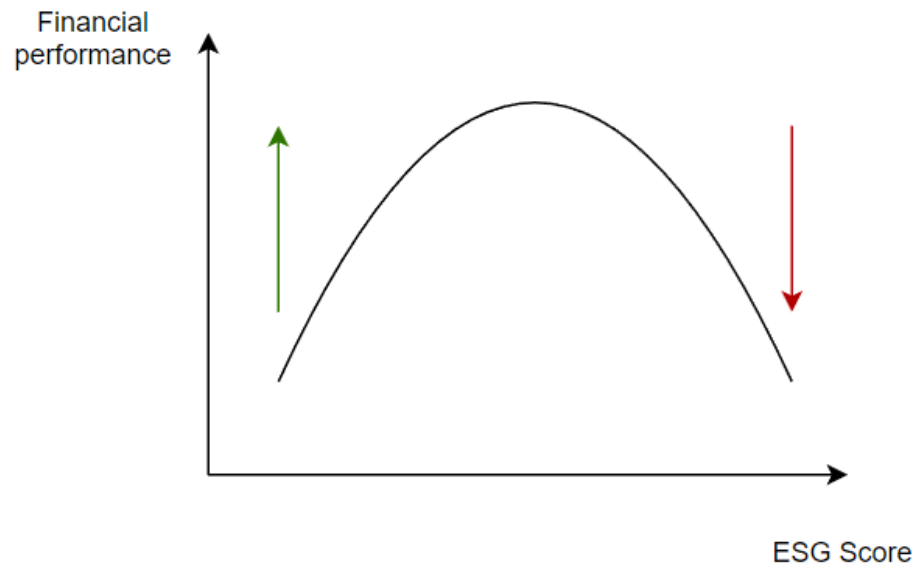
Picture 2, Relationship between financial performance and ESG score

The horizontal axis shows the amount of assets that are allocated to support the company's ESG ranking. With an increase in the ESG indicator, an increase in the overall performance of the company will first be observed, because the company reduces the potential risks associated with ESG. But at some point, the company's profit decreases, as the costs of ESG begin to exceed the benefits of reducing risks. Some actions immediately have a negative impact on profits - for example, environmental costs are immediately deducted from the company's profits. If we evaluate the financial results of a firm by profits, then the behavior of investors does not affect it. Therefore, the link must be in the form of an inverted U, as described.
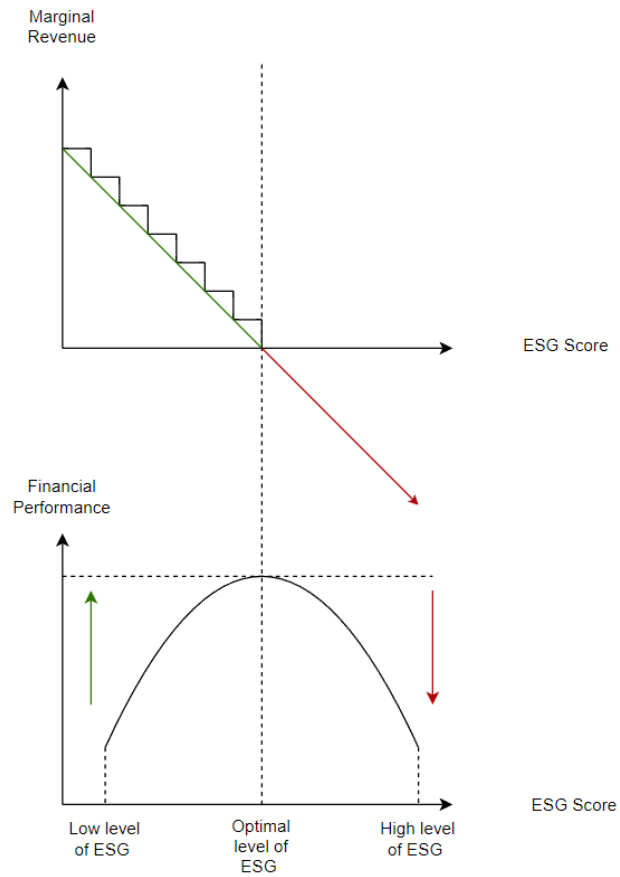
Picture 3, Explanation of relationship between financial performance and ESG score

If we evaluate the financial results of a company at the rate of its shares, then 2 scenarios are possible: investors are guided only by the financial performance of the company, or they also take ESG indicators into account. In the first case, the relationship should be an inverted U.

In the second case, a monotonous positive relationship can be observed - an increase in the ESG indicator will lead to an increase in the stock price. This effect will manifest itself if there are a majority of socially responsible investors in the market. In this case, companies with a higher ESG index have higher stock uptrends: more socially responsible investors will be inclined to buy shares of companies with a higher ESG rating. This is a subject for extended research.

Hypotheses

After precise analysis of both academic and non-academic resources we came up with the suggestion of the following hypotheses that needed to be tested:

I) The dependency between ESG scores and total revenue within public companies is non-linear and reversed U-shape;

II) The dependency between ESG scores and profit margin within public companies is non-linear and reversed U-shape;

These hypotheses are a subject of statistical analysis based on quantitative data. This analysis is going to be described in the Methodology section.

Methods and Data

Data Collection and Description

For our research, ESG scores from Refinitiv are going to be used. Refinitiv is a huge financial data provider that resulted from the recent strategic partnership between Thomson Reuters and Blackstone back in 2019 (David Kraig, 2022) We have chosen this data provider because it was available to us accounting for financial restrictions of the research and the number of companies covered. Moreover, the rankings by Thomson Reuters have been featured as top five in terms of quality for academic respondents by the research of SustainAbility. This is one of the latest research projects that has provided a broad outline on a sustainable rankings environment (Wong, et al., 2019). Refinitiv covers 10 themes in total for environment, social and governance aspects and is based on publicly available data accounting for industry materiality and company size biases. Rating is available for over 9,500 companies around the world, with time series data up to 2002 (data up to 2002 available for approximately 1000 organizations).

Thus, we are able to observe companies of different sizes. This distribution is essential for the research due to the fact that we can explore how the size factor influences the overall company's sensitivity to ESG ranking associated with a firm. The choice of control variable is another essential factor influencing the overall quality of the model. At the same time, we cannot deny the fact that in the majority of cases such factors as size, industry, cost structure and productivity have a higher impact on financial performance than ESG ranking. Nevertheless, the importance of ESG structure allows us to derive from the classical model of a public company estimation process and also consider other factors. As we have mentioned above, the nature of ESG ranking observes those aspects of a firm's operational process which are hardly distinguishable from the analysis made through the financial statements. Considering the modern system of the financial market, which is growing year after year, both for internal and external agents, it becomes harder to analyze the current position of a company and define the weak and strong sides it has.

The next step is to define the nature of proxy variables and substantiate the choice of dependent and independent variables. In their framework Refinitiv covers 10 themes in total for environment, social and governance aspects and is based on publicly available data accounting for industry materiality and company size biases. There are scores provided for individual E, S, G criteria as well as a combined score. Interesting feature is that it also has a separate controversy score. It addresses the market cap bias from that large-cap companies experience, due to the fact that they have a wider media coverage. The results of evaluation are available in both percentages and letter grades from D- to A+.

Procedures and design

The conducted cross-section dataset consists of 9860 observations with a public company as a unit of observation. The data has been accumulated through the Refinitive Eikon terminal with built-in download instruments as well as python pandas environment has been used for data parsing. The cross-section data is chosen due to the specificity of the ESG ranking process performed by Refinitiv group. In most cases the given ranking of a company does not have a high level of deviation. It means that, in fact, the assigned ESG score does not vary over time. Considering this fact, we decided to use cross-sectional data in order to prevent the problem of autocorrelation in proxy variables illustrating the financial performance. We have enough evidence from the previous research published to suggest that financial indicators tend to have high levels of correlation between different time periods (Bonnie Buchanana, et al., 2018). Considering the factors mentioned above, we decided to use cross-sectional data for the ESG ranking performed by Refinitv Group as well as financial indicators observed for the last fiscal year and obtained through the annual reports, company websites, stock exchange filings, CSR reports and news sources (Eikon product guide, 2021).

In order to prove or disprove the stated hypotheses about non-linear (U-shape) dependency of financial performance from the ESG score the regression model is going to be constructed. In order to illustrate the nonlinear dependency, we are going to add the square values of ESG score in the model which allows us to reflect and test the parabolic dependency of dependent variables (financial indicators) and core independent variables (ESG ranking). The analysis is going to be made though the Stata 17 environment.

Choice of dependent variables. For the dependent variables the core financial metrics mentioned above have been used. Since we took base financial indicators to assess financial performance, we were able to find the proxy variables which are directly associated with the ideal ones. Thus, there are two indicators which are going to be included in the model: profit margin of a company and total revenue earned.

Variable	Obs	Mean	Std. dev.	Min	Max
profit_mar~n	8,244	.2695783	11.84206	-704.0265	608.3425
total_reve~n	8,721	5415.976	19052.3	-376.6619	572754

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From the descriptive statistic we can conclude that both dependent proxy variables have a statistically significant number of observations. The mean value presented for the profit margin equals 0,26 with the standard deviation of 11,8 percent. The value is presented in the range from - 704 to 608. It means that in the dataset there are companies with extremely good and poor performance demonstrated for the last fiscal year. The same situation may be observed for the second chosen dependent variable, total revenue in the dataset varies from - 377,6 to 572754 mln USD with the mean value of 5415,976 and the standard deviation equal to19052. Even though all the value from the descriptive statistics is beyond the acceptable limits and we cannot suggest any sufficient problems existing, the overall variance for the data about public companies has a high level of variance. For the research, we were trying to construct the data frame with companies of different size, thus, we are satisfied with obtained results.

Choice of independent variables. As we mentioned above, the core independent variable is the ESG score presented by Refinitiv group. In order to include the variable in the model we make the following transformations in the variable. First, the variable has been transformed into the numeric format, thus, all the letter identification has been linked to the numerical expression ranked from the 1 to 12 (original data contain values from D- to A+) where the lowest value (1, D-) is associated with poorest ESG performance and the highest value (12, A+) is associated with highest ESG performance (Eikon product guide, 2021). Secondly, the new variable has been generated. We added squared values of ESG performance to reflect the parabolic dependence in accordance with stated hypotheses.

Variable	Obs	Mean	Std. dev.	Min	Max
esg	9,756	5.767015	2.502391	1	12
esg2	9,756	39.51978	30.60398	1	144

In this case we also do not have any sufficient arguments against the quality of the chosen variables.

Choice of control variables. At the current stage of model development, there are 2 control variables to be included in the model. In the following chapters of the thesis paper, we are going to focus on those dependent variables which indicate the statistically significant dependence from ESG scores and squared ESG score. Thus, in the upcoming regression models there may be added additional control variables in order to increase the quality of the models.

Variable	Significance for the model	Expected sign
Total assets	Reflects the overall number of resources a company has in order to generate revenue. Thus, it turns out that the more total assets a company has, the more products it produces, the more advertising companies and the more total revenue from all these actions is obtained	+
Number of employees	The variable is chosen to distinguish companies of different sizes. We believe that this is a very important variable, since it is wrong to compare companies completely different in size, which is why we took such a necessary control variable that will be responsible for the size of the company and thus differentiate between huge and small companies.	+

```
      Variable |       Obs       Mean    Std. dev.       Min        Max

  ------------+-------------------------------------------------------

  total_assets |     9,544    26378.16    167635.6   .1434866    5110354

      emp_numb |     6,728     16118.3    46602.09          0    1608000
```

The control variables have a statistically significant number of observations. Total assets and market capitalization indicators have the acceptable level of standard deviation as far as mean, minimal and maximal values. Nevertheless, from the descriptive statistic we can observe that in the dataset there are some companies who have 0 employees working. As far as we cannot explain how a firm is able to perform having no workers, we decided not to include these companies in the final regression model.

Correlation analysis. The following correlation matrix is going to be constructed: we are going to estimate the level of correlation between the chosen dependent and independent variables. In this case, we are mostly interested in 1) the level of correlation between the dependent variables and the variable of interest 2) the level of correlation between independent variables. The chosen confidence level is equal to 0.05, all the values in the correlation matrix assigned by a star (*) have equal or higher levels of significance.

```
             | total_~n profit~n     esg total_~s emp_numb market~p

-------------+------------------------------------------------------

total_reve~n |   1.0000

profit_mar~n |   0.0013   1.0000

         esg |   0.2637*  0.0184   1.0000

total_assets |   0.4234*  0.0024   0.1522*  1.0000

    emp_numb |   0.6777*  0.0028   0.2905*  0.3329*  1.0000
```

Performed analysis concludes that there is statistically significant positive correlation between the ESG score and the total revenue of a company. At the same time, we cannot suggest sufficient evidence of existing correlation between the ESG score and the profit margin.

Considering the relatively small levels of correlation between independent variables we cannot suggest the problem of multicollinearity existing in the model.

As far as analysis is going to be constructed with continuous variables, it is necessary to control the distribution shape of the variables included in the model.

Variable	Transformation Justification
Profit Margin	There is enough evidence to transform the variable and logarithmic variable in order to make the shape of the variable distribution closer to a normal shape.
ESG Ranking	There is not enough evidence to transform the variable
Total Assets, mln USD	There is enough evidence to transform the variable and logarithmic variable in order to make the shape of the variable distribution closer to a normal shape.
Number of employees	There is enough evidence to transform the variable and logarithmic variable in order to make the shape of the variable distribution closer to a normal shape.
Total Revenue, mln USD	There is enough evidence to transform the variable and logarithmic variable in order to

	make the shape of the variable distribution closer to a normal shape.

The distribution shapes are presented in the pictures 11-13.

Regression analysis. Before the regression analysis, we would like to introduce the current econometric equation for the stated hypotheses:

$$\ln(total\ revenue)_i$$
$$= \beta_0 - \beta_1 * ESG\ score_i + \beta_2 * ESG\ score^2_i + \beta_3 * \ln(total\ assets)_i + \beta_4$$
$$* \ln(number\ od\ employees)_i + \varepsilon_i$$
$$\ln(profit\ margin)_i$$
$$= \beta_0 - \beta_1 * ESG\ score_i + \beta_2 * ESG\ score^2_i + \beta_3 * \ln(total\ assets)_i + \beta_4$$
$$* \ln(number\ od\ employees)_i + \varepsilon_i$$

As it follows from the equation, the beta coefficient of the ESG score is negative while the sign for beta coefficient for squared ESG score is positive. This format of econometric equation is constructed to reflect the predicted downward parabolic dependence of dependent variables from the ESG score.

Before proceeding to the details of regression, we need to carry out the necessary manipulations related to determining the level of heteroskedasticity with built-in Breusch–Pagan/Cook–Weisberg test for heteroskedasticity.

Profit Margin:

```
Breusch-Pagan/Cook-Weisberg test for heteroskedasticity

Assumption: Normal error terms

Variable: Fitted values of ln_profit_margin

H0: Constant variance

     chi2(1) =  20.31

Prob > chi2 = 0.0000
```

Total Revenue, mln USD:

```
Breusch-Pagan/Cook-Weisberg test for heteroskedasticity

Assumption: Normal error terms

Variable: Fitted values of ln_revenue_mln

H0: Constant variance

     chi2(1) = 1743.38

Prob > chi2 =  0.0000
```

Both tests rejected the null hypothesis at 95% confidence level and determined the existence of heteroskedasticity problem.

Results

The following regression model has been constructed considering all the essential notes made above and using the robust standard errors in order to prevent the problem of heteroscedasticity:

	(1)	(2)
	Logarithm of profit margin	Logarithm of total revenue, mln USD
ESG score	0.00612	0.0634**
Squared ESG score	0.00212	-0.00374*
Logarithm of total assets, mln USD	0.0198**	0.584***
Logarithm of the number of employees	-0.130***	0.485***
Constant	-0.267***	-1.711***
	(0.0638)	(0.106)
Observations	5575	5839

Standard errors in parentheses

$^{*} p < 0.05,$ $^{**} p < 0.01,$ $^{***} p < 0.001$

Considering the F-statistics for both models we reject the null hypothesis and suggest that there is at least one significant variable existing in both models. This fact allows us to consider both

regression models as significant ones. Nevertheless, the second model tends to have a relatively small level of R-squared indicator (0.5372 vs 0.008) and says that the first one has a higher ratio of explained part of the regression.

From the regression model we cannot conclude the statistically significant influence of ESG score on a company's profit margin.

At the same time, both the ESG and squared ESG scores are statistically significant in the model concerning the influence on total revenue of a company. Considering the fact that these two variables have different signs we can suggest the non-linear U-shape dependency of total revenue from ESG score. In order to identify the extreme point and the direction of the parabola's branches the additional analysis is going to be conducted.

Considering the control variables for the model with the total revenue, we obtained following results:

Variable	Expected sign	Received sign
Total assets	+	+
Number of employees	+	+

The predicted signs have matched the signs received from the model. That note allows us to confirm the quality and the relevance of the constructed model.

Two hypotheses were presented in our research project and two of them were tested by regression analysis. The analysis results are going to be used in order to confirm or deny the stated hypotheses.

The first hypothesis, in which a non-linear relationship is expected between the ESG scores and their total revenue. There is not enough evidence to reject the hypothesis: an inverted U-shape dependency was confirmed. Our assumptions regarding the impact of ESG score on the total revenue turned out to be correct.

As for the second hypothesis, where the impact of ESG score on profit margin was considered, the situation is different. The hypothesis was rejected, which means that the dependency between profit margin and ESG scores does not have an inverted U-shape curve. This does not prove the fact that ESG scores can affect the profit margin - it only means that there is another type of dependence between them.

The essential note is that we confirmed the existence of ESG optimal level - the point where a company is able to attain the highest marginal utility gained from ESG score investments.

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The following development of the empirical analysis implies the two essential steps to be performed. Firstly, additional control variables should be included. Therefore, there are a lot of factors which influence the financial performance of a company. Secondly, we are able to focus on dependence between the total revenue of a public company and ESG scores from Refinitiv Ranking and conduct the U-shape test for extended regression model.

Since we confirmed the presence of the U-shape dependence for total revenue and profit margin, it was decided to consider both of these indicators even closer and slightly expand the regression model, making our analysis more in-depth, taking into account some other factors.

Our in-depth research should start with the distribution of the ESG indicator, taking into account the total revenue of the company and the number of observations.

As for the distribution of ESG indicators by total revenue, there is an increasing trend that can be noted that starting with 8 in ESG tanking and ending with the highest indicator - 12, the total revenue of companies increased from approximately 8 000 mln USD to 70 000 mln USD. For indicators from 1 to 7 rise is not a typical trend and the total revenue indicators for companies with such ESG indicator ranges from 1000 mln USD to 5000 mln USD, having an increasing trend only from 2 to 7.

And taking into account these trends, it seems that the higher the ESG indicator, the greater its total revenue. But this trend is erroneous, making a conclusion about the distribution of the amount of observation by esg indices, that is shown on the second graph, then it can be seen that we have few purely companies with the highest rating of 12 - there are only 16 of them, which is a negligible indicator.

Thus, moving on to the second one, it becomes noticeable that here we have an almost perfect distribution, and the largest share of observations falls on ESG indicators from 2 to 10. That is why it was decided to continue and go even deeper into the study and take some additional control variables to consider more factors.
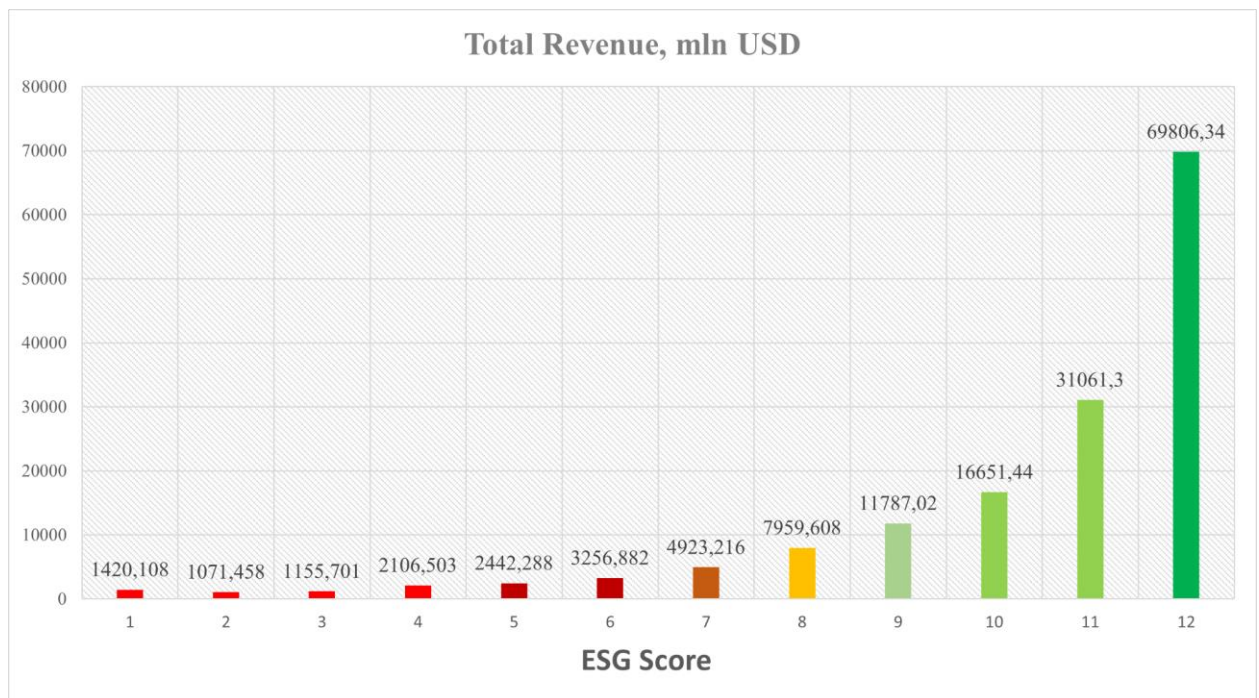
Picture 9, Distribution of Companies' total revenue through the ESG scores
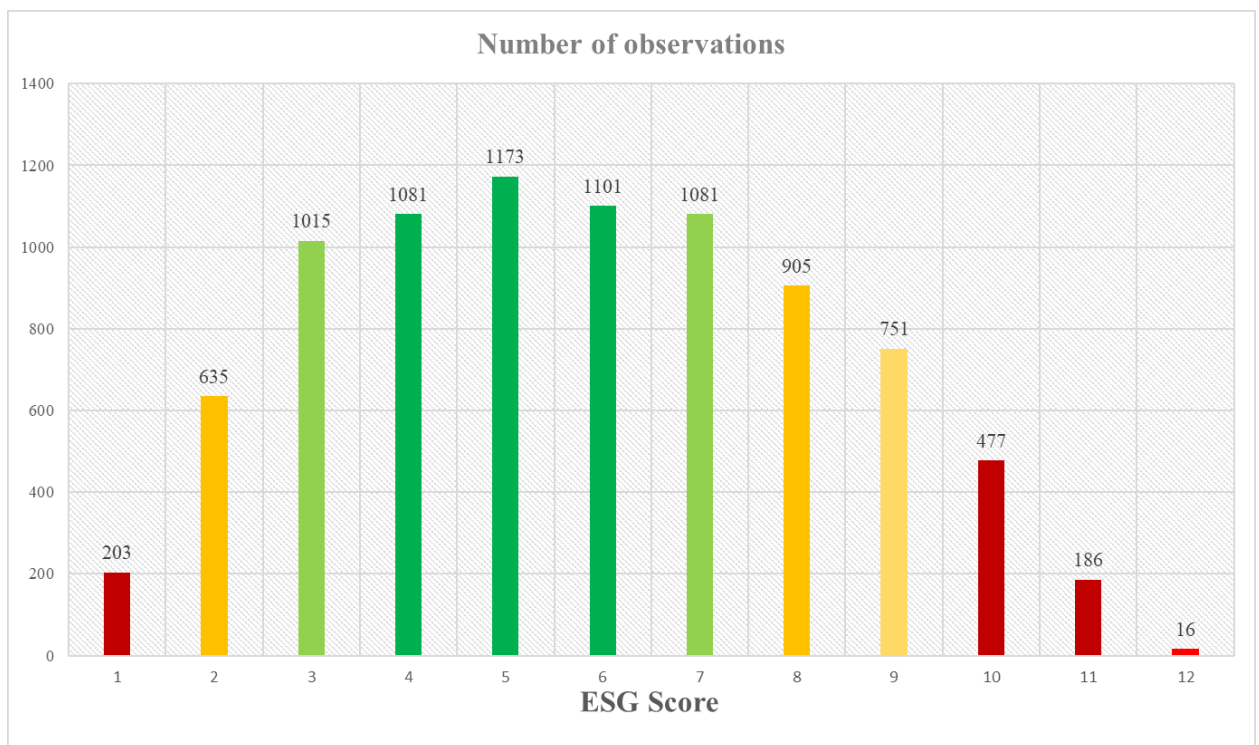
Picture 10, Distribution of the number of observations through the ESG scores

The next step is to determine the additional control variables which should be included in the model to describe and supplement the relationships between the ESG scores and total revenue of a public company. The following variables have been chosen to extend the regression model:

Variable	Significance for the model	Expected sign
Research & Development Expense	Innovational management today is considered to be one of the most crucial sources of profit generation (R. Adams, J. Bessant, R. Phelps, 2006). Thus, the higher amount of resources a company is able to spend for Research and Development purposes, the higher potential returns it will have.	+
Employee Satisfaction Score (ESS)	We suggested that higher rates of ESS are associated with higher levels of productivity and higher motivation through the working process (C. Shan, D. Yongjun Tang, 2022). The ESS is presented in the data frames from Refinitiv Portal. The raw data collected through the multidimensional surveys conducted in public companies	+
Debt - Total	We also suggested that the higher amount of a company's assets are generated through the debt, the lower the amount of real value acquired by a company (M. Nascimento Jucá, A. Fishlow, 2020)	-

```
    Variable |        Obs        Mean    Std. dev.        Min         Max
-------------+----------------------------------------------------------
research_mln |      3,108    307.7703    1642.691   -85.07588       56052
employee_s~s |        900    50.97677    28.74049    .4587156    99.54128
    debt_mln |      9,078    5805.628     59008.4           0     4158191
```

From the table with descriptive statistics of the added variables we can conclude that the Employee Satisfaction Score tends to have a relatively lower number of observations available for analysis. It may be explained by the specificity of the variable which is conducted through the survey. Thus, the ESS as a data variable is harder to obtain and formulate which decreases the number of companies available for measuring. Other added variables have acceptable numbers of observations compared with the original dataset presented by Refinitiv Portal.

In other aspects of descriptive statistics such as mean value, standard deviation and upper and lower bounds does not give sufficient evidence to suggest any other problems.

Variable	Transformation Justification
Research and Development expense, mln USD	There is enough evidence to transform the variable and logarithmic variable in order to

	make the shape of the variable distribution closer to a normal shape.
Employee Satisfaction Score	There is not enough evidence to transform the variable
Total Debt, mln USD	There is enough evidence to transform the variable and logarithmic variable in order to make the shape of the variable distribution closer to a normal shape.

The distribution shapes are presented in the pictures 11-13.

Thus, there are six variables included in the final regression analysis:

```
    name            type    format   label     Variable label

--------------------------------------------------------------------------------

ln_revenue_mln  float   %9.0g               logarithm total revenue, mln USD

esg             byte    %10.0g              ESG score fin

ln_assets       float   %9.0g               logarithm total assets, mln USD

ln_emp          float   %9.0g               logarithm number of employees

ln_research_mln float   %9.0g               logarithm research and development expense,

mln USD

employee_satis  double  %14.2fc             Employee Satisfaction Score

ln_debt_mln     float   %9.0g               logarithm total debt, mln USD
```

In order to confirm the quality of chosen control variables, the new regression model has been constructed. The ESG scores have been included as a categorical variable to estimate the separated dependence of the total revenue from each element of the combined score. The constructed model will also set the interval within which it is available to approve the existing dependency.

```
Breusch–Pagan/Cook-Weisberg test for heteroskedasticity

Assumption: Normal error terms

Variable: Fitted values of ln_revenue_mln

H0: Constant variance

    chi2(1) =   0.62

Prob > chi2 = 0.4296
```

Breusch–Pagan/Cook–Weisberg test for heteroskedasticity did not indicate the problem of heteroscedasticity at 95 % confidence level, which allows not to use the robust options.

	(1)	(2)	(3)
	Logarithm of the total revenue, mln USD	Logarithm of the total revenue, mln USD	Logarithm of the total revenue, mln USD
ESG score fin=1	0	0	
ESG score fin=2	-0.0716	-0.144	0
ESG score fin=3	0.401	0.00190	
ESG score fin=4	0.979***	-0.0511	0.852
ESG score fin=5	1.349***	0.0206	1.056*
ESG score fin=6	1.841***	0.0582	0.869
ESG score fin=7	2.336***	0.0586	1.129*
ESG score fin=8	2.708***	0.0896	1.156*
ESG score fin=9	3.195***	0.0807	1.253*
ESG score fin=10	3.625***	0.0720	1.412**
ESG score fin=11	4.232***	-0.0565	1.154*
ESG score fin=12	5.490***	0.138	1.169*

Logarithm of the total assets, mln USD		0.584***	0.397***
Logarithm of the number of employees		0.485***	0.411***
Logarithm of the research and development expense, mln USD			0.0267
Employee Satisfaction Score			0.000146
Logarithm of the total debt, mln USD			0.115*
			(0.0477)
Constant	5.057***	-1.512***	-1.169*
	(0.208)	(0.121)	(0.582)
Observations	8541	5839	140

Standard errors in parentheses

$^* p < 0.05,$ $^{**} p < 0.01,$ $^{***} p < 0.001$

From the regression model we can conclude that only two performed models are sensitive to the separated levels of ESG score. The first of them is the model excluding the control variables which is not appropriate for the research due to the factors mentioned above: there are other factors

influencing the level of financial performance of a public company which are more significant than the ESG scores (Maverick, J. B., 2022). It means that the most sufficient constructed model is the regression including the factors of R&D expense, ESS and total debt. This model includes statistically significant beta coefficients for the following groups of ESG scores: [5] & [7:12].

Considering the control variables, we received such results to be interpreted:

Variable	Expected sign	Received sign
Research and development expense, mln USD	+	Not significant
Employee Satisfaction Score	+	Not significant
Total debt, mln USD	-	+

Therefore, the final regression model to be estimated is following:

$$\ln(total\_revenue)_i$$
$$= \beta_0 - \beta_1 * ESG\ score_i + \beta_2 * ESG\ score^2_i + \beta_3 * \ln(total\ assets)_i + \beta_4$$
$$* \ln(number\ od\ employees)_i + \beta_5 * \ln(research\ and\ development\ expenses)_i$$
$$+ \beta_6 * Employee\ satisfaction_i + \beta_7 * \ln(debt)_i + \varepsilon_i$$

```
     Source |       SS           df       MS      Number of obs   =        140

-------------+----------------------------------   F(7, 132)       =     228.80

      Model |   357.32407         7  51.0462957   Prob > F        =     0.0000

   Residual |  29.4502349       132   .22310784   R-squared       =     0.9239

-------------+----------------------------------   Adj R-squared   =     0.9198

      Total |   386.774305      139  2.78254895   Root MSE        =     .47234

------------------------------------------------------------------------------

 ln_revenue_mln | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]

----------------+-------------------------------------------------------------

            esg |   .2753057   .1320644     2.08   0.039     .0140692    .5365421

           esg2 |  -.0132966   .0083859    -1.59   0.115    -.0298847    .0032914

       ln_assets |   .4195902   .0771414     5.44   0.000     .2669968    .5721836
```

```
        ln_emp |   .3991296    .0550903     7.25    0.000     .2901556    .5081035

ln_research_mln |   .0222737    .0255333     0.87    0.385    -.0282337    .0727812

 employee_satis |    .000175    .0015152     0.12    0.908    -.0028222    .0031723

    ln_debt_mln |   .1036349    .0462389     2.24    0.027     .0121698       .1951

          _cons |  -1.310124     .574229    -2.28    0.024    -2.446006   -.1742424
```

The observed regression model tends to reject the null hypothesis regarding F-statics and suggest that there is at least one significant beta coefficient. At 95% confidence level we can conclude that the regression model is significant and appropriate for further interpretation. Despite the fact that the regression model no longer supports the parabolic dependence between the ESG scores and the total revenue, we are still able to conduct the test of U-shape dependency. The changed significance levels for the beta coefficients of ESG scores and squared ESG score may be explained by the fact of adding new control variables directly influencing the total revenue earned by a firm.

In order to finalize the overall conclusion about the stated hypothesis, the U-shape test is going to be conducted.

```
        Specification: f(x)=x^2

        Extreme point:  10.35245

        Test:

            H1: Inverse U shape

         vs. H0: Monotone or U shape



            ------------------------------------------------

                        |   Lower bound      Upper bound

            ----------------+----------------------------

            Interval        |          1                12

            Slope           |   .2487124       -.0438138

            t-value         |   2.151641       -.5845818
```

```
P>|t|             |    .016623        .2799134
```

```
----------------------------------------------
```

The test rejected the null hypothesis and approved the existence of U-shape dependency between the dependent proxy variable and an independent variable of interest with the extreme point equal to 10,35 rounded to 10. Also, slope modulus on the interval [5] &[7;10,35245) is higher than slope modulus on the interval (10,35245; 12] where 1 and 12 is lower and upper bounds for ESG score ranking. It implies the sharp increase in total revenue for companies associated with ESG ranks between 5 and 10 (with slope coefficient equal to 0,24) and gradual decrease in total revenue for companies associated with ESG ranks 11 and 12 (with slope coefficient equal to - 0,43).

Discussion

ESG ranking does not support continuous values, thus, the extremum point has to be rounded for further interpretation. Therefore, from the empirical research that has been conducted we have enough sufficient evidence to suggest that

There is a non-linear and reversed U-shape dependency between ESG scores and total revenue within public companies with an extreme point equal to 10 on the scale presented by Refinitiv Group [1;12].

There is no non-linear U-shape dependency between ESG scores and total revenue within public companies.

For the discussion part it is essential to suggest the crucial reasons why the profit margin variable is not significant for the model. First of all, the profit margin or operating profit margin are relative variables indicating the financial performance of a company in comparison with its expenses. This factor makes the interval of the variable be tight enough to make different companies with different levels of financial performance seem indistinguishable. It also causes the problem of misalignment of the definition of the financial performance due to the fact that sufficient increase in returns causes the increase in associated expenses. That is why, from the chosen perspective, profit margins as a dependent variable are not able to reflect the requested level of financial performance.

At the same time, the presented results indicate that the statistically significant level of ESG ranking starts with the middle of the scale. According to the stated hypotheses, companies with low levels of ESG tend to have lower levels of financial performance. In fact, the companies with low level of ESG performance cannot be corresponded with particular financial success. We may suggest that the positive effect of ESG on the financial performance is illustrated for the higher ESG scores due to the fact that there is no sufficient difference between low and very low levels of ESG.

There is a list of limitations which were observed during the empirical part of the thesis paper. It is essential to mention them and provide possible solutions.

Limitation	Explanation	Possible solution
Cross-sectional data	The chosen data format is appropriate to evaluate the situation at the moment and build a predictive model for the near future, but it is not applicable for the long-term perspective. Even though the ESG scores are stable, the financial indicators tend to have high levels of deviation over the long period	To cover a massive layer of financial indicators over a long period of time

Insufficient number of observations for Employee Satisfaction Score	The number of observed companies from Refinitiv Groups for ESS is much lower than the number of companies with available financial data.	To find or generate substitute variable describing the motivation or productivity of workers
Accuracy of U-shape test built in Stata 17	The U-shape test may be recognized as not convincing tool for overall conclusion towards U-shape dependency	To use another software to conduct more reliable tool to evaluate or deny the predicted dependency; examine quasi-experiment regarding the stated hypotheses

Conclusion

This research study was aimed at identifying the relationship pattern between investments in ESG and financial indicators. A non-standard approach was used in this research: the reversed U-shape dependence between companies' ESG scores from Refinitiv ESG data and total revenue as well as profit margin was tested, which had not been conducted within this area before. There were some papers examining mainly external companies' performance related to reputation and stock prices.

Two hypotheses were presented in order to answer our research question and both of them were tested by regression analysis. Our study confirmed the hypothesis about the statistically significant U-shape dependence of total revenue from investments in ESG, and it turned out to be insignificant in terms of dependency between profit margins and ESG scores. So, we could not make an exact conclusion on U-Shape dependency for the profit margins. However, it does not mean that there is no dependency because it might have a different shape, so it is a topic for the potential research scope.

Since our hypothesis about total revenue was confirmed, we decided to include some other factors and categorical variables to expand the research. The results were also obtained in the form of the same inverse U-shape, taking into consideration the amount of total assets, number of total employees, research and development expenses, employee satisfaction scores and total debts. Accounting for these factors made the model more universal and statistically correct.

In addition to the confirmed slope, the research has shown that it would be ideal to stop investing in ESG at the score of 10, since after 10 there is a slight decline. Also, on the lowest levels of Refinitiv ESG rankings (approximately, at the score of 5 and less) the dependency between ESG scores and revenues is insignificant, so we cannot define either an upward or downward trend. Once again it confirms our hypothesis about the U-shape dependency between investments in ESG-related activities and financial indicators.

Our research has shown that investments in development should not always be the largest ones to achieve the best financial results even when it comes to sustainable actions. These results will have a practical potential for financial and operational managers in helping to find an optimal ESG scores level to make out the largest revenues for the companies from different sectors and with various parameters. There will be some trends to look at when making decisions on what sustainable actions to aim at while investing to achieve one or another ESG position.

There are some limitations which can be overcome: cross-sectional format of data, the differences between ESG-rankings, the number of observations for additional factors. Also, the

Refinitiv scores are updated on a weekly basis, so such trends cannot be traced quickly and be guaranteed in long-term perspective.

To expand the research, we would suggest testing the same logic with other ESG ranking systems because it is a well-known fact that methodologies significantly differ. It may happen that other scoring won't show the same U-shape patterns. Also, separate models might be constructed for the different industries. It can be explained by significantly different revenues and profits between some of those (except for the moment, when industry is taken into account in the ranking system). Finally, external company performance can be linked to the internal financial parameters and ESG scores: earnings per share and price - earnings. It is important to do so because originally the concept of ESG developed as an instrument for investors to construct reliable portfolios.

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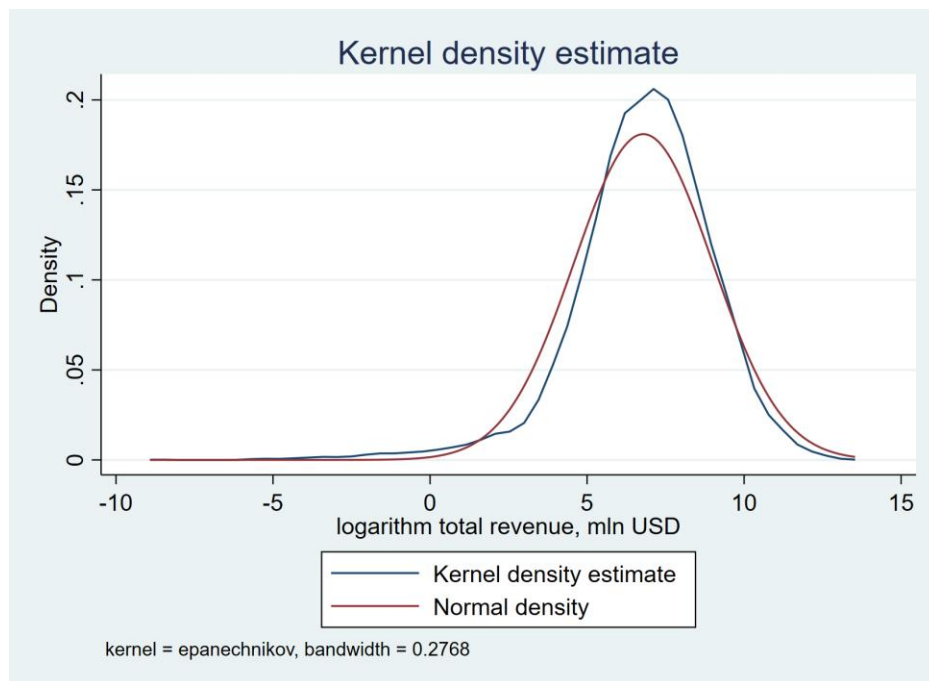
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Appendix

Picture 4. Logarithm of Profit margin

kernel = epanechnikov, bandwidth = 0.1053
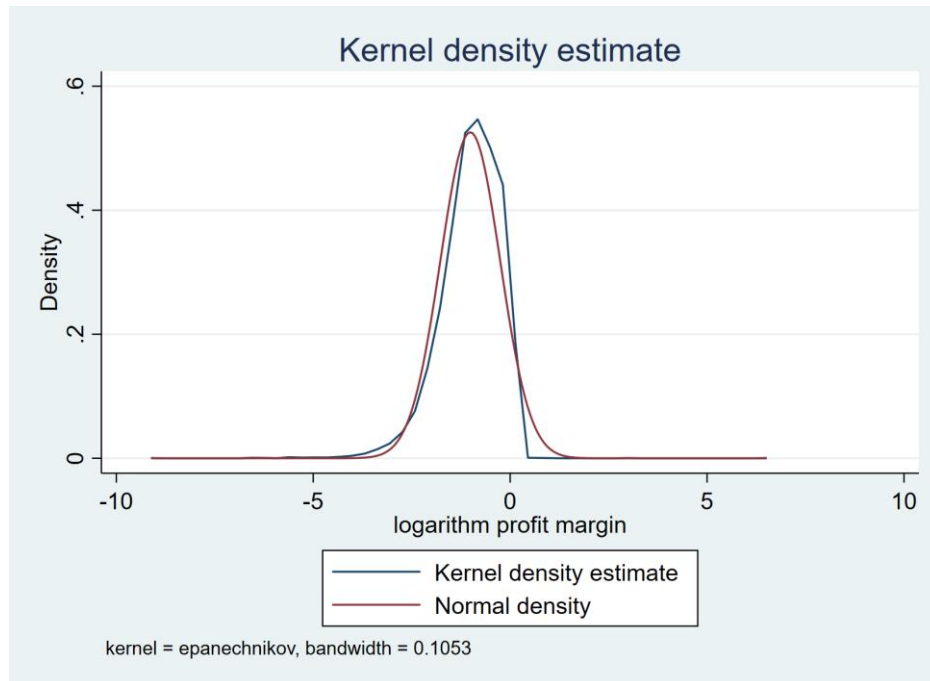
Picture 5. Logarithm of Total revenue, mln USD
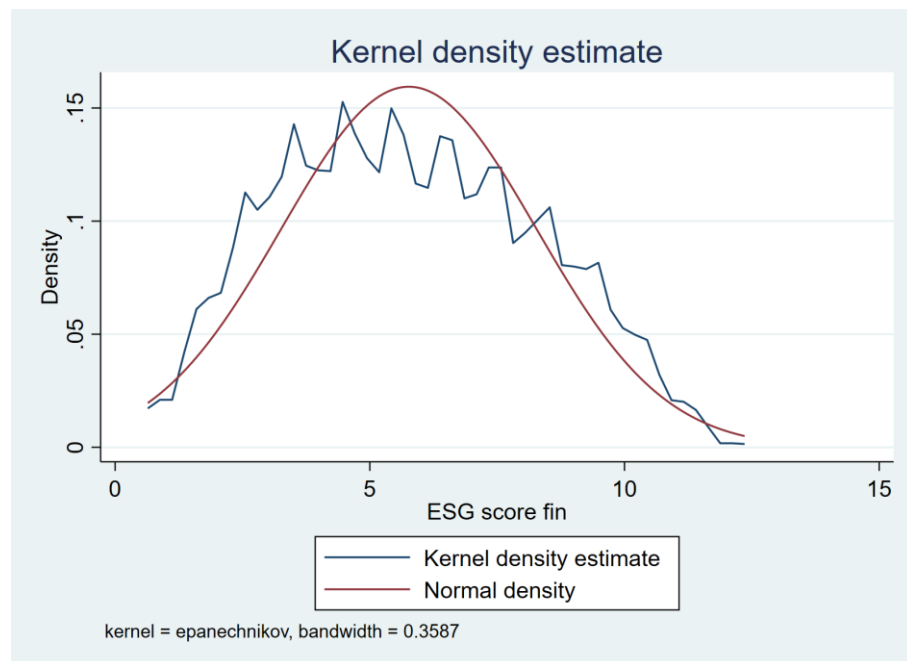
Kernel density estimate

kernel = epanechnikov, bandwidth = 0.3266
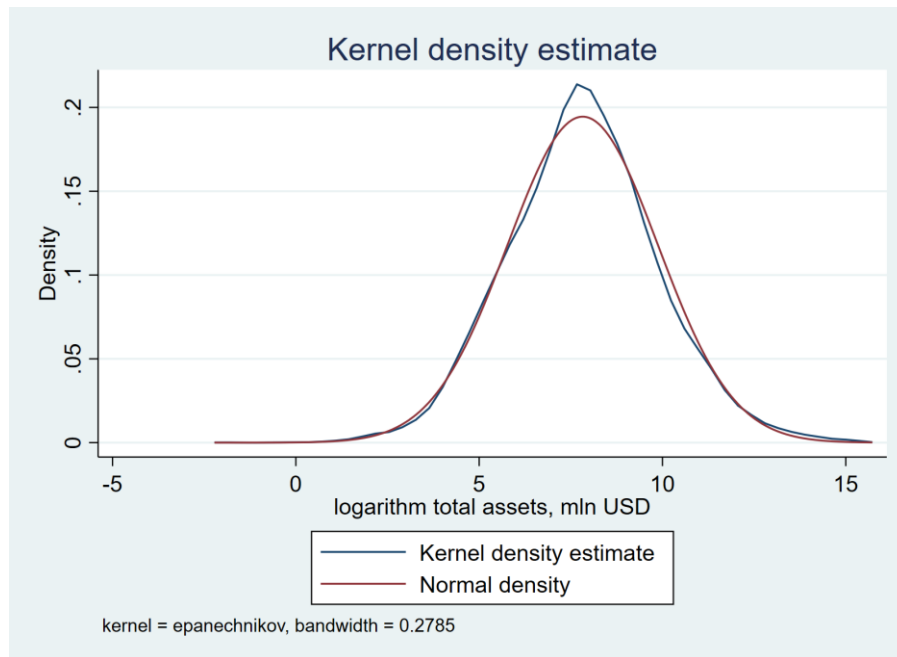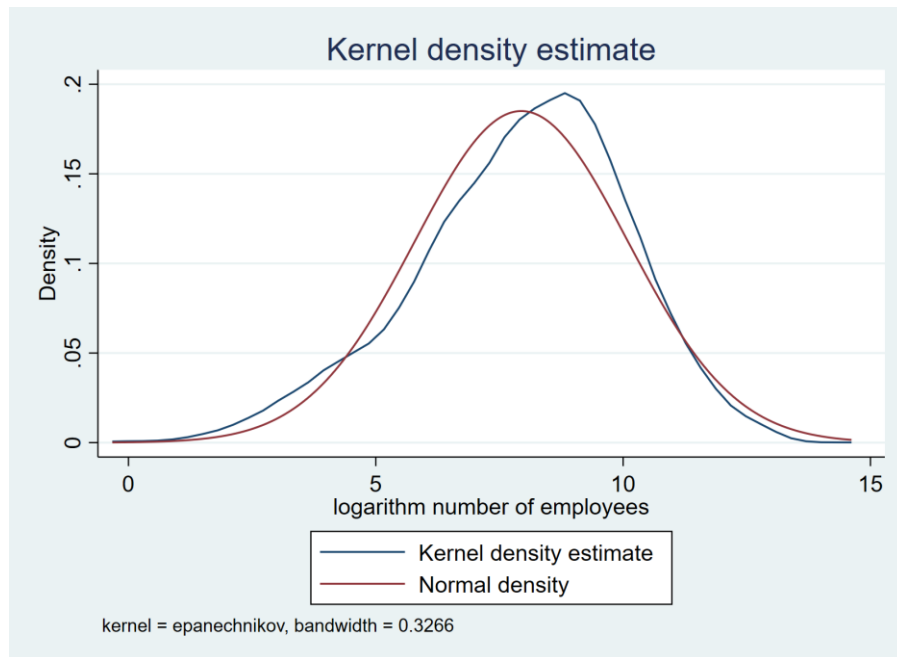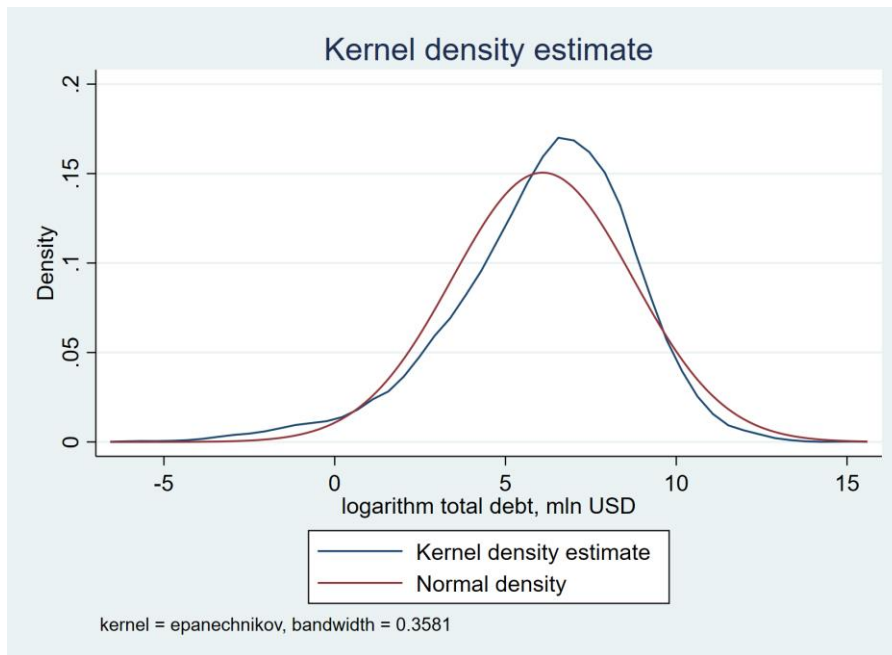
Picture 12. Logarithm of research and development expense, mln USD

Kernel density estimate

kernel = epanechnikov, bandwidth = 0.3142

Kernel density estimate

kernel = epanechnikov, bandwidth = 6.6357