

THE IMPACT OF SUSTAINABLE PERFORMANCE ON CREDIT RISK: THE CASE OF EUROPEAN BANKS

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Preface to “The impact of Sustainable performance on credit risk: the case of European banks”

Among other incumbents, the European banks are evolving in a complex ecosystem, faced with different challenges of both regulatory and market nature. They have to deal with new technologies, competitors, and regulations, and find the right path to sustainable growth. The banks' digital transformation is sometimes causing disruption in the traditional business models, creating though the opportunity to engage in a new path towards sustainable at the long term development, without letting apart the short term performance requirements.

In this context, for the European banks this seems to be the right moment to take advantage of the regulation to be put in place, in order to set the basis of its implementation and be among the leaders that would be fitting it the most rapidly. With our work, we will try to provide arguments and explanation to the need for this orientation to be taken as soon as possible.

For our study, we are thankful to Sana Ben Abdallah, PhD, who has kindly and constantly been supervising the work done, Anke Middelman, Director of the Program of Global Executive MBA in the frame of which this work has been done, as well as Fabien Seraidarian, PhD and Mônica R. de Carvalho, PhD for their brilliant teaching about transformation and sustainable organizations, Bernard Sinclair-Desgagné, PhD, Samentha Goethals and Yoann Guntzburger for having brought us to the world of Ethics, Sustainability and Technology, and all the Professors who have made us discover an amazing worldview with the GEMBA.

Abstract: We study the relationship between financial stability and sustainability in the banking industry. We contribute to the debate about sustainable financial performance and responsibility of the banks in the process of facilitating the transition to a more sustainable economy. Given the wide diversity of risk profiles and sustainability oriented business models and operations, this relationship has to be studied at the level of a specific industry, particularly at the level of the one having an essential role to play in the widespread sustainable practices. We rely on a sample for 2003 – 2022 and use the main risk profile indicators next to the specific for Environmental, Social and Governance scores associated with responsibility indicators to evidence the relationship between them.

As such, more responsible institutions appear to act in a less risky manner, and such responsibility signals banks' health. We also have observed that the Global Financial Crisis profoundly impacted the financial stability – sustainability relationship, perturbing it from 2008 till 2013. This temporary perturbation has not prevented us from finding out the relationship existing between banks' risk taking and sustainability.

Keywords: Environmental, Social and Governance (ESG) performance, Credit risk, Non-performing loans (NPLs), European banks, sustainability

Table of contents

I.	Executive summary	5
II.	List of tables	7
III.	Introduction	8
IV.	Literature review	12
V.	Methodology – econometric model.....	17
VI.	Sample data and variables chosen	18
A.	Sample data.....	18
B.	Variables chosen.....	19
VII.	Descriptive statistics.....	21
VIII.	Results and discussion.....	22
A.	Results presentation.....	22
1.	The relationship between NPLs and ESG score	22
2.	The relationship between NPLs and Environmental pillar score	26
3.	The relationship between NPLs and Social pillar score.....	30
4.	The relationship between NPLs and Governance pillar score.....	34
B.	Discussion of results	38
IX.	Robustness.....	41
A.	Mono-effect test with the Capital Adequacy	41
B.	Multifactorial test with the NPL ratio.....	46
1.	Multifactorial test with GLM application results.....	47
2.	Multifactorial test with GRM application results	48
3.	Analysis of the multifactorial tests results	48
X.	Conclusion and recommendation	49
A.	Summary.....	49
B.	Discussion and recommendantion	50
C.	Limitations and further research.....	51
XI.	Appendixes	53
A.	Appendix 1: EU progress towards the SDGs over the past 5 years, 2022	53
B.	Appendix 2: Year by year NPL/ENV	54
C.	Appendix 3: Year by year NPL/SOC	57
D.	Appendix 4: Year by year NPL/GOV.....	60
E.	Appendix 5: Year by year NPL/ESG.....	63
XII.	References	66

I. Executive summary

ESG score data and analytics is constantly increasing and their quality improving. Gathered in databases like Refinitiv, they are allowing the measurement of these scorings' impact on different stability and performance indicators of the companies that publish them. The publication of such information is led by the corporates, not only by constraint, but also by the fact that a better ESG score is an important lever for improving their reputation.

Following the move undertaken by corporates, more and more companies are publishing their ESG score, and that's what we observe during the selection of the European banks having their ESG score published throughout the 20 years of depth of our selection. Indeed, in the beginning of the period of our panel data, in 2003, we only had 55 banks that published their ESG score, while at the end, in 2022, we have 385. This represents a multiplication by 7 of the number of European banks publishing their ESG score since 20 years.

These figures are rather encouraging for the quantitative analysis to be performed on the depending from the ESG score variables, among which could be found the one usually used for the measurement of banks' financial stability, the Non-Performing Loans (NPL) ratio, to be compared to the one usually used for the banks' soundness measurement Capital Adequacy Ratio (CAR), representing the ability of an organization to stand in case of abnormal losses or in times of crisis.

The investors considering more and more the full integration of ESG factors into the investment process, the stability of the ESG scoring is of increasing importance as well. Frequent changes in score could potentially lead to excessive turnover in investors' portfolios, as well as to less predictable risk exposures and could then be a painpoint for the credit portfolio managers. For instance, the secondary liquidity in the corporate bond market has deteriorated since the Global Financial Crisis (GFC). On the long term, however, apart from the break of the GFC, the ESG score shows the needed stability, thus easing the task for corporate bonds portfolio managers, and this is even more true for the companies with relatively high ESG score (above 80).

The financial stability of a bank could also be assessed thanks to other factors, as the expected default loss, through the measurement of the credit risk by the ratings and spread (the secondary market bond yield spreads over a safe asset). The forecasts for loan losses and non-performing loans are two complementary tools used for the banks' soundness assessment. In the financial

intermediation area, they are part of the informations that the Financial Supervision Authorities are scrutinizing closely.

Although most examinations focus on the impact of ESG on profitability, their impacts on financial stability cannot be underconsidered. In our study, we will focus on the impact of the ESG score on the the European banks' soundness, rather than on their performance indicators.

Despite the limits of the NPL ratio (outsourcing of debt recovery, securitization activities, writing-off of bad loans, transfer to other problem loans categories of the loans in default), it remains however the main available indicator, largely used to help measure the soundness through the credit risk resilience of the banks.

In these times of turmoil for some banks, particularly those not submitted to the strict regulatory constraints of their European equivalents, we can be tempted to search for reliable assets to invest into or deposit holders that we could trust. Deregulation brings, for sure, a better significantly increasing banking competition and efficiency, but in some cases, in the absence of the needed regulation, it's letting incur some imbalanced situations, as for example the missing other than long-term debt to sell-off when a bigger sum of deposits withdrawals suddenly occur, as we have seen in the case of the Silicon Valley Bank. Similarly, given the absence of diversification of a bank's assets and activity, following an aggressive strategy to achieve a short term gain, can also lead to instability, as we witnessed with the Credit Suisse case. From this last case, we've learned that both for banks' stockholders and bondholders, the banks' stability is preferable to be ensured prior to the banks' profitability.

Therefore, the public should welcome any factor that could improve the banks' soundness. That is why we opted to study the potential ESG score impact on the European banks' soundness measured through their NPL ratio, expecting that the more a bank is sustainable in its practice, the better its risk profile would be.

II. List of tables

Table 1: Descriptive statistics	21
Table 2: GRM and GLM results for the NPL to ESG relationship measurement	23
Table 3: Test of the SS vs RSS for identification of the SD of the NPL to ESG relationship	23
Table 4: The Univariate Tests of Significance for NPL (Test).....	24
Table 5: The NPL to ESG beta estimation and the 95% confidence interval.....	24
Table 6: The NPL ratio predicted by ESG score	25
Table 7: Test of SS whole model vs SS residual of the NPL ratio predicted by ESG score.....	25
Table 8: The Univariate Tests of Significance for NPL (Test).....	25
Table 9: The GRM and GLM results for the relationship between NPL and ENV.....	27
Table 10: The test of SS whole model vs SS residual of the NPL ratio	28
Table 11: The Univariate Tests of Significance for NPL (Test).....	28
Table 12: The NPL to ENV beta estimation and the 95% confidence interval	28
Table 13: Test of the SS vs RSS for identification of the SD of the NPL to ENV relationship	29
Table 14: The Univariate Tests of Significance for NPL (Test).....	29
Table 15: The GRM and GLM results for the relationship between NPL and SOC.....	31
Table 16: The test of SS whole model vs SS residual of the NPL ratio	32
Table 17: The Univariate Tests of Significance for NPL (Test).....	32
Table 18: The NPL to SOC beta estimation and the 95% confidence interval.....	33
Table 19: Test of the SS vs RSS for identification of the SD of the NPL to SOC relationship.....	33
Table 20: The Univariate Tests of Significance for NPL (Test).....	33
Table 21: The GRM and GLM results for the relationship between NPL and GOV	35
Table 22: The test of SS whole model vs SS residual of the NPL ratio	36
Table 23: The Univariate Tests of Significance for NPL (Test).....	36
Table 24: The NPL to GOV beta estimation and the 95% confidence interval.....	37
Table 25: Test of the SS vs RSS for identification of the SD of the NPL to GOV relationship	37
Table 26: The Univariate Tests of Significance for NPL (Test).....	37
Table 27: The GRM and GLM results for the relationship between CAR and ESG.....	43
Table 28: The test of SS whole model vs SS residual of the CAR.....	43
Table 29: The Univariate Tests of Significance for CAR (Test).....	44
Table 30: The CAR to ESG beta estimation and the 95% confidence interval.....	44
Table 31: Test of the SS vs RSS for identification of the SD of the CAR to ESG relationship.....	44
Table 32: The Univariate Tests of Significance for CAR (Test).....	45
Table 33: The Univariate Tests of Significance for NPL (Test).....	47
Table 34: The NPL multi variables dependance beta estimation and the 95% confidence interval.....	48

III. Introduction

The banking system, during the last century and still till now, is playing a major role in the real economy financing through its role of financial intermediary redistributing the sources of finance among the different economic agents: households, companies and governments.

These financial institutions create liquidity by transforming relatively illiquid assets, such as loans, into relatively liquid liabilities, such as transaction deposits. In their Assets & Liabilities Management (ALM), they have to pay attention to the duration risk management, among other constraints imposed by the regulation. For example, the IAS39 – IFRS 9 requires the structuring of their assets and liabilities in an equilibrated manner with regards of their categories (cf. IAS 39 – IFRS 9 requiring macro hedging).

However by [Sbracia and Zaghini \(2003\)](#), banks are also transforming liquid liabilities into illiquid assets, thus allowing better risk sharing among agents with different consumption horizons, making them vulnerable to runs or panics.

Indeed, *“the information contained bank failures is very noisy”* and *“a single bankruptcy can easily trigger a contagious bank panic”* through different mechanisms, among which the foreign investment short term assets withdrawals, domestic to foreign currency denominated assets arbitrage causing currency devaluation, capital outflows on foreign reserves and possible currency devaluation, international interbank market presence increasing the fragility of the banking system etc.

“Aside from a few anecdotal episodes, panics have always been only a symptom of weaknesses in the financial system rather than the cause. Although there is not yet universal consensus on the causes of banking crises, in most countries episodes of financial turmoil occurred in the wake of asset-related problems, such as rising shares of non-performing loans”.

According to [Sassen et al. \(2016\)](#) *“environmental performance is generally negatively associated with idiosyncratic risk, whereas total and systematic risk are negatively linked to the environmental performance only in environmentally sensitive industries”*. Combined with good Social and Governance indicators, it could probably lead to better risk management by avoiding the creditor and debtor moral hazards, and lessening exposure to the *“gambling for*

redemption” investment strategy represented by the financing of risky projects in attempt to cover the losses (cf. [Sbracia and Zaghini \(2003\)](#)).

Banks are major players shaping the future of the economic ecosystems, thus endorsing the responsibility of adjusting their strategies to the expectations of the majority of the economic agents wishing a better treatment of people and nature. In the face of rising global temperatures, organizations across industries are under increasing pressure to reduce their emissions. Banks and private capital management funds would be the natural vehicle to take them on the road this way.

Credit risk is a major source of banking risk. A bank's non-performing loans (NPLs) is positively related to its credit risk. If NPLs are not correctly managed, it may induce bank's failure. The NPL ratio, along with other indicators, is an important macro and micro-prudential indicator taken into account by regulators for the overall financial stability evaluation and monitoring. That is why, it is closely observed by the Central Banks. In case of a crisis caused by the credit risk inadequate management, an acceleration of the NPL ratio is observed, both caused by the coupled effect of banks' growing risk aversion and the interest rates increase.

The output gap relates to Credit Risk (CR) by the ability that borrowers' cash inflows are reduced when growth slows or turns negative, making it harder for them to meet the interest and principal of bank loans falling due in exchange, especially in markets that have the potential to decrease the output gap. An increase in NPLs can cause decrease in economic activity due to the disintermediation of banks' lending activity caused by the erosion of the banks' profitability.

In a search for improving performance and risk management, we will explore the possibility that a better banks' ESG score would reduce the NPL ratio reported by the European banks. And if it was the case, then bank managers could benefit from this study to enhance their banks' performance, reduce credit risk, develop their value-based investment strategies, and implement each of their bank's strategy in line with their government's ESG-development agenda.

The disclosure of non-financial information becoming compulsory and often required by stakeholders, the relationship between the quality of the business assets in terms of sustainability and its reliability/seriousness in terms of loans repayments, if it is proven to exist, will be able to be enforced in the coming years for better targeting investments.

The purpose of this research is to find the relationship between the E, S and G components of the sustainability reporting of the financial institutions on one side, and the performance in terms of risk bearing of their lending activities on the other side. By financing the economic agents, banks affect directly the society, the environment and the economy. Therefore, if their lending activity is oriented towards sustainable business financing, we would like to prove that their NPL ratio would be lowering.

Although several studies have been actively analyzing the impact of environmental, social and governmental factors on the sustainability of the financial system, this study focuses on the specific part of risk level measurement through the NPL ratio, important indicator of the financial liquidity and stability in fine. Lending to the real economy is conditioned by sustainable risk management, with a low NPL ratio to be maintained by the banks.

Financial Institutions will be incited to disclose their ESG scoring, if it impacts positively their business activities, the financial stability and lending to the real economy. The ESG impact could therefore be even included among the lending origination guidelines.

Previously, studies primarily focused on a qualitative or quantitative research on:

- the relationship between ESG rating and banks risk taking globally
- the relationship between ESG rating and market based risk measurement
- the macroeconomic determinants influence on banks' NPL ratio
- the ESG rating impact on credit rating
- the relationship between ESG rating and ratio for banks in Asia.

In this paper, we will perform a quantitative research to define ESG score and measure statistically significant factors influencing the level of NPL ratio disclosures of large European banks. The thesis attempts to answer the central question whether receiving better score on ESG rating enhances European banks' risk profile.

Our aim will be to find out a relationship between European (from developed and emerging countries) banks' non-performing loans ratio and their ESG score, and specifically for each of its components E (environmental), S (social) and G (governance).

The European countries have been put on the forefront of the movement towards meeting sustainable goals, starting with the European Union (EU)'s sustainable finance action plan

initiated in 2018, with the aim to incentivize environmental, socially and governance transparent investments through better disclosure of such indicators. This initiative generated the Sustainable Finance Disclosure Regulation (SFDR) applicable to financial markets participants. This was the first cornerstone of the EU's ambition to drive capital toward companies that meet sustainable goals.

Further on, there has been a Green taxonomy definition, along with the Corporate Sustainability Reporting Directive publication, in December 2022 that led to the concretization of the clear European strategy orientation towards financing a more sustainable economy, which reflects the wishes of the major part of its citizens.

These European regulations, along with the regular follow up by Eurostat of the resulting SDG indicator review (cf. [Appendix 1](#)) constitute the framework for going forward with transition to a more sustainable economy at least in Europe. The remaining world regions are less prolific in regulation, but some of them could move forward more rapidly.

In the UK, the UK Sustainability Disclosure Requirements (SDR) are completing the measures taken by the EU. Both the SFDR and their equivalent in UK SDR are applicable to Asset Managers. Completed by the Taxonomy Regulation, they tend to prevent from intending “greenwashing” to these economic agents.

This way Europe stands out of the world regions in terms of ambition and decisiveness to enforce sustainability goals driven development and therefore appears to be the best choice for our analysis of the potential effect of its ESG oriented strategy to improve its financial system's stability.

We will be searching for an effect of the ESG score and each of its components on the loan portfolio quality of the banks measured through their annual NPL ratio. This indicator is an aggregate measurement of the stock of risk variables reported in the annual statements, without considering the outsourcing of debt recovery, any securitization activities, or writing-off of bad loans, or transfer to other problem loans categories of the loans in default.

Indeed, the research could be further improved by integrating all these normally marginal activities, but being able to false the measurement of the loan portfolio quality of the banks.

Also, other variables than the ESG score can certainly explain the NPL ratio evolution, and we are not considering them in this study, and they could be subject to further examination.

IV. Literature review

A huge amount of literature is already available about the different economic sustainability orientation and measurement, through their environmental, social and governance performance indicators.

The ESG performance of the banking system is even more important because it is responsible for the economy's financial irrigation through their investments and loans. It has been gaining momentum these last years, following an increasing public demand for ESG disclosures.

Several regulations encourage and require such reporting, including the new European Union setup regulation, the non-financial reporting directive (NFRD), followed by the EU Taxonomy for sustainable activities and the Sustainable Finance Disclosure Regulation (SFDR).

The results obtained by [Toth et al. \(2021\)](#) on a bench of 243 banks from the European Union (EU) and The European Free Trade Association (EFTA) member countries, have already shown that the ESG performance has beneficial impact on financial stability through its contribution to lowering significantly the NPL ratio. This study also highlights the importance of finance for channeling capital towards environment friendly investments.

Banks could have a multiplier role since they can enforce ESG aspects in their pricing, lending and investment policies and strategies with a positive effect according to [Elekes \(2018\)](#).

More largely, [Sassen et al. \(2016\)](#) have also evidenced the negative effect of Corporate Social Responsibility, measured through ESG scores, on total and idiosyncratic risk, including NPL, with a strong influence, in particular, of the E (environmental) and S (social) dimensions.

[Paltrinieri et al. \(2021\)](#), in their study led on 224 banks from 16 countries cross-regions, on the period from 2014 to 2017, have evaluated each of the ESG dimensions for their individual and combined impact on several bank performance and risk indicators, among which the ratio of loan loss provisions on non-performing loans (LLP/NPL).

Their results are showing a global positive relationship of the aggregated ESG score with the following IFDI (Islamic Finance Development Indicator) components: quantitative development indicator, knowledge indicator, awareness indicator, CSR (Corporate Social Responsibility), governance indicator, and bank-specific variables (size, equity over total assets ratio, the loan over deposit ratio, the cost-income ratio, the ratio between loan loss provisions and non-performing loans).

In particular, the relationship between the social pillar of the ESG score and the LLP/NPL ratio is strongly negative as per this study results. Even though nonlinear, the significance of the impact of the company size has been evidenced, since larger companies could “*increase their (perceived or actual) distance from their reference community*”, “*exhibit larger public involvement in workforce controversies*”, “*incur more difficulties in maintaining an effective management of a more complex corporate structure*”. According to this research results, environmental and governance scores do not seem to be related to the IFDI, neither for small nor for large financial institutions.

According to the results of another study performed by [Woei et al. \(2022\)](#) on Malaysian firms on the period from 2005 to 2018, large firms and firms with stronger corporate governance (board independence and female directorship) tend to improve their ESG performance over time, and the ESG rating (ex: FTSE4Good Index pertaining) is inciting them to continue improving.

According to both the [Bhojraj & Sengupta \(2003\)](#) and [Ashbaugh et al. \(2006\)](#), a positive correlation exists between corporate governance and a company’s credit rating and the related default risk and credit worthiness, because of the:

- transparency of disclosures by the firms’ management
- independent board structure and mitigation of agency cost
- board expertise
- existence of anti-takeover measures

They therefore conclude that ESG criteria can be used to improve predictive validity of the credit rating process.

These results are confirmed by another study, performed by [Attig et al. \(2013\)](#), revealing also that community relations, diversity, employee satisfaction and environmental performance matter for a company's creditworthiness.

According to the studies performed later on, by [Desclée et al. \(2016\)](#) and [Srivisal et al. \(2021\)](#), examining the effect of the ESG score pillars on credit rating, a positive correlation exist most of all with the environmental pillar ([Desclée et al. \(2016\)](#)), then with the governance one ([Srivisal et al. \(2021\)](#)). Indeed, companies with a better credit rating and a stronger balance sheet are better placed to comply with environmental constraints than those with lower credit quality.

A positive relationship with the social pillar is less obvious, since it is not evidenced by [Desclée et al. \(2016\)](#), and even contradicted by the [Srivisal et al. \(2021\)](#) study findings. According to [Fabozzi et al. \(2021\)](#), theoretically, same way as the previously mentioned research papers, we expect the CSR initiatives to have a mixed impact on credit ratings through two opposing perspectives, the risk mitigation (value enhancing) and agency perspective (misallocation of resources with managers overinvesting in CSR for private benefits instead of maximization of shareholder wealth).

Their results confirm this mixed impact expectation: *“The effect of the overall ESG score on credit ratings is positive and statistically significant at the 1% level, which is consistent with most previous studies. The evidence suggests that firms with higher overall ESG scores enjoy better credit ratings. The estimation results also show that the individual E, S and G scores are positively correlated with credit ratings, supporting the risk mitigation view (positive association between CSR activities and credit ratings) over the agency view (negative relationship between CSR activities and credit ratings).”*

The same way as the previous researches also, the overwhelming effect of the Environmental and Governance pillars, compared to the insignificant one of the Social pillar score are evidenced: *“the overall ESG scores as well as the E and G scores are positively correlated with credit ratings, but the effects of the S scores on credit ratings are not statistically significant after taking into account industry and year effects. The positive correlation found between the individual E and G scores and credit ratings in this study survives this robustness check and*

suggests that heightened efforts on environment and governance issues would have a statistically significant impact on credit ratings”.

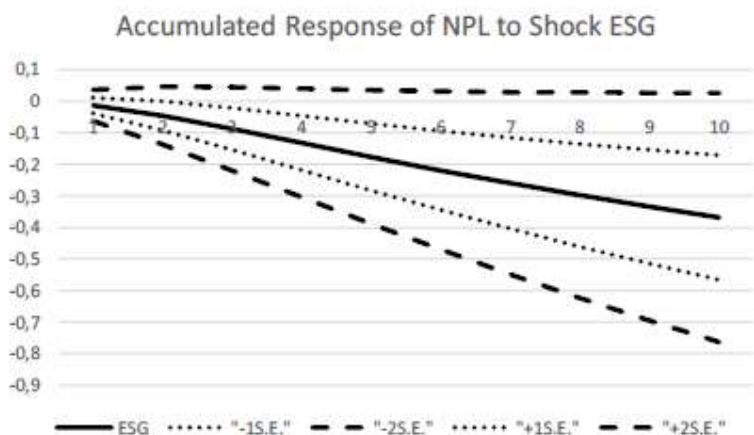
The [Mobius and Ali \(2021\)](#) study, however, is showing, that the ESG rating could have provided unfair assessment for some companies performing well without necessarily reporting it and vice versa: the cases of Sunny Optical and Yes Bank are illustrating respectively the 1st and 2nd cases. It highlights the importance of purpose led operations, to which the reporting should adapt to trace, as accurately and transparently as possible, what is really happening in the Corporate.

As per [Toth et al. \(2021\)](#) study results, banks with high ESG-scores contributed to low NPL levels, in the long run.

In its repartition, however the E-ESG index had no significant influence, and the S-ESG component had even a positive connection at the medium run.

The most significant of the impulse response functions from the entire ESG-score contributing to low NPL levels has been the G-ESG component.

They conclude that the importance of ESG information in banking operations is unquestionable, and that it can improve bank’s image, operations, and profitability through multiple channels.



Source: [Toth et al. \(2021\)](#)

This negative relationship between the overall ESG scoring and the NPL ratio of banks is comforted by the findings of [Ersoy et al. \(2022\)](#), with a -0.006 ESG to NPL ratio correlation found and statistically validated by the associated p-value lower than 0.10.

The study of [Izcan and Bektas \(2022\)](#) focuses on the relationship between ESG and the idiosyncratic risk banks take. It is proving that this relationship is negative. Indeed, according to this study results, there is a clear negative relationship between the environmental responsibility of banks, particularly the increase of stakeholders' environmental awareness and the level of risk taken by environmentally responsible companies.

Since the actions of institutions would have to align with the expectations of the whole society, according to the stakeholders theory, environmental engagement enhances the reputation of banks and legitimizes banks' actions by improving their social images. Therefore, ESG is considered even as a risk management tool and ESG communication becomes even more important as the risk mitigation effect increases with the bank's riskiness.

In our study, we will rather focus on the accounting-based risk measure, expressed by the Non-Performing Loans Ratio, which represents a macroprudential indicator directly related to the financial stability. Therefore the relationship between NPL and the ESG score, with each of its components, the Environmental, Social and Governance pillars, will be the subject of our empirical analysis. Based on the existing literature, in the frame of the present study, we will consider the following hypothesis:

H1: ESG score affects negatively and significantly the banks' NPL ratio

H1a: ESG score affects positively and significantly the banks' NPL ratio

H2: The Environmental pillar of the ESG score affects negatively and significantly the banks' NPL ratio

H2a: The Environmental pillar of the ESG score affects positively and significantly the banks' NPL ratio

H3: The Social pillar of the ESG score affects negatively and significantly the banks' NPL ratio

H3a: The Social pillar of the ESG score affects positively and significantly the banks' NPL ratio

H4: The Governance pillar of the ESG score affects negatively and significantly the banks' NPL ratio

H4a: The Governance pillar of the ESG score affects positively and significantly the banks' NPL ratio

Globally, we expect an inverse relationship: a high ESG score (ESG) leads to a low NPL ratio (NPL), as well as for each of the ESG score pillars, the Environmental (ENV), the Social (SOC) and the Governance (GOV) one, their high value should be leading to a low NPL ratio.

Indeed, the previous studies have suggested such a relationship for the main ESG score as well as for its components related to the NPL level.

V. Methodology – econometric model

Panel regressive methods will be applied to analyze a sample of 74 stock exchanged listed European lending institutions. The results of this study will show if there is a relationship between the NPL ratio and the ESG performance of those banks, in which sense (positive or negative) for each of the ESG components and at what point (strong or weak dependence).

We will use the linear statistical model Linear Mixed Model (LMM) and the General Regression Model (GRM) to analyze this relationship.

The linear statistical models are the eldest, the most widely used and mathematically simplest sort of statistical models. They serve as a first course in serious data analysis, as an introduction to statistical modeling and prediction. In such a model, we can assume that a binary variable y , which we believe to be determined by some threshold rules, is based on independent variables x_1, \dots, x_j . General Linear Regression is a generalized form of linear regression, which is also more flexible. It can be used when the output variables (y in our case) have not to be normal, continuous or unbounded.

The General (linear) Regression Models, on their part, are a subset of the General Linear Models, mainly used models for econometric analysis, to find the relationship between an individual, assumed independent variable and an output variable, which is very comfortable for the flows-like relationships that we often find in economy. With such a model, we can find

univariate or multivariate regression with one or several independent variables. The assumptions taken with this kind of methodology are often too strong, but they can also be quite flexible.

Both General Linear Models and General Regression Models have been used to test our assumptions, which express a loan portfolio quality of a bank by means of dependent variable identified in terms of Non-Performing Loans Ratio.

The NPL Ratio score defined in a relationship with the ESG score and its dimensions can be expressed mathematically in the following way:

$$Y = \beta_0 + \beta_1 X$$

With:

Y: NPL

X: a vector of ESG, E, S, and G scores

VI. Sample data and variables chosen

A. Sample data

In our study, we focus on the NPL as dependent on the ESG score and its components (Environmental, Social and Governance Pillars).

Among the 1076 banks incorporated in Europe available, the sample employed in this analysis comprises 74 banks for which relevant data have been found for more than 15 years of depth. These banks selection is based on both the availability of their ESG score and NPL ratio in the Refinitiv database during the last 20 years.

Based on the amount of loans granted to customers by the banks incorporated in Europe, the sample represents 91,6 % in 2003 85,5 % in 2022 of those having data available in Refinitiv. It is an open sample, regarding the delisting and M&A realized in the study's timeframe.

The data of the ESG score in percentage, and separately its E (environmental), S (social) and G (governance) components in percentage are pulled from the Refinitiv database for all the 74 banks in the scope, on the period of the last 20 years, from 2003 to 2022. The data of the NPL ratio for all the banks in the scope are also pulled from the same database.

B. Variables chosen

We have chosen the Non-Performing and Impaired Loans (NPL) percentage of Total Gross Loans as the dependent variable.

As per the control variables, we have opted for the Long Term Debt ratio (LTD) of the banks, the Gross Domestic Product growth percentage (GDP) and the Inflation percentage (INF) of the countries with which these banks are incorporated.

To go further, we also tested the effect of sustainability on banking stability measured by the Capital Adequacy Ratio (CAR).

Our sample data have been pulled directly from the Refinitiv database:

- NPL: Loans - Non-Performant, Impair Pct of Total Gross Loans In the last 20 FY

NPLs are the loans that remain unpaid. A loan is considered as NPL if it does not generate interest and the principal amount for a minimum of 90 days. Loans become NPLs if the full principal amount and interest payment is not done on the due date and is no longer expected in future dates. In our study, the NPLs were measured as the ratio of NPLs to total loans.

- ESG: ESG Score in the last 20 FY

This is a score between 0 and 100, resulting from the ESG grades converted into a Boolean numeric value by following a translation grid. The resulting ESG score is expressed in percentage and reflects the categories of the 3 pillars, Environmental, Social and Governance, weighted by a dedicated to each category weight method.

- SOC: Social Pillar Score in the last 20 FY

A score between 0 and 100, representing the relative sum of category weights expressed in percentage for the categories Community, Human rights, Product responsibility and Workforce.

- GOV: Governance Pillar Score in the last 20 FY

A score between 0 and 100, representing the relative sum of category weights expressed in percentage for the categories Shareholders, CSR strategy and Management.

- ENV: Environmental Pillar Score in the last 20 FY

A score between 0 and 100, representing the relative sum of category weights expressed in percentage for the categories Emissions, Resource use and Innovation.

- CAR: Capital Adequacy - Total (%) in the last 20 FY

The capital adequacy ratio is measuring the funds available to banks, preventing them from the risk of failure, with Tier 1, 2 and 3 used to measure the total ratio. For our research purpose, we use it expressed in percentage.

- LTD: Long Term Debt Percentage of Total Assets in the last 20 FY

This ratio represents the portion of assets financed by long term debt. It is providing the measure of the long term financial position and therefore can be used for potential solvency risk assessment in relative terms.

Control variables were collected from the Word Bank database:

- INF: Headline Consumer Price Inflation Annual average inflation rate

The inflation rate is used for measurement of consumer prices annual growth rate, constructed as an average weighted of a large number of elementary aggregated indices, based on a sample of prices for a defined set of goods and services obtained in, or by residents of the considered country.

- GDP growth: annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2015 prices, expressed in U.S. dollars.

GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

Then the excentric values have been compared to the results reported in the concerned banks' balance sheets (Company Fundamentals - Balance Sheet) and, for some of them, have been cleaned from the sample since their foundation has not been found in the related balance sheet.

VII. Descriptive statistics

The descriptive statistics of the overall ESG score and the individual sub-scores are presented in table 1 below.

TABLE 1: DESCRIPTIVE STATISTICS

Variable	Min.	Mean	Max.	SD
SOC	2.43	58.34	97.67	22.11
ENV	0.99	63.36	99.00	26.71
GOV	1.88	58.10	97.00	23.14
ESG	3.70	57.15	95.43	20.43
NPL	0.05	6.22	64.07	9.53
CAR	0.02	16.31	55.8	4.81
LTD	0.00	0.24	25.41	1.57
GDP	-11.33	1.71	24.37	3.61
INF	-4.48	2.18	24.37	2.47

We produced descriptive statistics for our original model with all initially chosen variables as an initial step in our analysis. This was to gain understanding of our model and its variables. In our analysis we use a sample of 74 incorporated in Europe Financial Institutions, whose ESG disclosure scores were available in the Refinitive database.

The data were fetched from FY2003 to FY2022. We can see that the minimum ESG Score is 4 and the highest is 95, representing a wide spread between the lowest and highest scoring companies. The mean ESG Score is 57, with the means of its components above it: 63 for the environmental and social pillars and 58 for the governance pillar.

We can also see that the maximum NPL ratio is of 64. Therefore, our model shares many characteristics with the model used by [Toth et al. \(2021\)](#). However, our descriptive values are a bit different, this could possibly be explained by the differences in the scale and time differences.

The standard deviation (SD) of all variables is low. This suggests that our sample is homogeneous.

VIII. Results and discussion

A. Results presentation

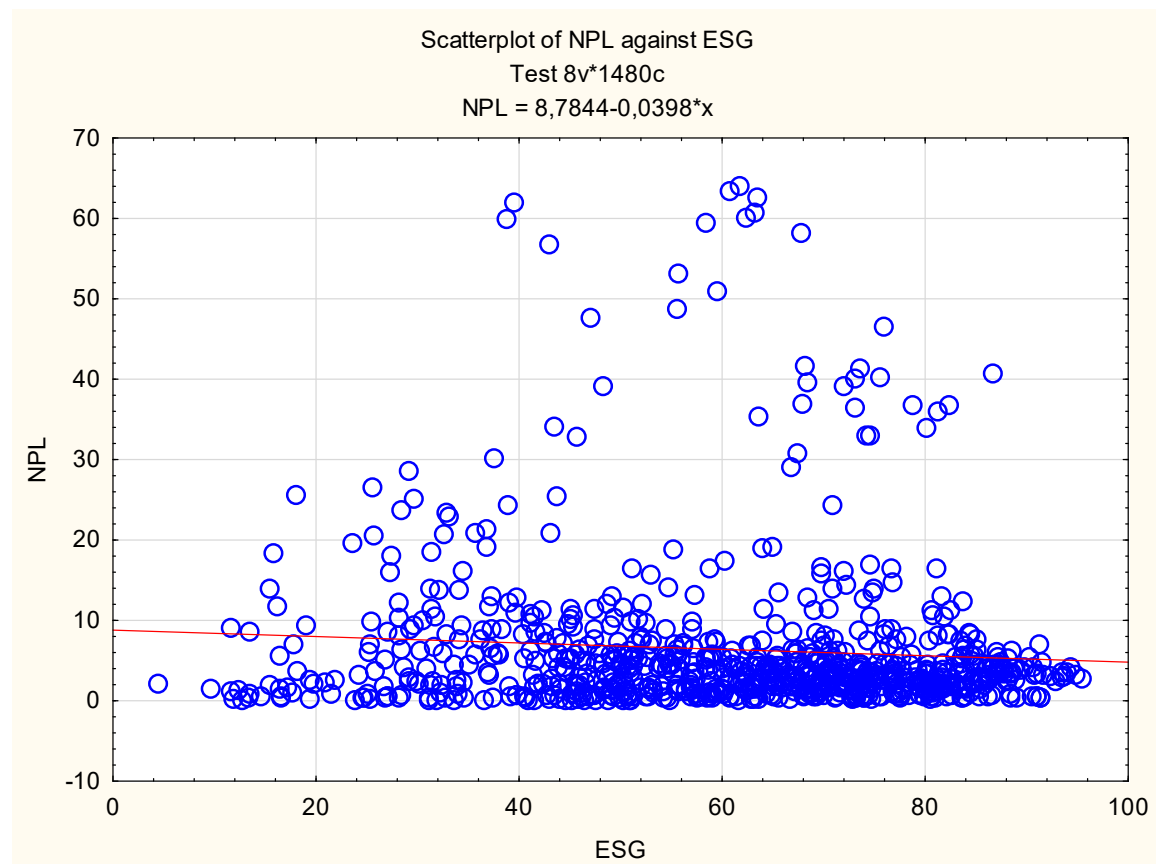
1. The relationship between NPLs and ESG score

The NPL Ratio score defined in a relationship with the ESG score can be expressed mathematically in the following way:

$$\text{NPL} = \beta_0 + \beta_1 \text{ESG}$$

with $\beta_1 = -0.03976647863$

It is illustrated by the data repartition observed on the following scatterplot, visually showing the relationship between the pair of continuous variables represented by the ESG score and the NPL Ratio. This graphical representation of the NPL/ESG relationship highlights a linear negative direction, with a fitting regression model, which results are presented later on.



The General Regression Model (GRM) and the General Linear Model (GLM) are producing both the same results as follows:

TABLE 2: GRM AND GLM RESULTS FOR THE NPL TO ESG RELATIONSHIP MEASUREMENT

Effect	Parameter Estimates (Test) / Sigma-restricted parametrization									
	NPL Param.	NPL Std.Err	NPL t	NPL p	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt	NPL Beta (β)	NPL St.Err.β	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt
Intercept	8.784	1.124	7.812	0.000	6.577	10.992				
ESG	-0.0398	0.0177	-2.253	0.0245	-0.0744	-0.00512	-0.0786	0.0349	-0.147	-0.0101

The coefficient of -0.03976647863 is the coefficient of regression that we made figure in the formula above. The results of our tests are accompanied by a standard error of 0.018, which is a low one and the p-value of 0.025 (well below the 0.05), which is validating the statistical significance of the results obtained against the observed data for our variables. These results validate our hypothesis, and the relatively high (in absolute terms) t-value validates the difference between the sample values tested for our two variables.

The following tests results are associated to this estimation.

The test of the Sum of Squares (SS) whole model versus the Residual Sum of Squares (RSS) dedicated to the difference in standard deviation description of the NPL ratio predicted by the ESG score produces the following results:

TABLE 3: TEST OF THE SS VS RSS FOR IDENTIFICATION OF THE SD OF THE NPL TO ESG RELATIONSHIP

Dependent Variable	Multiple R	Multiple R ²	Adjusted R ²	SS Model	df	MS Model	SS Resid.	df Resid.	MS Resid.	F	p
NPL	0.0786	0.00617	0.00496	482.301	1	482.30	77644	817	95.036	5.075	0.0245

The coefficient of determination R^2 of 0.006 (between 0 and 1) is showing that the model at least partially predicts the outcome. The Residual mean squares (MS) level, obtained by dividing the sum of squares (SS) by the degree of freedom (df) makes however appear an important difference between the observations and the predicted by the model values.

Finally, the F-value overall significance of 5.07 allowing the comparison of our model to a model without an independent variable is showing that our model is fitting data better than an intercept-only model (a model with no independent variable).

TABLE 4: THE UNIVARIATE TESTS OF SIGNIFICANCE FOR NPL (TEST)

Effect	Sigma-restricted parameterization Effective hypothesis decomposition; Std. Error of Estimate: 9.7486				
	SS	Degr. of Freedom	MS	F	p
Intercept	5799.92	1	5799.918	61.02894	0.000000
ESG	482.30	1	482.301	5.07496	0.024538
Error	77644.03	817	95.036		

The univariate significance test shows that the relationship between the NPL ratio and the ESG score is direct and significant, with a p-value of 0.025. This result is consistent with our previous results, which showed the same relationship.

The Linear Mixed Model (LMM) is confirming the negative relationship already evidenced by the GRM and GLM, with the following results produced:

TABLE 5: THE NPL TO ESG BETA ESTIMATION AND THE 95% CONFIDENCE INTERVAL

Effect	Test of SS Whole Model vs. SS Residual (Test)									
	NPL Param	NPL Std.Err	NPL t	NPL p	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt	NPL Beta (β)	NPL St.Err.β	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt
Intercept	3.656	2.479	1.475	0.141	-1.21	8.522				
ESG	0.171	0.0926	1.848	0.065	-0.0106	0.353	0.338	0.183	-0.0211	0.697
ESG^2	-0.00189	0.000815	-2.319	0.0206	-0.00349	-0.000291	-0.424	0.183	-0.783	-0.0652

Looking at the summary of the linear regression fit, we conclude that the slope is significantly different from zero, i.e. there is a statistically significant increasing negative relationship between NPL and ESG. The LMM allows random slopes and intercepts, which effects seem fairly similar to the ones obtained with the General Regression Model above.

The relationship between the NPL ratio and the ESG score is therefore confirmed to be significant and negative by the LMM model, with a resulting coefficient of -0.00189 and a p-value of 0.02, testifying of these results' significance.

The Random Effects statistics allow the control and adjustment for non-independence between samples, if it occurs. Further, comparing errors between Fixed and Random effects models, we

can see that the Residual error increased for the Random effects model, meaning that we captured more variation in the response variable with the Fixed effects model. GRM, with the Fixed effects simply fits the data better than the LMM with its Random effects.

The following tests results are associated to this estimation:

TABLE 6: THE NPL RATIO PREDICTED BY ESG SCORE

Effect	Parameter Estimates (Test) / Sigma-restricted parametrization					
	NPL Param.	NPL Std.Err	NPL t	NPL p	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt
Intercept	8.784387	1.124459	7.81210	0.000000	6.57721829	10.99156
ESG	-0.039766	0.017652	-2.25277	0.024538	-0.074416	-0.00512

TABLE 7: TEST OF SS WHOLE MODEL VS SS RESIDUAL OF THE NPL RATIO PREDICTED BY ESG SCORE

Dependent Variable	Multiple R	Multiple R ²	Adjusted R ²	SS Model	df	MS Model	SS Resid.	df Resid.	MS Resid.	F	p
NPL	0.113	0.0127	0.0103	990.858	2	495.43	495.43	77135	816	94.529	5.241

With the LMM, we get a coefficient of determination even higher than the one we had got with the GRM – this time it is of 0.01 which transcripts a small, but better than the previous effect size interpretation for the NPL ratio to the ESG score relationship. This model appears therefore to be better fitting our data.

TABLE 8: THE UNIVARIATE TESTS OF SIGNIFICANCE FOR NPL (TEST)

Effect	Sigma-restricted parameterization Type III decomposition; Std. Error of Estimate: 9.7226				
	SS	Degr. of Freedom	MS	F	p
Intercept	205.598	1	205.598	2.175	0.141
ESG	322.696	1	322.696	3.414	0.0650
ESG ²	508.557	1	508.557	5.380	0.0206
Error	77135.476	816	94.529		

The p-value (of 0.02, well below the limit of 0.05) and the F-value (of 5.38) are validating statistically our observations with this model as well.

We could conclude that the relationship between the NPL Ratio and the ESG Score of the European banks is linear and significantly negative by nature. These results confirm our first hypothesis.

The scatterplots generated year by year (cf. [Appendix 5](#)), make appear a positive relationship for the years 2003, 2005 and 2006, which is rather due to the scarce data available and not yet adjusted Environmental scoring for the first years of the sample.

Then from 2008 to 2010 we also have a strongly positive relationship, certainly highly impacted by the Global Financial Crisis (GFC). The impact of the GFC is also mentioned by [Hada et al. \(2020\)](#). They observed that from 2008 on and till 2015, “*the NPL levels have risen significantly*”, because of the exogenous to the ESG performance impact of the GFC.

The same, negative, relationship has been evidenced as well by other studies as the one performed by [Toth et al. \(2021\)](#) on the Contribution of ESG information to the Financial stability of European banks, with the following results: “*During the study of aggregated impulse response functions our finding has been confirmed, according to which the ESG effect is negative, significant and long-term.*”

Similar results are also obtained by the Research performed by [Di Tommaso and Thornton \(2020\)](#), stating that “*The impact of ESG on risk-taking is negative and statistically significant for each measure of bank risk after controlling for executive board characteristics and balance sheet variables, which broadly supports the stakeholder view of ESG and an ESG-based approach to bank governance in order to reduce risk-taking.*”

2. The relationship between NPLs and Environmental pillar score

Our second hypothesis is confirmed partially by the also negative is also evidenced by our results for the NPL to the Environmental Pillar (ENV) of the ESG score of the European banks, even though less pronounced than the one between the NPL Ratio and the ESG score.

The NPL Ratio defined in a relationship with the Environmental Pillar of the ESG score can be expressed mathematically in the following way:

$$\text{NPL} = \beta_2 + \beta_3 \text{ ENV}$$

$$\text{With } \beta_3 = -0.003760486158$$

Hereafter is presented graphically the data repartition, with the resulting negative, but not significant relationship:

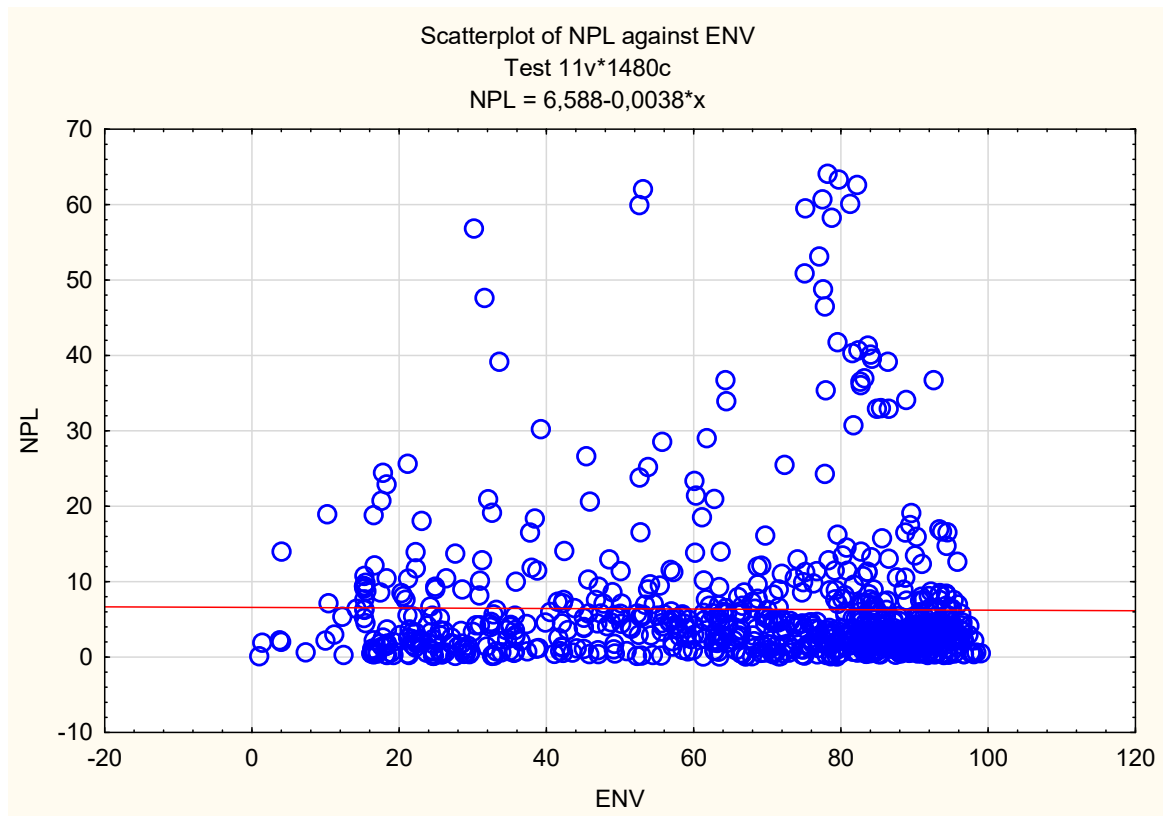


TABLE 9: THE GRM AND GLM RESULTS FOR THE RELATIONSHIP BETWEEN NPL AND ENV

Effect	Parameter Estimates (Test) / Sigma-restricted parametrization									
	NPL Param.	NPL Std.Err	NPL t	NPL p	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt	NPL Beta (β)	NPL St.Err.β	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt
Intercept	6.588	0.963	6.844	0.00000	4.698	8.478				
ENV	-0.00376	0.0134	-0.281	0.779	-0.03	0.0225	-0.00985	0.0350	-0.0786	0.0589

The coefficient of -0.003760486158 is the coefficient of regression that we made figure in the formula above. In the results of our tests, it is accompanied by a standard error of 0.013, which is well low, but the p-value of 0.78, the statistical significance of the results obtained against the observed data for our variables appear however not to be validated. These results validate our hypothesis, and the relatively high (in absolute terms) t-value validates the difference between the sample values tested for our two variables.

This negative relationship is less pronounced than the one between the NPL ratio and the global ESG score, but it remains negative as well.

The following tests results are associated to this estimation:

TABLE 10: THE TEST OF SS WHOLE MODEL VS SS RESIDUAL OF THE NPL RATIO

Dependent Variable	Multiple R	Multiple R ²	Adjusted R ²	SS Model	df	MS Model	SS Resid.	df Resid.	MS Resid.	F	p
NPL	0.00985	0.000097	-0.00113	7.553	1	7.553	77815	814	95.596	0.079	0.779

A coefficient of determination R² of 0.0001 (between 0 and 1) shows that the model predicts the outcome too slightly. The Residual MS level makes also appear an important difference between the observations and the predicted by the model values.

The F-value overall significance of 0.08 allowing the comparison of our model to a model without an independent variable is showing that our model is not necessarily fitting data better than an intercept-only model (with no independent variable).

TABLE 11: THE UNIVARIATE TESTS OF SIGNIFICANCE FOR NPL (TEST)

Effect	Sigma-restricted parameterization Effective hypothesis decomposition; Std. Error of Estimate: 9.7773				
	SS	Degr. of Freedom	MS	F	p
Intercept	4477.44	1	4477.437	46.83693	0.000000
ENV	7.55	1	7.553	0.07901	0.778718
Error	77815.38	814	95.596		

The univariate test of significance shows that the relationship between the NPL ratio and the Environmental Pillar of the ESG score is insignificant, with a p-value of 0.8, which is well above the maximum of 0.5 needed to validate our hypothesis. That would mean that the negative relationship we notice is highly likely not significant statistically and there is no evidence for the dependence between the Environmental Pillar of the ESG score and the NPL ratio of the European banks.

The LMM is confirming the negative relationship evidenced by the GRM and GLM, and moreover, it shows a much better statistical significance.

TABLE 12: THE NPL TO ENV BETA ESTIMATION AND THE 95% CONFIDENCE INTERVAL

Effect	Test of SS Whole Model vs. SS Residual (Test)									
	NPL Param	NPL Std.Err	NPL t	NPL p	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt	NPL Beta (β)	NPL St.Err.β	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt
Intercept	1.31188	1.819	0.721	0.471084	-2.25939	4.883				
ENV	0.23786	0.0721	3.298	0.001015	0.09631	0.379	0.623	0.189	0.252	0.994
ENV^2	-0.00212	0.000622	-3.409	0.000684	-0.00334	-0.001	-0.644	0.189	-1.0148	-0.273

The relationship between the NPL ratio and the Environmental Pillar of the ESG score is confirmed to be significant and negative, with a coefficient of -0.002119 and a p-value of 0.0007 according to the results obtained with the LMM.

The following tests results are associated to this estimation:

The test of SS whole model vs RSS of the NPL ratio predicted by the ENV score produces the following results:

TABLE 13: TEST OF THE SS VS RSS FOR IDENTIFICATION OF THE SD OF THE NPL TO ENV RELATIONSHIP

Dependent Variable	Multiple R	Multiple R ²	Adjusted R ²	SS Model	df	MS Model	SS Resid	df Resid.	MS Resid.	F	p
NPL	0.119	0.0142	0.0118	1104.14	2	552.0692	76718.8	813	94.365	5.85	0.003

With a higher coefficient of determination (of 0.01) and a better p-value (of 0.003), again, the LMM appears to better fit our data to represent the relationship between the NPL Ratio and the Environmental Pillar of the ESG Score.

The univariate test of significance for NPL with sigma-restricted parametrization:

TABLE 14: THE UNIVARIATE TESTS OF SIGNIFICANCE FOR NPL (TEST)

Effect	Sigma-restricted parameterization Effective hypothesis decomposition; Std. Error of Estimate: 9.7142				
	SS	Degr. of Freedom	MS	F	p
Intercept	49.0621229	1	49.0621229	0.519918305	0.471083821
ENV	1026.61233	1	1026.61233	10.8791571	0.00101479619
ENV^2	1096.58546	1	1096.58546	11.6206724	0.00068433429
Error	76718.7951	813	94.3650616		

The p-value (of 0.0007, well below the limit of 0.05) and the F-value (of 11.62) are validating statistically our observations with this model as well.

We could conclude that the relationship between the NPL Ratio and the Environmental Pillar of the ESG Score of the European banks is a linear one and it is negative by its nature, significant according to the results obtained with the LMM, but less significant as per the results obtained with the GRM and GLM.

The scatterplots generated year by year (cf. [Appendix 2](#)) make appear an intermittent positive relationship only for the years 2003, 2005 and 2006, and then for the years 2008 to 2010. This

deviation is rather due to the scarce data available and not yet adjusted Environmental scoring for the sample's first period, then to the GFC's strong impact from 2008 to 2010 at least.

Indeed, our results might be heavily impacted by the NPLs' particular behavior in the time of GFC, as highlighted in the study of [Mesnard et al. \(2016\)](#). According to their results, during the crisis, the NPL ratio was particularly behaving from 2008 to 2015, and especially for the hit by the GFC countries like Greece, Cyprus and Ireland. That is why, any dependency with another variable out of this time of crisis could not necessarily be confirmed within this period due to the uncommon behavior of the NPL ratio, under the effect of the exogenous factor that represents the GFC.

3. The relationship between NPLs and Social pillar score

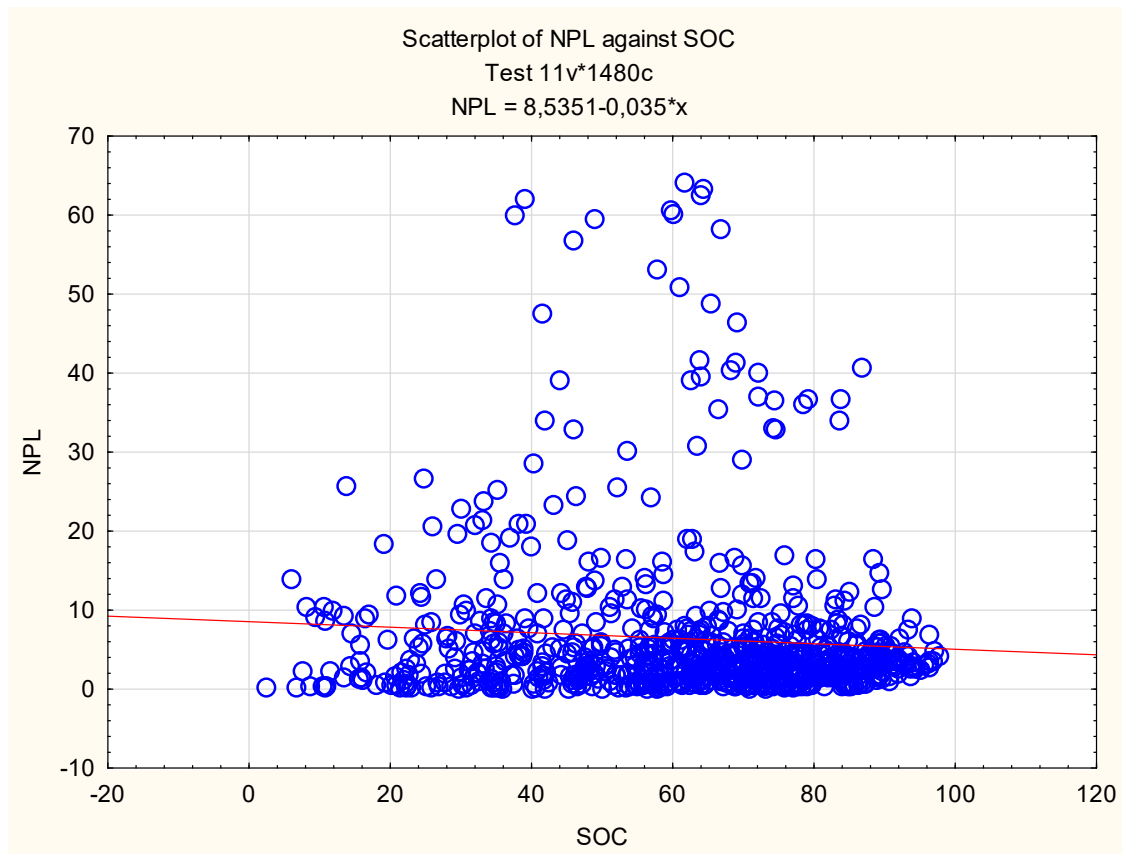
Our third hypothesis is also confirmed by the negative and significant relationship evidenced by our results for the NPL to the Social Pillar (SOC) of the ESG score of the European banks.

The NPL Ratio score defined in a relationship with the Social Pillar of the ESG score can be expressed mathematically in the following way:

$$\text{NPL} = \beta_4 + \beta_5 \text{SOC}$$

$$\text{With } \beta_5 = -0.03495520714$$

Hereafter is presented graphically the data repartition, with a negative relationship:



The GRM and GLM are producing the following results:

TABLE 15: THE GRM AND GLM RESULTS FOR THE RELATIONSHIP BETWEEN NPL AND SOC

Effect	Parameter Estimates (Test)									
	Sigma-restricted parametrization									
	NPL Param.	NPL Std.Err	NPL t	NPL p	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt	NPL Beta (β)	NPL St.Err.β	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt
Intercept	8.535	1.0599	8.0529	2.887	6.4547	10.616				
SOC	-0.03496	0.0162	-2.157	0.0313	-0.0668	-0.00315	-0.07525	0.0349	-0.144	-0.00677

The coefficient of -0.03495520714 is the coefficient of regression that we made figure in the formula above. The results of our tests are accompanied by a standard error of 0.016, which is low, and a p-value of 0.031, which is validating the statistical significance of the results obtained against the observed data for our variables. These results validate our hypothesis, and the relatively high (in absolute terms) t-value validates the difference between the sample values tested for our two variables.

This relationship is less pronounced than the one between the NPL ratio and the global ESG score, but it remains negative as well.

The following tests results are associated to this estimation:

- The test of SS whole model vs RSS of the NPL ratio predicted by the SOC score produces the following results:

TABLE 16: THE TEST OF SS WHOLE MODEL VS SS RESIDUAL OF THE NPL RATIO

Dependent Variable	Multiple R	Multiple R ²	Adjusted R ²	SS Model	df	MS Model	SS Resid.	df Resid.	MS Resid.	F	p
NPL	0.07525	0.005663	0.004446	442.41	1	442.41	77684	817	95.0844	4.6528	0.0313

The coefficient of determination R² of 0.004446 (between 0 and 1) is showing that the model predicts the outcome. The Residual MS level makes however appear an important difference between the observations and the predicted by the model values.

The F-value overall significance of 4.65 allowing the comparison of our model to a model without an independent variable is showing that our model is fitting data better than an intercept-only model (with no independent variable).

- The univariate test of significance for NPL with sigma-restricted parametrization:

TABLE 17: THE UNIVARIATE TESTS OF SIGNIFICANCE FOR NPL (TEST)

Effect	Sigma-restricted parameterization Effective hypothesis decomposition; Std. Error of Estimate: 9.7511				
	SS	Degr. of Freedom	MS	F	p
Intercept	6166.20336	1	6166.20336	64.8498136	2.8865799
SOC	442.408082	1	442.408082	4.65279524	0.0312940
Error	77683.9264	817	95.0843652		

The univariate test of significance shows that the relationship between NPL ratio and the Social Pillar of the ESG score is direct and significant, with a p-value of 0.031. This result is consistent with our previous results, which showed the same relationship.

The LMM is confirming the negative relationship already evidenced by the GRM and GLM. Indeed, we have the following results with the LMM.

- For the NPL to SOC beta estimation as well as the 95% confidence interval:

TABLE 18: THE NPL TO SOC BETA ESTIMATION AND THE 95% CONFIDENCE INTERVAL

Effect	Test of SS Whole Model vs. SS Residual (Test)									
	NPL Param	NPL Std.Err	NPL t	NPL p	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt	NPL Beta (β)	NPL St.Err.β	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt
Intercept	2.3334	2.098187	1.1121	0.266423	-1.78509	6.451869				
SOC	0.22888	0.078866	2.9021	0.003807	0.074072	0.383681	0.492722	0.169782	0.159461	0.825984
SOC^2	-0.00237	0.000694	-3.417	0.000664	-0.00373	-0.00101	-0.58019	0.169782	-0.91345	-0.24693

The relationship between the NPL ratio and the Social Pillar of the ESG score is confirmed to be negative and significant by the results obtained with the LMM.

The regression coefficient is of -0.002370 and the p-value of 0.0007, confirming the significance of our results.

The following tests results are associated to this estimation:

TABLE 19: TEST OF THE SS VS RSS FOR IDENTIFICATION OF THE SD OF THE NPL TO SOC RELATIONSHIP

Depend. Variable	Test of SS Whole Model vs. SS Residual (Test)										
	Multiple R	Multiple R ²	Adjusted R ²	SS Model	df	MS Model	SS Resid.	df Resid.	MS Resid.	F	p
NPL	0.14033	0.01969	0.017289	1538.454	2	769.227	76587.9	816	93.858	8.196	0.0003

With a higher coefficient of determination, the LMM appears to better fit our data to represent the relationship between the NPL Ratio and the Social Pillar of the ESG Score.

- The univariate test of significance for NPL with sigma-restricted parametrization:

TABLE 20: THE UNIVARIATE TESTS OF SIGNIFICANCE FOR NPL (TEST)

Effect	Sigma-restricted parameterization Type III decomposition; Std. Error of Estimate: 9.6880				
	SS	Degr. of Freedom	MS	F	p
Intercept	116.08	1	116.080	1.23676	0.266423
SOC	790.48	1	790.478	8.42209	0.003807
SOC^2	1096.05	1	1096.046	11.67775	0.000664
Error	76587.88	816	93.858		

The p-value (of 0.0007, well below the limit of 0.05) and the F-value (of 11.68) are validating statistically our observations with this model as well.

We could conclude that the relationship between the NPL Ratio and the Social Pillar of the ESG Score of the European banks is linear and significantly negative by nature. It is more significant than the one of the Environmental Pillar, but not as significant as the one of the global ESG score.

Similarly to the previously exposed analysis concerning the Environmental Pillar of ESG score to the NPL Ratio relationship, on the Social Pillar to the NPL relationship scatterplots generated year by year (cf. [Appendix 3](#)), we see a positive relationship for the years 2003, 2005 and 2006. This is rather due to the scarce data available and not yet adjusted Social scoring for the first years of the sample. Then in 2008 to 2010, we also have a positive relationship, certainly caused by the GFC as well.

4. The relationship between NPLs and Governance pillar score

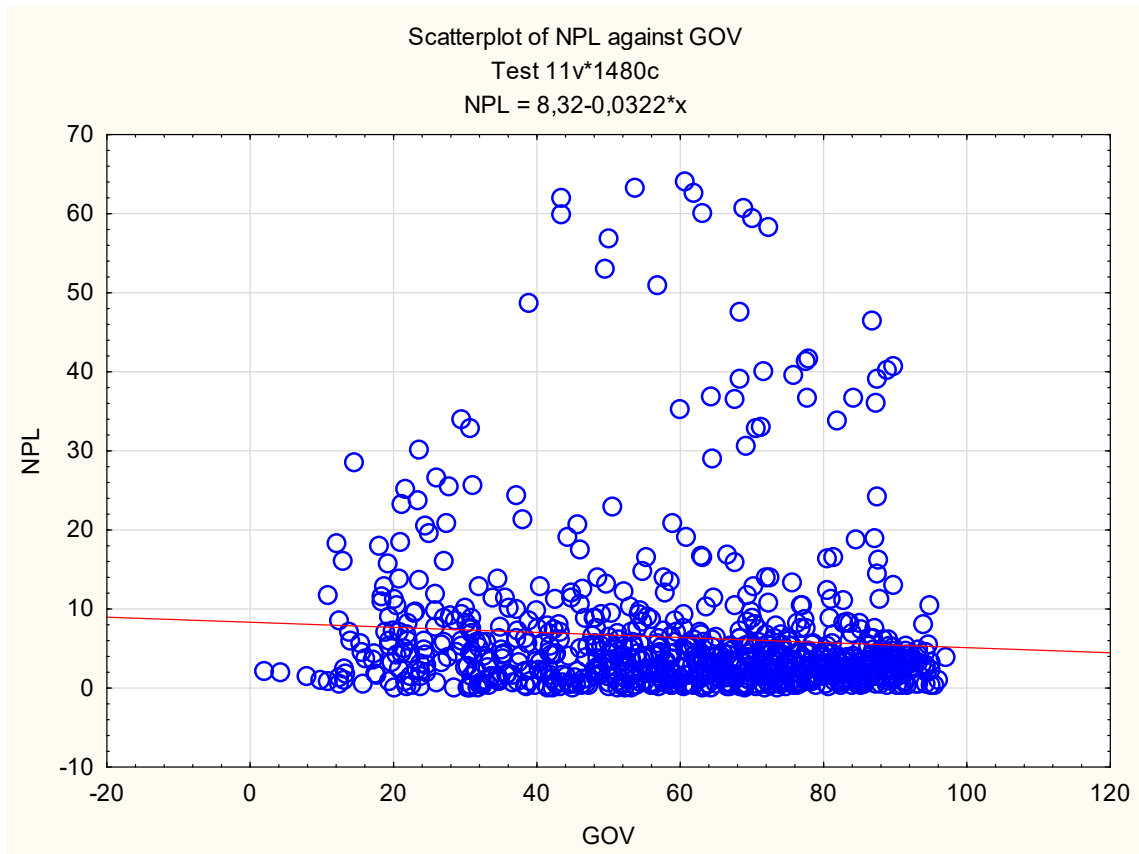
Our fourth hypothesis is also confirmed by the negative and significant relationship evidenced by our results for the NPL to the Governance Pillar (GOV) of the ESG score of the European banks.

The NPL Ratio score defined in a relationship with the Governance Pillar of the ESG score can be expressed mathematically in the following way:

$$\text{NPL} = \beta_6 + \beta_7 \text{ GOV}$$

With $\beta_7 = -0.03262620646$

Hereafter is presented graphically the data repartition, with a significant negative relationship:



The GRM and GLM are producing the following results:

TABLE 21: THE GRM AND GLM RESULTS FOR THE RELATIONSHIP BETWEEN NPL AND GOV

Effect	Parameter Estimates (Test) / Sigma-restricted parametrization									
	NPL Param.	NPL Std.Err	NPL t	NPL p	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt	NPL Beta (β)	NPL St.Err.β	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt
Intercept	8.34697	0.9939	8.398	0.00000	6.396055	10.29789				
GOV	-0.0326	0.0154	-2.123	0.03404	-0.062789	-0.00246	-0.07399	0.034847	-0.14239	-0.00559

The coefficient of -0.03262620646 is the coefficient of regression that we made figure in the formula above. The results of our tests are accompanied by a standard error of 0.035, which is not high, and a p-value of 0.034, which is validating the statistical significance of the results obtained against the observed data for our variables. These results validate our hypothesis, and the relatively high (in absolute terms) t-value validates the difference between the sample values tested for our two variables.

The following tests results are associated to this estimation:

- The test of SS whole model vs RSS of the NPL ratio predicted by the GOV score produces the following results:

TABLE 22: THE TEST OF SS WHOLE MODEL VS SS RESIDUAL OF THE NPL RATIO

Dependent Variable	Multiple R	Multiple R ²	Adjusted R ²	SS Model	df	MS Model	SS Resid.	df Resid.	MS Resid.	F	p
NPL	0.073987	0.005474	0.004260	427.75	1	427.75	77713	819	94.88750	4.508	0.034

The coefficient of determination R² of 0.005 (between 0 and 1) is showing that the model at least partially predicts the outcome. The Residual mean squares (MS) level, obtained by dividing the sum of squares (SS) by the degree of freedom (df) makes however appear an important difference between the observations and the predicted by the model values.

The F-value overall significance of 4.5 allowing the comparison of our model to a model without an independent variable is showing that our model is fitting data better than an intercept-only model.

- The univariate test of significance for NPL with sigma-restricted parametrization:

TABLE 23: THE UNIVARIATE TESTS OF SIGNIFICANCE FOR NPL (TEST)

Effect	Sigma-restricted parameterization Effective hypothesis decomposition; Std. Error of Estimate: 9.7410				
	SS	Degr. of Freedom	MS	F	p
Intercept	6692.21683	1	6692.21683	70.5279039	0.000000
GOV	427.753042	1	427.753042	4.50800179	0.034036
Error	77712.8665	819	94.8875049		

The univariate test of significance shows that the relationship between the NPL ratio and the Governance Pillar of the ESG score is direct and significant, with a p-value of 0.034. This result is consistent with our previous results, which showed the same relationship.

The LMM is confirming the negative relationship already evidenced by the GRM and GLM. Indeed, we have the following results with the LMM:

- For the NPL to GOV beta estimation as well as the 95% confidence interval:

TABLE 24: THE NPL TO GOV BETA ESTIMATION AND THE 95% CONFIDENCE INTERVAL

Effect	Test of SS Whole Model vs. SS Residual (Test)									
	NPL Param	NPL Std.Err	NPL t	NPL p	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt	NPL Beta (β)	NPL St.Err.β	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt
Intercept	6.60153	2.056314	3.2104	0.0014	2.565257	10.6378				
GOV	0.042408	0.078896	0.5375	0.5911	-0.11246	0.19727	0.096169	0.178915	-0.25502	0.447357
GOV^2	-0.00067	0.000694	-0.9696	0.3325	-0.00204	0.000689	-0.17348	0.178915	-0.52467	0.177708

Looking at the summary of the linear regression fit, we conclude that the slope is significantly different from zero, i.e. there is a statistically significant increasing negative relationship between the NPL Ratio and Governance Pillar of the ESG score.

The relationship between the NPL ratio and the Governance Pillar of the ESG score is confirmed to be negative, with a coefficient of -0.00067, but also with a p-value of 0.33, above the limit of 0.05 which means that the results obtained with this model could be statistically not significant.

The following tests results are associated to this estimation:

- The test of SS whole model vs RSS of the NPL ratio predicted by the GOV score produces the following results:

TABLE 25: TEST OF THE SS VS RSS FOR IDENTIFICATION OF THE SD OF THE NPL TO GOV RELATIONSHIP

Dependent Variable	Multiple R	Multiple R ²	Adjusted R ²	SS Model	df	MS Model	SS Resid.	df Resid.	MS Resid.	F	p
NPL	0.08134	0.00662	0.004187	516.9686	2	258.4843	77623.65	818	94.894	2.724	0.07

With a lower coefficient of determination (of 0.006) and a p-value (of 0.07) not validating the significance of our results, the LMM seems to not be fitting our data to represent the relationship between the NPL Ratio and the Governance Pillar of the ESG Score.

- The univariate test of significance for NPL with sigma-restricted parametrization:

TABLE 26: THE UNIVARIATE TESTS OF SIGNIFICANCE FOR NPL (TEST)

Effect	Sigma-restricted parameterization Type III decomposition; Std. Error of Estimate: 9.7414				
	SS	Degr. of Freedom	MS	F	p
Intercept	978.03	1	978.0277	10.30648	0.001377
GOV	27.42	1	27.4169	0.28892	0.591059
GOV^2	89.22	1	89.2156	0.94016	0.332524
Error	77623.65	818	94.8944		

We could conclude that the relationship between the NPL Ratio and the Governance Pillar of the European banks' ESG Score is negative by nature and statistically significant according to the results obtained with the GRM, but not significant according to the ones obtained with the LMM.

Similarly to the previously exposed analysis concerning the Environmental and Social Pillars of the ESG score to the NPL Ratio relationships, on the Governance Pillar to NPL relationship scatterplots generated year by year (cf. [Appendix 4](#)), we can observe a positive relationship for the years 2003 and 2005, which might also be due to the scarce data available and not yet adjusted Governance scoring for the first years of the sample. Then in 2009, we also have a positive relationship, certainly highly impacted by the GFC as well.

B. Discussion of results

Our results show that a growth of 1% of the ESG score of a bank would lead to a decrease by 0.05 of its NPL ratio, which represents almost 1% of the mean value of the NPL of the European banks in the scope of this study. These results are globally in line with the previous studies' results.

They are perfectly in line with those obtained by [Toth et al. \(2021\)](#) study findings on the negative relationship of the ESG scores and the NPL levels on the long term: *“Focusing on the impulse response functions of the entire ESG-score (Figure 1), our findings are similar to the anticipations. Banks with high ESG-scores contributed to low NPL levels, in the long run, meaning that this benchmark can be useful during the estimation of financial stability.”*

We are comforting the findings of [Toth et al. \(2021\)](#) of a negative, even though with a less significant effect, relationship between the NPL ratio and ESG score. The authors of this study were presuming that the ESG-index could be fitting to explain, in addition to the conventional financial indicators, the evolution of the key indicator for financial which is the NPL ratio. The coefficient of ESG score to NPL relationship found in the period under examination (from 2002 to 2018) on the sample of 243 European banks was of - 0.204, with a p-value of 0.0025, while in our study, it was less pronounced, with a coefficient of - 0.040 and the same level of p-value.

As a reminder, this negative relationship between the overall ESG scoring and the NPL ratio of banks was also comforted by the findings of [Ersoy et al. \(2022\)](#), with a -0.006 ESG to NPL ratio correlation found for $p < 0.10$, the ours being even more pronounced, with a -0.04 ESG to NPL ratio correlation found for $p < 0.05$.

In addition, our results find the same nature of relationship as the one figured by [Woei et al. \(2022\)](#) for the Debt ratio to the ESG score and to each of its components, on the basis of Malaysian listed firms' environmental, social and governance (ESG) performance during the period 2005-2018.

As the [Fabozzi et al. \(2021\)](#) led study on the impact of CSR through the ESG score and its different pillars (Social, Environmental and Governance) found a positive effect of the individual ESG score and the individual scores on the credit ratings of 300 firms worldwide, we find that this positive relationship could also be explained by the improving risk profile of the Corporates when their ESG score increases.

Indeed, as explained in this study, *“the risk mitigation perspective suggests that CSR activities improve credit ratings. Arguments in favor of CSR center on the negative correlation between CSR and risk. [Godfrey \(2005\)](#) argues that firms with more CSR engagement are exposed to a lower degree of risk. If the investments in CSR lead to lower risk, credit ratings would improve because they provide information about a firm's default probability. Credit rating agencies and debt holders concentrate considerably more on downside risk when reviewing a firm because their payoff on the upside is limited. Consequently, the risk mitigation view suggests that more socially responsible firms are assigned more favorable credit ratings.”*

Therefore, since the credit ratings are providing information about the firm's default probability, and that they are positively related to the ESG score and each of its components, then the risk profile of the firms would be effectively improving with the ESG score increasing, and that's the result of our observations as well.

The results of our study are also in line with those of the study of [Izcan and Bektas \(2022\)](#), leading to the conclusion that *“high-risk banks earn relatively more benefits by increasing their ESG scores. In other words, better ESG for these banks makes them more stable.”* and similar to those evidenced by the study of [Di Tommaso and Thornton \(2020\)](#), in which we have a clearly negative relationship between the ESG score and the z score through which is measured the bank risk.

As per the sporadically positive relationship we had got from 2003 to 2005 and then from 2007 to 2012, it can be explained by the scarcity and non-adjusted data that were made available 20 years ago, then by the exogenous factor represented by the Global Financial Crisis (GFC) that obviously had a non negligible impact on both the NPL levels and the ESG scores, as show the results detailed in the study of [Gonenc & Scholtens \(2019\)](#) for the sample period from 2002 to 2015, for which they found:

- a positive relationship between NPL and all the components of the ESG score with the Ordinary Least Squares (OLS) estimations;
- a positive relationship between the NPL and the Environmental pillar and a negative one with the Social and Governance pillars with the Weighted Least Squares (WLS) estimations.

These results are similar to the ones we observe for the same period, but then, starting from 2013 on, we observe only negative relationship between the NPL rate and the ESG score, and with each of its components (see Appendixes 2 to 5 hereafter).

However, our results are not in line with the significance of the positive relationship between the Governance pillar and the credit rating evidenced by [Ashbaugh et al. \(2006\)](#) and between the Social pillar and the credit rating highlighted by [Attig et al. \(2013\)](#). On our side, we have evidenced a rather weak relationship between the each of the pillars of the ESG score and the NPL ratio, measuring the credit risk and therefore linked to the credit rating.

The same way, we have not observed any disparity in the relationships among pillars, as the ones evidenced by [Srivisal et al. \(2021\)](#), havin found that there were positive relationships of the Environmental and Governance pillars to the creditworthiness improvement, but a negative one for the Social pillar score. The latter is not confirmed by our results, since we found that the ESG score and each of its components lead to the risk profile improvement measured through the negative relationship with the NPL ratio.

IX. Robustness

A. Mono-effect test with the Capital Adequacy

We conducted some robustness checks to confirm the results provided in the previous section. For this purpose, we used the measure of the Capital Adequacy Ratio (CAR) relation to the ESG score, in replacement to the NPL Ratio as dependent variable.

The previous literature widely accepts the capital adequacy as firm-specific risk measure. The positive coefficients indicate that ESG contributes to bank stability and has an inverse relationship with bank riskiness. The results align with our findings, in which ESG has an inverse relationship with the NPL Ratio of banks, and the negative relationship increases as the risk level of banks increases.

This shows that results support each other for both the risk measurement proxies. Additionally, these findings are in line with the previous literature, which found an inverse relationship between the CSR performance and the riskiness of banks. To check the robustness of the ESG dimensions, we regress each dimension to the CAR. The CAR and environmental dimension analysis results show that the environmental dimension positively correlates with bank stability for all quantile levels. These findings align with the previous literature and support the findings of this study.

The results of the governance dimension towards CAR shows a significant relationship between the governance dimension and this accounting-based risk measures. These findings support our initial results, which found a significant inverse relationship between governance and the NPL Ratio.

Finally, the relationship between the social dimension and the CAR analysis results indicate a positive relationship between the social dimension and risk measures of banks over the 0.25, 0.50, 0.75, and 0.95 quantile levels. These findings also confirm the initial results of this research, which could identify a significant relationship between the social dimension and banks' NPL Ratio.

Previous literature has indicated that the governance and social dimensions affect the various bank risks differently.

This shows that the impact of the ESG score and each of the ESG dimensions is well related to the accounting-based risk, measured both by the NPL Ratio and the Capital Adequacy Ratio.

Apparently, accounting based risk measure is reliant enough to let appear the clear relationship between the ESG score and banks risk that previous studies were already suggesting.

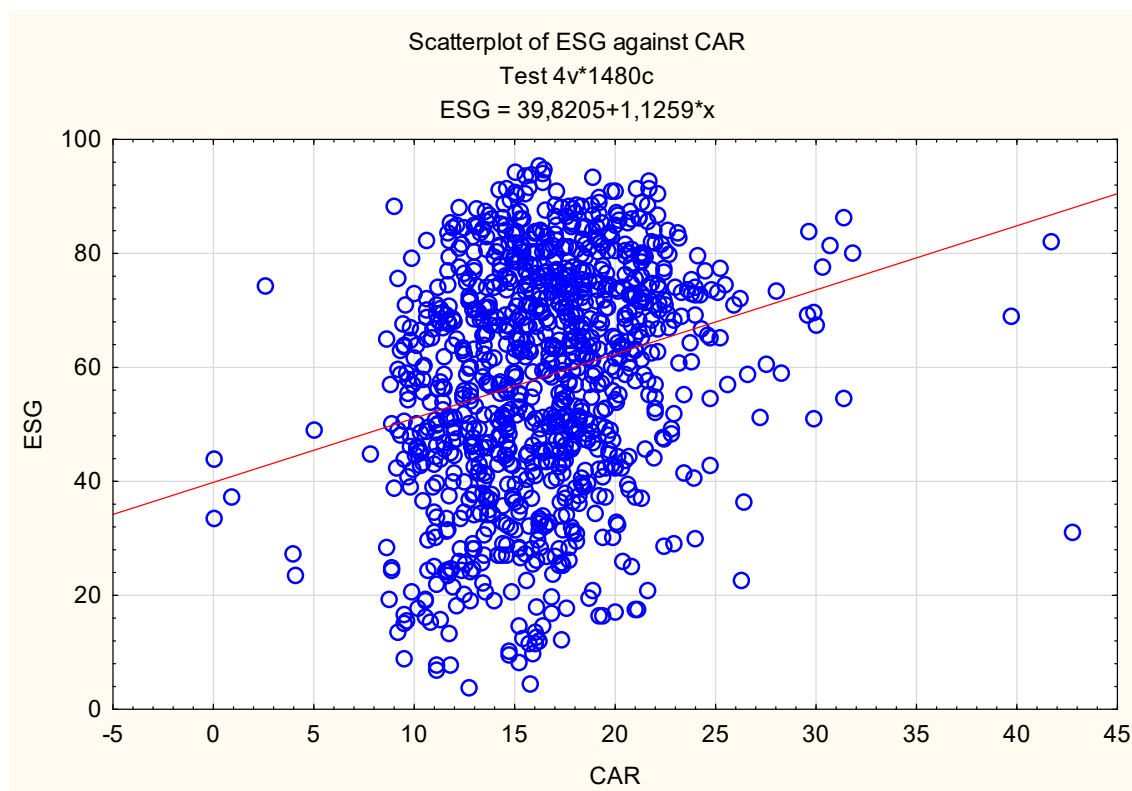
Our results for the CAR to the ESG score of the European bank show a positive relationship.

The Capital Adequacy Ratio defined in a relationship with the ESG score can be expressed mathematically in the following way:

$$CAR = \beta_8 + \beta_9 \text{ ESG}$$

$$\text{With } \beta_9 = + 0.05431097263$$

Hereafter is presented graphically the data repartition, with a significant positive relationship between the Capital Adequacy Ratio and the ESG Score of the banks in our scope:



The General Regression Model (GRM) is producing the following results:

TABLE 27: THE GRM AND GLM RESULTS FOR THE RELATIONSHIP BETWEEN CAR AND ESG

Effect	Parameter Estimates (Test) / Sigma-restricted parametrization									
	CAR Param.	CAR Std.Err	CAR t	CAR p	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt	CAR Beta (β)	CAR St.Err.B	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt
Intercept	13.2601	0.4134	32.076	0.00000	12.449	14.0714				
ESG	0.05431	0.0067	8.103	0.00000	0.0412	0.0675	0.247	0.030519	0.187396	0.307171

The coefficient of +0.05431097263 is the coefficient of regression that we made figure in the formula above. The results of our tests are accompanied by a standard error of 0.031, which is low and the p-value of 0, meaning that the positive relationship we found is statistically significant and that the relationship is existing. The relatively high (in absolute terms) t-value is validating the difference between the sample values tested for our two variables.

The following tests results are associated to this estimation:

- The test of SS whole model vs RSS of the CAR produces the following results:

TABLE 28: THE TEST OF SS WHOLE MODEL VS SS RESIDUAL OF THE CAR

Dependent Variable	Multiple R	Multiple R ²	Adjusted R ²	SS Model	df	MS Model	SS Resid.	df Resid.	MS Resid.	F	p
CAR	0.24728	0.06115	0.06022	1200.8	1	1200.8	18436	1008	18.29000	65.653	0.0000

The coefficient of determination R² of 0.06 (between 0 and 1) is showing that the model at least partially predicts the outcome. The Residual mean squares (MS) level, obtained by dividing the sum of squares (SS) by the degree of freedom (df) is much lower than the one of the NPL/ESG relationship, showing therefore a lower difference between the observations and the predicted by the model values.

The F-value overall significance of 65.65 shows that this model is fitting data much better than an intercept-only model.

- The univariate test of significance for CAR with sigma-restricted parametrization:

TABLE 29: THE UNIVARIATE TESTS OF SIGNIFICANCE FOR CAR (TEST)

Effect	Sigma-restricted parameterization Effective hypothesis decomposition; Std. Error of Estimate: 4.2767				
	SS	Degr. of Freedom	MS	F	p
Intercept	18817.76	1	18817.76	1028.855	0.000000
ESG	1200.79	1	1200.79	65.653	0.000000
Error	18436.32	1008	18.29		

The univariate test of significance shows that the relationship between the CAR and the ESG score is direct and significant, with a p-value of 0 validating it statistically.

The LMM is confirming the negative relationship already evidenced by the GRM. Indeed, we have the following results with the LMM:

- For the CAR to ESG beta estimation as well as the 95% confidence interval:

TABLE 30: THE CAR TO ESG BETA ESTIMATION AND THE 95% CONFIDENCE INTERVAL

Effect	Test of SS Whole Model vs. SS Residual (Test)									
	CAR Param	CAR Std.Err	CAR t	CAR p	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt	CAR Beta (β)	CAR St.Err.β	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt
Intercept	13.12287	0.864057	15.1875	0	11.4273	14.8184				
ESG	0.06026	0.033525	1.79731	0.0726	-0.00553	0.12604	0.27435	0.15264	-0.02519	0.573879
ESG^2	-0.00006	0.000304	-0.1810	0.8564	-0.00065	0.00054	-0.02762	0.15264	-0.32715	0.271914

The results obtained with this model for the CAR to ESG score relationship show a significant positive relationship, and a not significant slightly negative one (coef. -0.00006 and p-value 0.85). This would mean that the relationship is more likely positive than negative.

The following tests results are associated to this estimation:

- The test of SS whole model vs RSS of the CAR predicted by the ESG score produces the following results:

TABLE 31: TEST OF THE SS VS RSS FOR IDENTIFICATION OF THE SD OF THE CAR TO ESG RELATIONSHIP

Dependent Variable	Multiple R	Multiple R ²	Adjusted R ²	SS Model	df	MS Model	SS Resid.	df Resid.	MS Resid.	F	p
CAR	0.24735	0.06118	0.059315	1201.394	2	600.6971	18435.72	1007	18.308	32.8	0.000

With a coefficient of determination of 0.06 and a p-value of 0, the LMM appears to be, as well, fitting our data to represent the relationship between the CAR and the ESG Score.

- The univariate test of significance for CAR with sigma-restricted parametrization:

TABLE 32: THE UNIVARIATE TESTS OF SIGNIFICANCE FOR CAR (TEST)

Effect	Sigma-restricted parameterization Type III decomposition; Std. Error of Estimate: 4.2787				
	SS	Degr. of Freedom	MS	F	p
Intercept	4222.83	1	4222.832	230.6605	0.000000
ESG	59.14	1	59.139	3.2303	0.072586
ESG^2	0.60	1	0.599	0.0327	0.856446
Error	18435.72	1007	18.308		

We can conclude that the relationship between the CAR and the ESG Score of the European banks is a linear and clearly positive one, at the opposite of the one we registered between the NPL Ratio and the ESG score and each of its components (the Environmental, the Social and the Governance Pillars).

The results observed by [Toth et al. \(2021\)](#) are not exactly the same, since they found a coefficient of -0.2351 , but with a p-value of 0.0756 , above the limit of 0.05 for the ESG-index to the Capital Adequacy Ratio relationship. Their results seem different from the ones we obtained, but it could be due to the model they used for a multi-variable impact on the ESG-index estimation and it's probably less fitting for the univariate relationship that we assessed with the GRM. Indeed, they used a Pooled OLS panel regression model to explain the long-term impact of shocks arising from specific variables on the non-paying credits with a panel-vector autoregression (panel VAR) to describe deeper endogenous interactions, including previous fiscal years. This model allowed them to observe that *“unsurprisingly, the regulatory capital generated a risk-mitigating impulse”*.

Indeed, a negative relationship has been evidenced between capital and NPLs by the [Khan et al. \(2020\)](#) led study, even though insignificant, comparatively to the association between NPL and the income diversification of the banks, from sources other than interest earnings.

Our results are comforted by the ones evidenced by the study of [Gonenc & Scholtens \(2019\)](#), in which is found as well a positive and significant relationship between the Capital Adequacy Ratio and the responsibility indicators of the banking industry. Indeed, the more banks'

responsibility is highly rated, the better is their health, with a particularly profound impact of the GFC on the finance-responsibility relationship.

The positive relationship between the CAR and the ESG score, as well as with each of its components, measured both by linear and non-linear models shown by [Ersoy et al. \(2022\)](#) has a p-value below the 0.05 for each of them, thus validating the viability of these models used for this kind of multi-variable dependency of the market value on the ESG score as independent variable, along with the CAR and NPL as bank-level control variables.

B. Multifactorial test with the NPL ratio

An additional test of robustness consists of analyzing our dependent variable, the rate of NPL, by considering as independent variables the rates of inflation, of the growth of Gross Domestic Product (GDP) and of the Long Term Debt (LTD). The test of this multi-variables relationship has been performed with a General Linear Model, as well as with a General Regression Model. These two models have provided the results described hereafter.

The test evidenced that the NPL Ratio defined in a multifactorial linear relationship with the ESG, LTD, INF and GDP can be expressed mathematically by the following linear relationship equation:

$$\text{NPL} = \beta_{10} + \beta_{11} \text{ ESG} + \beta_{12} \text{ LTD} + \beta_{13} \text{ NF} + \beta_{14} \text{ GDP}$$

With:

$$\beta_{11} = -0.0538504832$$

$$\beta_{12} = -25.00934773$$

$$\beta_{13} = -1.302496678$$

$$\beta_{14} = -0.05076333576$$

1. Multifactorial test with GLM application results

From the results obtained with the General Linear Model, we can conclude that the NPL is related by a fixed effect to the ESG score, but also to the GDP growth. However, the p-value of 0.56 of the GDP growth variable is higher than the limit of 0.05, which invalidates statistically the results obtained for the NPL to the GDP growth relationship.

The latter can be explained by the cyclical nature of the banking system healthiness following the cycles of the macro-economic healthiness, measured among others by the GDP indicator, relationship that has been very well described in the BIS Paper N°1 intitled “*Marrying the macro- and micro-prudential dimensions of financial stability*”, and in particular in the paper of [Borio C. et al. \(2001\)](#).

TABLE 33: THE UNIVARIATE TESTS OF SIGNIFICANCE FOR NPL (TEST)

Effect	Sigma-restricted parameterization Effective hypothesis decomposition; Std. Error of Estimate: 9.3975				
	SS	Degr. of Freedom	MS	F	p
Intercept	11455.86	1	11455.86	129.7199	0.000000
ESG	730.87	1	730.87	8.2760	0.004137
LTD	5370.27	1	5370.27	60.8100	0.000000
INF	3205.12	1	3205.12	36.2931	0.000000
GDP	30.25	1	30.25	0.3426	0.558539
Error	63054.95	714	88.31		

The p-value of 0, the relatively high value of the MS and the F-value show a rather random effect on the NPL ratio that might be exercised by the Long Term Debt ratio and Inflation rate.

This would mean that the credit risk and banking stability are directly and negatively related to the ESG score, in a similar way that they are related to the macroeconomic health measured by the GDP growth ratio, according to the results obtained with the General Linear Model applied to our sample of European banks.

2. Multifactorial test with GRM application results

From the results obtained with the General Regression Model, we can conclude the same relationship between the NPL ratio and the ESG score, as well as the GDP growth, with, however, the p-value of 0.56 of the GDP growth invalidating statistically the latter.

TABLE 34: THE NPL MULTI VARIABLES DEPENDANCE BETA ESTIMATION AND THE 95% CONFIDENCE INTERVAL

Effect	Parameter Estimates (Test) / Sigma-restricted parameterization									
	NPL Param	NPL Std.Err	NPL t	NPL p	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt	NPL Beta (β)	NPL St.Err.β	-95.00% Cnf.Lmt	+95.00% Cnf.Lmt
Intercept	15.0600	1.322273	11.3895	0.0000	12.4640	17.6560				
ESG	-0.0539	0.018719	-2.8768	0.0041	-0.0906	-0.0171	-0.10110	0.035143	-0.17009	-0.03210
LTD	-25.0093	3.207117	-7.7981	0.0000	-31.3059	-18.7128	-0.27335	0.035053	-0.34217	-0.20453
INF	-1.3025	0.216204	-6.0244	0.0000	-1.7270	-0.8780	-0.21146	0.035100	-0.28037	-0.14255
GDP	-0.0508	0.086732	-0.5853	0.5585	-0.2210	0.1195	-0.02076	0.035472	-0.09040	0.04888

The effect of the ESG score appears to be clearly negative and significant, comparatively to the control variables, with its p-value and t-value validating its significance, and a very tinny standard error, comparatively to the other variables:

That would mean that the results obtained previously with the GLM applied to our sample of European banks are confirmed as well by the results obtained with the GRM.

3. Analysis of the multifactorial tests results

Among the control variables, we found that particularly the GDP is negatively associated with the NPL ratio, almost as much as the ESG score, but with lesser significance. This negative relationship could be explained by the obvious capacity of borrowers to make their debt payments on time and in full amount when the economic conjuncture is favorable and vice-versa – in case of a crisis as the GFC or COVID, they struggle to repay their due. The radical shrinking of the economy, without the quantitative easing that we witnessed during COVID crisis, led to an abnormal hike in the NPL ratio observed from 2008 till 2013. These were the findings of the assessment of the research performed by [Berger et al. \(2020\)](#). The other

variables, LTD and INF, seem to be as well negatively related, but their F-value, their MS and their 95% confidence interval and beta values are too high for them to be validated statistically.

X. Conclusion and recommendation

A. Summary

Prior research provides limited evidence on the direct relationship between the ESG score and the European banks' NPL ratio. Against this background, this study employs a panel dataset of 74 European banks observations covering the period of 2003–2022 to assess the impact of the ESG score on their NPL ratio. Three types of models have been applied to measure the importance of this relationship: the General Linear Model, the Linear Mixed Model and the General Regression Model and we used a set of control variables. We found that the higher the ESG score, the lower the non-performing loans ratio of banks is. Despite the fact that a well-managed ESG risk can improve the bank's capacity to tackle huge problems, the Global Financial Crisis has, however, impacted strongly the banks' risk profile, independently of their ESG score. As per the three pillar scores of corporate Governance, Environmental, and Social performance, our results indicate that all the three of them help decreasing the non-performing loans ratio of the banks in the scope, but the Governance and Social pillars scores in a more pronounced way than the Environmental one. The meaning of these findings is that a high social performance, both internally for the banking company, and externally towards the society as a whole highers the observed performance of the loans afforded to the economic agents. Similarly, the bank's management commitment and effectiveness towards maintaining its reputation of respecting ethics constraints seems to be an important way to improve its loans' performance.

As per the Environmental pillar score, this one being still the toughest to measure, its negative influence on the improvement of the NPL ratio has not been proven to be significant: the only significant relationship we found out is thanks to the Linear Mixed Model.

Our results remained mostly unchanged through the robustness tests.

B. Discussion and recommendation

Our research results could have theoretical and practical implications for banks' managers, investors and analysts. At the interest of investors, stockholders or bondholders, we brought to light the negative relationship that exists between the banks' ESG score and their risk profile in terms of non-performing loans compared to the total loans offered to the economic agents. For the investors, that would mean that the more sustainable the management of the banks they invest into, the better their risk profile is, and in fine, the better the cost of capital and return on investment. This relationship is explainable and reinforced by the reputation such banks would have among their stakeholders – the better it is, the better their ability to attract and keep liable borrowers, this relationship being bidirectional. By the same principle, such banks would attract loyal stakeholders that would be less tempted to desert in case of a storm for the bank, and that is interesting both from investors' and from banks' management point of view.

As stated by [Arora and Sharma \(2022\)](#), *“responsible management of ESG issues fosters a business spirit and ecosystem that strengthens both a company's societal integrity and stakeholder trust. As a result, companies that disclose ESG practice are reported to have improved their reputation, increasing investor confidence, making better use of resources, and staying competitive. While ESG performance relates to the firm's actual ESG related actions, ESG disclosure refers to how it channelizes these activities to its stakeholders.”*

A bank's reputation being influenced by all the components of the ESG practice, it is difficult to isolate one of them to be more driving to banks' reliability than the others. However, what we noticed from the results obtained is that the Social and Governance pillars are slightly more clearly improving banks' risk profile than the Environmental one, but it could be due to the still not precise enough measurement of the latter.

Other studies have also assessed the impact of the ESG performance of companies on their risk profile or credit rating. Thus [Fabozzi et al. \(2021\)](#) were looking for the Corporate and Social Responsibility effect on corporate performance and credit ratings in Japan and were using pooled OLS and quantile regression models for that purpose. The positive relationship they found is in line with the majority of the literature they reviewed. The [Woei et al. \(2022\)](#) performed work on the Malaysian market values, as well, has shown that ESG performance

positively impacts both performance and debt ratio of mostly large firms, thus encouraging them to pursue on their own ESG strategy improvement.

The work of [Di Tommaso and Thornton \(2020\)](#) has also shown that improving ESG performance was leading to a better risk profile for the European banks. These findings have effectively contributed to closing the gap in the empirical banking literature on the controversial view that ESG practices would “*deteriorate profitability*”, while “*ESG-based bank governance would be very much in line with the “stakeholder” view of ESG activities introduced by Freeman (1984) wherein they should improve the satisfaction of stakeholders and improve financial performance and firm value.*” Other studies were focusing on the same region and sector as well, as the ones of [Toth et al. \(2021\)](#) and [Elekes \(2018\)](#).

With our research, we have also tried to contribute to this layer of literature, and our results align with their findings about the risk-limiting effect of the ESG performance. We have chosen the European banks as panel for our research because Europe is the most advanced in terms of regulation of the ESG practices, and in particular those of the financial sector. As reminded by [Elekes \(2018\)](#), the European Commission formed expert group in 2016 “*defined two imperatives, for the European financial system: to improve the contribution of finance to sustainable and inclusive growth, and to strengthen financial stability by incorporating ESG factors into investment decision-making*”. The implementation is supervised by the European Supervisory Authorities to make sure that “*the sustainability standards are well applied by financial institutions, in compliance with EU financial legislation*” and that is impactful precisely for the European banks in first place.

Indeed, the risk reducing effect of the ESG performance should be taken into account in shaping the banks’ organizational structures, precisely now, when they all go through a transformation process, pushed both by technology/competition and regulation. Since they are meant to change, the change process should include ESG factors as drivers or at least constraints to set the target at strategic management level.

C. Limitations and further research

The results of our study are based on data available in the Refinitive database in March 2023 for the Fiscal Years 2003 to 2022. Such data have already been used by other reserches previously as the ones performed by [Toth et al. \(2021\)](#) and [Woei et al. \(2022\)](#).

According to the LSEG (London Stock Exchange Group) provided ESG scores computation methodology, the Refinitiv database “*is one of the world's largest providers of financial markets data and infrastructure. The ESG score it provides is based on calculated company-level ESG measures following the overall company assessment and scoring process to provide 10 categories that fit into the resulting three pillars, and in fine the ESG score. It reflects the company's ESG performance, commitment and effectiveness, based on publicly available information.*” Therefore, the information available in this database is reliable enough for all the companies of our sample. However, the ESG score precision might have improved with the time going, which could explain the disparate results in the beginning of the period of observation.

It would be worthwhile to challenge our findings with other datasets, and in particular for the first years of the period of observation.

Our research is focused on the European region, so future research could also investigate the relationship between banks' ESG score and risk profile for other regions.

Despite these limits, our research provides a comprehensive analysis of the impact of the ESG score on the European banks' risk profile by using the sample of 74 European banks and our results are confirming what has been announced by other studies: that the ESG performance of these banks is directly linked to their risk profile measured by their NPL ratio.

These finding should encourage sustainability goals setting by the banks strategists at the long term, in search for better reliability and soundness of the financial organizations they are in charge of. It appears to be clearly in their interest to integrate such goals in their transformation process, to set a solid basis for their future sound development.

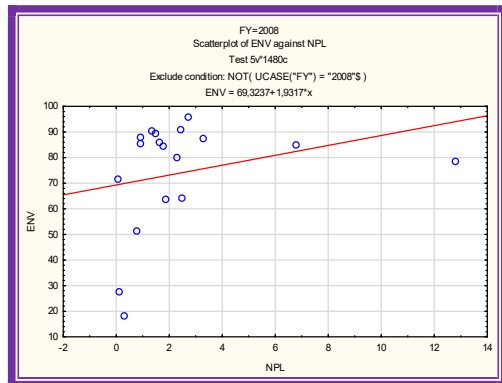
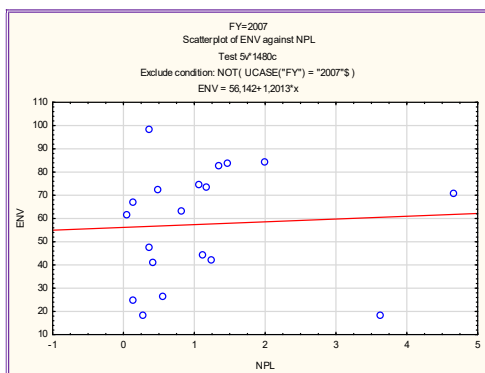
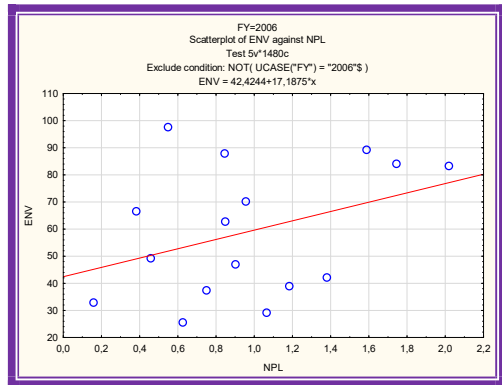
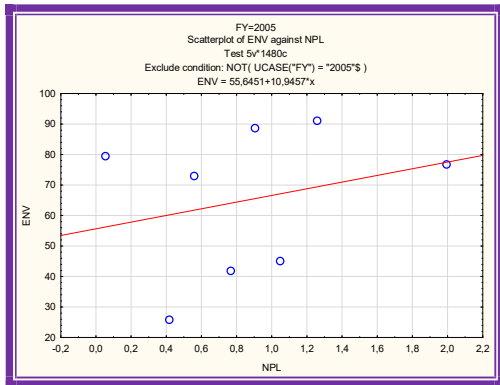
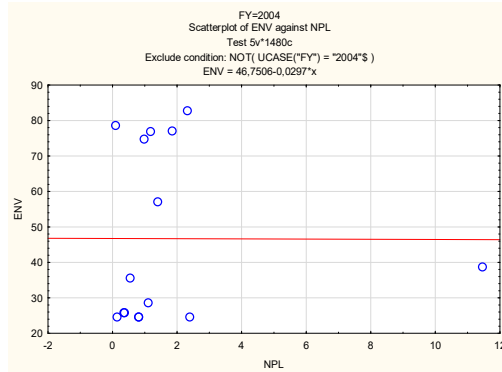
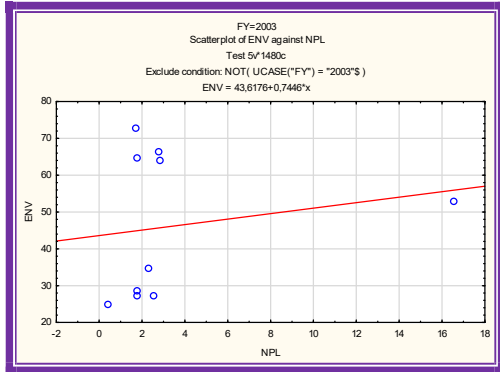
XI. Appendixes

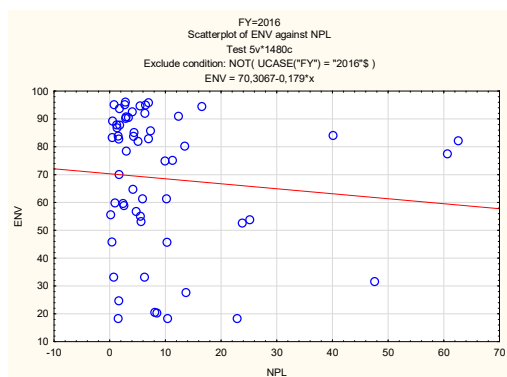
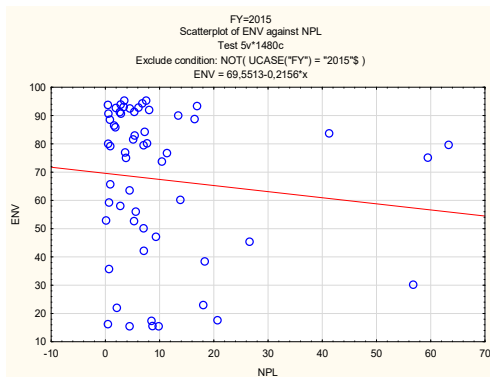
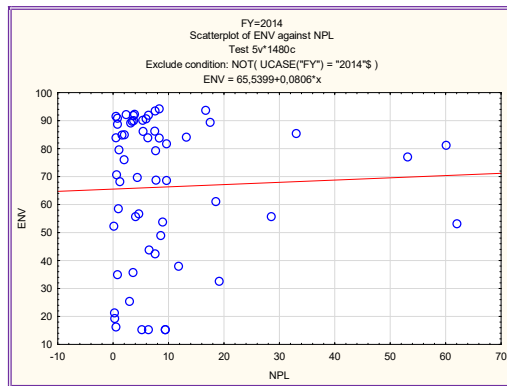
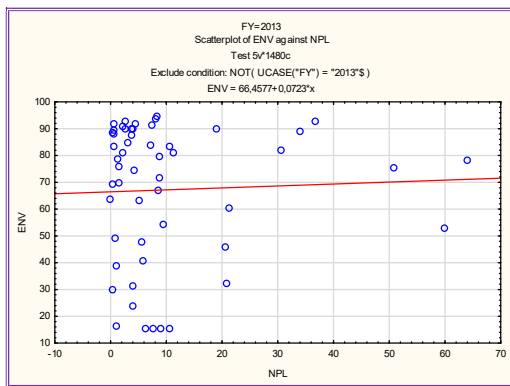
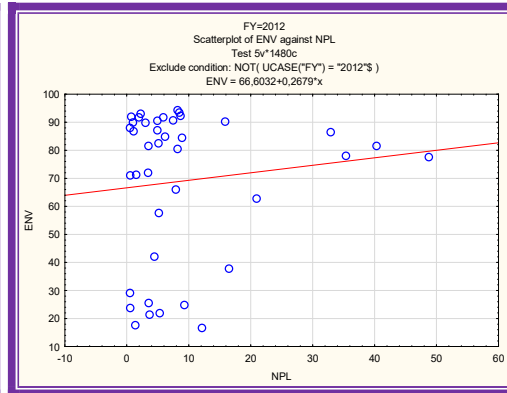
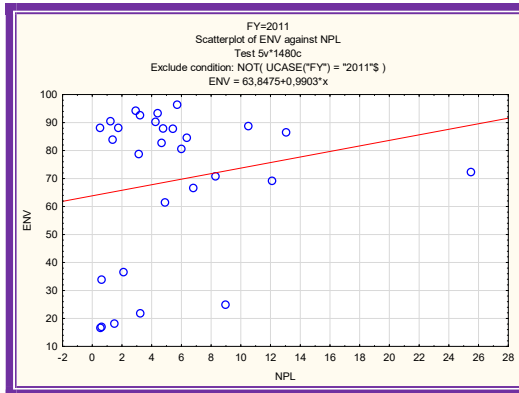
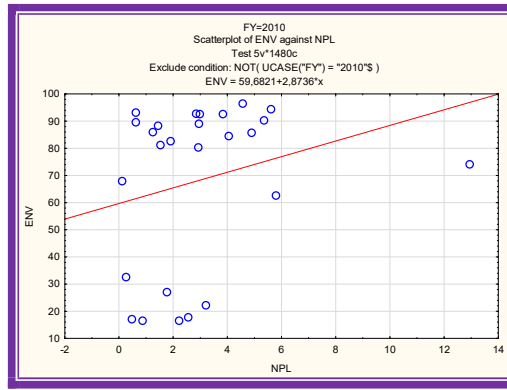
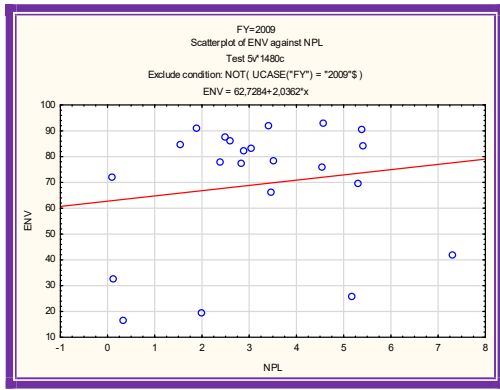
A. Appendix 1: EU progress towards the SDGs over the past 5 years, 2022

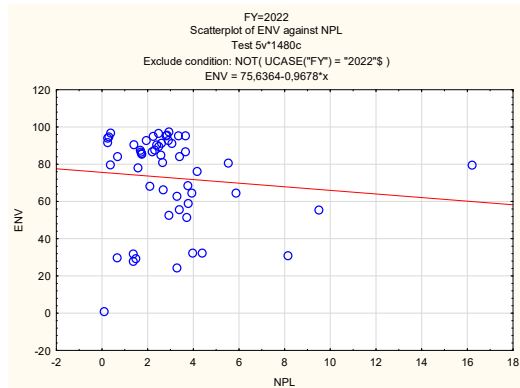
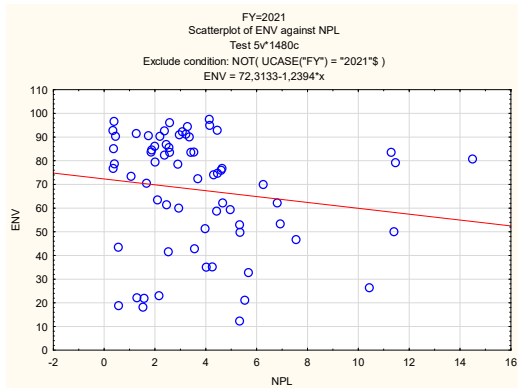
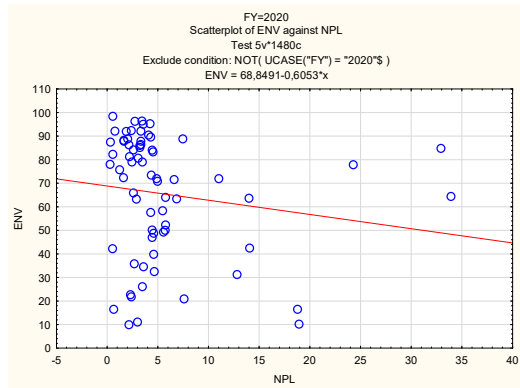
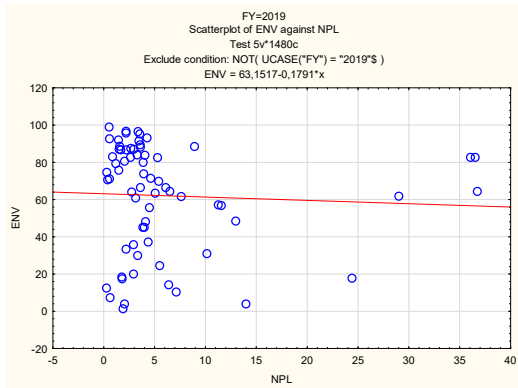
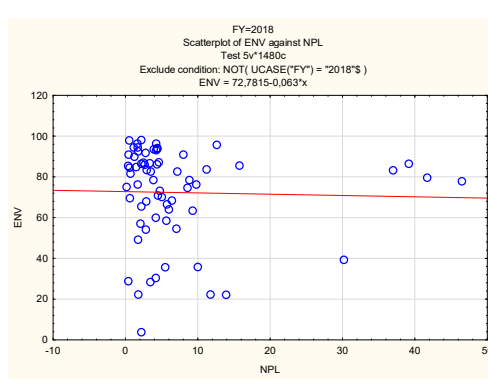
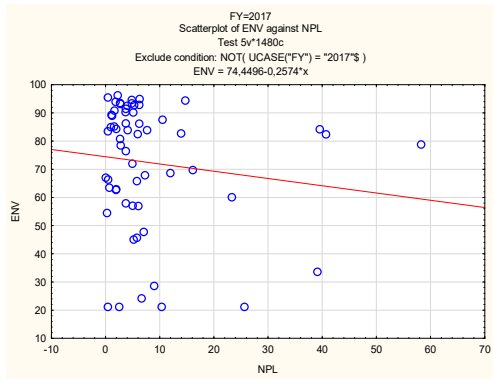


Source: europa.eu/eurostat

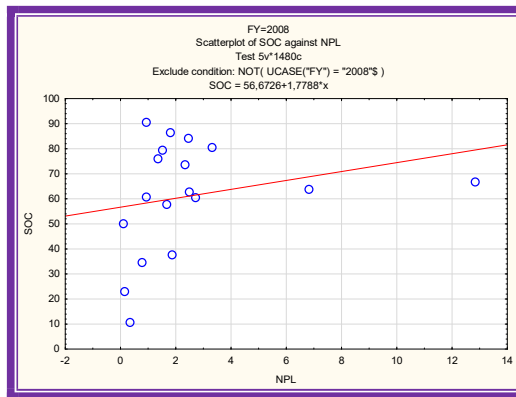
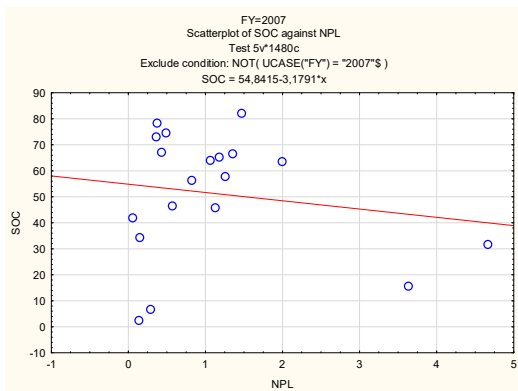
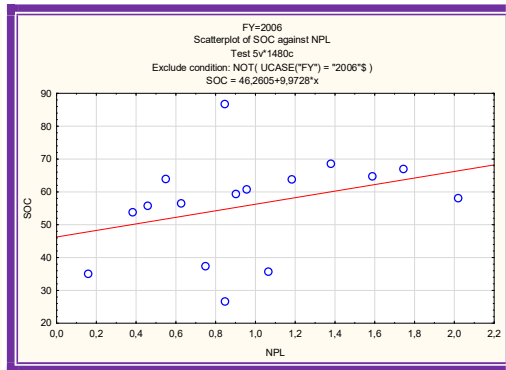
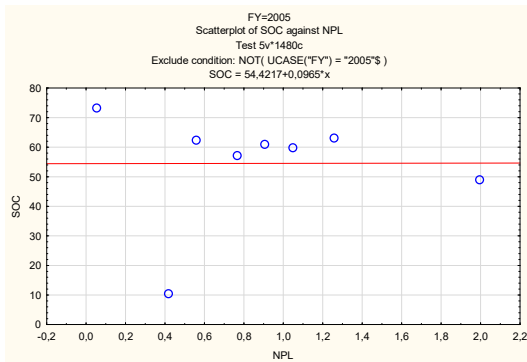
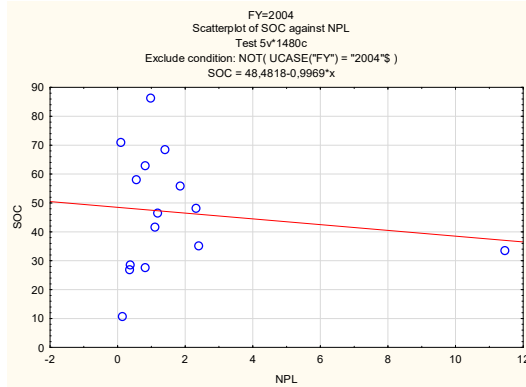
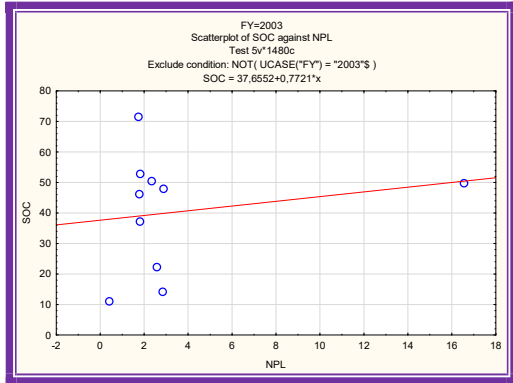
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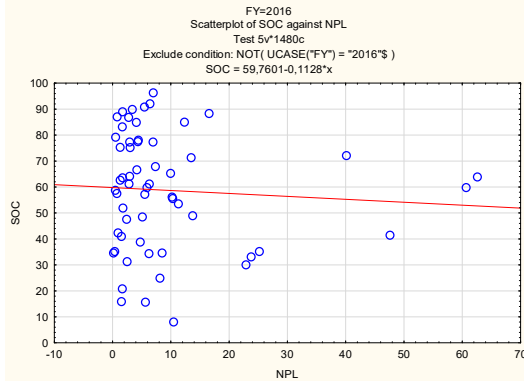
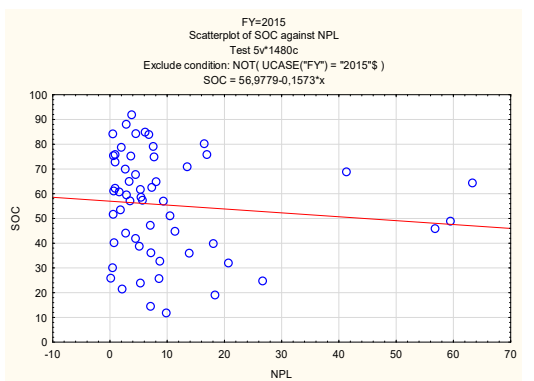
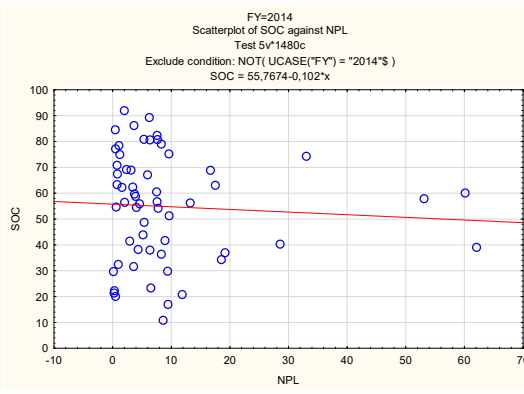
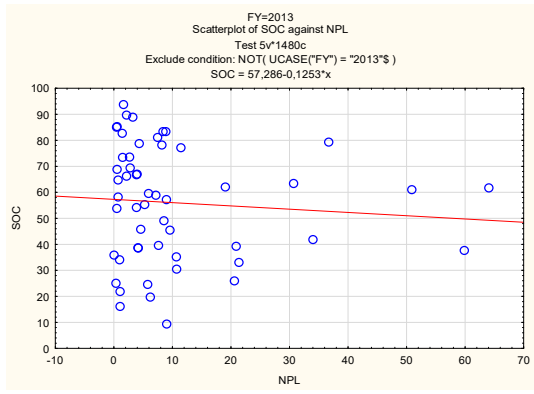
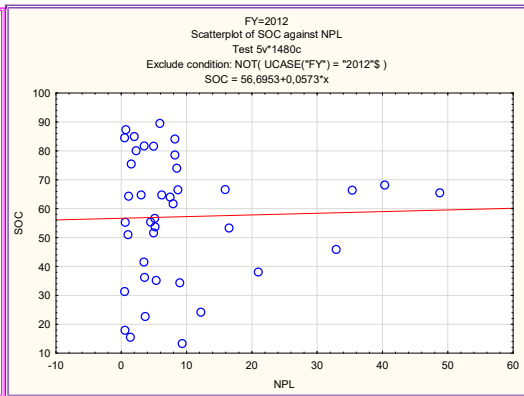
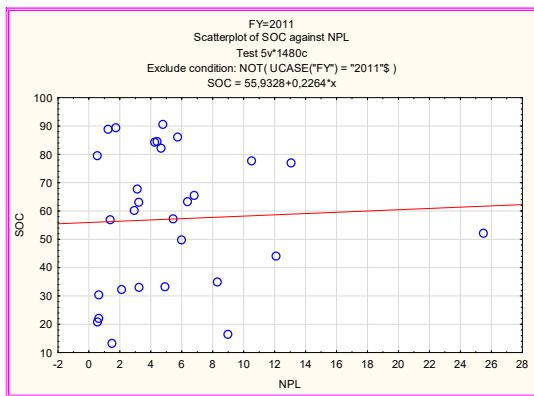
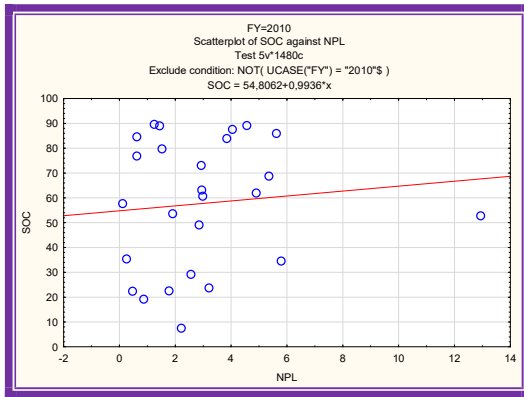
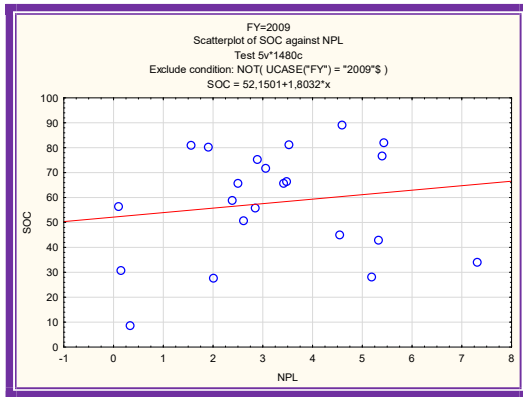


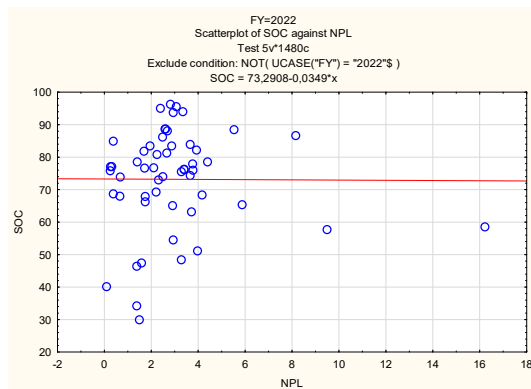
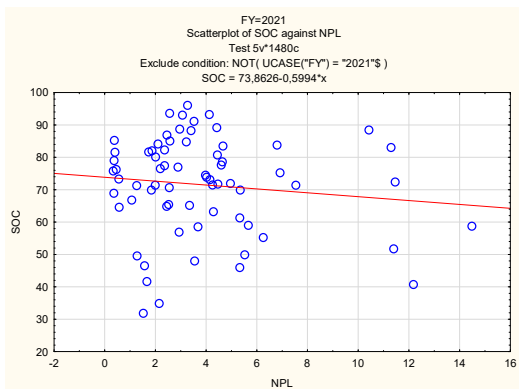
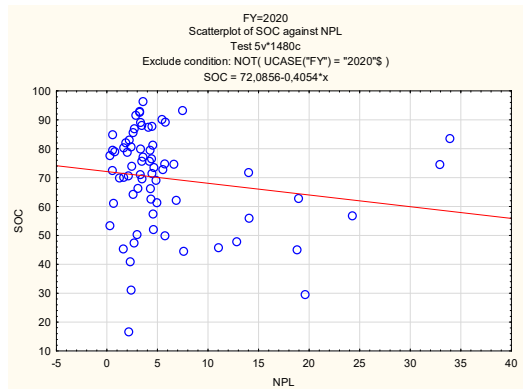
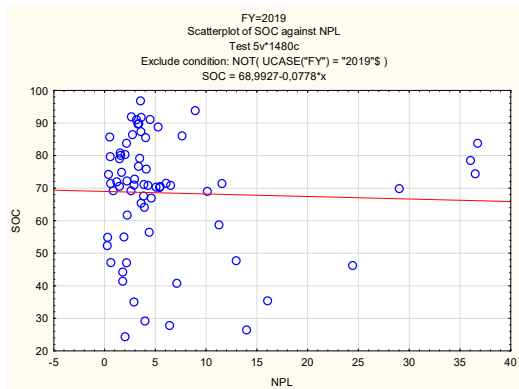
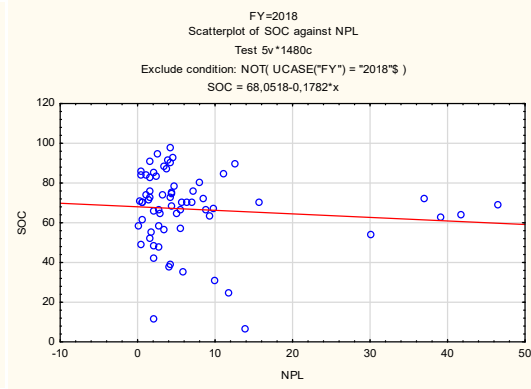
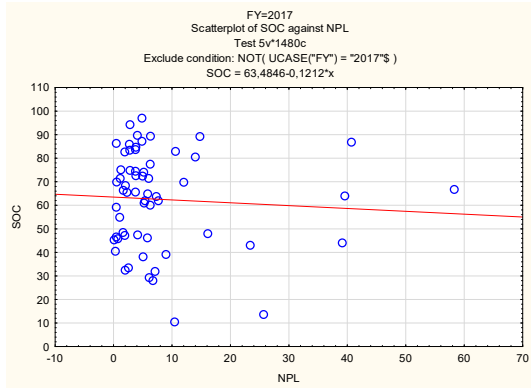




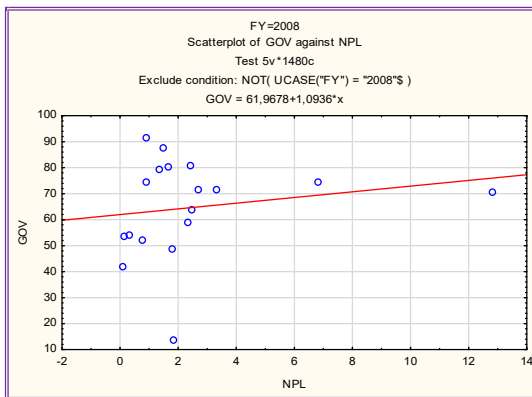
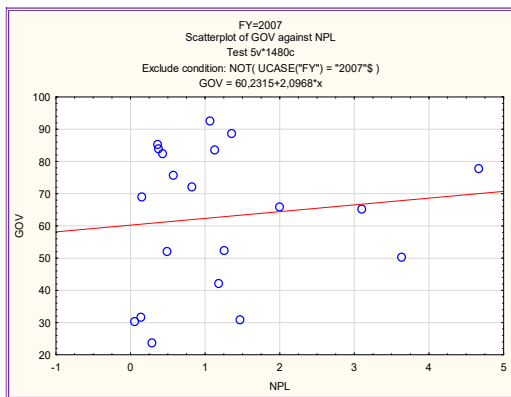
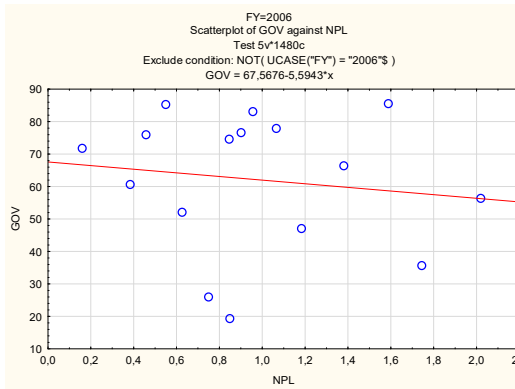
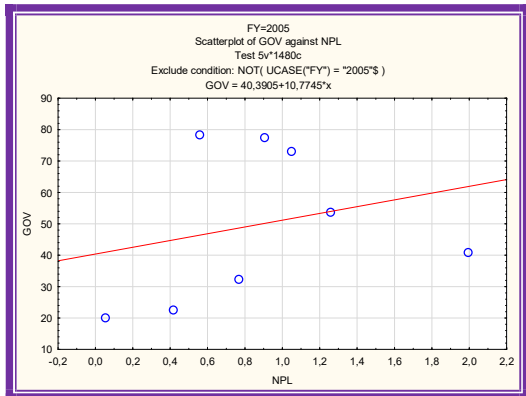
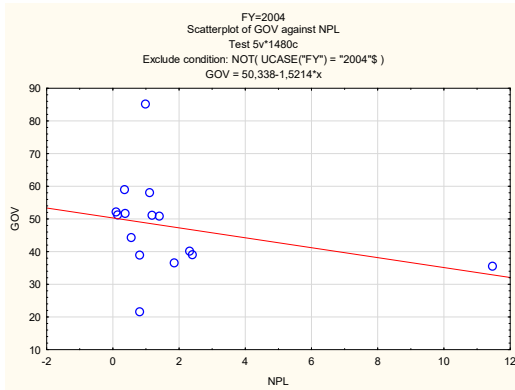
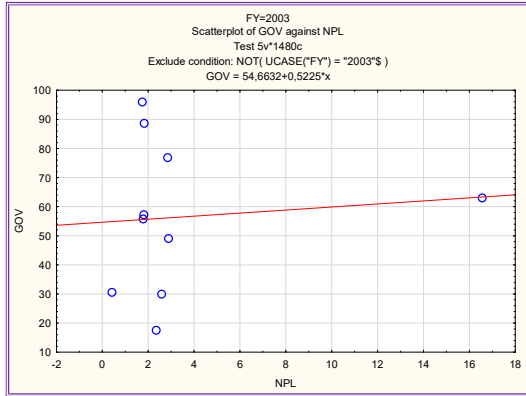
C. Appendix 3: Year by year NPL/SOC

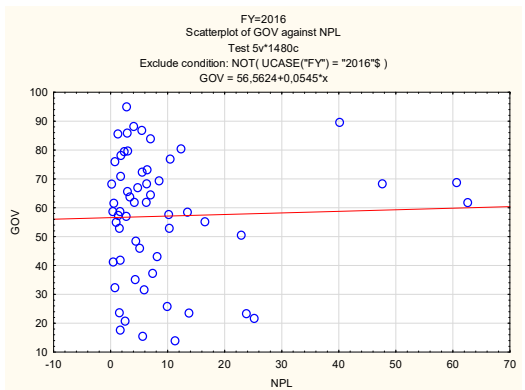
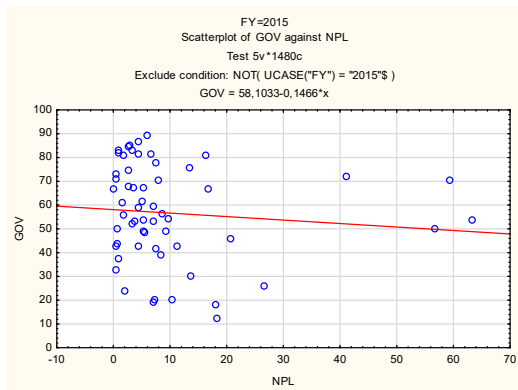
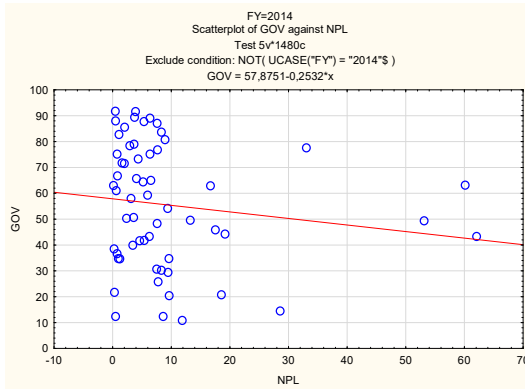
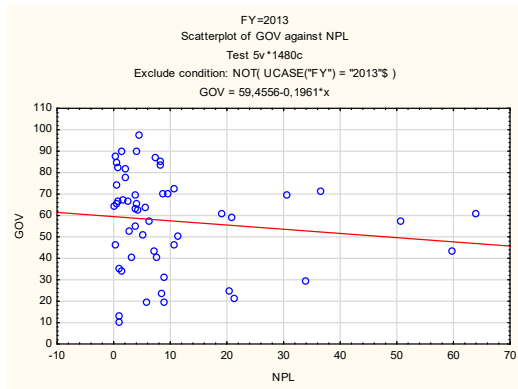
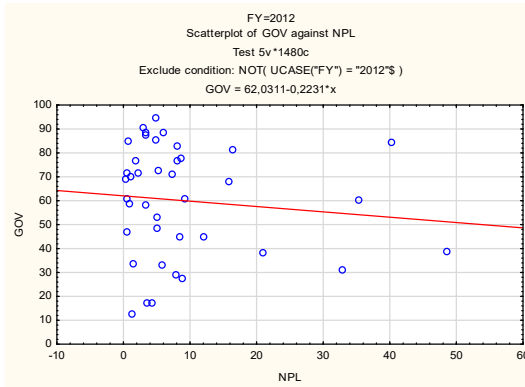
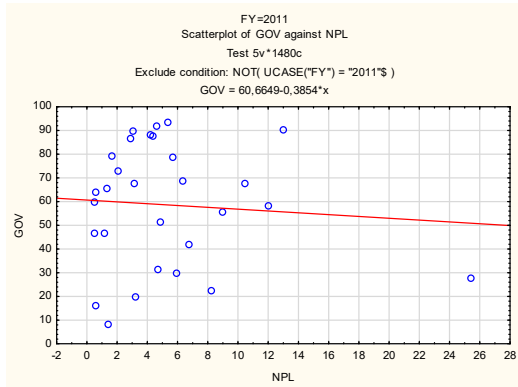
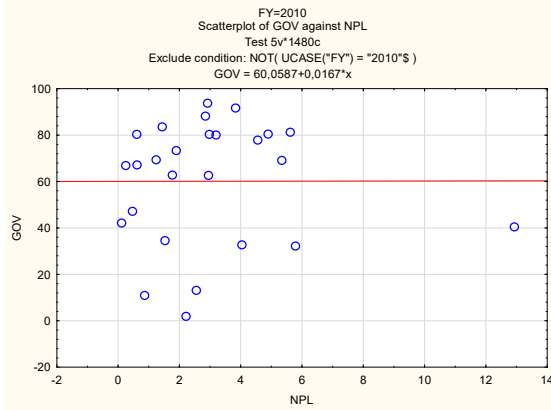
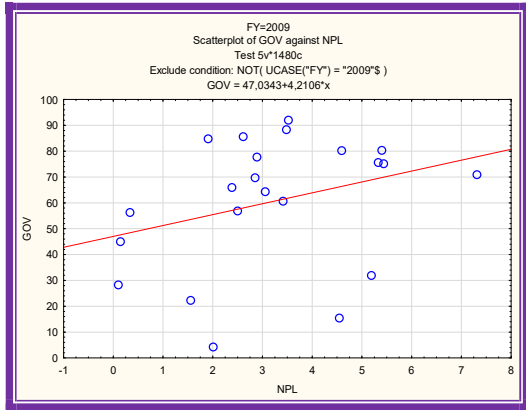


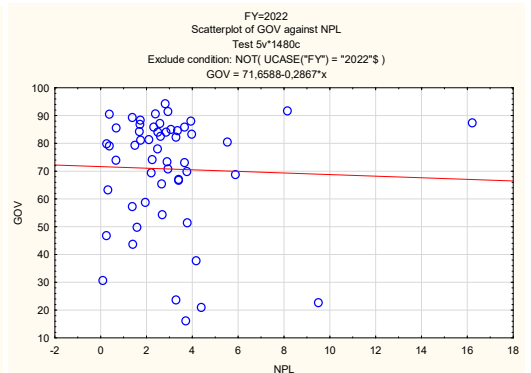
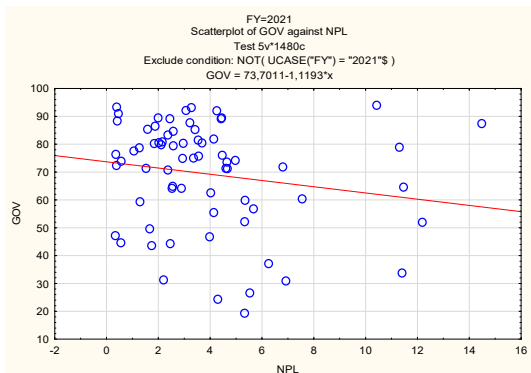
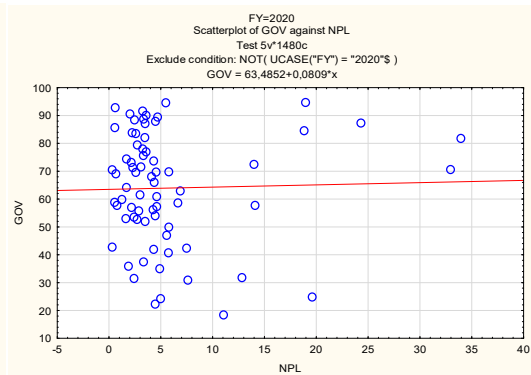
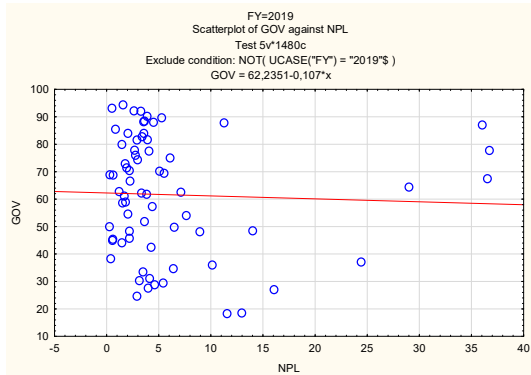
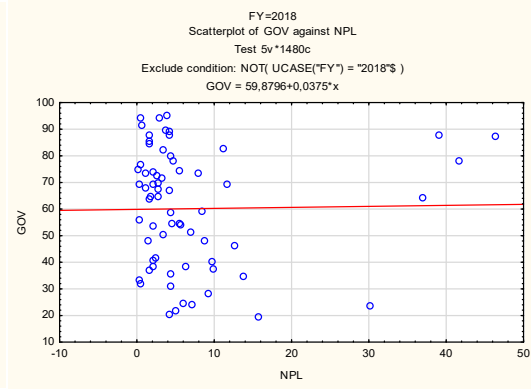
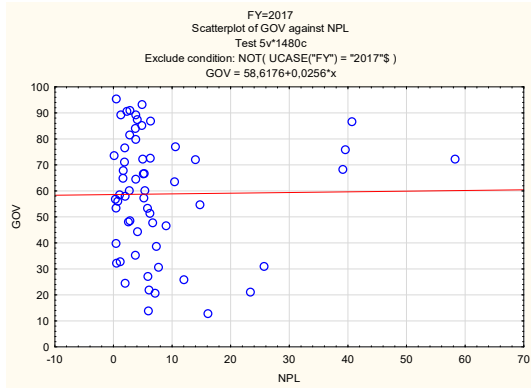




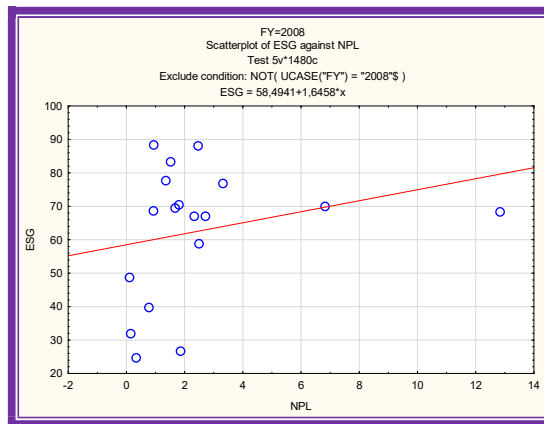
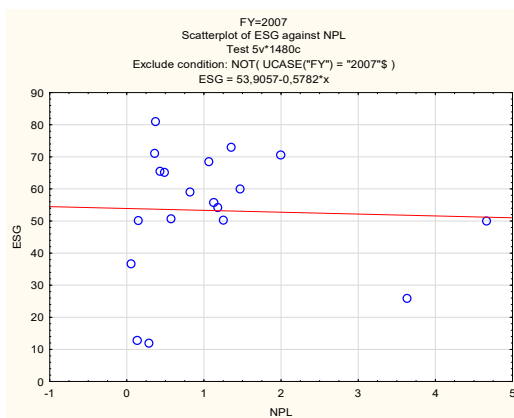
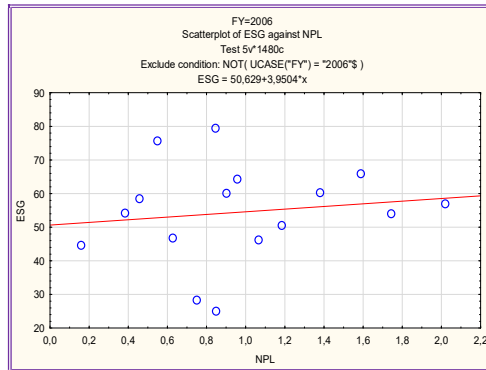
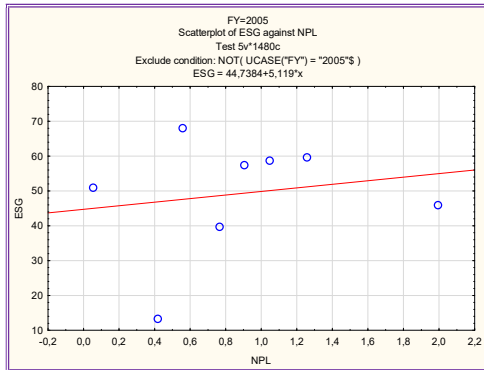
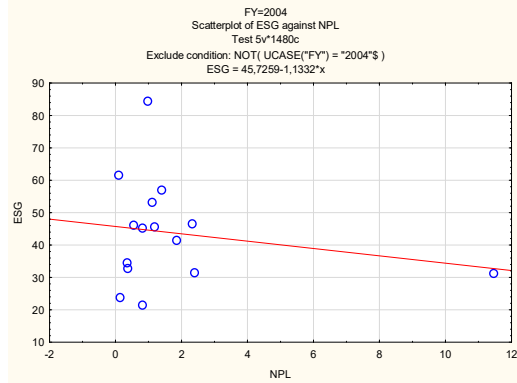
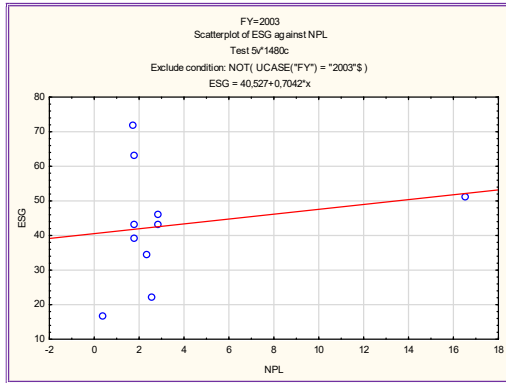
D. Appendix 4: Year by year NPL/GOV

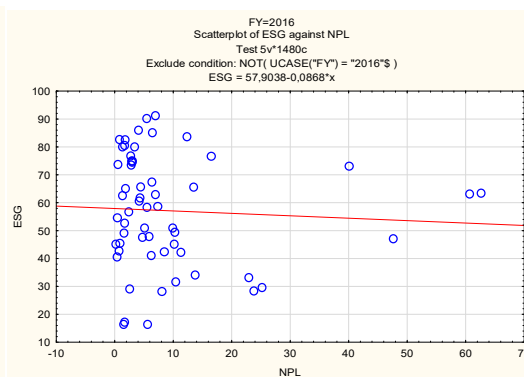
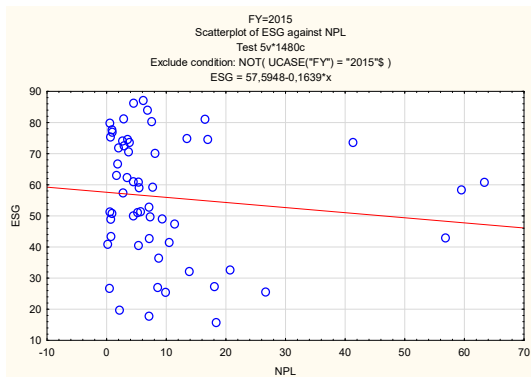
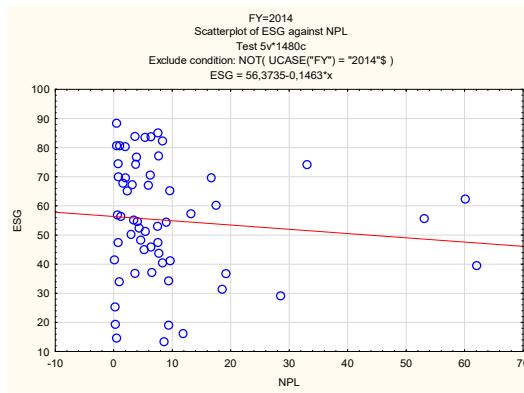
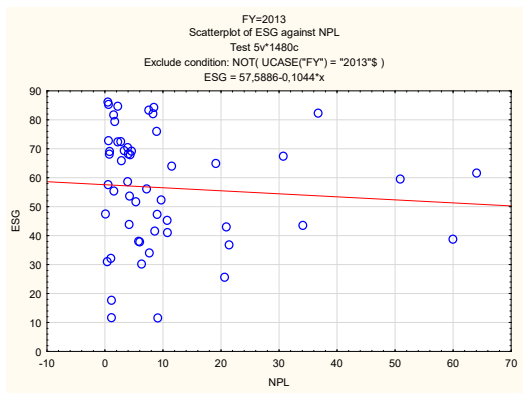
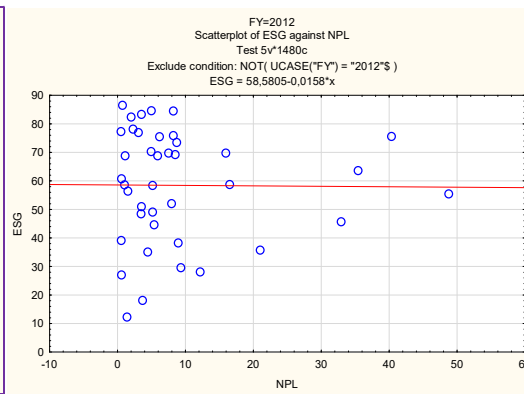
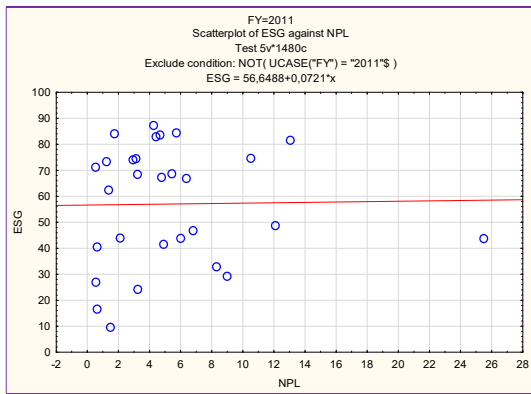
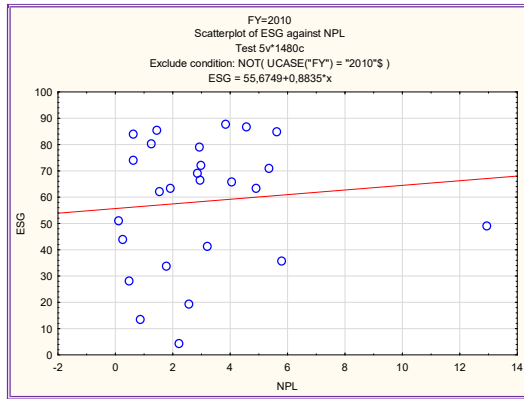
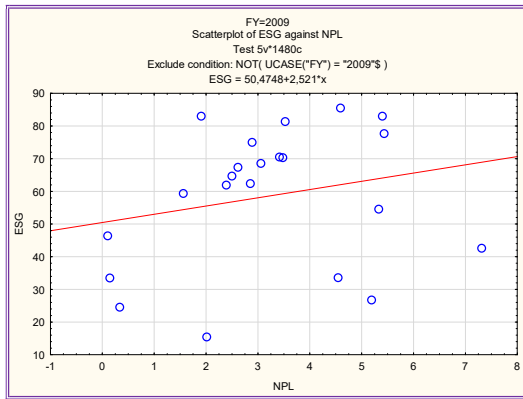


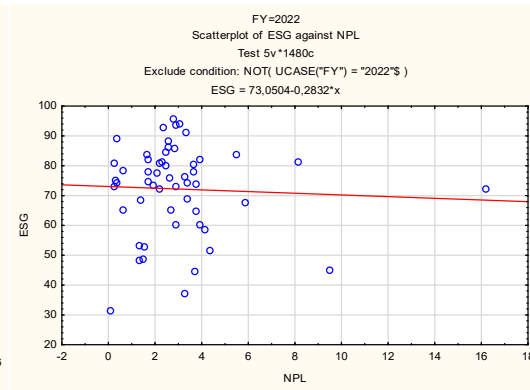
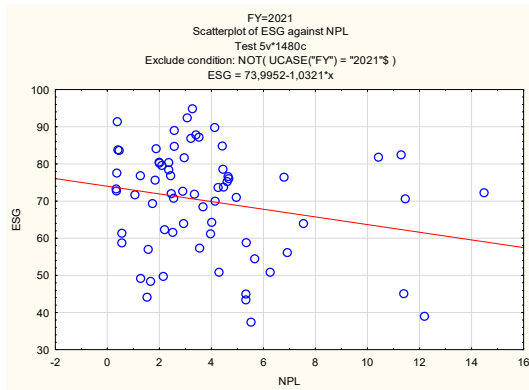
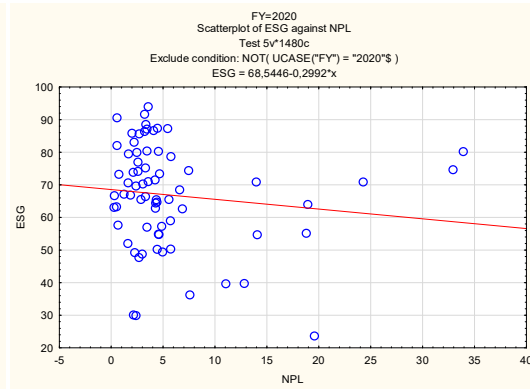
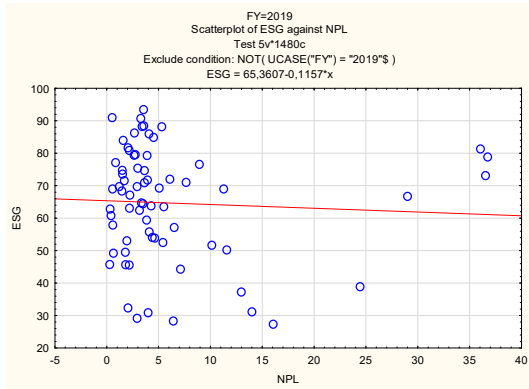
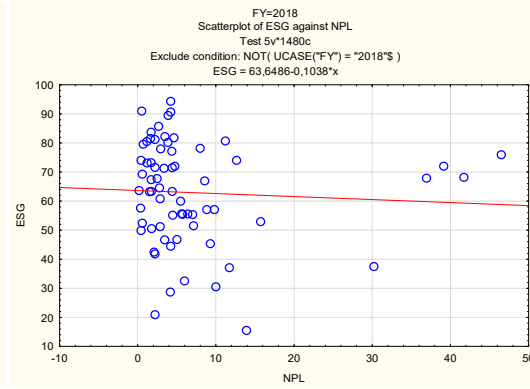
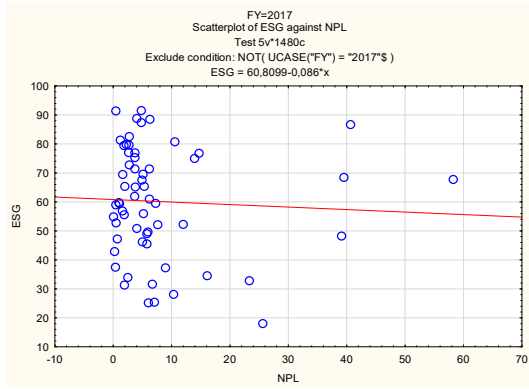




E. Appendix 5: Year by year NPL/ESG







XII. References

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