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"Green Bonds as Catalysts for Financial Efficiency: Investigating Their Impact on the Cost of Capital in the European Banking Industry."

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ABSTRACT

This study examines the relationship between green bond issuance and the weighted average cost of capital (WACC) for 16 European countries between 2012 and 2024. Nowadays there is an increasing emphasis on sustainable development, and the banking industry has rapidly become a focal point for examining how environmental initiatives impact the financial performance in general and the risk specifically. This thesis involves both bank-specific variables – such as size, profitability, capital adequacy ratio and credit rating – and green finance indicators, including the binary variable green bond issuance and the country-level sustainability index. Panel data were used and every Gauss-Markov assumption was verified in order to ensure the robustness of the database which was used to reach numerous conclusions. Data were sourced from official bank reports, sustainability platforms, and rating agencies and then they were all analyzed using EViews 12. The results confirmed that green bonds issuance is typically linked with lower costs of capital, supporting the hypothesis that sustainable practices reduce the banks' perceived risk. This research provides helpful insights for policymakers, investors, and the general public.

Key Words: finance, green bonds, sustainability, WACC, banks.

CHAPTER 1
INTRODUCTION

1.1 Introduction

In this chapter, an overall summary of the paper is presented along with the respective elaboration for every part of it. It begins with a comprehensive background of the banking industry throughout the years, emphasizing the significant relationship of this endless field with the cost of capital and sustainable finance - both of which have been key focal points over the past decade. The following subchapter provides a general overview of the concepts before narrowing to Europe, which is the primary area of study. Then, this paper continues with the problem statement subpart, which will deeply explain the research question and will briefly demonstrate the conflicting views in the actual financial literature. Thereafter, the purpose of this research paper will be thoroughly discussed, both in terms of the motivation behind this study and in terms of the significant contribution that it will add to the existing research. This section will be complemented by the research objectives, which are fundamental to guiding the study forward. The subsequent part will be dedicated to the scope of this paper, and more specifically it will justify the geographical and company type selection. The last section of the Introduction Chapter will elaborate on the organization and the structure of this paper with a special focus on the methodology. This part will briefly explain the data gathering strategy, selection criteria, robustness tests, and the corresponding results.

1.2 Background: Banks, Green Bonds, and the Case of Europe

Traditionally, the banking sector has played a crucial role in sustained economic growth and development. Banks are tightly integrated with the broad economic system, thus influencing its stability and proper functioning. (Tomuleasa, 2017). These institutions play numerous irreplaceable roles in the financial system. Firstly, banks create money by lending to potential clients. This has paramount importance for economists, as this activity, called credit-based money, is totally distinguished by commodity-based money, used in previous systems which utilized gold, silver etc. (Silviu, 2022). A robust banking system has a vital relevance in channeling excess funds from individuals or entities that have a surplus to those that have investment opportunities but lack financial means (Harbi et al., 2022). This efficiency in the reallocation of financial resources leads to lower transactions costs, asymmetric information, and also reduces income disparities.

One of the key concepts used by economists to understand the economic impact of bank lending is the "Multiplier Effect Theory". According to this theory, the lending activity of banks generates broader economic benefits by creating jobs, increasing income, and stimulating further economic opportunities. In addition to lending, banks play a critical role in providing liquidity through the transformation of illiquid assets into relatively liquid liabilities, that can offer immediate funds access to depositors (Berger et al., 2020). Through the implementation of strategic actions such as derivatives and diversification, banks can mitigate several risks such as credit, solvency and liquidity ones. The management of such risks is not only fundamental within the banking industry, but also in the wider sphere. Nowadays, banks are embracing more and more digital innovation, such as FinTech and digital banking, helping clients of all ages adapt to this rapidly changing environment. Moreover, in the absence of the banking sector, new initiatives and business opportunities would be available only to individuals with pre-existing wealth (Ehlers & Villars, 2023). This explains the fact that historically, the banking sector is considered the barometer of the financial perspective for a specific country.

Nevertheless, the role of the banking industry differs from country to country. In the context of Europe, banks and credit institutions are the main sources of funding, while in the United States, the significance of banks is less pronounced, as funding is mainly done through other financial intermediaries, such as hedge funds, pension funds etc. (Silviu, 2022). Stehnei & Korol (2020),

confirmed that, undoubtedly, European banking system is crucial in the world market economy, due to the fact that its components are major banks of the European Union. This system is composed by a wide range of institutions, starting from small savings banks to large multinational corporations. Among the last category it is worth mentioning banks like HSBC, Deutsche Bank or BNP Paribas, all of which give an utmost contribution to the global financial system. This diverse system is regulated by two well-known authorities; specifically, European Central Bank (ECB) and European Banking Authority (EBA), that ensure stability and compliance across all member states. European Central Bank has a pivotal impact in shaping the monetary policy in Europe, controlling inflation and supporting economic stability. An important role played by the ECB is the Lender of Last Resort (LOLR). This occurs generally during crisis periods, when liquidity is needed in order for the banking system to remain stable. When talking about the European Banking System, the concept of Single-Market Union cannot be neglected. This concept allows for a free movement of payments, capital, and services across all countries. According to Pitoska & Lazarides (2014), European Banking System has faced numerous challenges throughout the years. One of them was the 2008 global financial crisis, which was the reason why Basel III Framework was implemented (Goddard et al., 2009). This reform aimed to increase capital requirement and to reduce the systemic risk. For instance, certain buffers were added to the capital requirement for some of the most important banks due to their extreme importance in the economic cycle. In this manner, Basel III Reform eliminated the risk of the Domino Effect – where the failure of one major bank can trigger a huge reaction in the whole system (Cifuentes et al., 2025).

The weighted average cost of capital (WACC) of a certain bank is a widely used benchmark to practically assess investment opportunities (Carluccio et al., 2018). Consequently, it is a key topic in the banking industry. This metric determines the average cost of financing through both equity and debt. Based on the respective proportion of debt and equity that the bank has, WACC reflect the required return for investors. Mathematically speaking, the weighted average cost of capital is calculated according to their respective shares in the bank's capital structure. The cost of debt, generally denoted as R_d, is the interest that the bank must pay on borrowed funds. The tax rate plays a crucial role in the WACC's formula because it adjusts the cost of debt to reflect the tax shield gained from interest payments on their debt. Therefore, the effective rate will normally be lower than the nominal rate as the bank or any company will reduce the respective tax liability through the interest payments. The second component is the cost of equity, which is denoted as R_e.

This represents what the shareholders require from the company or the bank resulting from their investment there. As it will be thoroughly explained below, a theory closely related with R_e is the Risk and Return Theory. The cost of equity in a sense displays the risk that the investor perceives in a specific company that he/she will invest in. Therefore, the higher the risk perceived, the higher the cost of equity and, consequently, the higher the overall cost of capital. The relevance of WACC stands in the fact that it can guide strategic decisions and evaluate potential investments. For instance, if the return on a project is higher than the cost of capital, the project is value enhancing. This parameter is significantly important in Net Present Value (NPV) and Internal Rate of Return (IRR), two widely known investment assessment techniques.

There are numerous theories that relate to the weighted average cost of capital parameter. Firstly, the most well-known one is that of Modigliani and Miller dated around sixty years ago (Chen, 2021). This theoretical proposition is widely accepted among researchers. Modigliani and Miller showed that the value of a specific corporate is not correlated with the capital structure. Therefore, there should exist a distinct cost of capital independent of the capital structure. After the development of this esteemed theorem, the value of a firm can be calculated by its respective future cash flows discounted at a single discount rate, which includes both debt and equity, and this is the WACC. Logically, the value of the firm should be the same value as the sum of equity and debt (Chen, 2021). Secondly, Trade-Off Theory is highly relevant when discussing the weighted average cost of capital. According to this perspective, a certain company aims to create a balance between the financial distress caused by borrowing and the tax advantage that it offers. Due to the fact that interest payments are tax-deductible, a higher leverage can lead to lower WACC and therefore, higher firm value. However, this holds true up to a certain threshold. After this cut-off point, the negative effect will be predominant (Nicodano & Regis, 2019). Lastly, according to Pecking Order Theory, firms follow a hierarchy in choosing their source of financing. Initially, they prefer internal funds, then debt and the last choice would be issuing new equity. The reason behind this choice is related to higher asymmetry in information and higher transaction costs (Frank & Goyal, 2003).

Nowadays, sustainability has become a central focus in every sector, including the finance and banking industry. Green finance - frequently represented by green bonds - is considered a key mechanism for the transition toward more sustainable operations and for funding environmentally

friendly projects. Undoubtedly, green bonds are one of the most impactful financial innovations in the area of sustainability over the last decade (Maltais & Nykvist, 2020). These instruments are structured in the same manner as other traditional investment grade bonds. The thing that differentiates the two is the purpose, because green bonds are used to finance green investments only. The buyer of a green bond will have access to the issuer's balance sheet, meaning that the investor will not be directly exposed to the financial risk posed by the respective green project (Maltais & Nykvist, 2020). The first green bond was issued by the World Bank in cooperation with the Swedish Bank SEB in 2008. The green bond market is small but since then has been rapidly growing. Two theories relevant to Green Finance are: Corporate Social Responsibility (CSR) and Socially Responsible Investing (SRI). These two theories are considered fundamental in explaining the bottom-up growth of the green bond market. According to Maltais & Nykvist, 2020, there are three main categories of motivations for engagement with sustainability practices. Firstly, and the most direct one, is called "Straightforward Financial Incentive". For an investor, there is a considerable financial incentive in the case that the bond provides a lower risk, a better return or a better diversification than other comparable bonds. Another incentive may relate to large institutional investors, that have broad exposure to the economy. They can strategically engage in sustainable projects in order to shift investments away from those that pose economic risk. The second reason that motivates investors to engage in green bonds is called the "Business Case". This is also referred to as the non-financial incentive, because the core idea of this is to enhance the brand value to attract customers and to create new opportunities by reducing potential risks. The third and last motivation is called "Legitimacy, Institutional and Stakeholder Theory". This is not related to immediate gains, but it states that firms face societal and institutional pressure to comply with sustainable practices. The alignment with these norms, guarantees better reputation, long-term viability and also a competitive edge.

In *Chapter 1.2 Banks, Green Bonds, and the Case of Europe,* we provided a deep and comprehensive background of the four pillars of this paper: banks and their role, European Banking System, WACC – concept and its implication, and Green Bonds.

1.3 Purpose Statement

1.3.1 Motivation

Recently, continuous and major alterations in market factors and respective policies have a significant impact in the European's banking industry. During the last century, banks are not only regarded as lending institutions, thus their role is multifaceted (Tomuleasa, 2019). Especially the European banking system has always been considered strong but rapidly changing, and this has been translated as a higher risk for investors that want to enter the market. Moreover, the last decade's headline has been sustainability, and the wide public has become more and more intrigued about it. According to Fatica et al., (2021), financial institutions, especially banks, are undeniably the major players in the green bond market. It is noticeable that both sides of the balance sheet are becoming greener. However, it is yet unclear how this 'greening' changes the risk level of the bank. In addition, it has become clear that investing in green projects does not necessarily shift the attention from high-polluting sectors. This makes decision-making more dilemmatic and opaquer.

Therefore, the purpose of this research is to provide an in-depth analysis of the relationship between banks, green bonds and their riskiness represented by their average cost of capital. This will be studied under the umbrella of the European institutions, due to the great attention that is dedicated to them. Even though more and more authors are interested in exploring the green finance area, there remains a noticeable gap in understanding the relationship between green bonds investments and the riskiness behind this action, especially in the European context.

This research aims to fill this existing gap by addressing the overall factors that impact banks' capital costs and risk levels, with a specific focus on the green bond issuance's impact. Given the increasing importance of sustainable investments, it is of paramount importance to create a bridge between the risk of an investment, which is also related with the return, and the green investments.

From a personal perspective, my interest in both banks and sustainability drives my interest to investigate further how financial institutions, specifically banks can contribute through bond

issuance to achieve global sustainability goals. This paper will provide some helpful insights on how green bond issuance influence the weighted average cost of capital of banks and therefore how the risk profile of that respective bank will change. This analysis of the financial risk related to green bond issuance will guide policymakers, potential investors, and the mass public to better understand this relationship in the current shifting landscape. Furthermore, this study aims to fill the gap in the existing literature and also inspire future researchers to explore deeply this area, because its importance is growing rapidly.

1.3.2 Significance of the Study

There are currently no studies that scrutinize the relationship between green bond issuance and the weighted average cost of capital for the European case. There are several areas of improvements in the existing literature. Firstly, studies which consider the same topic, are focused in the United States, because it is considered as more developed in sustainability in general and green bonds specifically. Secondly, regarding the time frame, no previous study has taken into consideration recent times. Contrarily, this paper consists of a panel data analysis for the last 13 years in order to bring an insightful perspective of actual matters. The third pillar in which this study differs from the rest relates to the variables used. There are few studies that combine bank specific variables, such as size, total assets, CAR ratio, etc. and environmental variables. Moreover, the regressors used to capture the green finance involvement are quite innovative, enhancing even further the significance of this paper. For the abovementioned reasons, this study adds value to the existing literature and fills any potential gap in previous papers. We expect that this research will be helpful for upcoming studies, as well as to serve as supportive information for financial institutions. Hopefully, this work will be beneficial to policymakers and employees of the banking sector.

1.3.3 Research Objectives

There are numerous objectives that this paper aims to achieve. The primary one is to shed light and further analyze whether green bond issuance affects the cost of capital for banks, and if yes, in which manner. Furthermore, this research will also consider other internal and external factors in order to better understand their impact in the riskiness and cost of capital of banks. Through this combination, robust results are expected to be achieved. In order to accomplish the above-mentioned intentions, this study will be based on a few sub aims:

- To identify significant factors that affect European banks' cost of capital in recent times.
- To investigate how the involvement of banks in green bonds affect overall riskiness of banking industry.
- To identify whether there exists a correlation between green bond issuance and bank's internal factors.
- To interpret the sign and magnitude for all variables used in the regression model (bank-specific and environmental ones).

1.4 Scope of the Study

Whilst many studies have been made regarding banks' riskiness and green bonds or green finance in general, this relationship seems still vague and poorly understood. The aim of this research project is to examine this interdependence in the European Framework, where there is a lack of studies even though many European countries have taken the lead in green finance. The study is quite comprehensive, as it focuses on both developed countries in the sustainability area and on those that are considered neutral. Among developed ones we can mention France, UK and Scandinavian countries, while in the other category, we can mention Greece and Hungary. However, approximately 35 banks will be considered for this study, making the sample space quite exhaustive in order to achieve reliable conclusions. The time frame is from 2012 until 2024, thus we are dealing with panel data. This choice will certainly be an added value since the existing empirical researches regarding banks' riskiness have been made a long time ago, while for green bonds there are few. In order to be as inclusive as possible, aiming to identify the exact interrelationships that affect bank's WACC, both bank specific and environmental variables are included. Excluding one of them would be insufficient to analyze the true situation nowadays, when green finance is one of the hotly debated topics. Bank Specific variables include size in terms of total assets, profitability, credit rating, and CAR Ratio while environmental factors include the dummy variable Green Bond Issuance and the Country Sustainability Index. Macroeconomic factors are disregarded since the time frame is the same for each country and therefore, since every country is a European one, conditions are the same for such countries. Most importantly, our aim is to see how green finance impacts the WACC of banks and how is this environmental element linked with internal factors of a bank.

1.5 Methodology and Organization

As previously mentioned, the main purpose of this study is to study in depth the correlation between green bond issuance and riskiness (captured by WACC) in the banking sector. But before concluding a final econometric model, there are several phases that we have to go through. The first stage and probably the most crucial one is the literature review. The objective in this phase is not only to summarize what other authors have found about the topic of our interest, but also to find any potential gap in their reasoning and/or organization and try to fill it up in this study. Naturally we would aim to somehow organize other authors' opinions in some sub-groups. The upcoming phase requires the selection of variables that will be used in the final regression model. Regarding the data gathering, we use secondary data retrieved through official annual reports of each respective bank, and the two variables used for green finance, they are obtained from official pages of green finance. Lastly, data are analyzed through the statistical software EViews 12. Many robustness tests are conducted in order to ensure that the database is sound and unbiased. The study will be concluded with the interpretation and possible explanation for the impact of each variable included in the regression equation. In the end, conclusions will be summarized and recommendations will be given for policymakers and for the general public.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The second chapter of this thesis begins with a comprehensive overview of the broad and frequently discussed concept of Green Finance, with particular attention to Green Bonds. Both their definitions and implications will be described, thereby enhancing the coherence and clarity of this chapter. The subsequent subpart is dedicated to the interrelation between banks and green finance. This will be deeply analyzed using the relevant reviewed literature. Nowadays, the banking sector is considered a mechanism to bring together economic advancements and environmental conservations, thereby increasing socially responsible initiatives (Zhang, 2022). Thus, investigating this relationship is of paramount importance for all interested parties. The next subchapter similarly scrutinizes the interconnection between green bonds and one of the most important parameters in the banking industry, the weighted average cost of capital. This relationship can be complex and multifaceted; therefore, authors have given numerous interpretations, sometimes even conflicting perspectives regarding the aforementioned correlation. Nevertheless, in the broad sphere of WACC's determinants, authors have agreed that green bonds have an undeniable influence. In the rest of this part, each independent variable, including both those that are bank specific and those related to green finance, will be examined.

2.2 Green Finance and Green Bonds – theoretical background

According to Agirman & Osman (2018), sustainable development as a concept was initially introduced almost a quarter of a century ago with a main aim to reconcile the economic, social and ecological dynamics. This development is tightly and directly linked with a proper utilization of financial resources. The two authors mentioned above agreed that green finance is a phenomenon that combines the world of finance and environmentally friendly behaviors. However, it is important to notice that a single and widely-agreed definition is not yet available. Different researchers and organizations adjust their interpretations based on the scope of their activity. For instance, OECD mentioned that green finance is essentially traditional financial activity aiming to achieve economic growth while reducing pollution and greenhouse gas. Green finance is a wide concept which covers three main elements (Agirman & Osman, 2018). Those include: the financing of public and private green investments, the financing and implementation of green policies, and also the green financial system. On the other hand, they suggest that the concept of green finance is tightly linked with sustainable development, and the latter term is the development that meets the needs of the present without risking the ability of future generations to meet their own needs. However, there are some requirements that countries need to accomplish in order to fulfill the mission of sustainable development. For example, the political system needs to secure effective participation of the citizens, the economic system needs to be sustainable, the technological system needs to be continuously evolving and so on.

Numerous countries all over the world, including Brazil, China, France, Indonesia and others have implemented green finance and are committed to invest even further in it. This paper is concluded by providing certain recommendations that countries need to follow for a smooth implementation of green finance objectives. Among them, Agirman & Osman (2018) suggested that worldwide collaboration must be ensured so that countries support each other for technical, financial, conceptual issues and so on. Furthermore, continuous innovation and new ideas must be developed and new alternatives in green finance must be encouraged.

Ozili (2023) focused on green finance also known as sustainable finance, but in contrast from the first paper analyzed, he focused not on the definitions but on the six main theories which, according

to him are fundamental in comprehending this concept. The first theory is called *"The Priority Theory of Sustainable Finance"*. According to this theory, the extent of economic agents' efforts to achieve 'green finance' goals is a true and accurate reflection of the priority given to the sustainable finance. This priority can be evaluated based on three main criteria. The first one is how coordinated and collaborative the efforts are, the second one is how quickly or slowly the consensus is reached, and the last one is how quickly or slowly the actions are taken. The second theory that Ozili (2023) identified is called *"The Peer Emulation Theory of Sustainable Finance".* This theory supports the idea that uniform standards are absent and therefore economic agents have no choice but to adopt the sustainable finance policies and strategies of the peers that they value and admire the most. This phenomenon is more pronounced between economic agents who share the same political, societal and economical ideologies. Authors are optimistic about this as it promotes shared values, facilitates quicker adoption to the policies, identifies the flaws in the existing models, corrects them and fosters collaboration rather than competition. However, the author also mentions a major drawback of this theory – the loss of originality and inefficiency in adopting policies without considering different market characteristics. The *"Life Span Theory of Sustainable Finance"* suggests that the interests of economic agents depend on the life cycle of the sustainable finance products. The most important moments are: the introduction, growth, maturity and the decline. Agents use this analysis in order to determine whether to make a commitment or not, and if so, whether it should be a short-term or a long-term one. This theory explains the demand for many important instruments, such as the green bonds, which will be deeply discussed in the rest of this chapter. However, the author noted that this theory can be ineffective in case the agent provides inaccurate predictions about the life cycle of a product. *"The System Disruption Theory of Sustainable Finance"* argues that the orientation toward sustainable finance can potentially disrupt the traditional financial system and the businesses will undoubtedly be impacted negatively. Therefore, in these circumstances, economic agents need to conduct a rigorous assessment whether advantages of green finance outweigh costs of the disruption of the traditional financial system. This theory highlights the importance of information disclosure regarding the scope and the process of the transition. An evident flaw of this approach is that it assumes that green finance is better than the traditional one, it disregards the fact that the two systems can coexist and complement one another. This section is concluded by deeply explaining the last theory, the *"Positive Signaling Theory"*. According to this theory, different agents disclose

and promote their sustainability goals in order to attract potential investors. The most frequently used channel to do this is via public announcements. Therefore, the most evident advantage of this theory is the reduction in the information asymmetry between firms and investors, while the drawback is that the intention of the announcement may be to distract the attention from negative situations.

Bagh & Iftikhar (2024) mentioned that green finance has emerged as a pivotal force, and it serves as the main mechanism in addressing global environmental challenges. However, green finance is much more than just a simple concept, it involves a wide range of financial goods and services to support the so called "green projects" and reduce climate risks. Numerous institutional frameworks are now developed through green finance policies aiming to attract private investments into eco-friendly fields such as renewable energy and preservation. However, these authors criticize in a sense the green finance concept. According to them, this term shall include a wide range of environmental challenges, but now it is commonly used to fund reductions in greenhouse gas emissions. Therefore, there is an increasing need for a more comprehensive and multidimensional approach to financing that includes all environmental, societal and economic factors. International agreements, such as Sustainable Development Goals (SDG) and the Paris Agreement rely heavily on green finance to achieve their goals. New channels for financing eco-friendly projects have emerged, including here green bonds, the focus of this paper, but also certification systems and loans linked to projects relating to sustainability.

Similar views are shared also by Dhayal et al. (2025). Their study addressed a significant gap in the available green finance literature. Even though this area has remarkably evolved since the 90's, the terms are still inconsistent among institutions and academics. This paper began with a bibliometric approach in order to map the evolution of green finance throughout the years. Particular attention was paid to reputed organizations like UN, OECD, and ADB. Afterwards, in the textual analysis stage, Python Programming Language was used to clean and process the definitions that are available. It was concluded that ten common dimensions were found and they were respectively: *Environment, Sustainability, Energy, Finance, Economy, Institutions, Technology, Green, Society,* and *Sectors*.

Rai & Lin (2024) focused their green finance study in two categories: sustainable finance for developed countries and for developing countries. Thereafter, they considered China, as a representative case to investigate the correlation between green finance and green innovation especially in the spectrum of corporate risk-taking. The time frame was from 2008-2020, and the paper concluded that green finance positively influences green innovation but the effect is significantly shaped by the respective firm's risk-taking behavior. This paper provides some important practical insights for regulators who aim to create a balance between economic growth and environmental concerns.

Bhutta et al. (2022), distinguished their study from the above-mentioned authors by focusing specifically on green bonds as the most impactful financial instrument, rather than defining the broad concept of sustainability or green finance. These bonds are designed to raise sufficient capital for projects that aim to reduce carbon emissions and promote sustainability. Green bonds are recognized also by Green Bond Principles (GBP) in 2018 and also by prestigious platforms such as Bloomberg. Despite the promising mission of green bonds, they still appear to be ambiguous from investors' perspective and concerns persist regarding their risk and commercial viability, especially as they are still in the early stages of development and the returns that they yield are yet uncertain. For these instruments to succeed, transparent verification, reliable frameworks and investor confidence are crucial. Huge investments are made in technological advancements such as the Blockchain in order to monitor proper fund allocation and to prevent greenwashing. Green bond issuance has an undeniable impact, not only on investors and issuers but also on the general public. Moreover, authors also provided a deep analysis on the impact of issuance on the cost of capital, but this will be discussed in the coming subchapters.

On the other hand, Hachenberg & Schiereck (2018) examined whether green bonds offer better risk-return profiles than conventional or non-green bonds. They did this by analyzing differences in pricing. Conclusions indicated that corporate green bonds generally trade at slightly higher prices, thus at tighter spreads than traditional financing sources. The opposite was confirmed for government green bonds. ESG rating, together with maturity, bond's size and currency affect the price difference.

2.3 The relationship between Banks' WACC and Green Bond Issuance.

As briefly mentioned before, authors have different opinions and approaches when it comes to the effect of green bond issuance on banks' cost of capital. In this chapter, reliable papers will be analyzed in depth, and they will serve as a guide for the upcoming chapter of the methodology.

Muhammad et al. (2025) investigated the impact of green bond issuance on three indicators: cost of capital, market volatility and leverage. The researchers used a global dataset, for numerous banks and firms all over the world for 11 years, precisely from 2012 to 2022. In their methodology part, they clearly explained that they used PSM-DID approach (propensity-score-matching-difference-in-difference). This method proved useful in helping the authors compare the firms that issued green bonds and those that did not. Therefore, the impact of green bonds was isolated on the three financial metrics (Muhammad et al., 2025). This paper concluded that all firms that issue green bonds tend to have a significantly lower cost of capital, both in short term and in the long term. Researchers of this study justified this finding based on improved investor perception and broader access to sustainable investment funds. Moreover, authors stated that green bonds are associated with lower beta values, and this implies lower market risk and pronounced financial stability. This study provided a significant contribution to the existing literature as it is one of the few to use such an extensive database and advanced methodology. Nevertheless, this paper is mostly criticized due to the fact that it considers several firms that operate in different sectors. This has led to broad generalizations because banks are very specific in their nature, and our study will ameliorate this aspect.

Some studies, like the one conducted by Bedendo et al. (2022) mainly focus on the environmental effects of green bond issuance rather than on the financial one. They concluded that financial institutions issuing green bonds more intensively improve the environmental performance by reducing emissions. But these types of papers cannot guide investors for a sound decision-making. Another example is the paper published by Yeow & Ng (2021). In this study, the main focus was the impact of bonds that fund "green projects" on the profitability of the banks. Surprisingly, it was found that the issuance of green bonds has no impact on the metrics such as ROE or ROA.

Furthermore, the authors also addressed the problem of "green-washing", which refers to the situation when companies take advantage of the "green" label without taking any relevant action.

Li & Duca (2024), focused their paper on the direct effect that green bond issuance has on the cost of capital of companies in the energy and utility sectors. Similar to the authors of the first paper that was discussed in this subchapter, they used the DiD (difference-in-difference) approach. More precisely, they compared 191 green bonds and 191 conventional bonds for 19 countries between 2013 Q2 and 2020 Q4. The Synthetic Control Method was used in order to ensure the robustness of the model. The conclusion reached by this study is that issuing green bonds lowers the WACC by 25 basis points. SCM displayed a reduction of the WACC by 24 basis points. The similarity in the two values reassures the reliability of this study. Thus, according to this paper, investors perceive firms that issue green bonds as less risky and they are willing to accept lower returns from greener firms. Two criticisms are valid for this study. Firstly, only the first-time issuance of green bonds is considered, but this paper doesn't explain how the cost of capital can change in the upcoming issuances. Secondly, further tests are recommended to ensure the soundness of the model apart from the Synthetic Control Model.

Another study of paramount importance for our paper is the one conducted by Antti (2020). This paper examined whether green bonds are priced higher or lower than regular bonds and how this pricing affects the valuation of the company. The valuation method used here is the DCF (Discounted Cash Flow model), and moreover authors applied Cumulative Abnormal Returns (CAR) tests to see stock price reactions around the bond issuance date. Conclusions indicate that green bonds carry a pricing premium of around 0.60%. compared to conventional ones, meaning that they are priced higher and offer lower yields. Because investors accept lower yields on green bonds, the issuing company benefits from a lower cost of debt. This decrease leads to a higher valuation through DCF method. Since the cost of debt is one of the two components of the WACC, a decrease in debt leads also to a lower weighted average cost of capital. A lower WACC also implies a lower level of risk, which increases the company's financial attractiveness.

Petreski et al. (2024), investigated whether companies that issue green bonds repeatedly have a lower cost of capital, and apart from this, authors also analyzed the reputational effects associated

with sustainability-linked activities. Swedish listed companies are taken into consideration and the correlation between the frequency of green bond issuance and the change in the firm's cost of capital is examined. Results showed that firms that heavily finance green projects throughout the years, tend to build a stronger and long-lasting reputation. Consequently, investors consider these companies as very safe and not very risky, leading to a decreased WACC. This paper recommends that companies can strategically benefit from issuing non-conventional bonds and build up a better reputation. However, it is important to note that this paper is focused only on the Swedish sector, thus, the conclusions cannot be easily applied to every country.

On the other hand, some studies, in contrast to the ones mentioned before, do not support the idea that green bond issuance can potentially lower the capital costs. For instance, the study conducted by Zhang et al. (2021) which was focused on the real estate sector for Chinese firms between 2016 and 2020, argued that green bond issuance has no impact in the cost of capital of a firm if the issuance occurs only once and it is not done repeatedly. According to their findings, a one-time green bond issuance may not be enough to build investor trust and to alter the firm's risk profile in the eyes of the general public. Without a strong commitment to sustainability actions, investors can remain skeptical about those isolated "green" activities. The principal suggestion of this paper for different firms in several sectors is to be consistent and persistent in green bond issuance activities. Building trust and reputation takes time and requires commitment rather than one single action.

Moreover, there are also papers, such as the one written by Ingemansson & Stjernfeldt (2022), that argued green bond issuance actually leads to a higher cost of capital for firms. Authors in this study analyzed the Swedish real estate market, and they concluded that green finance and particular green bonds are still new concepts and market participants are still skeptical about the implications of green bonds, therefore, they associate a higher risk with green bonds compared to the conventional ones, thus leading to a higher WACC, especially in cases of one-time green bond issuances.

2.4 Independent Variables.

In order for policymakers and stakeholders to make strategic and informed decisions to maximize banks' performance and ensure long-term financial stability, it is crucial to examine and interpret the impact that all regressors taken into consideration have on the cost of capital. These variables can be categorized in two main groups: bank-specific variables and green finance ones. The first category includes internal factors specific to that particular bank. They are usually interrelated with management activities, financial policies and operational complexities. Variables such as size (captured by total assets), profitability, credit rating, CAR and CET1 ratio are considered fundamental when analyzing a bank's internal perspective. On the other hand, green finance variables are also central for this paper. They demonstrate the commitment of each country and specifically of each institution to ecological practices. Among them we can mention the Green Bond Issuance and the Country Sustainability Index. Nowadays it is commonly agreed that green bond issuance has emerged as an undeniable tool, impacting not only banks' ecological footprint but also the cost of capital.

2.4.1 Bank Specific Variables

Bank Size

The influence of bank size in different performance metrics and the cost of capital has historically been the subject of extensive research. Previous research has argued that larger firms have more advantages compared to smaller ones because of two main reasons. The first one is due to economies of scale, which relates to lower costs to produce, and the second is due to lower proprietary costs, which relate to the risk of information made available to the public used by competitors. Numerous economic theories have stated that banks' size captures their ability to generate revenue and enhance profitability, thus this variable cannot be neglected when analyzing the cost of capital for banks.

Embong et al. (2012) investigated whether large firms benefit from higher disclosure requirements in terms of lowering their cost of capital when compared to smaller firms through empirical testing. The sample involved 460 firms from Malaysian stock market. Results showed that for large firms

there is a negative relationship between disclosure and cost of equity. More disclosure requirements led to a lower cost of equity and therefore a lower weighted average cost of capital. However, for small firms no significant relationship was found. Managers, knowing that they can benefit from disclosure policies to reduce their financing costs, can tailor their strategies depending on firm's size. This study supports the idea originally proposed by Diamond & Verrecchia (1991) that larger firms gain more financial advantages.

Kishan & Opiela (2000) explored the relationship between bank size, capital adequacy and cost of capital in the U.S. context. They concluded that small and undercapitalized banks are subject to monetary contractions and loan growth is more difficult compared to large and consolidated banks. This is directly linked to the sensitivity of small banks in accessing external funds, and therefore to the higher cost of capital that they face. In contrast, large and well-capitalized banks, have more diversified funding sources, making them more resilient and therefore they have lower capital costs.

Profitability

Magni (2015) in his paper named *"Investments, financing and the role of ROA and WACC in value creation"* emphasized that profitability and cost of capital are among the most important parameters for a bank and they need to be analyzed together and not separately. The author built a general model and used the pro-forma financial statements to calculate the 'project ROA' and 'project WACC'. He concluded that value is created when ROA is higher than the WACC, and the bigger the gap, the more value is created. This study is very useful because it connects two of the most powerful indicators together.

A study conducted by Rahman (2022) is also very important and relevant for our paper. He analyzed 12 companies listed on the Dhaka Stock Exchange over a 15-year period (2005-2019). A fixed effect panel regression model was used and a negative relationship between WACC and ROA was observed, indicating that higher WACC is associated with a lower profitability. The main explanation behind this finding is that banks with higher profitability have more creditworthiness and a lower risk perceived by investors, which can lead to reduced costs of debt and equity.

The same conclusion was also reached by Hussain et al. (2012), even though they focused their study on Pakistan.

Credit Rating

The majority of writers support the idea that credit rating and the weighted average cost of capital are inversely related because the rating in itself is a reflection of the financial health and the risk perceived for a company. A better credit rating serves as an incentive to invest in that company as it is less risky than its peers. As a result, investors will naturally demand a lower interest rate, reducing this way the cost of debt and the weighted average cost of capital. For instance, Minardi et al. (2017), collected credit ratings from two well-known agencies, Standard & Poor's and Moody's along with accounting information for 627 American companies. It was concluded that credit ratings undeniably influence the costs of debt, and that higher credit ratings lead to lower borrowing costs, making firms more attractive and reducing their WACC.

Capital Adequacy Ratio

When discussing the banking industry, it is important to consider capital adequacy ratios and especially CET1 Ratio. Authors share different perspectives on this matter. Cifuentes et al. (2022), examined how alterations in capital adequacy ratios, affect banks' WACC. Authors used a panel data with numerous banks from Chile. As control variables they used asset risk, bank size, and profitability. They concluded that an increase in CET1 ratio leads to a slight increase in WACC. The reason behind this is that, even though higher capital requirements make banks safer, it can increase financing costs as equity financing is more expensive than debt financing.

Nielsen et al. (2020) shared the opposite view. They focused on the main drivers of the weighted average cost of capital, with a particular focus on capital ratios. They use U.S. bank-level data for their regression analysis in order to examine how different components of the capital structure affect the cost of capital. Authors considered the cost of equity and debt separately before combining them. They concluded that higher capital ratios actually do lower the WACC. This is mainly due to lower perceived risk by both equity and debt investors.

2.4.2 Green Finance Variables

Sustainability Development Index

This index is a province-base index that assesses how well each country complies with Sustainability Development Goals (SDGs). These goals were initially set in 2015 and they are targeted for achievement by 2030. Every member state of the United Nations is required to participate on them. SDGs have three main pillars: economic growth, environmental protection, and social development. Kawaharad et al. (2022) who analyzed firms listed in Tokyo Stock Exchange found an inverse relationship between SDGs and WACC. This means that transparent and committed sustainability practices can lower the cost of funding.

CHAPTER 3
METHODOLOGY

3.1 Introduction

In our paper, the methodology section is focused on identifying and understanding the most important characteristics of green bonds with a focus on developed European countries, as they have been regarded as the most advanced regions in the area of green finance in general, and green bonds in particular. It is important to note that this topic is still new in the research area, and no previous studies are available for these countries that consider the variables analyzed in this thesis. This chapter is of fundamental importance for this study as it will enable us to answer the research questions. Awl (2020) concluded in his study that the methodology is the part of the paper that discusses relevant problems and proposes the most adequate solutions. This chapter is composed of four subsections, with this being the first one. The following one will explain in depth the data collection process and data gathering strategy. The third part will explain every variable's measurement in detail. They will be categorized into: dependent variables, bank-specific, and green finance regressors. For each category, we will examine their connection to the research question and objectives mentioned in the Introduction chapter of this thesis. Finally, the chapter concludes with the data analysis part, focusing exclusively on the multicollinearity test, which is among the most important tests to ensure the robustness of our dataset.

3.2 Data and Data Gathering Strategy

This paper considers 16 European countries, including France, the United Kingdom, Sweden, Denmark, Cyprus, Poland and others. A key novelty and contribution of this paper lies in the fact that the selected countries represent different levels of engagement in the ecological sphere. This allows our study to focus on Europe as a whole, rather than only on the most advanced countries. This approach is beneficial because it allows broader applicability and reflects the real situation across all European countries. While the aim in the data selection process was to be as inclusive as possible, data were collected only for the countries with available and reliable data sources. In our sample, all sources considered the Nordic countries as the most innovative and as those that have invested the most in green finance and therefore paid considerable attention to green bonds. Nevertheless, countries such as France and the Netherlands have recently taken the lead, as they have rapidly advanced their engagement in this new area of finance.

To shed light on the relationship between green bond issuance and the weighted average cost of capital, we collected data from two perspectives: bank-specific ones and sustainability indicators. Therefore, the type of data collected is secondary. Official and reliable web pages were used and they are publicly accessible.

For bank-specific variables, this study extracted cross-country secondary data from the balance sheets and the income statements of each commercial or investment bank used in our sample. These two crucial financial statements provided information on data such as banks' size in terms of total assets, profitability captured by the return on equity, and the year when the first green bond was issued, which was part of the annual report published by each bank at the end of the year. The annual reports also included the capital adequacy and the CET1 ratios.

On the other hand, the credit rating was retrieved from the official Moody's website, one of the most reliable credit rating agencies. These prestigious institutions provide a score or a letter to several organizations to reflect their stability and performance. In this way, potential investors can take informed decisions and the general public can rely on these estimates for different reasons too. The country sustainability index was downloaded from official websites of green finance such as the Global Sustainable Competitiveness Index Website (GSCI Index Website).

Data were gathered for 13 years, from 2012 to 2024 specifically. The aim was to include several years in our analysis in order to generate reliable conclusions and recommendations but also to provide a recent and coherent standpoint.

3.3 Dependent and Independent Variables:

3.3.1 Dependent Variable Selection

Weighted Average Cost of Capital (WACC)

The weighted average cost of capital is the explained variable in the linear regression model that we are discussing and often it is considered a proxy for the riskiness of a bank. According to Frank & Shen (2016), WACC represents the average rate of return that a company must pay to finance their operations and investments, and this calculation has to be weighted by the proportion of each funding source. These sources can be equity, debt, or preferred stock. This parameter is of utmost importance for numerous reasons. Firstly, it helps different parties to evaluate their investment options. WACC is often used as a discount rate in investment appraisal, and investors typically make sure that the return from an investment has to be higher than the cost of capital. Secondly, WACC is undoubtedly linked with the riskiness of a certain project. A higher WACC indicates a higher perceived risk, and the opposite holds true also. WACC can be quite helpful in decisions regarding the capital structure. Firms tend to minimize this discount factor in order to optimize value, in this way WACC helps interested parties assess whether they are creating or destroying value.

In this thesis, all independent regressors, which will be explained below, are used to explain the dependent one. WACC is useful as it will help us accomplish two of our research objectives mentioned in the first chapter: precisely objective number 1 and 2. Firstly, we will examine whether variables included in our model have an impact on the WACC. Then, for the ones that appear statistically significant, we will analyze the direction of their impact and their magnitude.

This variable will be included in our model as “WACC” which stands for the Weighted Average Cost of Capital and it is included as a percentage. This variable is retrieved from the Bloomberg platform, which represents one of the most reliable platforms available to retrieve data from listed firms. In some cases, WACC was directly available, and in some other cases, we had to manually calculate it, through combining components such as *Rd, Re*, tax rate, and the proportions of the financing sources.

3.3.2 Bank-Specific Variables:

Green Bond Issuance

This variable is considered central to our thesis as we will examine whether firms that issue green bonds have a lower cost of capital compared to companies that do not issue such bonds. It is a dummy variable, which means that it takes the value 0 for all the years in which the firm did not issue a green bond, and 1 for the years in which the issuance occurred. Based on what we observed in the literature review section, we would expect an inverse relationship between the green bond issuance and the cost of capital. Numerous authors supported this hypothesis and the main explanation behind it was that companies who actively participate in green finance activities are seen as more reputable due to the fact that they contribute to ecological preservation, and therefore investors associate lower risk with such companies. We would expect the same result from our model, even though exceptions from the main literature are possible too. This will help us answer the second research question. Initially we will check if this binary regressor has an impact on the cost of capital, and if so, in which direction.

Size

This variable is considered one of the most fundamental variables by several authors who have examined banking performance or capital structure. It is quantitative in nature and is captured by the total assets. Given that the numbers are quite large it may be impractical to include them in their pure form, and instead it is needed to include the logarithmic form of them. This is an approach used by many authors and we will use it too. This variable is retrieved from the official financial statements of each bank. The consolidated data are used in order to have a comprehensive view of the banks included in our database. Based on the literature that we reviewed in the previous chapter, we would expect an inverse relationship between a bank's size and the cost of capital. This idea is based on the fact that larger banks enjoy greater diversification, economies of scale, and stronger market power. These three factors lower the perceived risk among different investors and creditors. As a result, due to their strength and resilience, they often face lower borrowing costs, and we expect to find the same result.

ROE

Return on equity is a quantitative regressor, expressed as a percentage and calculated by using the information from the two most important financial statements: balance sheet (total equity) and income statement (net income). It is a measure of profitability and in our paper, we will investigate whether banks that have high levels of profits enjoy a lower cost of capital or not. ROE is somehow related also to the size of the banks, and this relation can be better observed in the part where we will be analyzing the multicollinearity between variables. It is commonly agreed that bigger firms, due to larger activity base, have higher profits and are perceived as less risky by the general public, leading to lower capital costs. Nevertheless, it is important to note that while larger banks may exhibit higher levels of profitability, the relationship is not always linear or guaranteed. External factors such as market conditions or regulatory requirements can influence profitability regardless of size, and therefore, impact the cost of capital. By including ROE in our model, we will not only understand its standalone impact on the weighted average cost of capital but also its interrelation with other independent regressors.

Credit Rating

Credit rating is another important quantitative regressor, reflecting the external assessment of a bank's creditworthiness by prestigious rating agencies such as Moody's or S&P. These institutions typically express their rating through a letter-grade system, and these letters refer to the banks' ability to repay debt and meet their respective financial obligations. In this paper we will consider whether banks with higher credit ratings – indicating lower perceived default risk – are able to secure a lower weighted average cost of capital. Credit rating in itself is also impacted by other factors, such as size, profitability, and capital adequacy. In our database, the letters are translated into numbers because this is required by EViews 12, the data analysis platform that is being used. 1 indicates AAA, which is the best credit rating and so on.

Capital Adequacy Ratio

This ratio is also a quantitative regressor, expressed as a percentage, and found in the annual reports of the banks. It is a reflection of the financial strength and resilience of a bank. It measures the proportion of a bank's capital to its risk-weighted assets and serves as a crucial indicator of the ability to absorb losses and maintain financial stability in periods of financial distress. For this

reason, we want to shed light on its impact on the cost of capital for the banks that we are analyzing. According to the literature, well-capitalized banks have a lower risk and are safer from the investors' perspective. Therefore, we would expect an inverse relationship with the dependent variable.

3.3.3 Green-Finance Variables:

Country Sustainability Index

This is a very important independent variable in our thesis, as this will be responsible for representing the green finance part. It is quantitative in nature, and it captures the broader environmental, social and governance (ESG) context where banks operate. This index is usually calculated by world-renowned organizations such as the Global Sustainable Competitiveness Index, which assesses countries through numerous dimensions including resource efficiency, natural capital, governance, environmental engagement and economic stability. Each country receives a numerical score ranging from 0 to 100. The higher the score, the better the environmental performance. For instance, scores above 75 generally indicate a top performance while scores below 40 suggest that the country needs to be improved in several areas. In our study, we aim to examine whether banks that operate in countries with higher sustainability ratings have lower capital costs. The rationale behind this is that sustainable environments may reduce systemic risks, strengthen investors' confidence and create favorable conditions for green finance and lowering the cost of capital.

Table 3.1 illustrates the expected sign of each variable based on the existing literature and our expectations.

Table 3.1: *Expected signs of the regression variables*

Variable	Expected sign
WACC	
Bank Size	Negative
Green Bond Issuance	Neutral
Cap. Adequacy Ratio	Negative
Credit Rating	Positive
Country Sust. Index	Negative
ROE	Neutral

3.4 Data Analysis.

This is the final subsection of the Methodology chapter, and here will be shown some very important descriptive statistics for the dependent and independent variables.

Specifically, Appendix A represents some parameters such as the arithmetic mean, minimum and maximum values, standard deviation and also the number of observations, which is 398, the same for every variable. Even though these values do not shed light directly on the impact that the green bond issuance has on the cost of capital, they give us general idea of the regressors used in our analysis.

For the dependent variable WACC, the average of the banks in our sample from 2012 to 2024 is 4.62%, and the lowest value recorded was only 0.05%, which as we highlighted in the literature review part, indicates low levels of risk. Regarding the arithmetic mean, there is not much space left for interpretation, because there exists no benchmark to be compared to. For larger banks, although they may have higher profits, they are generally perceived as less risky due to diversification, which can justify a lower WACC according to risk-return theory.

When it comes to the profitability measure, which is captured by the return on equity (ROE) the arithmetic mean is approximately 0.085 which means 8.5%. To reach the conclusion whether this value is satisfactory or not is not easy, as this value depends on several factors. One of them is undoubtedly the cost of capital, so if ROE is higher than WACC, yes, the firm is in a good position. A particular characteristic of ROE in the descriptive statistics table is the standard deviation, which is considerable. This is due to fact that the highest value recorded is 32%, while the lowest one is -35%, so the gap is quite high.

Regarding the banks' size, the statistics are available in both natural and logarithmic form. For log size, the mean is equal to 27.21, which means that the mean of assets is 1.3 trillion EUR. The standard deviation is significant, because the banks used in our sample are of different sizes and regulatory environments, making this thesis of comprehensive scope.

For the binary variable Green Bond Issuance, it is expected that the maximum value will be 1, which means that a particular bank in this particular year issued a green bond, and the minimum is 0, in the cases when there was no green bond issuance.

Regarding the credit rating, we translated the letter-based credit ratings into numerical values for the statistical software: for example, 1 corresponds to AAA (highest rating) and 12 to the lowest rating. It is important to note that the interpretation is inverted — the lower the number, the better the credit standing

Lastly, the average of the Capital Adequacy ratio is 14.6%, which is well above the suggested value of 8% proposed by the Basel Accords. While the maximum is around 25%, indicating strong capitalization, the minimum recorded is 7%, slightly below the Basel Accord's recommended 8% threshold. This suggests that at least one bank in our sample was operating close to or just below the regulatory minimum during a particular period.

Notably, variables such as ROE and WACC display relatively high skewness and kurtosis compared to other variables, reflecting the inclusion of different banks in Europe. In the coming chapter we will conduct robustness tests to ensure that the model is not influenced by outliers.

3.4.1 Multicollinearity Test:

Appendix B illustrates that the multicollinearity test that we conducted as part of the Gauss-Markov Assumption number 3 is fully satisfied.

The main purpose of this test is to make sure that there exists no perfect collinearity between independent regressors. The rationale behind this reasoning is that if two variables are highly correlated, it is almost impossible to capture the impact that one regressor has on the dependent variable. In our case, for instance if ROE is highly correlated with CAR, then we are unable to analyze the standalone impact that ROE has on the Weighted Average Cost of Capital. However, it is certain that a sort of correlation is justifiable between regressors, but up to which point is acceptable?

According to Gauss-Markov Assumptions, the correlation between independent variables should not exceed 0.8 in absolute terms. Thus, the condition here is that:

$$\mathbf{r\,(X_j : X_g) \leq 0.8}$$

In order to test this, we need to retrieve from EViews 12, the correlation matrix between regressors. This will show each pair and the value of the correlation, which should be less than 0.8. Of course, we ignore the correlation of regressors with themselves, as normally it is 1. As we can observe, all the correlation pairs fall below the verge of 0.8, therefore Assumption 3 / Part 1 is totally fulfilled. In the scenario that one of the pairs exceeded 0.8, we would either have to increase the sample size or drop one of the variables. In our case, no adjustment is needed.

CHAPTER 4
RESULTS AND DISCUSSIONS

4.1 Econometric Model Specification

This chapter specifies and analyzes the regression model that is used to determine the influence that green bonds have on the weighted average cost of capital. This analysis is conducted through the statistical software EViews 12.

The regression model has the following form:

$$Y = \beta_0 + \beta_1 x_1 + \ldots + \beta_k x_k$$

The coefficient β_0 is called the intercept, and it displays the numerical value of the dependent variable, precisely the weighted average cost of capital, when all other independent variables (β_1, $\beta_{2,\ldots,}\beta$) are equal to 0. Furthermore, another very important element of this model is the slope coefficient. This one is denoted with β_j, and this one captures the change in the dependent variable when x_j changes by one unit.

Before running the estimation output in the chosen software, the initial expected model is displayed as follows:

$$\mathbf{WACC = \beta_0 + \beta_{1gbi} + \beta_{2logtot\_assets} + \beta_{3profitability} + \beta_{4cap\_adequacy\_ratio} + \beta_{5country\_sust\_index} + \beta_{6credit\_rating}}$$

Normally, we would like to understand and then interpret the impact that every independent variable has on the cost of capital, so there will be six hypotheses to be tested, one for every variable.

H1: Banks that issue green bonds tend to have a lower cost of capital on average.

H2: There is a negative association between the size of the bank (captured by total assets) and WACC.

H3: Country Sustainability Index is negatively correlated with the cost of capital.

H4: A satisfactory Capital Adequacy Ratio is associated with a lower WACC.

H5: Profitability of the bank (captured by ROE) has a significant impact on the costs of capital.

H6: Credit rating is negatively associated with WACC.

4.2 Preliminary Tests.

In order to reach unbiased and trustworthy results we must ensure that our dataset and model satisfy all Gauss-Markov assumptions. Fulfilling these conditions is critical for our study as it guarantees the validity of OLS for estimating coefficients. In the unpleasant case that one assumption is violated, this would indicate that one or more of our estimators are biased and inconsistent, and therefore, it is impossible to proceed with the further steps in our model. All conclusions and recommendations would be based on an inaccurate model, thus the practical significance and importance of the paper would be negligible.

Below every Gauss-Markov test will be analyzed in details along with our results.

Stationary Test (Unit Root)

The Unit Root test, which is often considered as the best substitute of the Ramsey Reset Test, is appropriate for panel data, which coincides with our methodology. There is still not a generalized test, therefore this examination has to be done for each and every variable separately and independently. In order for our regressors to be stationary, which means that they don't change their form over time, we need to look for probability values lower than the chosen significance value (usually, and in our case 0.05). This is somehow translated in the hypothesis set shown below:

In table 4.1 we may observe the result for each regressor.

H_0: The series passes a unit root and hence it is not stationary.

H_A: The series does not pass a unit root and hence is stationary.

Table 4.1:

CET1:

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-14.2387	0.0000

Country_Sust_Index:

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-21.7258	0.0000

Credit_Rating:

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-5.73347	0.0000

ROE

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-8.49233	0.0000

Log_Size:

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-10.5588	0.0000

WACC (Y)

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-5.68767	0.0000

* Source: EViews 12

We can confidently assert that the Unit Root Test is satisfied under any confidence level, given the results showed above.

Hausman Test

After testing for stationarity, the second test that needs to be conducted is called the Hausman Test, and the main aim of this Gauss-Markov assumption is to test whether variables can be included in the model or not. Numerous researchers use this test to differentiate between two types of models for panel data: fixed or random effect models. We estimate both these effects models using the same set of regressors. In the end of this examination, it will be determined if unique errors (individual effects) are correlated with regressors. If they are not, the random effects model is preferred due to higher efficiency. However, if there is a correlation, the fixed effect is more consistent. This test is fundamental in determining the final form of the estimation output, and table 4.2 shows the final results. The set of hypotheses is as follows:

H_o: Random effect model is appropriate

H_a: Random effect model is not appropriate.

Table 4.2:

Correlated Random Effects - Hausman Test
Equation: Untitled
Test period random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	38.080296	6	0.0000

* Source: EViews 12

The results of the test produced a p-value lower than the chosen significance level of 0.05, leading us to reject the null hypothesis. The result indicate that the random effect model is not appropriate and confirm the presence of correlation between the individual effects and the regressors. Therefore, fixed effect is the one needed in our case.

Random Sampling

In our study there are 398 observations from 16 banking institutions in Europe, covering the period from 2012 to 2024. According to the third Gauss-Markov assumption, the sample used in the regression analysis must be randomly drawn from the population. In this way it will be ensured that the estimators are unbiased and the results can be generalized beyond the sample. Even though the data collection process is based on data from annual reports and databases, we assume that there is no systemic bias in the selection process. The inclusion of banks of different sizes, ratings, and degree of green finance involvement favors the representativeness of the sample.

Zero Conditional Mean

This assumption has two equally important parts. The first one indicates that the arithmetic mean of the residuals shall equal approximately to zero or to a scientific number very close to zero. The rationale behind this is that some values are underestimated while the others are overestimated. In this manner the values offset each other. This can be translated into:

[ε (u) = 0].

Table 4.3 shows that the mean is quite close to 0, thus we can confidently assert that this assumption / part one is successfully satisfied.

Table 4.3:

Series: RESID01	
Sample 2012 2024	
Observations 398	
Mean	-1.72e-15
Median	-0.504823
Maximum	57.47867

* Source: EViews 12

The second part of this Gauss-Markov assumption indicates that the correlation matrix between residuals and regressors should not exceed the 0.8 threshold. Theoretically speaking, residuals (denoted by U), are all the factors that do influence the dependent variable, but are disregarded in the current model. Therefore, logically speaking they cannot be related to the regressors that we are currently including in our model. Appendix C displays the absence of a correlation between residual factors and the independent variables. Now we can confidently say that both parts of this assumption are successfully fulfilled.

We also accounted for multicollinearity assumption in the previous chapter and we concluded that our variables have no issue regarding this matter. Thus, all Gauss-Markov assumptions are fulfilled, and this confirms that all regression estimates are unbiased and the accuracy levels are high.

Now the coming step is to interpret our model's results and moreover make recommendations for policymakers and all interested parties. Table 4.4 displays the estimation output for our study.

4.3 Empirical Findings.

In order to shed light on the impact of all independent variables in our model on the cost of capital, as well as on the hypothesis made on the first section of this thesis, we need to analyze the empirical results produced by our database through the software EViews 12. Initially, we will focus on the statistical significance of each independent regressor. Next, only for variables which are significant statistically speaking, we will analyze the sign of their coefficients, which indicates the impact that they have, and their magnitude as well.

Table 4.4:

Final Estimation Output

Variable	Coefficient	Standard Error	t-Statistic	p-Value
ROE	7.0725	3.9214	1.8036	0.0721
LOG_SIZE	–0.5570	0.2392	–2.3288	0.0204
G.B.ISSUANCE	–0.0410	0.0205	–1.9971	0.0445
CREDIT_RATING	0.4883	0.1037	4.7091	0.0000
COUNTRY_SUST	–0.1205	0.0313	–3.8537	0.0001
CAR	–0.0198	0.0084	–2.3532	0.0190

Model Summary	
R-squared	0.3482
Adjusted R-squared	0.3190
Prob(F-statistic)	0.0000

On the table above, one of the most important figures is undoubtedly R-squared. This element explains the overall explanatory power of the model. In our case, it means that approximately 35% out of the total variability is explained by our model using five independent variables (log_size, green_bond_issuance, credit_rating, country_sustainaility_index, and capital adequacy ratio). This figure of 35% is somehow difficult to interpret as there is no threshold available, but the relatively low explanatory power can be justified by the fact this exact study is still new and other variables need to be included in the future in order to shed more light on this matter. The effective

explanatory power is slightly lower, precisely at 31.9%, as this is captured by the adjusted R-square. The main difference between R-square and adjusted R-square is that the first one increases with any kind of independent variable, even if they are not very relevant in the model, while the latter one shows if the model is improving because of better explanatory power, not only because more variables are added.

Moreover, the probability of the regression as a whole is 0.0000, which means that the model is very significant statistically speaking. This is due to the fact that the probability value is way lower than our chosen alpha 0.05 (5%). The intercept, which is usually found on similar tables generated by statistical softwares, is not shown in our case, since it is not common at all for banks to have all variables equal to zero. Thus, this element is skipped and not analyzed here.

It is important to note that ROE, which captures profitability, shows no significance in the model statistically speaking at 1% and 5% respectively. Therefore, it has no influence on WACC, which is our dependent variable and thus, commenting on the coefficient for this variable, adds no value to this study.

After doing a preliminary analysis on the variables' significance, we can conclude that the final model is:

$$\mathbf{WACC = \beta_0 + \beta_{1gbi} + \beta_{2logtot\_assets} + \beta_{3cap\_adequacy\_ratio} + \beta_{4country\_sust\_index} + \beta_{5credit\_rating}}$$

Green Bond Issuance

This is the most important and meaningful variable in this study. The reason behind this statement is that green bond issuance (as a binary variable) is the regressor that shows us whether issuing these kinds of bonds reduces or not the riskiness of institutions. The coefficient is negative and statistically significant at our chosen confidence level (0.05). Banks that have issued green bonds experience a direct reduction in their Weighted Average Cost of Capital by approximately 0.041 percentage points ceteris paribus. This result clearly supports the main hypothesis of this thesis that green finance practices, in this case green bond issuance, can lower capital costs and enhance financial efficiency. In other terms, green bond issuance serves as a signal for environmental responsibility and reduced risk perception. Thus, investors seem more confident about investing

in these kinds of initiatives and will normally require a lower return. This finding is consistent with our initial assumption and with the vast majority of the literature. To sum it up, according to the relevant literature mentioned above, lower credit spreads and improved market perception directly reduce capital costs.

Size (Log_Size)

The negative coefficient of -0.5570 for the logarithmic version of banks' size indicate that, all other variables held constant, a one-unit increase in the total assets of the bank, leads to a 0.5570 percentage points decrease in WACC. This interpretation is not only significant statistically speaking, but it also highlights strong economic meaning. The inverse relationship between banks' size and cost of capital implies that larger banks benefit from lower capital costs and lower risk. This can be due to numerous factors. Firstly, larger banks benefit from diversification, and this reduces the overall risk exposure. Secondly, they enjoy greater credibility, better access to capital markets and economies of scale.

Credit Rating

The coefficient for credit rating is positive and highly significant, indicating that a worsening credit rating is linked with a higher WACC. The rating scale in our econometric model is numeric and inversely ranked (1=AAA, 12=lowest rating), thus a higher number signifies a weaker credit profile. Holding everything unchanged, moving one level down in credit quality (from 5 to 6 for example) increases WACC by approximately 0.49 percentage points. This is in line with one of the most important financial theories, which confirms that institutions with poorer creditworthiness are considered as risker by investors and therefore must offer higher returns than other less risky alternatives. A weaker credit profile is translated into higher probability of default and financial instability, leading to a higher cost of funding.

Capital Adequacy Ratio

The coefficient for capital adequacy ratio is statistically significant and negative, displaying that banks with higher capital adequacy ratios tend to have a lower Weighted Average Cost of Capital. Precisely, a one-unit increase in this ratio is associated with a 0.0198 percentage point decrease in capital costs ceteris paribus. This finding is relevant also when compared to the previous literature.

Banks with high levels of CAR reflect a strong core capital base and a greater financial resilience. Therefore, investors and creditor perceive a reduced risk. Banks with high capital ratios are stable and less likely to default. On the other hand, well-capitalized banks are totally in compliance with Basel III Regulatory Framework, so they can benefit from lower regulatory risk premiums and also from better market credibility. These elements lead to a reduction in the required returns by both debt and equity investors, lowering in this way the capital costs.

Country Sustainability Index

Banks that operate in more sustainable countries tend to have a lower weighted average cost of capital. This statement is supported by the negative and highly significant coefficient. Specifically, for each one-unit increase in the index score, WACC decreases with almost 0.12 percentage points. This highlights the importance of the macro-environmental area in which banks operate. Higher scores/indexes reflect better institutional frameworks, better governance, and stability. Investors reward institutions that operate in green and sustainable jurisdictions with more confidence and lower required returns. This is due to several influencers such as: lower systemic risk, stable policies, and also public support for green initiatives.

CHAPTER 5
CONCLUSIONS

5.1 Conclusions

This thesis investigated the relationship between the issuance of green bonds and the weighted average cost of capital for 16 European countries, using panel data from 2012-2024. Empirical findings indicate that both bank-specific and environmental-based regressors do have a significant impact in the cost of capital for these banks.

Among the most meaningful findings is the negative and significant relationship between the binary variable of green bond issuance and the Weighted average Cost of Capital, suggesting that banks that are involved in green finance and precisely in issuing green bonds face a lower WACC. Similarly, banks that operate in greener countries, that have a higher sustainability index score also face a lower cost of capital. In this way, we can highlight the importance of the intersection between macro-level environmental and institutional frameworks.

Moreover, traditional financial metrics such as the size of the banks and the capital adequacy ratio were found to negatively impact WACC. This is in line with the theories mentioned in the Literature Review Section, that larger and well-capitalized institutions are perceived as less risky and better positioned. Credit rating showed a strong and positive effect in the costs of capital, as expected, indicating that lower-rated banks face a higher WACC. Lastly, while ROE's coefficient was positive, it was not significant statistically speaking at the 5% level, indicating that ROE, which captures profitability, adds no value in explaining costs of capital in our model.

To summarize, the findings validate the assumption that green strategies reduce capital costs and make banks more resilient.

5.2 Recommendations

Based on the above-mentioned findings, numerous key recommendations can be made not only for policymakers and banking institutions, but also for the general public.

Firstly, banks should actively consider green bond issuance as an activity not only to improve the environmental area, but also to reduce capital costs. Data suggest that these relatively new instruments can offer financial advantages by increasing credibility and attracting several investors, not only those who are focused on ESG matters.

Secondly, governments and regulators need to strengthen sustainability frameworks at a country level. This is because macro-level sustainability indexes positively lead to lower costs. This implies that different reforms, regulations, and national green strategies can play an important role in enhancing financial efficiency in banking institutions.

Thirdly, capital adequacy ratio and especially CET1 ratio shall remain a key and central focus for these institutions. This is because higher levels of this ratio are associated with lower capital costs. Strengthening capital buffers enhance inversors' confidence, leading to better and easier sources of funding.

Finally, future studies are needed in order to shed more light in this new topic, by incorporating other ESG metrics or by studying different geographical areas and different industries. Moreover, as the European green market continues to evolve and grow, ongoing data collection and analysis is appreciated in order to monitor and comprehend new trends.

CHAPTER 6
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Appendix A:

Descriptive Statistics of the regression variables

Number of observations: 398

	WACC	ROE__PR...	LOG_SIZE	GBI	CREDIT_R...	COUNTRY...	CAPITAL_...
Mean	4.625468	0.085064	27.21772	0.567839	5.414573	14.26382	0.146260
Median	2.927600	0.089000	27.33822	1.000000	5.000000	11.00000	0.143900
Maximum	65.09000	0.323400	31.30919	1.000000	12.00000	63.00000	0.251000
Minimum	0.052270	-0.350000	23.70895	0.000000	1.000000	1.000000	0.070000
Std. Dev.	6.686366	0.077198	1.359385	0.496000	3.486785	12.70666	0.027851
Skewness	5.687647	-1.784765	-0.228976	-0.273889	0.394197	1.372353	0.483902
Kurtosis	44.06890	11.81517	3.381366	1.075015	1.923959	4.810211	3.847686

** Source: EViews 12*

Appendix B:

Correlation Matrix of the independent variables

CAPITAL ...	COUNTRY...	CREDIT_R...	GBI	LOG_SIZE	ROE PR...
1	-0.3105037...	-0.3589733...	0.31776966...	0.13294918...	0.22083475...
-0.3105037...	1	0.59164006...	-0.3522290...	-0.4897067...	0.05742687...
-0.3589733...	0.59164006...	1	-0.2476260...	-0.3512641...	0.02604452...
0.31776966...	-0.3522290...	-0.2476260...	1	0.23993793...	0.12145080...
0.13294918...	-0.4897067...	-0.3512641...	0.23993793...	1	-0.0261843...
0.22083475...	0.05742687...	0.02604452...	0.12145080...	-0.0261843...	1

** Source: EViews 12*

Appendix C:

	CAPITAL ...	COUNTRY...	CREDIT_R...	GBI	LOG SIZE	RESID01	ROE PR...
CAPIT...	1.000000	-0.301113	-0.346194	0.312373	0.099793	3.84E-16	0.244942
COUN...	-0.301113	1.000000	0.576004	-0.337167	-0.457417	-7.71E-16	0.097222
CRED...	-0.346194	0.576004	1.000000	-0.228220	-0.315754	1.06E-15	0.045650
GBI	0.312373	-0.337167	-0.228220	1.000000	0.216520	-3.45E-16	0.113568
LOG_S...	0.099793	-0.457417	-0.315754	0.216520	1.000000	1.30E-15	-0.052337
RESID01	3.84E-16	-7.71E-16	1.06E-15	-3.45E-16	1.30E-15	1.000000	9.07E-16
ROE_...	0.244942	0.097222	0.045650	0.113568	-0.052337	9.07E-16	1.000000

** Source: EViews 12*