



Greenium in the Bond Market: A Review

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Abstract: Global warming and climate conditions have been a subject of concern globally. Many countries have come together to take steps in this direction through financing various projects. For this many new financial instruments have been introduced which can help the growth process of green projects. One such category of instruments is green bonds. Present study targets to summarize the research papers published in this area in last five years so as to highlight the main conclusions and suggestions which can provide a direction for future research in the area. Mixed evidence was found on greenium in the literature. Greenium seems to be dependent upon the data and market studied, methodology used, time period, issuer type and many such other factors.

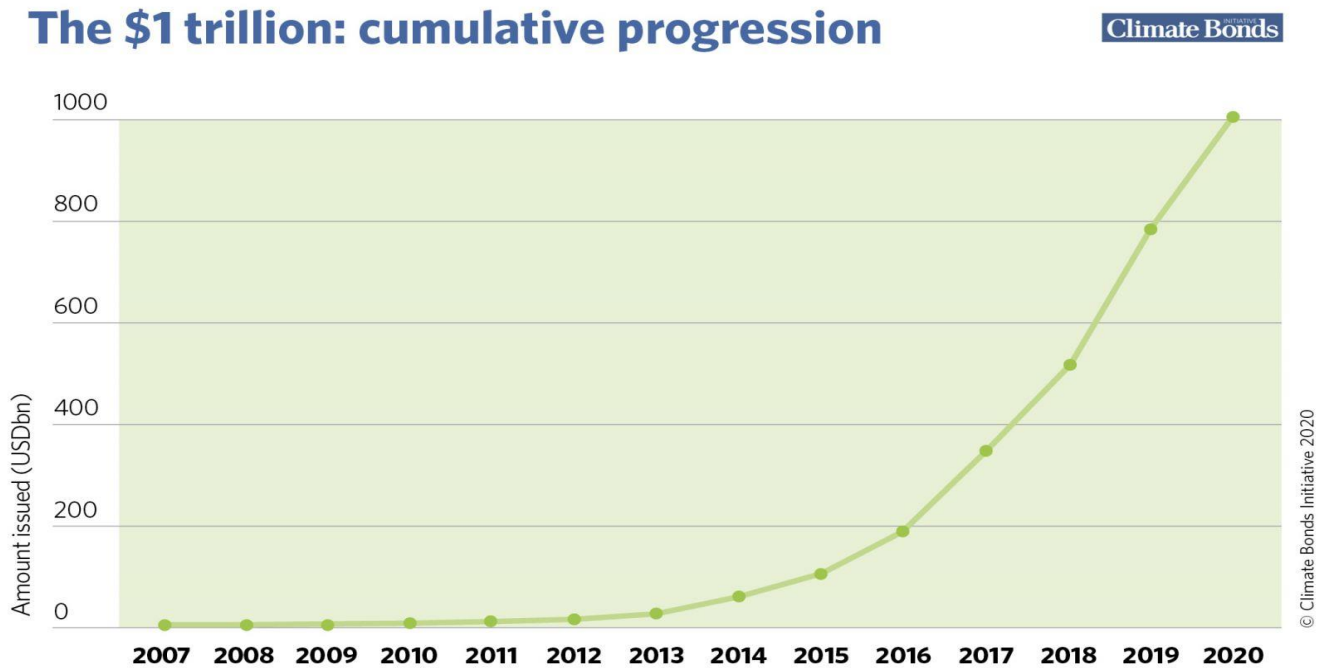
IndexTerms - Bonds, Greenium, Debt Market, Literature Review

I. INTRODUCTION

Earth is all set to surpass a perilous global warming threshold by the next decade, according to the AR6 report by Inter-governmental panel on climate change (IPCC). Extensive changes are happening at a very quick pace leading to irremediable losses for mankind. “Adaptation planning and implementation has progressed across all sectors and regions, with documented benefits and varying effectiveness. Despite progress, adaptation gaps exist, and will continue to grow at current rates of implementation..... Current global financial flows for adaptation are insufficient for, and constrain implementation of, adaptation options, especially in developing countries” (Synthesis report of AR6 by IPCC 2023). Amongst the numerous factors mentioned in the report, lack of sufficient financial resources is one key hindrance in taking impactful steps to reduce global warming. Governments across the globe have come up with new financial instruments in order to raise enough funds for the purpose and one such instrument is Green bonds. There is no uniform standard definition for Green Bonds (GBs). “Green Bonds are any type of bond instrument where the proceeds or an equivalent amount will be exclusively applied to finance or re-finance, in part or in full, new and/or existing eligible Green Projects and which are aligned with the four core components of the GBP” (Green Bond Principles) GBP (2021). “A green bond is a hybrid financial instrument that combines environmental benefits and conventional fixed income instruments to channel funds to environmentally friendly projects” Hyun et al. (2019). “As clarified by the United Nation Development Program (UNDP) green bonds have no other differences from conventional bonds; their only unique characteristic is the specification that the proceeds from bond sales have to be invested in projects generating environmental benefits” Bachelet, L. Becchetti and S. Manfredonia (2019). Thus, GBs are normal bonds with a differentiating factor attached in the usage of the proceeds of the bond. According to GBP 2021, four types of green bonds exist currently, namely, Standard Green use of proceeds Bond, Green Revenue Bond, Green Project Bond and Secured Green Bond.

European Investment Bank issued the first GB in the year 2007. From there onwards there has been no looking back by the market. The market for green bonds have grown enormously since then and the growth curve, as shown in figures 1 and 2 below, started picking an upward trend around 2014 onwards.

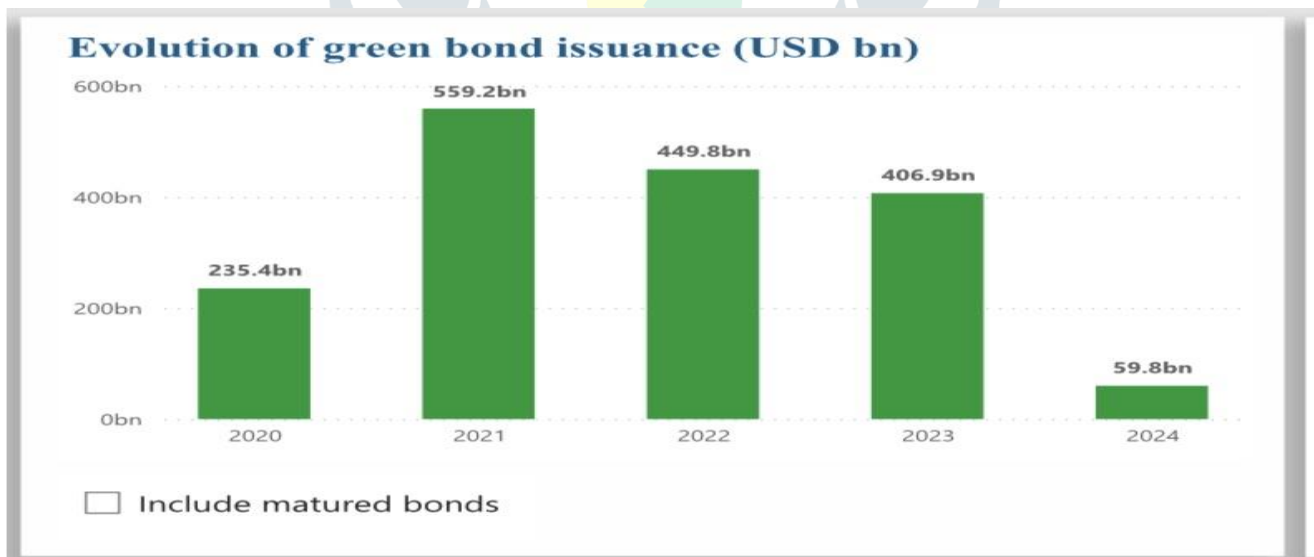
Figure 1: Green Bond cumulative progression from 2007 to 2020



Source: ICMA website

There are multiple factors responsible for the GB market’s growth. Some important ones include signing of Paris Agreement by various countries, introducing Green Bond Principles (GBP) for clarifications, entry of private institutions into the GB market, tracking of green bonds issued by rating agencies, better disclosure practices followed by issuers so as to improve investor confidence, etc.

Figure 2: Green Bond Issuance from 2020 tilldate



Source: ICMA website

Green bonds can be issued by Governments, municipalities, private organizations and Financial institutions. A GB though similar to a Brown bond, has shown some confirmation of having a tighter pricing as compared to the latter. This difference is called as “green premium” or “greenium”. If the GB’s yield is higher than the brown ones, greenium is taken to be positive, otherwise it is negative. Some researchers could confirm the occurrence of greenium whereas others were not. Present study is a review of literature regarding the greenium’s existence and the factors that govern the greenium in different markets.

II. METHODOLOGY

The main purpose of the present paper is to analyze the scholarly articles published on existence of greenium in various bond markets across the globe. Some of the aspects that we intend to study includes the following: the evolution of GB markets; the factors determining the greenium; markets in which greenium exists and those in which investors are not ready to pay greenium and the reasons for the same, etc. Our dataset consists of papers from the two most popular sources, namely, Scopus and Web of Science. There have been a few studies on the topic in the past. Liaw (2020) reviewed greenium and its related aspects by studying publications till 2019. Present paper therefore, studies the more recent work published in the area. The first dataset consists of research journal papers and conference papers on greenium in GB market from 2019 to 2024 retrieved from Scopus. This will help researchers and other concerned parties to know what all new developments and trends have been in existence in the GB market in these latest years.

Table 1: Methodology for identification and selection of relevant papers

<p>1) Topic: Existence of Greenium</p> <p>2) Research Question: Does Greenium or Green Premium in the GBs exist or not?</p> <p>3) Keyword of the search string: “Greenium” OR “Green Premium” and not “Green”</p> <p>4) Paper Database: Scopus and Web of Science</p> <p>5) Selection Criterion:</p> <ul style="list-style-type: none"> • Paper published in English language • Paper published since 2019, that is in previous five years • Paper published in journal or conference proceedings
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Source: Author’s own preparation

In order to get the best results, we used a systematic approach for searching the relevant papers on the topic. Scopus and Web of Science are two well-known and accepted data sources as per the previous studies on literature review. So we restricted the data from only these two sources. The first dataset provided us with 30 papers published in Scopus journals and conference proceedings the second dataset consisted of 6 papers published in Web of Science journals. The keywords used were “Greenium”, “Green Premium”, “Green” with the Boolean words “OR” and “AND NOT” used respectively. These two datasets were then combined and further cleaned according to the criterion given in table 1 below. The first criteria were that the research should have been published in English language as it was not possible for us to understand any other language. Secondly, as mentioned earlier, literature has already been reviewed by Liaw (2019) and MacAskill (2020) on related topic covering earlier years. So present study concentrated on papers published after 2019 till 2024. And third criteria were that papers published in research journal or conference proceedings only were considered. Other sources like published books, chapters in edited books, etc were not considered as these generally don’t go through blind review process.

After applying the three selection criterion, namely, paper in English language, papers published between 2019 and 2024, and papers published only in journals or conference proceedings, 30 papers were retrieved from Scopus and 6 from Web of Science. Amongst these two were duplicates, thus leaving 34 papers. These 34 papers were reviewed in detail so that conclusions and suggestions can be made. After reviewing in detail some more papers were removed from the dataset as they were not related to the topic. So after content screening only 19 papers were found to be related to the topic and the details of these 19 papers are provided in table 2 and 3 below.

Table2: Author and Journal details

Authors	Title	Source title	Scopus/ WOS	Year
Agliardi E.; Agliardi R.	Corporate Green Bonds: Understanding the Greenium in a Two-Factor Structural Model	Environmental and Resource Economics	Scopus	2021
Alessi, L; Ossola, E; Panzica, R	What greenium matters in the stock market? The role of greenhouse gas emissions and environmental disclosures	Journal of Financial Stability	WOS	2021
Arat E.; Hachenberg B.; Kiesel F.; Schiereck D.	Greenium, credit rating, and the COVID-19 pandemic	Journal of Asset Management	Scopus	2023
Ayaydin Hacıömeroğlu H.; Danişoğlu S.; Güner Z.N.	The grass is greener on the other side: Comparison of green versus brown corporate bonds	Borsa Istanbul Review	Scopus	2022
Fatica S.; Panzica R.; Rancan M.	The pricing of green bonds: Are financial institutions special?	Journal of Financial Stability	Scopus	2021
Ghitti M.; Gianfrate G.; Lopez-de-Silanes F.; Spinelli M.	What's in a shade? The market relevance of green bonds' external reviews	British Accounting Review	Scopus	2023
Grishunin S.; Bukreeva A.; Suloeva S.; Burova E.	Analysis of Yields and Their Determinants in the European Corporate Green Bond Market	Risks	Scopus	2023
Ho L.T.; Gan C.; Yang W.; Jin S.	Green-labeled bonds and sustainable bonds: A missing puzzle piece	Proceedings of the International Congress on Modelling and Simulation, MODSIM	Scopus	2023
Hu, XL; Zhong, A; Cao, YD	Greenium in the Chinese corporate bond market	Emerging Markets Review	WOS	2022
Huang, CY; Dekker, D; Christopoulos, D	Rethinking greenium: A quadratic function of yield spread	Finance Research Letters	WOS	2023
Hyun, S; Park, D; Tian, S	Pricing of Green Labeling: A Comparison of Labeled and Unlabeled Green Bonds	Finance Research Letters	WOS	2021
Intonti M.; Serlenga L.; Ferri G.; De Leonardis M.; Starace G.	The "Greenium" in Green Bonds: How Did It Change with COVID-19?	Sustainability (Switzerland)	Scopus	2023
Koziol C.; Proelss J.; Robmann P.; Schweizer D.	The price of being green	Finance Research Letters	WOS	2022
Larcker, DF; Watts, EM	Where's the greenium?	Journal of Accounting & Economics	WOS	2020
Lau P.; Sze A.; Wan W.; Wong A.	The Economics of the Greenium: How Much is the World Willing to Pay to Save the Earth?	Environmental and Resource Economics	Scopus	2022
Mutarindwa S.; Schäfer D.; Stephan A.	Certification against greenwashing in nascent bond markets: lessons from African ESG bonds	Eurasian Economic Review	Scopus	2024
Pastor; Stambaugh R.F.; Taylor L.A.	Dissecting green returns	Journal of Financial Economics	Scopus	2022
Sergei G.; Alesya B.	In Search of Greenium. Analysis of Yields in the European Green Bond Markets	Procedia Computer Science	Scopus	2022
Zenno Y.; Aruga K.	Institutional Investors' Willingness to Pay for Green Bonds: A Case for Shanghai	Journal of Risk and Financial Management	Scopus	2022

Source: Author's own preparation

Table 3: Objectives, database and findings of the papers reviewed.

Authors	Data	Objective	Green Premium exists?	Other findings and recommendations
Agliardi E.; Agliardi R. (2021)	Case study on GB issued in Italy by Hera from 2014 to 2018	Paper aims to develop a structural model which can incorporate several determinants of GB prices and greenium.	Found greenium for issuers whose core business is linked with the green project	Other factors positively affecting greenium are volatile asset prices, larger interest rates and corporate taxes. Studying the impact of green biases on asset allocation decisions of investors, it is shown that the same may revert the preference in favor of bonds that are less remunerative but more environmental-friendly.
Alessi, L; Ossola, E; Panzica, R (2021)	European stocks	To know the existence of greenium by including greenhouse gas emissions and quality environment disclosures into the process	Existence of negative greenium	Authors provided evidence for pricing factor linked to climate risk which is negative & significant.
Arat E.; Hachenberg B.; Kiesel F.; Schierack D.	Green labeled bonds till 17 th November 2020	To explore presence of greenium in pre as well as during COVID period	Existence of greenium in pre-COVID period which widens further in the COVID period	The study further shows that the greenium is linked with the fact whether the issuer has good credit rating or not.
Ayaydin Hacıömeroğlu H.; Danişoğlu S.; Güner Z. N.	Green labeled corporate bonds on Thomson Reuters database from 2013 to 2019	To compare GB with Brown bonds after controlling for various yield factors like market, bond, currency etc.	Greenium doesn't exist if yield factors considered	Issuers don't have any cost advantage over brown bonds if these factors are incorporated in the analysis.
Fatica S.; Panzica R.; Rancan M.	All bond tranches issued by financial, non-financial and supranational institutions from 2007-2018 in primary market provided by Dealogic DCM.	To investigate the consequences of green label on pricing of the bonds in primary market.	Found greenium for GBs issued by supranational institutions & corporates but no yield differences in case of issuances by financial institutions	GBs with external review benefit from a larger premium compared to self-labeled GBs. Also, there is additional premium for repeat issuers.
Ghitti M.; Gianfrate G.; Lopez-de-Silanes F.; Spinelli M.	Corporate GB included in the Environmental Finance Database till 2023	To assess the premium attached, if any, to GB with Second Party Opinions (SPO) from external reviewers.	No greenium for rated bonds. But greenium related with shades of unrated GB.	SPOs shade of green is given importance when GB are unrated.
Grishunin S.; Bukreeva A.; Suloeva S.; Burova E.	Corporate bonds from 2007 to 2023 from 33 countries	To test the European corporate debt market for existence of some green premium	Mixed evidence	Presence of negative green premium in European markets. But for the corporate debt in the local markets in UK and Netherlands this premium is absent.
Ho L.T.; Gan C.; Yang W.; Jin S.	Corporate and Municipal bonds from 83 countries	To test the performance of Green labeled and newly identified category of sustainable	Greenium exist between labeled and unlabeled bonds	The type of bond ownership plays a key role in explaining the performance of green bonds.

		bonds		
Hu, XL; Zhong, A; Cao, YD	Chinese corporate bonds from January 2016 to April 2021	To understand the pricing implications on GBs	Large Greenium exist	Various determinants for greenium are identified like certification, local factors, environmental stimuli, etc
Huang, CY; Dekker, D; Christopoulos, D	Corporate GB following GBP from 2014 to 2022 in Bloomberg database.	To find a new way of estimating greenium and testing its presence	Existence of greenium but which disappears within certain bounds	A new way to find GB's yield discount is provided by the authors
Hyun, S; Park, D; Tian, S (2021)	Labeled and unlabeled GBs from Bloomberg from January 2014 to December 2017	To empirically test the price differences between labeled and unlabeled GBs	Greenium exist on labeled bonds as compared to unlabeled bonds	Labelled GBs are traded at 24-36 basis points lower in bond yields compared to unlabeled GBs that share similar common pricing factors.
Intonti M.; Serlenga L.; Ferri G.; De Leonardis M.; Starace G.	GBs and Traditional bonds from 2017 to 2021	To investigate the impact of covid on greenium	Covid crisis has increased the greenium	Post pandemic changes of the Greenium don't depend on liquidity of the GB.
Koziol C.; Proelss J.; Robmann P.; Schweizer D.	German Government GBs	To investigate the greenium and its determinants	Greenium is present	Environmental awareness and yield to maturity positively impacts greenium
Larcker, DF; Watts, EM	Self-labeled fixed rate coupon GB in US Municipal market from 2013 to 2018	The objective was whether investors are willing to forgo pecuniary benefits to invest in environmentally friendly projects.	No greenium	The paper confirms the presence of large issuance cost which is the biggest reason for low market penetration in GB market
Lau P.; Sze A.; Wan W.; Wong A.	Global GB data from Bloomberg, CBI and Dealogic from 2014 to 2019	To provide a theoretical and empirical analysis of the greenium	Small amount of greenium evidenced	Greenium is a result of greenwashing
Mutarindwa S.; Schäfer D.; Stephan A.	African ESG government and corporate bonds from 2010 to 2023	To test whether certified bonds are priced differently than self-labeled bonds	Certification makes a difference	Certification is better than self-labeling to help grow African bonds markets
Pastor; Stambaugh R.F.; Taylor L.A.	German bonds from 2012 to 2020	Can past good performance of GB be taken as an indicator for good performance in the future?	Wide greenium present	GB perform better than Brown Bonds during bad climate change, thus leading to being a better hedge against climate shocks.
Sergei G.; Alesya B.	European GBs and conventional bonds from 2007 to February 2022	To investigate existence and determinants of greenium in Europe	Greenium of 4bps present in whole European market.	On individual country level, significant greenium found to be absent in UK, France, Neitherland and Germany
Zenno Y.; Aruga K.	CVM based survey data for	To investigate the Institutional investor's level of Greenium and	Greenium of 0.47% present	Credit and currency variables had a positive impact on greenium from amongst all variables tested.

	Institutional investors in Shanghai GB market	also the impact of 7 variables on greenium		
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Source: Author's own preparation

III. RESULTS AND DISCUSSIONS

We collected 34 papers from the two sources, namely, Scopus and Web of Science. After initial content screening 19 papers were found relevant to the topic in question published in the past five years. The pricing structure of GBs as compared to their conventional counterparts were studied. Overall most of the studies found greenium present except for one or two which either didn't find it or had mixed results. The paper which found mixed results took data from 33 countries and found greenium in European markets which confirmed results from other studies on the European markets. Greenium was absent in UK's and Neitherland's local markets. A lot of research happened on the government and corporate bonds from US, European markets and Chinese markets. There is a lot of research scope on confirming the findings on greenium in other markets.

The greenium in different markets has got many influential factors affecting it. For example, volatile asset prices, larger interest rates and corporate taxes were found to be positively impacting greenium. The more the investors are able to understand climate change risk the more premium they are ready to pay. Therefore, it is crucial for governments of various countries to understand that in order to pace the growth in environmental projects financed through GBs, it must increase the environmental awareness amongst investors. In fact, environmentally concerned investors give preference to environment friendly projects costing more premium.

Rating, certification and labeling are important driving forces in the GB market. Credit rating can help corporates to have more greenium for their bonds, though these may increase the issuance cost for the issuers. A reviewer who is a third party and not linked with the issuer can become an important factor for greenium for GBs. Also, investor give preference to issuers with GBs who have already come up with GBs earlier as this can provide them with some history regarding the issuer. Self-labeling doesn't help much as compared to labeling done by some third party. Shades of green also become relevant if bonds are unrated. There was evidence that GB premium is absent in case of rated bonds, and present in case of unrated bonds with darker shades of green.

Some authors have tested the impact of Covid 19 pandemic also on greenium. They conclude that the pandemic has increased the greenium. They could conclude that the changes in the greenium after the pandemic was not dependent on liquidity of the GB. Moreover, different studies carried out in different time periods resulted in different conclusions. Greenium was not found to be significantly related to the eco-friendliness of the country to which the GB's issuer belongs to.

Some authors found greenium of a very small amount and others found that the greenium is no more present if various yield factors are considered like market, bond, currency etc. Also, greenium can be due to greenwashing. Moreover, large issuance cost was found to be one of the notable reason leading to low market penetration in the GB market.

IV. CONCLUSIONS

There is an immense urgency for humans on earth to take significant, comprehensive and impactful steps to deal with global warming and climate change issues. For this corporates and governments should initiate environment friendly projects and finance these projects through green finance. Green bonds,

whose proceeds are meant to be used specifically for some green projects, are one of the significant type of securities included in the category of green finance. The present study targeted investigation of the published literature for collecting some evidence on whether GBs have tighter premium as compared to conventional bonds, specifically concentrating on the publications from the last five years.

The data studied was collected from two sources, namely Scopus and Web of Science. We found 30 papers in Scopus and 5 papers in Web of Science. After removing the duplicates and initial screening of the abstract, only 19 papers were left, which were studied in detail. The papers reviewed provide significant insights about the topic in last five years. Most of the studies tested US, European or Chinese bond markets and found greenium present in these markets. Certification, labeling and rating are positively related to greenium. Some factors when considered reduced greenium in some markets. Environmental awareness on part of investors is also vital for the growth of GB market. Governments should put efforts to make investors more aware and sensitive to environmental changes. Corporates should avoid greenwashing and try to get certifications for their bonds in order to penetrate more in the GB market. Covid increased greenium which is an expected conclusion indicating sensitivity of investors to negative environment changes. Present study limits the literature review to previous five years and to only two data sources. Future research can expand the research on these two lines.

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