The Role of Green Bonds in Sustainability Efforts

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Although green bonds are a relatively new innovation in the financial world, they are changing the way financial institutions address the growing issue of sustainability. They offer companies an alternative method for financing their socially responsible activities and raising capital for environmentally friendly projects. The various applications of green bonds in financial markets, such as financing the transition to low-carbon economy and decelerating the depletion of natural landscapes, are important in combating humanitarian crisis such as climate change. To be able to finance projects that mitigate the effects of climate change, it is vital to focus not only on developed countries, but also on underdeveloped and developing countries. The uncertain fate of the planet brought about by climate change can be made far less foreboding if large corporations and industries persist in their commitment to transitioning to more sustainable practices. Green bonds are an essential part of this commitment, and their full impact on climate change mitigation has yet to be realized.

Keywords: green bonds, sustainability, climate change

Introduction

Green bonds are a relatively new innovation in the world of finance, but they are changing the way financial institutions are addressing the growing issue of sustainability. When people think of business, sustainability and environmental awareness are not typically at the forefront of thought. Green bonds are changing that perception. Due to the growing popularity and impact of green bonds, the concept of environmentally friendly industries is gaining ground on many fronts.

The European Investment Bank issued the first green bond in 2007, followed by the International Bank for Reconstruction and Development in 2008. Since then the green bond market has grown exponentially, from $1.5 billion in 2007 to $620 billion in 2023 (Statista, 2024a), and could reach a record $1 trillion in 2024 (Markets Media, 2024). In 2023, China issued the largest number of green bonds, totaling $84 billion, followed by Germany with $68 billion, and the United States with $60 billion (Statista, 2024b). In fiscal 2023, the World Bank committed a total of $2.2 billion and disbursed $955 million to green bond-eligible projects. Since 2008, the World Bank has committed $21.7 billion and disbursed $16.3 billion across 139 projects in 38 countries through June 30, 2023, to help member countries transition to low-carbon and climate-resilient development and growth transformation (World Bank, 2023).

The explosive growth of the green bond market led Morgan Stanley (2017) to describe it as a "green bond

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boom", while the *Financial Times* (Street, 2014) concluded that "green bonds are the answer to Africa's investment need." With the recent development and significant growth of the green bond market, issuing green bonds provides an alternative method for companies to finance their socially responsible activities. Businesses and governments are increasingly interested in using green bonds to help them achieve their low-carbon goals. Whether it is to finance low-carbon transition, slow the depletion of the Amazon rainforest, or influence the global economy, green bonds have earned their reputation in the ongoing effort to combat climate change.

Definitions of Green Bonds

Green bonds are fixed-income instruments like any corporate bond. They can be issued on financial markets by companies (financial or non-financial) or public entities (cities, regions, governments, development banks, etc.). They are labelled "green" because the issuer commits to spending its proceeds on environmentally friendly or climate-focused projects that meet sustainability standards. They are designed to encourage sustainable development and support climate-related or other types of special environmental projects. More specifically, green bonds provide financing for projects aimed at energy efficiency, pollution prevention, sustainable agriculture, fishery and forestry, aquatic and terrestrial ecosystem protection, clean transportation, clean water, and sustainable water management (Segal, 2020). Proceeds are earmarked for financing or refinancing, partially or in full, new and ongoing green projects, particularly infrastructure investments. They differ from traditional bonds in the detailed reporting of their use of proceeds and the "green" nature of the projects. Net proceeds from green bonds must be credited to a sub-account, placed in a secondary portfolio, or be the subject of an appropriate form of allocation. The essential feature of green bonds is to link the use of proceeds to specific environment-friendly projects.

Measuring the Effectiveness of Green Bonds

Combating climate change can be costly. Leveraging green bonds to finance low-carbon economies is no exception. Generational inequity is one of the major financial barriers facing societies today in the pursuit of one day transitioning to a low-carbon economy, particularly mitigating environmental degradation. The financial burden of this transition is likely to fall on the current generation, leaving future generations to reap the benefits at no cost. But green bonds can offset this burden. Before the advent of green bonds, carbon tax was a proposed tool aimed at discouraging industries that produce large amounts of greenhouse gases (GHGs) and encouraging the transition to a low-carbon economy. However, carbon tax is not a popular solution because the public is reluctant to pay additional tax. It may also further negatively impact the well-being of today's society by reducing economic activity as well as net household income and employment (Orlov, Rovenskaya, Puaschunder, & Semmler, 2018).

Whether issued by a company, government, or institution, green bonds allow for projects related to fighting climate change to proceed with the understanding that the debt will be repaid. As with any bond issued, there are various factors that influence the time frame and cost of issuing (and repaying) green bonds, and therefore, the uncertainty about potential courses of action is also affected. One major factor (Orlov et al., 2018) is the decision on the number of bonds to be issued. Issuing more bonds would make more funds available, allowing emissions to decline further and alleviating the larger losses accumulated from climate change. However, more bonds in circulation also means more interest will need to be paid.

Researchers have developed different models to address generational inequality as well as bond issuance

and repayment. An early model used to measure whether green bonds are effective in reducing generational inequity is the Overlapping-Generations (OLG) Model (Sachs, 2015). This model measures the negative impact of GHGs on individual wages and government mitigation efforts. The OLG Model shows that if the incremental cost of alleviating GHG emissions is lower than the incremental social costs of GHG emissions, then a combination of green bonds and carbon taxes can prevent negative impacts on the welfare of current generations while improving, or at least maintaining the welfare of future generations.

Based on the OLG Model, Flaherty, Gevorkyan, Radpour, and Semmler (2016) created another model that in part explains the potential success of green bonds. In this model, the issuance and repayment of bonds occur in separate subsequent stages of fixed length. Flaherty et al. (2016) demonstrate that green bonds can indeed mitigate significant GHG emissions to pre-industrial level and that debt can be repaid in a finite time.

However, concerns have been raised regarding the feasibility of both the OLG Model and Flaherty model due to their simplified nature, raising questions about whether green bonds are truly effective in eliminating generational burden sharing and whether benefits outweigh costs.

A socially optimal model that explores practical solutions to questions posed, but not answered, by Sachs (2015) and Flaherty et al. (2016) is the DICE model (see Nordhaus, 2008; Nordhaus, 2017a; 2017b; Nordhaus & Sztorc, 2013). The DICE model addresses the shortcomings of the other two models and provides evidence of the beneficial role of green bonds in mitigation attempts. The DICE model uses real data and takes into account all necessary variables that may affect the effectiveness of green bonds in the area of generational equity. These variables include economic growth, emissions and concentrations across industries, rising global temperatures and their adverse effects, and the impact of green bonds on mitigation policies. The DICE model acknowledges the fact that some degree of global warming is bound to occur. Using the DICE model, Orlev et al. (2018) show that once emissions are reduced to a certain amount, economic activity can be taxed and bonds can be repaid. They also show that green bonds are effective in reducing emission, improving welfare, and minimizing generational inequity.

Despite the positive implications of these models, Orlev et al. (2018) conjecture that green bonds alone cannot eliminate generational inequality completely if the goal is to improve social welfare function. The effectiveness of green bonds will be greatly enhanced if they are combined with carbon taxes. In essence, carbon taxation is an easier approach to implement than green bonds alone. Determining the role and impact of carbon taxation does not require understanding the costs or benefits of climate control projects as in the case with green bonds. A carbon tax is also easier to implement and more beneficial in low-income countries because it will not increase a country's debt. Green bonds, on the other hand, are more useful in economically developed countries. Carbon pricing can enhance the characteristics of green bonds and vice versa. By combining green bonds with carbon taxes in the DICE-2013R model (a variant of the DICE model), Orlev et al. (2018) demonstrate that, from the perspective of social welfare maximization, three phases emerge: expanding the scale of emission reductions through bond financing, repaying bonds through carbon taxes, and financing emission reductions through carbon taxes. Hence, combining green bonds and carbon taxes can eliminate distortionary taxation.

Impact of Green Bonds on Amazon Forest

The role of green bonds in controlling climate change is continually being discussed. One application for testing the efficacy of green bonds is how they can slow the depletion of the Amazon rainforest. Environmentally focused debt instruments such as green bonds have garnered support from the Brazil government. Deforestation

of the Amazon rainforest is an ongoing problem that warrants immediate action. Since 1970, over 270,000 square miles of the Amazon Rainforest have been destroyed (Wikipedia, 2024), with approximately 15.6 square miles (10,000 acres) lost every day since 1988 (Heacox, 2021). Historically the Amazon has been a great carbon absorber because trees take in carbon dioxide and release oxygen. But now it releases more carbon than it stores, exacerbating the global climate crisis. Due to deforestation, the Amazon became a net emitter of GHG in the 2010s. It accounts for an estimated 10% of global GHG emissions, making it a significant contributor to climate change (Imolore, 2023). Recent increases in mining and agricultural activity have offset the natural benefits of a healthy rainforest. Faced with growing global outcry over its environmental policies, Brazil invited foreign investors to help the country preserve the Amazon and other endangered areas. Brazil is increasingly reliant on market financing for its infrastructure projects, many of which require environmental licensing, and the government is backing greater use of green bonds to help combat deforestation in the Amazon. Those involving the Amazon will receive an environmental seal from the start so that they can obtain financing through the sale of green bonds.

Green bonds and other "green" financial instruments are being used to compensate for and temper the recent increase in deforestation. Brazil's international and domestic climate commitments include pledges to reduce carbon emissions by 37% by 2025 compared to 2005 levels and to achieve a 43% reduction by 2030 (Rowley, 2020). Tereza Cristina, Brazil's Minister of Agriculture, Livestock and Supply, stated that the green financing investment potential identified in the roadmap report will reach $163.3 billion by 2030 (Rowley, 2020). With these goals in mind, Brazil has become the largest green bond market in Latin America and the Caribbean. Since issuing its first green bond in 2015, Brazil has accumulated $5.9 billion in green bonds.

Environmental licensing is required for many of the projects Brazil needs to improve and expand domestic infrastructure, especially projects that involve the Amazon rainforest. Green bonds are used to finance these projects to ensure that the rainforest is preserved while still allowing infrastructural development. One specific project that Brazil is intent on financing is the construction of a railway through the rainforest to connect a port and region that specializes in producing grain. The railway, known as "Ferrograo", is on track to receive special credentials that allow private investors to finance their investments through the sale of green bonds. If these credentials are obtained, it will have a direct impact on reducing carbon emissions and further land development because fewer trucks will be transporting grain through this area of the rainforest (Beck & Iglesias, 2019). By issuing green bonds and establishing an increasing number of mitigation projects, particularly in agriculture and infrastructure, Brazil has proven itself a case study in the opportunities green bonds can offer.

Challenges of Green Bonds Market

Flammer (2020) of the National Bureau of Economic Research evaluates various benefits of green bonds such as economic performance, both financial and environmental, of companies after issuing green bonds. Using data on green bonds issued by listed companies, Flammer finds that there is a positive stock market reaction, as shown by cumulative abnormal return, within the two-day event window of the bond announcement. Flammer also finds that among publicly traded companies, the return on assets and return on equity are significantly higher over time, further proving the benefits of green bonds. In addition, companies' CO_2 emissions decrease after the issuance, resulting in a higher environmental rating of the companies.

While Flammer's findings suggest that green bonds are beneficial to both issuing companies and their investors, challenges do exist in the green bonds market.

Certification

Before any green bonds can be issued, they must be certified by an independent third party. As a relatively new financial instrument, public policy discussions have focused on how to achieve continuity among green bonds in both certification and issuance standards. However, since the definition of green bonds is not standardized nor universal, one of the problems faced by green bonds is the use of the term "green". There are no uniform public regulations for such bonds, therefore, there is no universal understanding of what exactly the term "green" means and how to verify that projects financed by green bonds actually have an impact on mitigation efforts. Since most green bonds are issued by private entities, it is possible for companies to issue green bonds under the pretext of mitigating climate change when in fact the proceeds are allocated to assets that have little or questionable environment value. The ambiguity of the term "green" hinders the bond certification process and could actually obstruct the chances of some green bonds being certified.

There is also a lack of continuity within the realm of green bonds between and within countries because several non-binding frameworks that define green bonds exist. The International Capital Markets Association developed the Green Bond Principles (GBP), which are voluntary guidelines for the issuance of green bonds. According to the GBP, all green projects must have clear environmental benefits, estimated and measured by the issuer. Categories of eligible projects include clean energy, energy efficiency, low-carbon transport, smart grids, and agriculture and forestry. However, climate or climate-aligned bonds are not labeled as green bonds under the GBP.

The Climate Bonds Initiative (CBI), an international investor-focused charity trust, developed a standard for climate bond certification. CBI's database contains only green bonds whose issuers label as such, have at least 95% of proceeds earmarked for green assets aligned with the Climate Bonds Taxonomy, and provide sufficient information on the projects being financed (CBI, 2018).

The EU Technical Expert Group (TEG) on Sustainable Finance published the Green Bond Standard (GBS) (TEG, 2019). According to the GBS, any type of bond or any other capital market debt instrument issued by a European or international issuer is a green bond if it meets the following three requirements: (1) the issuer's Green Bond Framework explicitly confirms the alignment with the EU-Green Bond Standards, (2) proceeds will finance or re-finance Green Projects, and (3) conformance to the EU-Green Bond Standard is verified by an accredited External Verifier.

Until rules for green bond issuance are standardized and consistent, their effectiveness may continue to be impeded. Convergence towards generally accepted definitions is essential to maximizing the effectiveness, efficiency, and integrity of the market. Flammer (2020) believes that it would be beneficial to construct a system of tiered bond ratings as opposed to the current nature of certification. Flammer claims that such tiered rating system would be more beneficial because the environmental impact of green bonds is bound to vary.

Implementation

Climate change poses a threat to which no one in the world is immune. Countries everywhere are aware that this threat will persist and they must act now before it is too late. Consequently, green bonds have become a popular debt instrument around the world. China, Germany, and the United States rank among the top issuers of green bonds in the world. Green bonds are used to finance innovative projects that would not otherwise be possible. France, for example, embraced the use of green bonds to construct paths that allow wildlife to cross safely where infrastructural barriers (such as roads) exist. Projects like this are made possible by green bonds.

Countries around the world are funding similar projects to meet their country-specific climate targets known as Intended Nationally Determined Contributions. Approximately 190 countries participated in setting goals to mitigate climate change and created projects that advanced them towards their goals (Weber & Saravade, 2019).

Despite the global popularity of green bonds, there are still differences in their performance depending on whether the bonds are issued in developed, developing, or underdeveloped countries. Global warming is not country-specific, so it is important to assess the effectiveness of green bonds not only in developed countries, but also in low- and middle-income countries (LMICs). Green bonds continue to develop despite the multiple difficulties (poverty, political conflicts, and ecosystem degradation) faced by LMICs. Africa's green bonds represent 0.18% of its total market capitalization, compared to 0.4% in North America (United States and Canada), 1.9% in Euro zone, and 0.89% in China (World Bank Group, 2019). African and other LMICs are expected to engage in reducing carbon emissions while continuing to improve and develop their economy. However, standardization of the green bond certification process may pose an obstacle for LMICs because implementation is more difficult for these countries than for well-developed countries. In addition, certification qualifications for green bonds in LMICs often differ from those in Western countries.

Investor Demand

Some other barriers to successful implementation in LMICs include lack of investor interest, difficulty in tracking bond performance, and insufficient institutional capabilities. Liquidity of green bonds may be low in LMICs while transaction costs remain high, which prevents them from adequately meeting investor demand. As a result, investors could be deterred from investing in a particular country. The adequacy of LMICs often depends on investor attitudes towards these countries. Something as seemingly trivial as a country's weather could cause investors to shy away from buying green bonds. A country must also be able to track the growth and performance of bonds issued. With a lack of uniformity in bond standards, it is increasingly difficult for underdeveloped and developing countries to provide sufficient information to investors. Lastly, LMICs often lack institutions of the necessary size that are equipped with technology compatible with that of developed countries. These factors are being addressed through Environmental, Social or Governance (ESG) criteria that aim to unify the standard practices accompanying the use of green bonds (Ntsama, Yan, Nasiri, & Mboungam, 2021).

Standardization

The various guidelines that exist are often country- or region-specific. There are two globally recognized sets of green bond standards. They are the Green Bond Principles (GBP) developed by the International Capital Market Association and the Climate Bond Standard (CBS) developed by the Climate Bond Initiative. In addition to these two standards, six other sets of standards have been implemented in Asia, Africa, and Latin America (Lebelle et al., 2020). For the green bond market to continue to be successful, the goal of achieving uniform standards both nationally and internationally must be achieved.

Conclusion

The various applications of green bonds in financial markets, such as financing the transition to low-carbon economy and slowing the depletion of natural landscapes are important in combating humanitarian crisis such as climate change. Proceeds from green bonds can help companies raise capital for projects that are environmentally friendly and assist in sustainable development for the future. Economists continue to search for the optimal course of action for implementing green bonds by creating various models that account for the plethora of social and

economic factors involved in climate change. They aim to reduce generational inequity and work to reduce the impact of climate change, thereby maximizing social welfare now and into the future. Climate change is being mitigated globally and is making a significant impact on Brazil through projects aimed at reducing deforestation in the Amazon rainforest. To be able to continue financing projects like these, it is vital to focus not only on developed countries, but also on underdeveloped and developing countries. Financing low-carbon transitions can become a facet of every industry around the world so long as a standardized set of guidelines is implemented. The uncertain fate of the planet brought about by climate change can be made far less foreboding if large corporations and industries persist in their commitment to transitioning to more sustainable practices. Green bonds are an essential part of this commitment, and their full impact on climate change mitigation has yet to be realized.

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