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Treating ecological deficit with debt: The practical and political concerns with green bonds

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ABSTRACT

Recent years have witnessed calls to 'unlock' private capital and unleash a wave of green finance that can address the global environmental crisis. To this end, ample resources are being invested in the rapidly growing market for *green bonds*: a debt security that links finance to projects that claim environmental benefits. This has placed green bonds in the vanguard of green finance, with a promise of treating our ecological deficit with debt. Such positioning demands close scrutiny of their obstacles, opportunities, and socio-environmental impacts. This paper contributes to this task with a multi-disciplinary review of green bond media articles, grey literature, and academic research. The paper has three key aims. It seeks to provide an introduction to green bonds for scholars who are not fluent in finance. Secondly, it attempts to provide a platform for further green finance research by delineating the major practical and political concerns with green bonds. Finally, it aims to widen our view of the green bond market by putting applied and critical research agendas into direct conversation. The paper concludes by calling for more explicit analysis of what green bonds can actually do; centring an expanded notion of greenwashing in green bond discourse; and pursuing more comparative, case driven research on green bond market development.

1. Introduction

In 2019, the globally inequitable demand for environmental resources and services exceeded the earth's annual bio-capacity by the 31st July (Schlanger, 2019). This ecological deficit has been growing for decades and diminishing the planet's ability to support life as we know it. From climate change, to plummeting insect populations, we face a global environmental crisis requiring mitigation and adaptation on a massive scale. This has prompted the question of paying for change, with concern about the so-called *green finance gap*. By 2050, for example, analysts argue we need to invest $US 3.95 trillion per annum in low-carbon energy, transport, and building projects (Fulton & Reid, 2018; IEA, 2019). Current flows of low-carbon capital are dwarfed by such figures (Buchner et al., 2019) and many believe public money cannot close the gap on its own (Castree & Christophers, 2015; Clark et al., 2018). This has supported calls to 'unlock' private capital so it can be redirected to environmentally beneficial projects (Clark et al., 2018). With signatories endorsing this approach in the Paris Agreement (UNFCCC, 2015), the burgeoning field of green finance is tasked with scaling up capital flows that can be used to address the environmental crisis (G20 GFSG, 2016).

To this end, green finance policymakers and practitioners are investing ample resources into the rapidly growing market for *green bonds*. Green bonds are part of a trillion dollar sustainable debt market that includes other thematically labelled credit instruments (BNEF, 2019). They account for 77% of this market after averaging annual growth of 54% in their first ten years (BNEF, 2019; Counihan, 2019). Forecasts for 2020 predicted $US 350–400 billion in new green bond issues on the back of surging investor demand (Boyd, 2019; Fatin, 2019). Green bonds are reportedly "flying off the shelves" with the average offering three times over-subscribed (Nauman, 2020). As well as this investment capital, green bonds are attracting optimism about their social, environmental, and economic impacts. It is thought they will lower the cost of capital for green projects (Karpf & Mandel, 2018), improve capital allocation by better matching green investors with suitable investments (Shishlov et al., 2016), and help drive cultural

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change in the financial industry (Weber & Saravade, 2018). There are even emerging claims that issuing green bonds already benefits companies, investors, and the planet (Flammer, 2018). A triple bottom line for post-Paris finance, perhaps.

Green bonds ostensibly herald the promise of treating our ecological deficit with debt. They offer to reorient investment capital and their advanced market size puts them in the vanguard of green financial innovation. This means their successes and failures may well have far reaching socio-spatial consequences. At the local scale, green bonds partially finance public services that (re)produce uneven landscapes of racial and class-based disadvantage (Bigger & Millington, 2019). At the regional scale, green bonds are already financing electricity, transport, and building projects that aim to decarbonise our infrastructure networks and support the transition towards sustainability. This will not only reshape the built environments where people live, it may also have national and global implications by mediating our exposure to the environmental risks of a warming planet.

This potential power is why a nascent geographical literature is beginning to coalesce around the green bond market. In this, geographers have primarily sounded a sceptical or critical note. Existing research has rightfully illustrated the undesirable social, spatial, and political costs of green bond financing (Bigger & Millington, 2019; Christophers, 2018a). The misgivings about green bonds chime with the wider geographies of debt that highlight the malign power of financial actors and credit arrangements (Kirkpatrick, 2016; Ponder & Omstedt, 2019). Other scholars, however, have left the door ajar for private investment to play a supportive role. Fainstein (2016) suggests financial capital is not inherently regressive as its impacts depend on the wider political-economic context it operates in. Castree and Christophers (2015) also find cautious optimism for green finance in historical precedents and the rise of 'patient capital'. They argue the "often sweeping condemnation of finance capital, and debt in particular, therefore needs revisiting" (Castree & Christophers, 2015, p. 385). This leads them to bounce off Blackburn (2013) in calling for us to consider 'healthy credit' alongside 'bad debt'.

In this paper, we bring this approach to the burgeoning green bond market. The varied socio-spatial effects green bonds might engender call for close scrutiny of their obstacles, opportunities, and socio-environmental impacts (Elliott & Zhang, 2019). We contribute to this project with a multi-disciplinary review of green bond media articles, grey literature, and academic research. The paper primarily maps the discursive architecture through which green bonds are being engaged as an ostensible fix for our ecological deficit. The paper has three key aims in this regard. It seeks to provide an introduction to green bonds for scholars who are not fluent in finance. Secondly, it attempts to provide a platform for further green debt research by delineating the major practical and political concerns with green bonds. Finally, it aims to widen our view of the green bond market by putting applied and critical research agendas into direct conversation.

This article represents the first foray into a wider project examining green bond market development in Australia and New Zealand. While the broader project includes interviews with green bond issuers and investors, this paper draws on our analysis of publicly available documents. Our method of review began iteratively—employing google (scholar) searches and following citational pathways between texts—until four 'clusters' of literature could be discerned. The four clusters were Critical Academic Research in human geography and allied disciplines; Applied Academic Research in economics, finance, and law; Policy Papers and Market Reports from (non)governmental agencies such as The World Bank, Climate Bonds Initiative, and the European Commission's High-Level Expert Group on Sustainable Finance; and News Articles and Commentary from trade publications such as Environmental Finance, KangaNews, and the Financial Times. These four clusters were then used as focal points to concentrate the review on outlets and publications where green bonds were discussed in-depth. In some cases, such as the geographical literature, the review process seemingly exhausted the literature published to date. In other cases, such as News Articles and Commentary, 'data' collection was relaxed when documents ceased to reveal new information about the current obstacles, opportunities, or socio-environmental impacts of green bonds.

The paper begins with a short introduction to green bonds' structure and development. This section describes their similarities and differences to conventional bonds, before recounting some major milestones in the market's evolution. The second section reviews the key practical challenges for enhancing the green bond market. The paper narrates these key challenges as protecting product integrity, enhancing product performance, and globalising the market. The article then turns to the nascent critical literature. In this case, research has focused on the (re) production of value and risk in green bonds. This has led critical scholars to suggest green bonds risk amplifying social inequality and prioritising financial incomes over environmental outcomes. The paper concludes by reflecting on the point of view afforded by putting practical and political concerns into conversation. It calls for more explicit analysis of what green bonds can actually do; centring an expanded notion of greenwashing in green bond discourse; and pursuing more comparative, case driven research on green bond market development.

2. Green Bonds: A Short Introduction

2.1. Structure

"Bonds are boring," write Bigger and Millington (2019, p. 7), and this is generally thought to be one of their virtues. A bond is a traditional financial instrument that dates back to the 13th century *prestiti* (loans) issued by the Venetian government (Mobius, 2012). Bonds are used by corporate and governmental organisations to borrow money from the market. They function as a fixed-term IOU between the borrower (the bond issuer) and their lenders (the bond investors). Investors loan money to issuers by purchasing their bonds. In return, investors receive regular interest payments until the bond 'matures' and the issuer repays the principal in full. The interest payments provide steady and relatively safe returns so they typically provide more secure sources of income in an investment portfolio (Mobius, 2012). On the issuer side, bonds typically provide cheaper capital than bank loans (OECD, 2017). This makes them an attractive option for financing capital intensive projects like renewable energy or public transport infrastructure (OECD, 2017).

Green bonds retain this loan structure and follow convention in the construction of risk and recourse if the borrower defaults on their debt. There are four types of green bond in use and they are primarily differentiated by the scope of legal recourse (Table 1). Most green bonds are standard use-of-proceeds bonds. In this case, bond proceeds are earmarked for green projects in the issuer's portfolio and investors have recourse to the issuer's entire balance sheet should they default (Banga, 2019; Berensmann et al., 2018). Contrast this with a green project bond. The proceeds of a project bond are earmarked for a specific project and investors only have recourse to the cash flows and assets of that project if the issuer defaults (Banga, 2019; Berensmann et al., 2018). As the use-of-proceeds bond provides a lot more 'collateral' they will generally receive a better credit rating. This typically translates into cheaper capital for issuers and lower, but more secure, returns for investors.

The financial structure of green bonds, then, is basically identical to conventional 'vanilla' bonds. The first and most obvious difference is green bond proceeds are pledged to (re)finance projects that should have environmental benefits. *Should* is the operative word as what projects qualify for green bond labelling has primarily been a matter of self-regulation[1]. Most states have been hands-off and happy for two

[1] The exception is China's state regulated framework. In this case, state

Table 1
A Typology of Green Bonds and their Key Features.

Green Bond Type	Key Features
Use-of-Proceeds Bond	• Proceeds are earmarked for green projects in the issuer's portfolio. • Recourse is to the issuer's entire balance sheet.
Use-of-Proceeds Revenue Bond	• Proceeds are earmarked for green projects in the issuer's portfolio. • Recourse is limited to an issuer's pledged revenue streams, not their entire balance sheet.
Project Bond	• Proceeds are earmarked for a specific project or group of projects. • Recourse is limited to those project(s) assets and balance sheet.
Securitised Bond	• Bond is collateralised by one or more revenue generating green projects e.g. loan repayments on rooftop solar packages. • Project revenue is used to repay the bond and recourse is limited to the collateralised assets.

Source: (Banga, 2019; Berensmann et al., 2018; ICMA, 2018).

voluntary frameworks to provide eligibility criteria and product assurance. These are known as the Green Bond Principles (GBPs) and the Climate Bond Standard (CBS). Both frameworks have a taxonomy of sector eligibility, although the CBS provides stronger thresholds and project level prescription (cf: Climate Bonds Initiative, 2019b; ICMA, 2018). Some of the eligible sectors include transportation, renewable energy, green buildings, industrial efficiency, biodiversity conservation, waste and pollution control, and sustainable land-use and water management. In 2017 and 2018, almost 80% of newly issued green bonds directed proceeds to energy, transport, and building projects (Climate Bonds Initiative, 2019a).

The pledge of environmental benefit leads to a second point of difference between green and vanilla bonds. As well as the standard credit rating process, green bonds are increasingly issued with additional environmental assurance. Most green bonds are self-labelled by the issuer with a second party commissioned to confirm the bond complies with the GBPs (Climate Bonds Initiative, 2019c; Karpf & Mandel, 2018). A much smaller portion of issuers have their green bond verified for CBS certification (Climate Bonds Initiative, 2019c). Certification indicates compliance with the GBPs, confirms the proceeds are pledged to CBS eligible projects, and indicates the bond is aligned with the Paris Agreement goal of keeping global warming under 2°C (Climate Bonds Initiative, 2019c). In both cases, compliance and certification commits the issuer to post-issuance reporting on the use-of-proceeds. The GBPs, for example, suggest bond issuers should provide an annual report that details how proceeds were used and the impact of the projects they (re)financed (ICMA, 2018).

2.2. Development

The first green bonds were issued in 2007 and 2008 by two supranational agencies: the European Investment Bank (EIB) and the World Bank (Stoian & Iorgulescu, 2019). The latter bond was issued after a group of Swedish pension funds inquired about investment products that addressed climate change (World Bank, 2019). Their interest raised the question of eligibility and how investors could be confident in the environmental benefit of their investment. The Centre for International Climate and Environmental Research (CICERO) was engaged to provide credible advice on project impact and suitability for green labelling. After the green bond was issued, the World Bank claimed their process created a blueprint for the market. Eligibility criteria was defined, a second opinion provider was engaged, and there was post-issuance impact reporting too (World Bank, 2019).

Three major milestones were realised in 2013 and 2014. The first billion dollar offering was made by the International Finance Corporation and sold out within the first hour of issuance (Wang, 2018). With another big green bond from the EIB, this prompted the first run of corporate green bonds and new issues grew from $US 3.1 billion to $36.6 billion inside two years (Stoian & Iorgulescu, 2019). This rapid growth increased demand for green bond performance data. The first green bond indices were launched in 2014 and signalled the market was beginning to mature (Stoian & Iorgulescu, 2019). Finally, the GBPs were formally released in 2014 (Ehlers & Packer, 2017). The GBPs were backed by a consortium of major banks and sought to create transparent standards for the burgeoning product (Kidney, 2014). Their introduction was a catalyst for market development and quickly became the basis for other green labels and indices (Ehlers & Packer, 2017).

Another major turning point was the 2015 Paris Agreement. The agreement calls for global warming to be kept within 2°C and to make finance flows consistent with a pathway to that goal (UNFCCC, 2015). This agreement formally recognised a role for private finance in the transition towards sustainability (Thwaites et al., 2018). The Paris meeting also played host to an important statement of investor intent. 27 global investors, managing investment capital worth $US 11.2 trillion, issued the Paris Green Bonds Statement (Whiley, 2015). The statement committed signatories to supporting policies that would drive the development of a global green bond market. It also called on governments, bond issuers, and other stakeholders to develop projects that can be financed by green bonds, ensure transparency around the use of bond proceeds, and to develop clear standards for climate change impacts and the benefits of green bond financed projects (Whiley, 2015).

Between 2015 and 2016, the number of new issues doubled and the market diversified in terms of countries, issuers, and the use-of-proceeds (Stoian & Iorgulescu, 2019). This growth was mainly driven by a surge in Chinese borrowing with $US 36 billion of new green bonds issued there in 2016 (Climate Bonds Initiative, 2017). A new sign of market maturity was the launch of the world's first green stock exchange in Luxembourg (Medland, 2016). Eligibility was linked to the GBPs and the CBS to improve disclosure (Medland, 2016), with the exchange listing €63 billion of green bonds in its first year (Hirtenstein, 2017). Poland ended 2016 by issuing the world's first sovereign green bond (Whiley, 2016). France followed in 2017 and sovereign issues from Fiji and Nigeria represented the increasing involvement of emerging economies (Stoian & Iorgulescu, 2019). Rapid market growth continued in 2017 with an 86% increase in new issues. A noticeable change, however, were the development banks shifting from key issuers to key investors in green bonds. The green label also started to find its way onto Islamic finance products (Stoian & Iorgulescu, 2019).

Debt markets had a difficult year in 2018, with the Bloomberg Barclays Global Aggregate Bond Index falling 1% (Robins, 2019). Green bonds, nonetheless, showed remarkable resilience in volatile conditions. Green bonds recorded 5% growth for the year as total issuance passed the $US 500 billion milestone (Counihan, 2019; Hurley & Durrieu, 2018). The world's largest green bond fund was also launched after raising $US 1.4 billion to invest in emerging economies (Cripps, 2018c). Looking forward, a significant development will likely be the Action Plan on Sustainable Finance adopted by the European Commission. The Action Plan aims to scale up sustainable investment with

(*footnote continued*)
regulation has allowed environmentally dubious coal power and petrochemical projects to be funded by green bonds (EuroMoney, 2019)

measures addressing fiduciary duty, benchmarks and product labels, and the incorporation of environmental factors into the management of financial risk (European Commission, 2020). The commission also convened a Technical Expert Group to assist with some of its most consequential reforms: a Green Bond Standard and the Sustainable Finance Taxonomy that will define environmentally sustainable economic activities (European Commission, 2019).

The proposed reforms were published in mid-2019. The expert group recommended a voluntary green bond standard built on mandatory reporting, accredited verification, and alignment with the taxonomy (EU TEGSF, 2019). Some had feared the taxonomy's standards would be too strict (Cripps, 2019a). Alongside controversial bond issues from major energy companies (Dupré, 2019), this fed into a wider debate about whether transitional activities—such as moving from coal to gas-fired power—have a place in the labelled bond universe (Cripps, 2019b). In review, 2019 was finally described as a year of "creative chaos" for the sustainable debt market (Cripps, 2019c). Several new bond labels emerged as the market reportedly evolves in response to the environmental crisis (Cripps, 2019c). Despite concerns this was splitting hairs (Hurley, 2019a), green bond growth returned to form in 2019. New issuance soared towards $US 250 billion as the sustainable debt market grew by 40% (Cooper, 2020b). Non-financial corporates became the dominant issuers, though sovereign participation is growing too. The size of their deals is one reason the market was predicted to pass one trillion in annual issuances within four years (Cooper, 2020b).

The Covid-19 pandemic, of course, had immediate impact on the green bond market. Though governments were issuing bonds at record levels (Taylor, 2020), green labelled borrowing nosedived in the first half of 2020. New issues in March slumped to $US 5 billion after $29 billion was recorded in January and February (Cooper, 2020a). Overall supply in the first four months of 2020 was subsequently down 9% on the same period last year (Hurley, 2020). That said, commentators found reason to be optimistic about the market's prospects and performance. A quick rebound was anticipated as Europe moved to implement its 'Green Deal' and preparations for the COP26 climate change summit got underway (Hurley, 2020). There was also some evidence green bonds outperformed vanilla bonds in March's tumultuous market conditions (Avery, 2020). Finally, market leadership was observed in the way some recent vanilla bonds, issued in response to the health crisis, eschewed the standard practice of declaring proceeds were for "general corporate purposes" (Cripps, 2020; Eckhart, 2020). They were, instead, following the use-of-proceeds model green bonds promoted by declaring *how* the credit would be spent (Cripps, 2020).

3. Practical Challenges

The green bond market has experienced rapid growth since the first issue in 2007. Green bond demand routinely outstrips supply and the market's infrastructure continues to mature. That said, they are not without their critics or problems. The Chief Investment Officer of a trillion dollar pension fund described green bonds as a "lose-lose product" because they cost more to issue and are harder to trade than conventional bonds (Cooper, 2018). There is also a growing academic and grey literature focused on the barriers to green bond market development in politics (Chiang, 2017), law (Wang, 2018), finance (Banga, 2019) and economics (Shishlov et al., 2016). This literature focuses on the potential benefits of green bonds and considers the measures needed to grow its size and impact. Below we describe the key practical challenges identified in this work.

3.1. Protecting Product Integrity

A commonly cited challenge for green bond market development is protecting the integrity of the financial product. With some national exceptions (Faske, 2018), the market is primarily self-regulated by a mixture of non-governmental organisations, credit-rating agencies, and second opinion providers that formulate and verify adherence to voluntary standards (Berensmann et al., 2018). There is no universally accepted definition of what *green* means or a common international standard for determining green bond eligibility (Shishlov et al., 2016; Talbot, 2017). Externally assured compliance with industry standards is considered good practice, but it is not legally mandated and there is no strong enforcement mechanism to hold issuers accountable to them (Wang, 2018). Observers argue this differentiated, self-regulating environment is creating reputational and legal risks that undermine the integrity of green bonds (Berensmann et al., 2018; Talbot, 2017).

Reputational risk stems primarily from the potential for greenwashing, where green bonds are implicated in superficial displays of environmental concern. The key issue here is green bonds may be used to finance projects that do not satisfy expectations of environmental benefit (Shishlov et al., 2016; Wang, 2018). There are already controversial cases where green bonds have financed environmentally dubious or destructive projects. This includes a 725 space parking garage in the U.S. (Berensmann et al., 2018), coal-fired power and petrochemical factories in China (EuroMoney, 2019), and a Brazilian hydropower dam with negative social and ecological impacts (Bracking, 2015). The absence of strong and consistent regulation means issuers are not prevented from financing these projects with green bonds (Talbot, 2017). A lack of uniform and enforceable standards also makes it difficult to assess the environmental benefits of a green bond (Berensmann et al., 2018). There are no legally binding standards for disclosing how proceeds are used or reporting on the environmental impact of green bond projects (Berensmann et al., 2018). These issues collectively create uncertainty about green bonds' environmental benefits. This can undermine the product's credibility and diminish investor confidence in the market (Berensmann et al., 2018; Talbot, 2017; Wang, 2018).

The second concern with green bond integrity is the legal risk of "green default" or environmental non-performance (Shishlov et al., 2016, p. 14; Talbot, 2017). This occurs when an issuer provides insufficient or misleading information that is material to investors' decisions to buy green bonds (Talbot, 2017). If an investor purchased green bonds, and the use of proceeds did not satisfy standards of green-ness, this may constitute a legal case of misguiding the customer using false information (Shishlov et al., 2016). The risk for investors is a lack of firm, harmonised standards may diminish their legal recourse for green default. Firstly, it may be difficult to judge whether issuers have departed from a reasonable standard of information provision if this standard is not clearly stated, commonly accepted, and legally enforceable (Ludvigsen, 2015). Secondly, the financial value of the environmental benefit is rarely quantified for green bonds (Ludvigsen, 2015; Talbot, 2017). This would make it difficult for the court to assess damages in the event of environmental non-performance. This lack of accountability harms the market's credibility and diminishes investor confidence in the integrity of green bonds (Ludvigsen, 2015; Talbot, 2017). Such risks may have serious spatial consequences for our built environment. Dishonest borrowers may feel confident in building environmentally dubious infrastructure without fear of green default. On the other hand, bona fide low-carbon infrastructure may be harder to finance if poor product integrity convinces investors that green projects have higher risks and lower returns (see: Campiglio, 2016).

3.2. Enhancing Product Performance

The second practical challenge for green bonds is improving their environmental and financial performance. As it stands, green bond issuers are dominated by governmental and corporate actors who have little trouble raising capital whether their bonds are labelled green or not (Shishlov et al., 2016). Green bonds have thus been criticised for repackaging regular bonds without achieving additionality (Dupre et al., 2018; Shishlov et al., 2016). Additionality is defined as financing new, *additional* projects that wouldn't have otherwise been funded by

vanilla bonds or another financial instrument (Chiang, 2017). This has profound spatial implications because our ability to instigate new mitigation and adaptation projects will shape climate change's severity in our cities and regions. The assumption, then, is that improving green bonds' financial performance will enhance their environmental impact. Three key elements identified for improvement are lowering capital costs for issuers, increasing liquidity for investors, and integrating environmental risk into fixed-income indices and credit ratings.

To achieve additionality, green bonds will need to lower the cost of capital so they can finance projects that would otherwise be too expensive (Chiang, 2017; Shishlov et al., 2016). This may prove challenging as it crystallises some contradictions between reducing interest rates, attracting new investment, and protecting bond integrity. The first contradiction is that lowering capital costs misaligns the interests of issuers and investors (Shishlov et al., 2016). Green bonds need to provide cheaper debt than regular bonds to stimulate additional investment in environmentally beneficial projects. To attract investors, and increase capital availability, green bonds will also need to provide comparable returns to regular bonds. This means borrowers need investors to accept lower yields when doing so may not be compatible with their interests or fiduciary responsibility (Shishlov et al., 2016).

The second contradiction ostensibly misaligns the need to reduce the cost of borrowing with the wider imperative to protect green bond integrity. Issuing green bonds incurs added transaction costs for external verification, monitoring use-of-proceeds, and post-issuance reporting that can reach $US 100,000 (Banga, 2019; OECD, 2017). Rather than offsetting these extra costs with price benefits, some markets have historically required higher rates for green bonds (Bachelet et al., 2019; Karpf & Mandel, 2018). This means some borrowers face higher transaction costs and higher interest rates for issuing green bonds. The procedures for protecting product integrity can therefore increase the cost of capital when a decrease is needed to achieve additionality. Such contradictions explain why researchers and policy makers are concerned with the possibility of a 'green premium' (Agliardi & Agliardi, 2019; Chiang, 2017; Gianfrate & Peri, 2019; Shishlov et al., 2016). Conflicting imperatives could be nullified if the weight of investor demand, or their willingness to accept lower yields for environmental benefit, gives green bonds a price advantage over regular bonds.

In the absence of higher yields, growing investor demand would be supported by increasing liquidity and improving the debt market's evaluation infrastructure. Liquidity measures market volume and trading activity in describing how easy it is to quickly buy or sell a financial asset without significantly changing its price (Chen, 2020). Bonds that trade at low volumes create liquidity risk for investors because it is harder to buy or sell them when market conditions favour it. The limited secondary markets for trading green bonds are thus identified as a handbrake on demand (OECD, 2017). Some U.S. investors are deterred by the market's illiquidity (Chiang, 2017). Our initial interviews with Australasian fund managers suggests the same, though emerging evidence from Europe indicates anxiety about illiquidity may be waning there (Febi et al., 2018). The preferred solution, in any case, is increasing the size of new green bond issues (Chiang, 2017; Timbers et al., 2014). $US 200–250 million is seen as the minimum size needed to support liquidity, though many issuers cannot initiate environmental projects that support that volume (Banga, 2019; Chiang, 2017). In the case of green buildings, for example, bond proceeds might be earmarked for multiple projects and still not reach $NZ 100 million in value (Dey, 2019). This is one area where state intervention can make a profound difference. Sovereign bonds can drastically 'deepen' the market when they borrow by the billions for public infrastructure projects (Alvardo & James, 2019). The New South Wales government increased supply in the Australian market by 20% with an $AU 1.8 billion issue for public transport and water recycling projects (KangaNews, 2018).

Improving fixed-income evaluation is another way of enhancing market performance and investor demand. The chief concern here is that key metrics are misaligned with long-term environmental objectives and risks (HLEGSF, 2018a; OECD, 2017). While green bond and ESG[2] conscious indices continue to develop, their penetration into conventional portfolio allocation remains marginal (HLEGSF, 2018b). Traditional benchmarks also fail to reflect the opportunities and risks of environmental change as they are not adequately incorporated into the valuation of exchange-traded bonds. This inhibits green bond demand as investors following traditional benchmarks will tend to allocate capital to assets that are not aligned with environmental imperatives (HLEGSF, 2018b). A similar problem exists for credit ratings too (HLEGSF, 2018b; Hurley, 2019b). Fixed-income investors say a lack of reliable ESG data is a barrier to considering climate change in their investment strategies (Hurley, 2019b). ESG data was first developed for equities and so it's not quite fit for purpose when investors want to assess the credit materiality of ESG issues (Hurley, 2019b). This helps explain why credit rating agencies currently fail to adequately consider the influence of long-term environmental risks on future creditworthiness (HLEGSF, 2018b; Hurley, 2019b).

3.3. Globalising the Market

The third challenge for growing green bonds is globalising the market by increasing the number of countries where green bonds can be issued and purchased. Two key issues are identified in discussions of how to globalise the green bond market: improving local access for foreign investment and developing market capacity in countries of the global south. Low-income countries of the global south have the greatest need for green finance, but they currently receive very limited proceeds from green bonds. Only 6.5% of global green issuance flowed to Africa and Asia (excluding China) between 2007 and 2016 (Banga, 2019).

A key challenge for growing green bonds is enhancing local market access for an emerging class of global green investors (OECD, 2017). Market access is limited in countries of the global north and south, though the conditions providing these limits can be quite different. In the U.S., for example, the country's tax settings limit foreign access to the green component of their multi-trillion dollar municipal bond market (Bigger, 2017; Chiang, 2017). Capital gains from municipal bonds are generally tax exempt and so the market is primarily patronised by domestic investors who use it as a tax shield. This allows municipal issuers to offer lower interest rates relative to corporate bonds or public debt issued in other countries. Lower rates make municipal bonds less desirable to major international investors, like foreign pension funds and insurance companies, who do not have U.S. tax liabilities to offset smaller returns. The tax exemption is thus described as an "important hindrance" to greening the municipal bond market and using it to finance the massive climate-related infrastructure needs in the U.S. (Bigger, 2017; Chiang, 2017, p. 12).

The situation is rather different for some countries of the global south where the problem is two-fold. Firstly, limited market access for international investors can be self-imposed by their own conditions of fiduciary responsibility (Bigger, 2017). Many U.S. and European pension funds are only authorised to invest in AA/AAA rated bonds[3]. Debt issued in the global south, with smaller projects and lower credit ratings, is therefore off-limits to major institutional investors from the global north (Bigger, 2017). Secondly, countries with inconvertible currencies—such as the Angolan kwanza or the Chilean peso—limit foreign access to their domestic debt markets (Banga, 2019).

[2] ESG refers to the Environmental, Social, and Governance criteria investors may use to evaluate and predict an investee's performance. Performance can be defined in ethical terms, financial terms, or both.

[3] AA/AAA are the best ratings a bond offering can receive from the major credit rating agencies. These agencies consider AA/AAA issuers the least likely to default i.e. fail to repay their investors.

Inconvertible currency is money that cannot be converted to another country's legal tender and traded on foreign exchanges (Chen, 2019). This protects local economies from rapid capital outflow (Chen, 2017), but it also hinders green bond growth by creating a currency risk for foreign investors (Banga, 2019). Small domestic credit markets in developing countries means they would typically need to issue green bonds in foreign currencies to raise large amounts of capital in international markets. With the revenue flows of financed projects held in local currency, borrowers and lenders may not be able to convert repayments of interest and principal back into foreign currencies (Banga, 2019).

The second issue in the global south is the institutional and market barriers of minimum size, transaction costs, and technical capacity. Minimum size is the minimum value a green bond should bear to support liquidity and appeal to bond underwriters (Banga, 2019). $US 200–250 million is generally considered the minimum value needed to support liquidity, interest the underwriters, and be eligible for green bond indices (Banga, 2019; Chiang, 2017). Low-income countries of the global south generally have smaller, standalone projects with financing needs that will not satisfy minimum size (Banga, 2019; Berensmann et al., 2018). Transaction costs for verification, monitoring, and reporting also impede market growth (Banga, 2019; OECD, 2017). Without a pricing benefit for green bonds, this would be a significant barrier for smaller borrowers (Banga, 2019; OECD, 2017). Finally, some countries in the global south may lack the knowledge and technical skills necessary for growing green bonds (Banga, 2019). Issuers and policy-makers may lack knowledge of the international practices and standards important to the development of domestic green credit markets (Banga, 2019; G20 GFSG, 2016). They may also lack some of the technical assessment and administration skills needed to ensure projects are implemented according to international standards (Banga, 2019).

4. Political Concerns

The practical challenges outlined above highlight the key hurdles to increasing the size and impact of the green bond market. Their discussion primarily focuses on the impediments to fuller market maturity and improving the product's profile for issuers and investors. What's typically left unconsidered is green bonds' socio-political context and wider questions about finance's place in the transition towards sustainability. These issues are starting points for the emerging critical scholarship on green bonds. This literature has primarily focused on how value and risk is being (re)produced and (re)distributed by green bonds. Initial observations suggest green bonds risk prioritising financial profits over environmental outcomes, as well as amplifying inequality with lopsided ratios of financial and environmental risk and reward.

4.1. Incomes over Outcomes

The first political concern emerges from the scholarship on value and evaluation in the green bond market (Tripathy, 2017). Geographers have shown that methods of evaluating 'green-ness' and creditworthiness are central to the production of risk and surplus value for green bonds (Bigger, 2017; Christophers, 2018b). They have also considered the project level impact of voluntary product standards (Hilbrandt & Grubbauer, 2020) and the relationship between certification and the realisation of financial and environmental value (Bracking, 2015). In the latter case, the question of additionality is drawn into an analysis of value that raises political concerns about fairness and deserts. This initial research suggests green bond profitability has no strict, commensurate relationship with their environmental benefit. This disconnection therefore risks creating a situation where green bonds favour incomes over outcomes.

This concern is best demonstrated in the work of Bracking (2015) and Hilbrandt and Grubbauer's (2020) study of standard setting organisations (SSOs). Standards are considered a pivotal piece of market infrastructure even if they cannot fully make things the same (Timmermans & Epstein, 2010). As we saw earlier, the GBPs and the CBS are the two frameworks that set standards of environmental benefit by specifying project eligibility for green bonds. Hilbrandt and Grubbauer explore the 'arrival' and implementation of these standards in the lead up to Mexico City's first municipal green bond. They found the standards' specifications had a negligible impact on project design or implementation. What's more, the green bond did not finance additional projects as the city's debt ceiling did not allow new money to be raised. Green bonds essentially relabelled projects and debt that were already planned as part of the city's existing development and capital expenditure programs. This supported the conclusion that green bond standards "neither immediately raised the bar of urban development nor did certifying these projects have direct climate effects" (Hilbrandt & Grubbauer, 2020, p. 12).

This observation lends credence to Bracking's (2015) speculative analysis of green bond use value. In this case, Bracking uses the example of the Clean Development Mechanism (CDM) in South Africa to consider the 'fictive' effect of green bond certification. The CDM is a Kyoto protocol mechanism. It allows for developing countries to produce carbon credits that can be sold into emission trading schemes overseas. Industrialised countries can then buy the credits to meet their Kyoto commitments. South Africa had 54 CDM projects between 2001 and 2012, but the actual environmental value of some of these projects was deeply questionable. At least 15 CDM projects had weak cases of additionality. For example, one project captured waste gases from a closed mine furnace even though that measure was already mandated by South Africa's air quality laws. A second gas project was also included with the claim it reduced carbon emissions by allowing a company to cancel their plans for a new coal mine. However, there was only weak proof the mine would have ever been built (Bracking, 2015).

One lesson Bracking (2015) takes from the South African CDM is that carbon credits can be produced, sold, and traded with only weak evidence of environmental improvement. Carbon markets had no strong institutional reason for trade to reflect the quality of the underlying assets beyond the issue of reputational risk. This risk was ostensibly addressed by certification, but with the secondary effect of distancing the environmental projects from the tradeable asset they produce. This is because:

In the case of carbon trading…the value of the underlying asset, the dirty industry 'cleaning up' or sequestrating part of 'nature', is of little temporal interest after the initial rating or certification, or scientific confirmation of carbon to be 'saved', has been made (Bracking, 2015, p. 2341).

This temporal disinterest is partly explained by the fact that, for some actors at least, a carbon credit's value is determined by its certification more than the projects that produced it. Certification is what makes the carbon credit tradeable—evaluation partially generates the asset itself—so there is little institutional incentive to check on the impact of the underlying projects once the credits are certified. Carbon credits, produced by dubious projects with weak proof of additionality, could be freely traded and profited from so long as they were certified. Their financial value had no strict relationship to their environmental value.

There are obvious parallels here with the green bond market. Green bonds have not achieved additionality and already have a record of financing environmentally dubious projects. Reputational risk is also the primary reason for green bond trade to bear some connection to the green-ness of the projects they finance. This risk is currently managed by several different regimes of evaluation—enshrined in the CBS, the GBPs, and eligibility criteria for green bond indices (see: GBP DIWG, 2017)—that vary in stringency and technical specification. This can add further complexity to the temporal distance observed in the carbon market. As Bracking explained,

When the quality, existence, or materiality of assets are considered as epistemologically separable, it becomes clear that answering the question of what is, and what is not a green economy asset becomes impossible, not least because this judgement is a product of differing evaluation processes (Bracking, 2015, p. 2347).

If evaluation partially generates the financial asset itself, then green bonds will trade with varying degrees of fidelity to the environmental value of their underlying projects. The chief concern is the gap these variable evaluation regimes can open between the value circulating in exchange and the value fixed in production. Investors will receive their income from coupons, traders will profit from arbitrage, and fees will flow to financial service providers even if green bonds are issued for dubious projects with weak cases of additionality. Green bonds could therefore favour financial incomes over environmental outcomes. The environmental value of the underlying projects could remain quite modest, even while the monetary value of the green bond market rises rapidly (Bracking, 2015).

4.2. Amplifying Inequality

The second political concern emerges from scholarship on value and risk in the green bond market. This analysis has primarily focused on the relation between risk and surplus value (Christophers, 2018b); the way risk may coordinate multiple units of value in the green economy (Bracking, 2019); as well as the (re)constitution of risk across different scales and social groups (Bigger and Millington, 2019; Christophers et al., 2020). The chief political concern raised here is that green bonds may amplify social inequality. Initial research suggests green bonds can heavily skew the risk-reward ratio in favour of investors while exposing different publics to increased financial and environmental risk.

The risk of amplifying inequality is demonstrated most clearly in two recent articles. In the first case, Bigger and Millington (2019) show how municipal green bonds could deepen racial and class-based inequalities. In New York City, green bonds were issued by the local government to finance repairs and upgrades to the subway system after Super-storm Sandy in 2012. The subway is critical infrastructure for the city's low-income workers—particularly women and people of colour in the service industry—as they have limited transportation options relative to the subway's whiter, higher-income commuters. These wealthier commuters, though, were targeted by the green bonds sales campaign with 50% of the issue reserved for retail (i.e. non-institutional) investors. Bigger and Millington (2019) suggest this could create a system where higher-income, bond-owning commuters extract rent from the low-income commuters. The New York City subway system is a scarce asset and retail bondholders would derive an income from it. In this way, green bonds can work as a "reverse subsidy" where poorer, communities of colour indirectly transfer rent to wealthier and whiter residents through their taxes and subway patronage (Bigger & Millington, 2019, p. 11).

The second case is Christophers' (2018a) analysis of green bonds used to finance the Clean Rivers Project (CRP) in Washington D.C. The 2005 CRP was DC Water's solution to the sewer overflows polluting the Potomac River, the Anacostia River, and Rock Creek. It was initially designed as a $US 2.5 billion grey infrastructure scheme that would install deep tunnel systems on each of the waterways to store sewerage for treatment. By 2015, however, project debt had ballooned before the first tunnel was even completed. DC Water's long-term debt grew from $US 785 million (2004) to $2.5 billion (2014). The cost of servicing this debt was mostly borne by ratepayers as the average monthly water bill doubled over the same period. This precipitated a two-fold change to the CRP. Firstly, there was a shift from grey to green infrastructure solutions. The Potomac River Tunnel would be reduced, and the Rock Creek Tunnel replaced, with a network of rain gardens and permeable paving designed to reduce storm water inflows. Secondly, there was a shift from vanilla to green bond financing. DC Water issued $US 1.5 billion in conventional municipal bonds between 2007 and 2013. This was followed by green bond issues of $US 350 million (2014), $100 million (2015), $25 million (2016), and $100 million (2017).

The 2016 issue is particularly noteworthy as it was a much-lauded, first-of-its-kind environmental impact bond (EIB). The EIB was for the Rock Creek projects only. It was issued for 30 years, with an interest rate of 3.43%, and a $US 3.3 million payment contingent on the project's performance in 2021. The green infrastructure was expected to achieve runoff reductions between 18.6% and 41.3%. If the project exceeds these expectations, DC Water will make the contingent payment to investors. If the project underperforms, then bondholders will collectively pay $3.3 million to DC Water. The latter scenario principally provides a compensation payment that DC Water could use to address deficiencies with the green infrastructure. The Rock Creek EIB, then is ostensibly structured as a hedge against performance risk for DC Water.

Christophers (2018a) suggests the modified plan heavily favours investors while amplifying the financial and environmental risk to the public. In 2017, for example, the green use-of-proceeds bond was 0.21% dearer on total yield than a vanilla bond. This meant investors charged DC Water an extra $US 210,000 for a green label that has no discernible effect on sewerage overflows. The proposition looks even worse for the EIB, which Christophers compares to the 0.98% coupon on a similarly rated, five-year municipal bond. In the underperformance scenario, where investors pay DC Water $3.3 million, the effective interest rate would be 0.81%. If the green infrastructure performs to expectation, the interest rate will be 3.43%. In the over-performance scenario, where DC Water pays investors $3.3 million, the effective interest rate would rise to 5.8%. This means DC Water could end up paying almost six times the market rate to borrow with the EIB. Investors, on the other hand, only risk slightly below market rates if the project underperforms. The financial risk is overwhelmingly carried by DC Water and the public that ultimately services its debt.

This inequity is made worse by the fact the EIB would not provide underperformance insurance for anything but minor deficiencies to the green infrastructure. In the event of major failure, DC Water's Chief Financial Officer admitted the $3.3 million payment would only partially cover the cost of testing the green infrastructure solution. Even if it did cover construction costs, DC Water would still face the added expense of reverting to the tunnel systems in the original plan. There would also be the amplified environmental risk to DC residents as sewer overflows continued to enter Rock Creek in the intervening years. The waterways and ratepayers of Washington D.C. would ultimately bear the cost of failure though an increased debt and pollution burden. These inequities are why Christophers (2018a) suggests green is not necessarily good when it comes to financial products.

5. Conclusion

The globally inequitable demand for environmental resources and services has driven us into an ecological deficit that is diminishing the planet's ability to support life as we know it. Green bonds, for their part, herald the promise of treating this ecological deficit with debt. Offering to redirect investment capital, their advanced market size places them in the vanguard of green financial innovation, and their successes and failures may well have far reaching socio-spatial consequences at a range of scales. This calls for us to consider the possibility of healthy credit and bad debt in closely scrutinising the green bond market's obstacles, opportunities, and socio-environmental impacts (Elliott & Zhang, 2019). This article contributes to this task with a multi-disciplinary review of green bond media articles, grey literature, and academic research. It is not the first to discuss the practical and political concerns with green bonds, but it is novel for synthesising and placing them into more direct conversation. We believe this provides a firm platform for future green finance research and may support further engagement across the applied and critical literatures. We also argue it provides a fuller picture of a green bond market still growing and open

to further innovation. We end with some conclusions afforded by this point of view.

Firstly, it is not yet clear whether green bonds can meaningfully contribute to addressing the environmental crisis. Additionality is a shared concern for applied and critical researchers. While the presence of a 'green premium' is still a matter of dispute, what does seem clearer is that green bonds may not achieve additionality by weight of demand alone. Competing interests and market imperatives are crystallised by the need to lower capital costs for green bonds. These contradictions are not easily resolved while investors demand pricing parity with regular bonds or environmental risk is poorly incorporated into credit ratings. Further innovation is needed and is being considered (Cripps, 2018a; Levine, 2019). In the meantime, the academic discussion might benefit from more explicit consideration of an ostensibly simple question: what can green bonds *actually* do? An emerging argument from green finance practitioners is that additionality is an unfair demand because bonds are primarily used for refinancing existing projects (Cripps, 2018a). This does not negate concern about disconnecting incomes from outcomes, but it may ask us to take a wider view of green bond use value. Some argue their impact is better measured by the cultural change and new standards of practice they are catalysing (Cripps, 2018b; Michaelsen, 2018). Future research could test these claims empirically and consider whether the results have any bearing on how we think about green bonds' efficacy or political substance.

Secondly, policy actors and applied researchers should heed the warning that green is not necessarily good for financing low-carbon public infrastructure. Sustainable development is typically rendered as three pillars of social, economic, and environmental sustainability (Purvis et al., 2019). By amplifying inequality, green bonds risk undermining the first two pillars in pursuit of the third. They may also serve to entrench the malign political power of financial actors. Credit rating agencies already discipline governments with the threat of downgrading their debt (Omstedt, 2019; Ross, 2017). Rating agencies and bond underwriters are accused of de-democratising politics for a class of creditors that aim to turn public goods into private income (Kirkpatrick, 2016; Ross, 2017). It is easy to argue this would still be the case for regular bonds and that inequitable risk-return profiles are the price of scaling-up green finance. A more challenging question is whether this makes green bonds unfit for responsible investment. By finance's own emerging standards of social and governance risk, will green bonds be a good investment if the public comes to see them as another agent of disparity and domination? This poses the risk of greenwashing in quite different terms. An important line of inquiry, then, is whether green bonds can be structured to smooth out these imbalances or whether there are viable alternatives we need to nurture.

To this end, the paper finally suggests the design and governance of green bond markets may well determine whether they lean towards healthy credit or become another case of bad debt. Additionality, for example, is more likely with preferential tax treatments or an investment culture willing to pay a green premium. Inequality is a much thornier issue. Justice in green finance requires a wider reckoning with austerity and financial frameworks that reflect disparities within and between nations (Bigger & Millington, 2019). This will be a tough nut to crack in the 10 years we have to limit global warming to 1.5°C. Nonetheless, the rise of *citizen debt audits* suggest we might begin to address inequalities with measures that re-democratise public borrowing and development planning (see: Montgomerie & Tepe-Belfrage, 2019). We therefore need more comparative, case driven research of green bond market development to understand the pitfalls and possibilities afforded by different modes of design and governance. Special attention could be paid to product design and deal making (Levine, 2019), the structure and efficacy of information ecologies (Christophers, 2019), or the role non-western actors and values are playing in (green) finance markets (e.g. Aotearoa Circle, 2019; Reidy, 2019). In this, researchers can learn from and inform practitioner efforts to reform finance and make it more capable of supporting the transition towards sustainability.

CRediT authorship contribution statement

Ryan Jones: Conceptualization, Methodology, Investigation, Writing - original draft, Writing - review & editing, Project administration. **Tom Baker:** Conceptualization, Methodology, Writing - review & editing, Supervision, Project administration, Funding acquisition. **Katherine Huet:** Investigation, Writing - original draft. **Laurence Murphy:** Writing - review & editing, Supervision. **Nick Lewis:** Writing - review & editing, Supervision.

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