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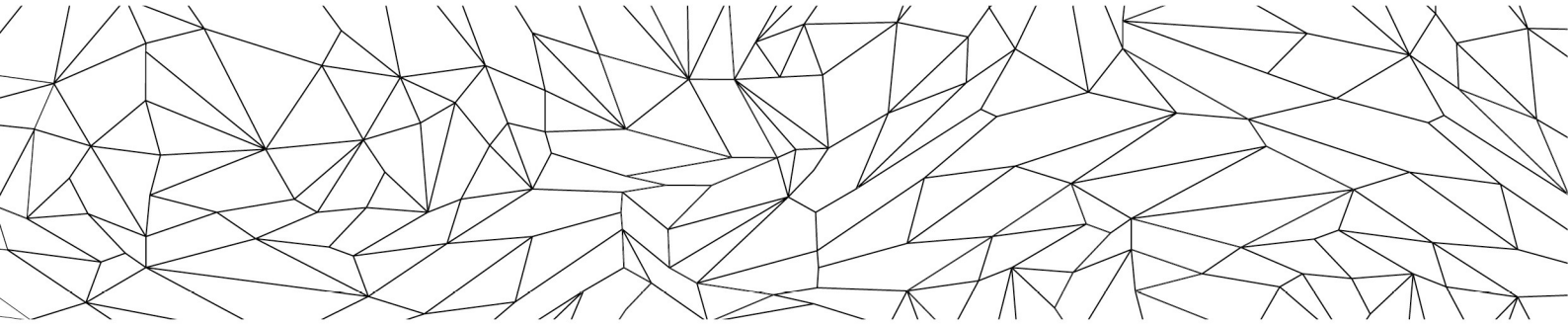

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Alexander Dryden and Enrico Pulieri

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Department of Economics
SOAS University of London
Thornhaugh Street, Russell Square, London WC1H 0XG, UK
Phone: + 44 (0)20 7898 4730
Fax: 020 7898 4759
E-mail: economics@soas.ac.uk
http://www.soas.ac.uk/economics/

The Price of Trust: Greenium and Greenwashing in Asia's Green Bond Markets

Alexander Dryden[*]

Enrico Pulieri[†]

Abstract

This study investigates whether bond certification in Asian green bond markets leads to larger "greeniums" compared to traditional debt instruments. Utilizing a dataset of 2,753 green bonds issued between 2014 and 2024, we employ coarsened exact matching (CEM), ordinary least squares (OLS), and quantile treatment effects (QTE) regressions to analyze secondary market pricing. Our findings reveal that certified green bonds in Asia achieve a "greenium" of 12 basis points, with lower volatility levels when compared to traditional debt instruments. In contrast, self-labeled bonds face yield penalties, reflecting investor concerns about greenwashing and the credibility of their environmental claims. Our findings further suggest that Asian green bond markets require more market leadership from governments and public institutions to develop a more effective and trustworthy green bond market.

Keywords: Asia, Green Bonds, Greenswashing, Greenium, Climate Change.

JEL classification: G12, G15, G18, M14, O53, Q56.

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[*] Department of Economics, SOAS, University of London. ad106@soas.ac.uk

[†] Department of Economics, SOAS, University of London. ep37@soas.ac.uk

1. Introduction

Asia's economic growth has come at a significant environmental cost. As of 2020, the region accounted for nearly 40 percent of global greenhouse gas (GHG) emissions, primarily due to its heavy reliance on coal and energy-intensive industries (IMF, 2023). This trajectory poses significant risks for the region's future: by 2050, over one billion Asians could face severe water shortages and extreme heatwaves (Shaw et al., 2022). Rising sea levels and more frequent natural disasters threaten to displace 143 million people, triggering a wave of climate migration. Despite these challenges, the gap between the region's annual climate finance needs—estimated at $1.1 trillion—and actual investments remains stark, with a shortfall of $800 billion annually (IMF, 2024).

To bridge this significant climate finance gap, green bond markets have emerged as a critical mechanism for mobilizing capital. The region's green bond market has witnessed extraordinary growth, with a compound annual growth rate of 79 percent from 2010 to 2023 and total issuance reaching $1.2 trillion by late 2024—accounting for 23 percent of global cumulative issuance. Green bonds have been issued in 24 Asian countries, funding transitions in polluting infrastructure, scaling renewable energy, and developing innovative climate solutions.

However, this remarkable expansion has not been without challenges. Poor environmental performance across sectors and fears of "greenwashing"—where issuers overstate their environmental credentials—have hampered the market's full potential. These concerns have kept borrowing costs for sustainable debt higher in Asia compared to other regions and raised investor skepticism. A recent survey by the Association of Investment Companies (2024) revealed that two-thirds of investors consider greenwashing a significant barrier to trust in the market, citing insufficient transparency and accountability. Without stronger safeguards to ensure that funds genuinely advance environmental goals, the erosion of investor confidence threatens to undermine the credibility of Asia's green bond market, depriving the region of a vital source of climate finance.

To contextualize these challenges, this paper examines the historical growth, current structure, and critical risks facing Asian green bond markets, particularly the issue of green- washing. By situating these concerns within the broader literature, we aim to explore how green bond frameworks have evolved and where gaps in regulation persist.

A growing number of researchers are analyzing the dynamics of sustainable finance, particularly the risks of greenwashing and the potential for a greenium in green bond markets. Zirek and Unsal (2023) argue that in the absence of clear regulatory criteria defining a 'green project,' third-party certification of green bonds can help reduce greenwashing risks and maintain investor confidence. Baldi and Pandimiglio (2022) find that investors are willing to accept lower returns for green bonds that demonstrate genuine sustainability impact but demand higher yields when greenwashing risks are perceived. Empirical studies suggest that investor preference

for green bonds leads to a measurable greenium compared to traditional bonds (Zerbib, 2019; Hachenberg and Schiereck, 2018). This premium is more pronounced when bonds receive third-party certification (Flammer, 2021), as certification helps mitigate information asymmetries between issuers and investors (Li et al., 2020), thereby reducing the risk of greenwashing in bond markets (Bachelet et al., 2019).

Despite the growing research on green bonds, little attention has been paid to how investors differentiate between certified and self-labeled green bonds, particularly in Asia. Existing studies primarily focus on Western markets, leaving gaps in understanding how greenwashing concerns affect investor behavior and pricing dynamics in Asian bond markets. This paper addresses this gap by examining how greenwashing influences investor confidence, market dynamics, and the broader transition to sustainable finance in Asia. Our analysis contributes to the literature by assessing the credibility of green bond markets under the hypothesis that greenwashing presents a significant risk to their integrity and ability to channel funds into genuine sustainable investments. Using an extensive dataset, we provide an econometric evaluation of greenwashing's impact on pricing and investment behavior in the region.

The contribution of this paper is twofold. First, we investigate the borrowing costs associated with different types of green bonds in Asia. Our empirical findings indicate that self-labeled green bonds, which lack third-party verification and are more susceptible to greenwashing concern, particularly in China, face higher borrowing costs than certified green bonds and traditional debt instruments (Zirek and Unsal, 2023; Baldi and Pandimiglio, 2022). By contrast, certified green bonds achieve a greenium of approximately 12 basis points, reflecting investors' preference for verified sustainable investments and their lower volatility compared to non-green debt. Second, we provide key policy recommendations. Given the high prevalence of self-labeled bonds in Asia's green bond market, our findings highlight the need for stronger public-sector leadership. Increased issuance from governments and quasi-sovereigns could establish best practices for the market, strengthening investor confidence and ensuring the credibility of green bond markets in the region.

In order to address whether investors differentiate between different types of green bonds in Asian markets, this paper will be structured as follows: Section two provides necessary context on the growth and structure of the Asian green bonds as well as the critical risk posed by greenwashing. Section three outlines the econometric methodology used, and Section four presents the results. Section five provides a summary of our findings and offers policy recommendations, including the need for greater public sector leadership in Asian green bond markets.

2. Background and Related Literature

The increasingly urgent impact of climate change, combined with the rising investor demand for green financial instruments, has triggered a period of sustained growth in global green bond markets (Flammer, 2019; World Bank, 2019).1 Starting with the first green bond from the European Investment Bank in 2007, the 'green bond boom' has seen global markets grow from USD 1 billion in 2008 to over USD 3 trillion in 2024 (Morgan Stanley, 2017; Maltais and Nykvist, 2020; Tyson, 2021).2

The rise in green bond issuance reflects mutual benefits for both investors and issuers. For investors, green bonds align portfolios with socially and environmentally responsible practices while potentially offering favorable financial returns. These bonds have shown lower volatility than traditional debt, particularly during market turbulence, making them attractive to both profit-driven and socially conscious investors alike (Faske, 2018; Maltais and Nykvist, 2020; Pham and Do, 2022).

The concept of a "greenium" in green bond pricing reflects the potential willingness of investors to accept lower yields for supporting projects that contribute to the green transition and address climate change (Ehlers and Packer, 2017). However, the presence of a "greenium" in bond markets is an area of active debate.

Bakshi and Preclaw (2015) demonstrated that green bonds trade 17 basis points tighter than traditional debt instruments. Zerbib (2019), by matching similar green and traditional bonds, identified a notable greenium in secondary markets. Similarly, Karpf and Mandel (2018) analyzed a large dataset of green municipal bonds paired with conventional counterparts, finding a consistent greenium of 23 basis points since 2016. In contrast, Larcker and Watts (2020) argue that any observed greenium disappears when accounting for risk and return conditions. Meanwhile, IMF (2024) compared the market pricing of a conventional 10-year rupee-denominated bond with a similar green bond issued by the government. Interestingly, they found that the yield on the conventional bond was consistently lower than that of the green bond, suggesting no evidence of a greenium.

More recently, investigations have sought to differentiate between the different types of green bonds trading in the market (see table 4 for more details). Bonds with credible external certifications appear to attract lower yields (Singh et al., 2024), benefiting from a greenium in both the primary and secondary markets (Kapraun et al., 2021; Pietsch and Salakhova, 2022; Gianfrate and Peri, 2019). Hyun et al. (2022) and Löffler et al. (2021) showed that the greenium varied depending on the level of certification with CBI certification leading to a yield discount of around 15 to 20 basis points compared to conventional bonds. Such a finding is supported by (Singh et al., 2024) who observe that certified green bonds have traded at a discount to uncertified green bonds in U.S municipal debt markets. There has been no study exploring whether green bond yields vary between categories within Asian bond markets. Specific country studies suggest that a small greenium is achieved for certified bonds in China but a whole regional study has yet to be conducted (Hyun et al., 2022; Zenno and Aruga, 2022).

Outside of the perceived cost of capital benefits, Flammer (2021) argues that participation in green bond markets can signal a credible commitment by corporations to investors of their willingness to invest in green projects. Indeed, in the immediate aftermath of a green bond announcement, stock returns of involved corporations increase on average 7 basis points (Flammer, 2021).

However, issuers may have ulterior motives when issuing green bonds. Specifically, green- washing—the practice of issuing green securities with the intention of creating a misleading impression of commitment to environmental sustainability—can be employed as a tactic to attract new financial resources without genuine investment in green initiatives (Flammer, 2021; Leung et al., 2023). Indeed, (Ehlers et al., 2020) note that green bond projects have not led to a material reduction in carbon emissions, bringing into question the motivation for issuing green debt.

To effectively explore the risk of “greenwashing” in Asian green bond markets and examine investor responses, Section 2.1 contextualizes the growth and development of these markets within global trends, Section 2.2 addresses the technical challenges and risks, with a focus on the critical issue of greenwashing, and Section 2.3 investigates the categorization and credibility mechanisms that sustain market confidence and shape investor behavior.

2.1 The growth and development of Asian green bond markets

Asia’s inaugural bond issuance occurred in 2010 when the Asian Development Bank (ADB) opted to issue a water bond, using the proceeds to improve water infrastructure in the region. However, as table 1 shows, despite this positive step, issuance within regional bond markets was initially muted with Asian markets comprising just 3 percent of total global issuance prior to 2015. Despite a sluggish start, Asian green bond markets have gradually developed, catalyzed by Chinese entry in 2014 and increasing demand amongst global investors for green bonds (ICMA, 2022; Tan and Iyer, 2024).

As of 2024, Asian green bond issuance is primarily led by China, Japan, and South Korea, which historically represented 73 percent of the region’s green bond market (see table 2). China’s onshore green bond market, in particular, holds significant importance due to the strategic emphasis placed by Chinese policymakers on expanding the domestic green bond sector (Azhgaliyeva et al., 2020; Lin and Hong, 2022). With a total issuance volume exceeding USD 500 billion, China’s market is the second largest globally, following the United States. Notably, regional market concentration has been decreasing, as ten new countries have entered the green bond market since 2021. The increase in both the size and the diversity of Asian bond markets has seen a wider array of investors seeking to participate in the market. In 2020, HSBC reported that order-books for new green bond issuances in Asia were 5.7 times oversubscribed with significant interest from both regional and international investors HSBC (2024).

Table 1. Global ESG bond issuances and Asian shares.

Year	Number	Asia (%)	Asia ex-China (%)	Billions (USD)	Asia (%)	Asia ex-China (%)
Pre-2015	306	4.2	3.9	54	3.2	3.0
2015	311	5.1	4.2	49	7.6	5.6
2016	276	25.0	7.6	104	32.7	5.3
2017	531	36.7	18.6	184	20.5	5.3
2018	700	34.7	19.1	202	24.0	9.7
2019	1,204	36.0	22.3	374	23.7	13.1
2020	1,578	31.7	19.5	486	16.7	9.2
2021	3,104	38.8	24.7	1,070	20.0	12.0
2022	2,701	42.3	23.8	880	26.9	13.7
2023	2,576	44.5	29.0	811	28.0	15.6
2024e	2,173	39.3	23.1	751	25.2	16.2

Source: Author's calculations taken from Eikon Refinitiv ESG bond guide. Notes: Social bonds excluded. Pre-2015 issuance is between 2010 to 2014. 2024 data is as of October 2024.

In many regions, green bond issuance is largely dominated by governments and multilateral development banks (MDBs) (Duru and Nyong, 2016; OECD, 2023). In Asia, policymakers have encouraged green bond issuance, with the Association of Southeast Asian Nations (ASEAN) establishing a common framework for defining and evaluating these bonds (ACM Forum, 2017; Azhgaliyeva et al., 2020). However, despite these recent agreements and the pioneering efforts of the ADB, Asian markets have seen relatively low issuance from government and quasi-sovereign entities. As shown in Table two, only 14 percent of total issuance in Asia comes from government or MDBs—one of the lowest proportions globally and significantly below levels in Europe and North America. This indicates that governments in the region are adopting a more laissez-faire approach to fostering green bond markets.

Table 2. Proportion of green bond market by issuer

Region	Corporate	Government and public organisations	Other*
Asia	70	15	15
Latin America	69	25	6
Africa	62	38	0
Europe	58	30	12
North America	45	54	1
Pacific	42	14	44

Source: Author's calculations taken from Eikon Refinitiv ESG bond guide. Notes: Social bonds excluded. Issuance between 2010 to October 2024.*Other includes other types of issuers not classified as corporate or government such as government state-owned enter- prises or regional agencies.

2.2 Technical Challenges and the Threat of Greenwashing

The rapid growth of green bond markets, while encouraging, has been accompanied by significant technical challenges and the pervasive threat of greenwashing. Practical im- pediments to market efficiency continue to hinder the green bond market's development. Among these challenges, regional disparities in supply exacerbate liquidity risks, while high transaction costs deter broader participation (Febi et al., 2018; Banga, 2019; Deschryver and De Mariz, 2020). Additionally, a lack of harmonized tax policies and poor coordination between government institutions, corporations, and issuers create inefficiencies in resource allocation, further stalling market growth (Azhgaliyeva and Kapsalyamova, 2023; Baldacci and Possamaï, 2022).

While these technical issues remain significant, greenwashing poses a more critical threat to the credibility of the green bond market. Coined by environmentalist Jay Westerveld in the 1980s, greenwashing refers to the practice of misrepresenting environmental performance or sustainability commitments (Deschryver and De Mariz, 2020; Dempere et al., 2024). In the context of green bonds, this involves allocating proceeds to projects with limited environmental value, which undermines investor confidence (Bartels et al., 2015; Shaw et al., 2022). Maintaining transparency and investor trust is essential for the market to thrive, as Freeburn and Ramsay (2020) emphasize that "confidence in green credentials is essential to a sustainable market". The phenomenon of greenwashing has the prospective capacity to erode investor confidence in the architecture of sustainable finance, which potentially could result in a collapse in demand for green bonds and higher borrowing costs for green debt issuance (Singh et al., 2024). In other words, more or less indirectly, greenwashing represents a serious threat to the financial sustainability of the green transition.

The increasing demand for sustainable investments has inadvertently incentivized green- washing. By misleading investors about the environmental impact of bonds, greenwashing distorts the allocation of resources and undermines truly sustainable projects, ultimately eroding the market's credibility (Delmas and Burbano, 2011). In the long term, green- washing jeopardizes the flow of capital for the green transition, hindering the achievement of climate targets (Azhgaliyeva and Kapsalyamova, 2023).

Asia, particularly China, has emerged as a critical case study for greenwashing in green bond markets. The Chinese government has implemented policies, such as the "green credit policy", aimed at incentivizing sustainable investments through subsidies and tax exemptions. However, these policies have inadvertently encouraged greenwashing practices, as funds from green bonds are often diverted to general working capital rather than sustainability-oriented projects (Wang and

Shen, 2024). Approximately 50 percent of green bonds issued in China may not align with international standards, such as those established by the Climate Bond Initiative (Yu et al., 2024).

Political connections exacerbate the issue, as firms with stronger ties face less regulatory pressure, leading to higher levels of greenwashing (Liu et al., 2024). Despite efforts to align domestic guidelines with international frameworks, inconsistencies persist, further undermining investor confidence (Yu et al., 2024). The Hong Kong Monetary Authority reports that about one-third of global green bond issuers exhibit significant discrepancies between their stated environmental goals and actual practices, contributing to market volatility (Leung et al., 2022).

To address these concerns, financial market practitioners and issuers have introduced third- party certification and diversified green bond instruments to enhance market credibility (Yu et al., 2024). Independent verification can provide greater assurance of adherence to international standards, thereby reducing greenwashing risks and bolstering investor confidence.

2.3 Categorization and Credibility in Green Bond Market

The “green” label for bonds remains largely unregulated, with no unified global framework to govern it. This regulatory void raises significant investor concerns over greenwashing, as the lack of standardized definitions and verification processes undermines the perceived credibility of this asset class (Banahan, 2018).

Consequently, investors face difficulties in reliably assessing the environmental impact of green bonds. In response, green bond markets have evolved to incorporate more nuanced categories of what qualifies as a green bond, as shown in Table 3.

While regional taxonomies such as the ASEAN Green Bond Standards and the Chinese Green Bond Catalogue reflect local priorities, their variability in defining ‘green’ projects introduces challenges in cross-country comparisons. We therefore use the CBI taxonomy as our benchmark due to its consistency, global recognition, and ability to provide comparability across diverse markets. This approach ensures that our analysis reflects global investor preferences while acknowledging that some regional nuances may not be fully captured.

Historically, research into green bond valuation has centered on pricing differences between ESG and non-ESG bonds (Preclaw and Bakshi, 2015; Gianfrate and Peri, 2019; Baker et al., 2022). However, the proliferation of diverse green bond types has prompted recent studies to examine whether investors distinguish between these categories. For instance, Mutarindwa et al. (2024) find that, in African markets, CBI-certified green bonds trade at a noticeable premium compared to both conventional debt and other green bonds. Similarly, Kapraun et al. (2021) demonstrate that in euro and U.S. dollar green bond markets, certified bonds command an additional greenium, reflecting investor willingness to pay for verified environmental credibility.

In China, Wang et al. (2020) show that firms with strong social credentials are often rewarded with material greeniums in subsequent green bond issuances. Conversely, studies by Rose (2019) and Cheong and Choi (2020) highlight theoretical concerns about self-labeled bonds, arguing that their lack of third- party verification and reliance on self-declared claims could be problematic for investors, though empirical evidence remains limited.

Table 3. Green Bond Labels and Definitions

Green Bond Label	Definition	References
CBI-certified	Bonds certified by the Climate Bonds Initiative to fund environmentally vetted projects, reducing greenwashing risks with third-party assurance.	Ehlers and Packer (2017); Baker et al. (2022); Hyun et al. (2021); Mutarindwa et al. (2024)
CBI-aligned	Bonds voluntarily aligned with the Climate Bonds Initiative taxonomy, offering some transparency but lacking formal certification or third-party verification.	Mutarindwa et al. (2024)
Self-labeled	Bonds where issuers claim green intentions without third-party verification, global standards alignment, or mandatory reporting, posing higher greenwashing risks.	Bracking (2015); Baker et al. (2022)
Sustainability-focused	Bonds aimed at broader sustainability, funding environmental and social projects or incentivizing corporate sustainability targets, though accountability varies with target specificity.	Silva and Stewart (2021); Volz (2023); Initiative et al. (2024)

Source: Comprised by authors.

Despite advancements in categorization, greenwashing risks remain pervasive. Certification frameworks, such as those offered by the Climate Bonds Initiative (CBI), aim to enhance accountability and foster investor trust in green bonds. However, as illustrated in Table 4, over 22 percent of the cumulative issuance in Asia's green bond market is self-labeled—10 percent higher than in Latin America and significantly above levels in Europe and North America. This higher prevalence of self-labeled bonds exposes the Asian green bond market to heightened greenwashing risks due to relatively lax standards and oversight.

The limited empirical exploration of how investors value certified versus self-labeled green bonds highlights a critical gap in the literature. This gap forms the basis for our

study. By examining pricing distinctions among green bond types in Asia, where self-labeled bonds are disproportionately common, we aim to identify areas where greenwashing risks are most pronounced. Our analysis will provide insights into the extent to which investors differentiate between bonds with rigorous verification standards and those with minimal oversight, shedding light on the effectiveness of current market mechanisms in addressing greenwashing.

Table 4. ESG Bond Type (% of Cumulative Issuance Volume by Region)

ESG Bond Label	Asia	Europe	North America	Africa	Latin America	Pacific
CBI-Certified	5.0	4.9	0.2	26.8	3.6	27.1
CBI-Aligned	49.7	69.1	31.9	42.2	32.5	29.5
Self-Labeled	22.4	7.5	8.4	6.9	12.7	5.7
Sustainability-Focused Bonds	0.2	0.2	0.6	0.2	0.5	0.4

Source: Author's calculations taken from Eikon Refinitiv ESG bond guide. Notes: Social bonds excluded. Issuance between 2010 to October 2024.

3. Methodology

3.1 Data sources

This study uses data obtained from the Thomson Reuters Refinitiv and Datastream databases. The analysis focuses on plain vanilla bond issued by investment grade issuers in Asia between 2010 and October 2024. In total, there are over 19,981 conventional, non-ESG bond issues, primarily from corporate and sovereign issuers in the region.

In addition, the study includes green bonds that are certified and aligned with the CBI taxonomy framework as well as self-labeled and sustainability-linked bonds (see section 2.3 for full descriptions). However, social bonds are excluded from the sample, as a large proportion of issuance in this category occurred in response to the COVID-19 pandemic rather than to address environmental challenges or assist with climate transition (Mutarindwa et al., 2024). When applying these criteria, there are 2,753 plain vanilla green bonds issued from 964 Asian issuers across corporations, governments, and agencies.

3.2 Estimation Approach

To investigate the relationship between bond yields and green labeling, we employ a two-step methodology. First, consistent with the approach by IMF (2024) and Nurvita et al. (2024), we use Coarsened Exact Matching (CEM) to generate a more balanced

dataset and to achieve more consistent comparisons between bonds. To do this, we have matched bonds by identifying issuers who have issued at least one conventional and one green bond, denominated in the same currency, and having remaining maturities that differ by no more than 18 months.

The second step of our process then leverages both ordinary least squares (OLS) and quantile regressions to explore the effects of ESG classifications on bond borrowing costs, providing a robust and comprehensive framework. While OLS estimates the average effect, it can be sensitive to extreme values or skewed data. Quantile regressions address this limitation by enabling us to analyze how ESG classifications affect different points of the interest rate distribution. This is particularly advantageous in bond markets, where borrowing rates vary widely across debt structures and market conditions. Furthermore, quantile regressions allow us to uncover heterogeneous effects of ESG classifications, such as premiums or discounts observed in certain segments; insights that would be missed in a traditional OLS framework. To enhance the robustness of the analysis, we incorporate fixed effects for bond issuers and currencies, controlling for unobserved heterogeneity that might influence borrowing rates. This ensures that the estimated effects of ESG classifications are not confounded by issuer-specific or currency-specific factors. Quantile regression models are also computationally efficient and straightforward to implement, making them practical for analyzing large bond datasets. Finally, by combining OLS and quantile regressions, we achieve a comprehensive understanding of how ESG classifications impact borrowing rates, capturing both the central tendency and the variability across the distribution.

The estimation equation can be expressed as:

$$y_{it} = \alpha + \beta_1 ESG\ bond\ type_{it} + \beta_2 X_{it} + \mu_i + \lambda_t + \epsilon_{it} \qquad (1)$$

Where y_{it} denotes the yield-to-maturity (YTM) for the bonds borrowing costs in the secondary market, for the bond i in period t. The focus of this study is on the market valuation of different ESG bond types and conventional bonds, as such ESG bond type is a categorical variable that provides a dummy value for each bond category: non-ESG bond, CBI-aligned bond, CBI-certified bond, sustainable-focused bond or a self-labeled green bond (see table four for definitions). This allows us to observe the relative borrowing costs across the different categories and consider whether investors reward or punish respective categories of green-bond when compared to traditional bonds, providing insights as to their concerns regarding greenwashing.

Within equation (1), X denotes the continuous control variables, which are coupon rate, time to maturity and issuance volume (expressed in US dollars). λ_t shows the fixed period effects (quarterly frequency). In addition, μ_i summarizes the fixed effects

of the issuer. Consistent with the work of Mutarindwa et al., 2024, our paper looks to compare ESG bonds with non-ESG bonds from the same issuer. In doing so, we can control for important issuer-specific variables associated with overall credit quality and default risk, which can have a material impact on secondary market pricing. In addition, μ_i includes the fixed effects of seniority rank and currency.

3.2 Definition and measurement of variables

Table A2 provides the definitions for the control variables we utilise in this analysis. Consistent with the work of Mutarindwa et al., 2024, the dependent variables of our analysis are the yield to maturity (YTM). YTM reflects the total, expected annual return on a bond if held until maturity, accounting for its current price, coupon payments, and face value. The higher the YTM the higher the risk of the respective bond.

The YTM provides a more consistent and comparable measure of borrowing costs, avoiding the complexities and potential inconsistencies arising from the use of difference risk-free base rates that can arise from using option-adjusted spreads (OAS), which may vary across countries and currencies, potentially introducing bias into cross-country comparison studies.

4. Results

Table six presents the results of regression models analyzing the impact of ESG classifications on YTM. Column (1) reports results from OLS estimations, incorporating fixed effects for issuers, quarterly time periods, coupons, and currencies. Columns (2), (3), and (4) detail results from quantile regressions at the median (p50), 5th percentile (p5), and 95th percentile (p95), respectively. Column (5) provides estimates for the standard deviation of YTM as a proxy for volatility. The analysis spans a dataset of over 22,000 active and matured bonds, resulting in over 250,000 bond-quarter observations between 2014Q4 and 2024Q3. Non-ESG bonds within the same issuers serve as the reference category.

The findings reveal that CBI-certified green bonds in Asia consistently trade with a notable “greenium” of 12 basis points relative to non-ESG bonds, slightly smaller than what was observed by Löffler et al. (2021) and Hyun et al. (2022). Interestingly, CBI-aligned bonds, which lack certification, exhibit no statistically significant yield discount. This difference reflects the value investors place on third-party certification in distinguishing credible green bonds from potentially less transparent green bond structures. Column 5 also demonstrates that CBI-certification leads to lower volatility levels when compared to the wider bond market, in line with previous studies conducted by Maltais and Nykvist (2020) and Pham and Do (2022).

In contrast, self-labeled green bonds trade with yields 12 basis points higher than non- green debt, indicating that investor skepticism regarding their green credentials results in them being penalized in secondary markets. Investors concerns regarding

greenwashing also extend to sustainable-focused bonds, which trade at yields 37 basis points above their traditional counterparts. However, sustainable-focused bonds comprise a relatively small share of the Asian green bond market, meaning that any premium may be reflecting issues regarding illiquidity, rather than concerns over greenwashing.

Consistent with prior research (e.g., Mutarindwa et al. (2024)), the “greenium” effect varies across the risk spectrum. Among low-yield, high-quality bonds, the greenium for CBI- certified bonds disappears entirely, as sovereign or highly-rated corporate issuers already attract significant investor demand due to their low-risk profiles. In contrast, the greenium becomes more pronounced at higher yields, with CBI-certified bonds trading over 100 basis points lower than comparable non-green bonds in riskier segments. Even CBI-aligned bonds, despite their lack of certification, demonstrate a greenium of approximately 45 basis points for higher-yielding, riskier issuers.

Our findings further show that investor concerns about greenwashing are amplified for riskier issuers. Sustainable-focused bonds, for example, trade with yields that are 64 basis points higher than comparable non-ESG bonds in higher-risk segments, while self-labeled bonds see a 9-basis-point penalty. These results, particularly for self-labeled bonds, suggest that investors place a premium on transparency and credibility, especially for riskier issuers, and penalize instruments perceived as lacking rigorous reporting standards.

Control variables generally align with expectations. Higher coupon rates are strongly associated with higher yields, consistent with compensation for risk. Bonds with longer maturities also exhibit higher yields, reflecting the additional risk associated with extended time horizons. The relationship between issuance volume and yield is less consistent, but larger issuances tend to correlate with slightly lower yields, potentially due to greater market liquidity.

To ensure the robustness of our findings, we re-estimate the models without applying the coarsened exact matching (CEM) filter, thereby utilizing the full dataset of bond issuances. The results, shown in table A3, remain consistent with those obtained using the matched sample, suggesting that the observed effects of certification and self-labeling on yield-to- maturity (YTM) are not driven by the matching procedure but are broadly applicable across the entire dataset. In addition, we apply to bootstrap method to our data sets, with the results broadly in line with our initial findings.

It is also necessary to acknowledge that since the COVID pandemic and the resurgence of inflation global bond markets have entered into a new investment regime. Interestingly, when decomposing the results to consider both pre-COVID and post-COVID trends, the broad relationships remain consistent albeit the observed greenium amongst certified bonds was larger prior to the pandemic compared to more recent observations. However, the distribution along the curve alters most notably among the highest yielding bonds in the post-COVID era. This

may be a sign that in a higher interest rate regime, worries over credit risk among lower quality borrowers overwhelms any potential greenium as yields rise across all sectors. However, the results do suggest that investors in Asian green bond markets are willing to award greeniums in both low-interest rate and higher interest rate regimes.

Taken together, the results highlight that certified green bonds outperform their self-labeled counterparts in terms of lower borrowing costs and reduced volatility. However, the perceived “greenium” benefits are likely concentrated amongst higher risk borrowers.

Table 5. Robustness Test: OLS and quantile treatment effect (QTE) of ESG bond type on yield - pre-COVID versus post-COVID.

	Pre-COVID			Post-COVID		
	(2)	(3)	(4)	(2)	(3)	(4)
OLS	-0.598	-0.064	0.241	-0.203	0.094	0.245
	(-6.20)***	(-2.10)**	(5.77)***	(-0.67)	(8.34)***	(24.92)***
QTE (p50)	1.065	1.436	2.62	-0.936	1.095	0.814
	(5.73)***	(30.35)***	(37.28)***	(-1.43)	(23.77)***	(16.90)***
QTE (p5)	-0.032	0.087	0.159	-0.016	0.118	0.316
	(-0.76)	(8.09)***	(8.86)***	(-0.24)	(13.16)***	(23.48)***
QTE (p95)	4.896	5.028	3.967	2.29	0.122	1.434
	(7.38)***	(29.98)***	(35.79)***	(12.84)***	(0.022)**	(22.75)***
Observations	54,620	54,620	54,620	210,354	210,354	210,354

Source: Dependent variable is the yield-to-maturity (YTM) and derived QTE measures. YTM winsorized at 2.5 and 97.5% for all models. QTE(p50) is a quantile regression on the YTM median, while QTE(p10) and QTE(p90) are regressions on the 5% and the 95% percentiles of the YTM. QTE(std) is a regression on the standard deviation of YTM. t statistics are expressed in parentheses. *p ¡ 0.1, **p ¡ 0.05, ***p ¡ 0.01. Pre-COVID: 2014-2019. Post-COVID: 2020-2024.

Investors skepticism of greenbonds do not seem to apply to lower yielding, less risky issuers of CBI-certified bonds or self-labeled debt.

5. Summary and Policy Recommendations

Our findings suggest that not all green bonds are created equal in Asian markets. Indeed, there is a significant disparity in how investors perceive and value green bonds, as reflected in the borrowing costs charged to different types of green bond structures. Our estimates suggest that CBI-certified bonds, which are least exposed to accusations of greenwashing, attract a “greenium” of 8 basis points compared to traditional debt instruments. Meanwhile, self-labeled bonds in Asia, which have some of the least stringent green credentials, are punished by investors with yields that are 12 basis points higher than non- green bond equivalents. As our analysis highlighted in table five, this disparity in green bond borrowing costs is particularly challenging for Asian markets, given that 22.4 percent of cumulative regional green bond issuance consists of self-labeled instruments—far exceeding the 8.4 percent and 7.5 percent observed in North America and European green bond markets, respectively.

While our study suggests that the type of green bond structure matters most among the highest-risk investment-grade issuers, there is still a significant need for increased green bond issuance from high-quality, government issuers. Green bond issues from public institutions can play a transformative role in regional markets by providing a template for Asian corporations to follow, helping to improve transparency and increase investor confidence. Government leadership is lacking in regional bond markets and can be strengthened through targeted actions. For example, governments can increase the issuance of certified green bonds to set a benchmark for credibility and transparency, encouraging private issuers to follow suit. As shown in Table 3, government and quasi-sovereign issuers have accounted for only 14 percent of cumulative green bond issuance in Asia since 2010, significantly lower than 53 percent in North America and 30 percent in Europe. Increasing public-sector participation can enhance market stability and investor confidence.

Beyond the issue of governmental leadership, index providers such as MSCI and Bloomberg also have a unique opportunity to act as gatekeepers for financial markets. By tightening green bond benchmark requirements and excluding self-labeled green bonds from ESG indices, these providers could place further pressure on corporate issuers to pursue formal certifications, alleviating investor concerns and fostering credibility in the green bond market.

Our study has focused solely on plain vanilla bond structures in order to enhance comparability in secondary market pricing between traditional debt instruments and green bond issues. However, greenium differences could also be reflected in alternative bond structures. Furthermore, our work suggests that investors’ concerns over greenwashing are not consistent across all major countries. Further research is required to identify which currencies and bond structures provide the most effective frameworks for mitigating greenwashing risks and fostering sustainable growth in Asia’s green bond markets. In addition, comparison between Asia’s green bond market and other large global markets, such as North America or Europe, would also

be beneficial to consider whether the same relationships hold in other green debt markets.

References

ACM Forum, A. C. M. (2017). Asean green bond standards.

Association of Investment Companies (2024). ESG attitudes tracker: Advisers and wealth managers give cautious welcome to FCA labels.

Azhgaliyeva, D., Kapoor, A., and Liu, Y. (2020). Green bonds for financing renewable energy and energy efficiency in south-east Asia: a review of policies. Journal of Sustainable Finance & Investment, 10(2):113–140.

Azhgaliyeva, D. and Kapsalyamova, Z. (2023). Policy support in promoting green bonds in Asia: empirical evidence. Climate Policy, 23(4):430–445.

Bachelet, M. J., Becchetti, L., and Manfredonia, S. (2019). The green bonds premium puzzle: The role of issuer characteristics and third-party verification. Sustainability, 11(4):1098.

Baker, M., Bergstresser, D., Serafeim, G., and Wurgler, J. (2022). The pricing and ownership of us green bonds. Annual review of financial economics, 14(1):415–437.

Bakshi, A. and Preclaw, R. (2015). The cost of being green. Barclays Credit Research. Baldacci, B. and Possamaï, D. (2022). Governmental incentives for green bonds investment. Mathematics and Financial Economics, 16(3):539–585.

Baldi, F. and Pandimiglio, A. (2022). The role of ESG scoring and greenwashing risk in explaining the yields of green bonds: A conceptual framework and an econometric analysis. Global Finance Journal, 52:100711.

Banahan, C. M. (2018). The bond villains of green investment: why an unregulated securities market needs government to lay down the law. Vt. L. Rev., 43:841.

Banga, J. (2019). The green bond market: a potential source of climate finance for developing countries. Journal of Sustainable Finance & Investment, 9(1):17–32.

Bartels, W., Holland, P., Metzgen, T., and King, A. (2015). Gearing up for green bonds.

Bracking, S. (2015). Performativity in the green economy: how far does climate finance create a fictive economy? Third World Quarterly, 36(12):2337–2357.

Brzozowska, K. (2018). Green bonds as a transfer of sustainable development idea into financial sector. European Journal of Service Management, 27(3/1):15–22.

Cheong, C. and Choi, J. (2020). Green bonds: a survey. Journal of Derivatives and Quantitative Studies, 28(4):175–189.

Delmas, M. A. and Burbano, V. C. (2011). The drivers of greenwashing. California management review, 54(1):64–87.

Dempere, J., Alamash, E., and Mattos, P. (2024). Unveiling the truth: greenwashing in sustainable finance. Frontiers in Sustainability, 5:1362051.

Deschryver, P. and De Mariz, F. (2020). What future for the green bond market? how can policymakers, companies, and investors unlock the potential of the green bond market? Journal of risk and Financial Management, 13(3):61.

Duru, U. and Nyong, A. (2016). Why Africa needs green bonds.

Ehlers, T., Mojon, B., and Packer, F. (2020). Green bonds and carbon emissions: exploring the case for a rating system at the firm level. BIS Quarterly Review, September.

Ehlers, T. and Packer, F. (2017). Green bond finance and certification. BIS Quarterly Review September.

Faske, B. (2018). Turning billions into (green) trillions: Tracking the growth and development of the green bond market in China, France, India, and the United States. Tulane Environmental Law Journal, 31(2):293–325.

Febi, W., Schäfer, D., Stephan, A., and Sun, C. (2018). The impact of liquidity risk on the yield spread of green bonds. Finance Research Letters, 27:53–59.

Flammer, C. (2019). Green bonds: Effectiveness and implications for public policy. Environmental and Energy Policy and the Economy, 1:95 – 128.

Flammer, C. (2021). Corporate green bonds. Journal of financial economics, 142(2):499– 516.

Freeburn, L. and Ramsay, I. (2020). Green bonds: legal and policy issues. Capital Markets Law Journal, 15(4):418–442.

Gianfrate, G. and Peri, M. (2019). The green advantage: Exploring the convenience of issuing green bonds. Journal of cleaner production, 219:127–135.

Hachenberg, B. and Schiereck, D. (2018). Are green bonds priced differently from conventional bonds? Journal of Asset Management, 19:371–383.

HSBC (2024). Sustainability for businesses.

Hyun, S., Li, C., et al. (2022). Exploring greenium in the Chinese green bond market: Focusing on the primary market. Chen, Exploring Greenium in the Chinese Green Bond Market: Focusing on the Primary Market.

Hyun, S., Park, D., and Tian, S. (2021). Pricing of green labeling: A comparison of labeled and unlabeled green bonds. Finance Research Letters, 41:101816.

ICMA (2022). Pre-Issuance Checklist for Green Bonds / Green Bond Programmes.

IMF (2023). Asia’s Perspectives on Climate Change: Policies, Perceptions, and Gaps, volume 2023. International Monetary Fund.

IMF (2024). Unlocking climate finance in Asia-pacific.

Initiative, C. B. et al. (2024). Sustainability-linked bonds: Building a high-quality market. Report, March.

Kapraun, J., Latino, C., Scheins, C., and Schlag, C. (2021). (in)-credibly green: Which bonds trade at a green bond premium? In Proceedings of Paris December 2019 Finance Meeting EUROFIDAI-ESSEC.

Karpf, A. and Mandel, A. (2018). The changing value of the 'green' label on the us municipal bond market. Nature Climate Change, 8(2):161–165.

Larcker, D. F. and Watts, E. M. (2020). Where's the greenium? Journal of Accounting and Economics, 69(2-3):101312.

Leung, P. H., Wan, W. T. S., and Wong, J. (2023). The Shade of Green: Greenwashing in the Corporate Green Bond Markets. SSRN.

Leung, V., Wan, W., and Wong, J. (2022). Greenwashing in the corporate green bond markets. Market Research Division. Hong Kong Monetary Authority, 30:2023.

Li, Z., Tang, Y., Wu, J., Zhang, J., and Lv, Q. (2020). The interest costs of green bonds: Credit ratings, corporate social responsibility, and certification. Emerging Markets Fi- nance and Trade, 56(12):2679–2692.

Lin, L. and Hong, Y. (2022). Developing a green bonds market: lessons from China.

European Business Organization Law Review, 23(1):143–185.

Liu, H., Wang, Q., Pei, J., and Li, J. (2024). Benchmarking of corporate social responsibility in China. Journal of the Asia Pacific Economy, pages 1–26.

Löffler, K. U., Petreski, A., and Stephan, A. (2021). Drivers of green bond issuance and new evidence on the "greenium". Eurasian Economic Review, 11(1):1–24.

Maltais, A. and Nykvist, B. (2020). Understanding the role of green bonds in advancing sustainability. Journal of Sustainable Finance & Investment, 0(0):1–20.

Morgan Stanley (2017). Behind the green bond boom.

Mutarindwa, S., Schäfer, D., and Stephan, A. (2024). Certification against greenwashing in nascent bond markets: lessons from African ESG bonds. Eurasian Economic Review, 14(1):149–173.

Nurvita, T., Achsani, N. A., Anggraeni, L., Malahayati, M., and Novianti, T. (2024). Exploring greenium and the determinants of green bond performance in Asia. Journal of Environmental Assessment Policy and Management, page 2450015.

OECD (2023). Report on green, social and sustainability bonds issued by multilateral development banks and its use for infrastructure financing.

Pham, L. and Do, H. X. (2022). Green bonds and implied volatilities: Dynamic causality, spillovers, and implications for portfolio management. Energy Economics, 112:106106.

Pietsch, A. and Salakhova, D. (2022). Pricing of green bonds: drivers and dynamics of the greenium. ECB Working Paper.

Preclaw, R. and Bakshi, A. (2015). The cost of being green. Barclays credit research. Rose, P. (2019). Certifying the ‘climate’ in climate bonds. Capital Markets Law Journal, 14(1):59–77.

Shaw, R., Luo, Y., Cheong, T., Abdul Halim, S., Chaturvedi, S., Hashizume, M., Insarov, G., Ishikawa, Y., Jafari, M., Kitoh, A., Pulhin, J., Singh, C., Vasant, K., and Zhang, Z. (2022). Asia. In P¨ortner, H.-O., Roberts, D., Tignor, M., Poloczanska, E., Mintenbeck, K., Alegr´ıa, A., Craig, M., Langsdorf, S., L¨oschke, S., M¨oller, V., Okem, A., and Rama, B., editors, Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, pages 1457–1579. Cambridge University Press, Cambridge, UK and New York, NY, USA.

Silva, A. and Stewart, F. (2021). My word is my bond: Linking sovereign debt with national sustainability commitments. World Bank Blog, Washington, DC.

Singh, V., Jain, S., and Singh, S. (2024). Identification and pricing of labelled green bonds. Finance Research Letters, page 106691.

Tan, S. X. and Iyer, R. N. (2024). Energizing sustainable bond markets in Asia.

Tyson, J. E. (2021). Developing green bond markets for Africa. The joint FSD Africa-ODI research program-Policy Brief, 3.

Volz, U. (2023). On the potential of sovereign state-contingent debt in contributing to better public debt management and enhancing sustainability outcomes. Journal of Globalization and Development, 13(2):379–409.

Wang, H. and Shen, H. (2024). Self-restraint or external supervision: Green bond issuance and greenwashing. Research in International Business and Finance, 70:102402.

Wang, J., Chen, X., Li, X., Yu, J., and Zhong, R. (2020). The market reaction to green bond issuance: Evidence from China. Pacific-Basin Finance Journal, 60:101294.

World Bank (2019). 10 years of green bonds: Creating the blueprint for sustainability across capital markets.

Yu, Q., Hui, E. C.-M., and Shen, J. (2024). The real impacts of third-party certification on green bond issuances: Evidence from the Chinese green bond market. Journal of Corporate Finance, page 102694.

Zenno, Y. and Aruga, K. (2022). Institutional investors’ willingness to pay for green bonds: A case for shanghai. Journal of Risk and Financial Management, 15(11):508.

Zerbib, O. D. (2019). The effect of pro-environmental preferences on bond prices: Evidence from green bonds. Journal of banking & finance, 98:39–60.

Zirek, D. and Unsal, O. (2023). Green bonds: Do investors benefit from third-party certification? Global Finance Journal, 58:100872.

Appendix One - Data

Appendix Table A1. Asia ESG-bond issuance by country

Domicile	Debut Issuance	Frequency	Total (USD billions)
China	2014	2,300	533.62
Japan	2014	1,031	168.31
South Korea	2013	1,029	150.55
Hong Kong	2013	202	88.33
Singapore	2017	82	36.21
India	2014	113	30.99
Indonesia	2018	54	26.54
Philippines	2010	119	25.27
United Arab Emirates	2015	48	25.06
Thailand	2018	128	22.52
Malaysia	2015	478	17.29
Taiwan	2017	164	12.86
Qatar	2024	4	5.00
Uzbekistan	2021	14	4.42
Macao	2019	10	3.54
Israel	2021	3	3.50
Russia	2019	15	3.20
Saudi Arabia	2021	4	3.00
Vietnam	2016	5	0.83
Pakistan	2021	1	0.50
Kazakhstan	2022	4	0.49
Laos	2022	6	0.36
Bangladesh	2021	1	0.25
Jordan	2023	1	0.25

Source: Author's calculations taken from Eikon Refinitiv ESG bond guide. Notes: Social bonds excluded. Issuance between 2010 to October 2024.

Appendix Table A2. Variables Description.

Appendix Table A2. Variables Description

Variables	Description
Yield to Maturity	Defined as the interest rate that will make the present value of the bond's cash flows equal to its current price plus accrued interest, assuming the bond is held to its maturity date. YTM represents the total return an investor can expect to earn on the bond if all payments are made as scheduled and the bond is held until it matures.
Coupon rate	Yearly coupon rate of bond issue expressed in percentage points.
Bond structure	Plain vanilla bonds were used in this study to improve comparability.
ESG Bond Type	Categorical variable describing the type of ESG bond, for definitions see Table three.
Issuance amount	Issuance amount in USD.
Issuance currency	Categorical variable denoting the currency of issuance.
Time to maturity	Measured in days as the difference between date and maturity dates, expressed.

Source: Eikon Refinitiv ESG bond guide.

Appendix Table A4. Descriptive statistics of Asia Bond Markets: Bond Quarter Observations

	Observations	Mean	S.D.	p5	p50	p95
Asia Conventional Bonds (Non-ESG)						
Yield (%)	239,433	2.31	8.12	0.06	1.98	5.21
Coupon rate (%)	239,433	2.13	1.66	0.10	1.89	4.96
Time to Maturity (log)	239,433	5.20	0.58	0.02	2.94	19.19
USD Issuance	239,433	7.83	0.67	6.86	7.81	8.75
CBI Aligned Green Bond						
Yield (%)	900	2.20	2.25	0.07	1.44	7.64
Coupon rate (%)	900	2.09	2.43	0.02	0.63	8.12
Time to Maturity (log)	900	7.15	5.77	0.62	6.16	18.91
Issuance (USD billions)	900	7.91	0.46	7.38	7.81	9.32
CBI Certified Green Bond						
Yield (%)	10,728	2.40	2.04	0.25	2.11	6.06
Coupon rate (%)	10,728	2.24	1.99	0.15	1.89	6.20
Time to Maturity (log)	10,728	5.31	5.61	0.56	3.58	17.30
Issuance (USD billions)	10,728	7.83	0.49	6.99	7.81	8.62
Self-Labeled Green Bond						
Yield (%)	7,409	3.54	6.68	0.52	3.27	6.64
Coupon rate (%)	7,409	3.40	2.09	0.33	3.30	7.00
Time to Maturity (log)	7,409	4.99	4.99	0.56	3.80	15.90
Issuance (USD billions)	7,409	7.92	0.40	7.72	7.92	8.57
Sustainability-Linked Bonds						

Yield (%)	6,504	2.85	1.78	0.33	3.01	5.65
Coupon rate (%)	6,504	2.03	1.47	0.15	1.77	4.47
Time to Maturity (years)	6,504	4.31	5.63	0.19	2.83	13.71
Issuance (USD billions)	6,504	7.72	0.49	6.85	7.75	8.49