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Governance Quality and Policy Frameworks in Certified Green Bond Issuance: Panel Evidence from Five Emerging Economies (2015–2023)

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A CAPSTONE PROJECT REPORT

Submitted in Partial Fulfillment of the Requirements for the Degree of

MASTER OF BUSINESS ADMINISTRATION (EXECUTIVE)

in

DATA SCIENCE AND ANALYTICS

By

Nisha
24/UEMBA/10

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Under the Guidance of
Prof. Amit Mookerjee



UNIVERSITY SCHOOL OF MANAGEMENT & ENTREPRENEURSHIP
DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)
Shahbad Daulatpur, Main Bawana Road, Delhi-110042, India

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August, 2026

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I would like to express my sincere gratitude to everyone who contributed to the successful completion of this project, "Governance Quality and Policy Frameworks in Certified Green Bond Issuance: Panel Evidence from Five Emerging Economies (2015–2023)".

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This research project would not have been possible without the encouragement and support of all those who contributed directly or indirectly. I sincerely thank each one of them for being a part of this academic journey.

Name: Nisha
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DECLARATION

I, Nisha, hereby certify that the work which is being presented in the project report entitled "Governance Quality and Policy Frameworks in Certified Green Bond Issuance: Panel Evidence from Five Emerging Economies (2015–2023)" in the partial fulfillment of the requirements for the award of the degree of Masters of Business Administration (Executive) in Data Science and Analytics, submitted in the University School of Management & Entrepreneurship, Delhi Technological University is an authentic record of my own work carried out during the period from June 2026 to July 2026 under the supervision of Prof. Mookerjee.

I have not submitted the matter presented in the project report for the award of any other degree of this or any other institute.

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CERTIFICATE BY THE SUPERVISOR

Certified that Nisha (Roll No. 24/UEMBA/10) has carried out their project work presented in this project report titled "Governance Quality and Policy Frameworks in Certified Green Bond Issuance: Panel Evidence from Five Emerging Economies (2015–2023)" for the award of Masters of Business Administration (Executive) in Data Science and Analytics from University School of Management and Entrepreneurship. Delhi Technological University, under my supervision. The thesis embodies results of original work, and studies are carried out by the student herself, and the contents of the project report do not form the basis for the award of any other degree to the candidate or to anybody else from this or any other University/Institution.

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ABSTRACT

This research seeks to examine the policy and institutional predictors of certified green bonds issuance in five emerging market economies, namely, China, India, Brazil, Thailand, and Mexico, during 2015-2023. Applying a balanced panel data approach of 45 observations, one per year per country, and using count regression, we examine whether the quality of institutional governance and adoption of national green bond framework could be used to explain the number of annual issuances of certified bonds based on information available in Climate Bonds Initiative Database. We show that Poisson regression model overestimates the impact of governance quality on the number of issuances due to the presence of confirmed overdispersion (variance to mean ratio = 2.886) and employ negative binomial regression as the optimal specification. We also detect and account for structural confounding factor related to the framework adoption variable: since all five frameworks in our sample have been adopted during four years and this period was characterized by steady growth of green bonds markets in emerging countries, a simple framework dummy variable acts as a proxy for time variable, not the policy framework itself. Quality of governance comes out as the only consistent variable that predicts issuance, statistically significant for all the models, even the strictest one, whereas adoption of framework lacks any predictive power once linear time trend is accounted for. This clearly points out that institutional capabilities matter more as a foundational basis of certified green bonds in emerging countries than mere existence of policy framework and has important implications for the way development finance institutions and policy makers allocate their resources for promoting green finance.

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CHAPTER 01
INTRODUCTION

33 The global green bond market has expanded from an estimated USD 3 billion in annual issuance in 2011 to over USD 600 billion by 2023, representing one of the most significant structural transformations in international capital markets over the past decade (OECD, 2017; Climate Bonds Initiative, 2024, as cited in Statista, 2024).While expanding, emerging market economies account for an increasingly larger share of certified green bond issuance as governments, financial institutions and companies in the developing world strive for a more sustainable direction for their finance. This trend has, however, occurred against an academic literature that has paid too little attention to certified green bond markets of developed markets (most of which is centered on issues from Europe and North America). Where emerging market economies have been studied, the literature on green bond markets has mainly focused on the prices of green bonds (relative to their non-green counterparts) rather than on the institutional and policy context of market activities. The questions regarding what factor facilitates the development of a certified green bond market in emerging market economies that thus emerge therefore still have largely not been studied.

To that end, this paper seeks to explore this knowledge gap directly. I explore the variables that are correlated with the issuance of certified green bonds across the five largest emerging markets: China, India, Brazil, Thailand, and Mexico from 2015-2023. I particularly focus on certified green 27 bond issuance, that which is certified under the Climate Bond Standard by the Climate Bonds Initiative, because certification requires credible third-party verification of their green-ness thereby distinguishing them from self-labelled green labelled green bonds. I therefore can explore whether certified green bond issuance is positively correlated with various green market indicators in a more rigorous manner.

We analyze two channels to affect the annual certified green bond issuance across countries. Firstly, countries that perform well in terms of institutional governance quality that is, government effectiveness, rule of law, control of corruption show significantly positive relation with annual certified green bond issuance. Secondly, countries with explicit national green bond frameworks or taxonomies display more certified issuance activity than countries without these arrangements, drawing on established arguments relating institutional quality to financial markets and the signaling effects of national regulatory structure. Given the panel's limited size — five countries observed over nine years — and the absence of an exogenous source of variation in either governance quality or framework adoption, our analysis is correlational and exploratory in nature; we make no claim to have identified causal effects, and we return to this limitation explicitly in Section 7.

Our empirical approach makes two methodological contributions to the emerging market green bond literature. First, we demonstrate that certified green bond issuance counts exhibit significant

overdispersion — the variance-to-mean ratio in our sample is 2.886 — rendering standard Poisson regression, the most commonly used count data model in this literature, is technically inappropriate. We show that Poisson estimation can overstate the significance of governance effects relative to a negative binomial specification, which we adopt as our preferred model, with implications for how existing empirical findings in this space should be interpreted. Second, we identify and correct a structural confound in the framework adoption variable: because national green bond frameworks in our sample were adopted within a narrow four-year window (2015–2018) and EM green bond markets grew substantially over the entire study period for reasons unrelated to any single country's policy, a naive framework variable mechanically proxies for time rather than measuring a genuine policy association. Once a linear time trend is controlled for, the apparent significance of framework adoption disappears.

Our principal finding is that governance quality is a significant or marginally significant predictor of certified green bond issuance across every specification we test and that this association strengthens rather than weakens once the secular growth trend in EM green bond markets is partialled out. Framework adoption, by contrast, shows no independent association with issuance once time is controlled for — a result with meaningful implications for policymakers who may otherwise overestimate the role of framework adoption, in isolation from broader institutional quality, in stimulating green bond market development.

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The rest of the paper is organized as follows: Section 2 reviews the literature and establishes the hypotheses; Section 3 provides description of the data and data construction; Section 4 presents our empirical strategy; Section 5 reports the empirical results; Section 6 includes robustness checks and Section 7 presents the paper conclusion with implications for policy and avenues for future research.

CHAPTER 02
LITERATURE REVIEW

This section sets out three strands of literature underpinnings for the two hypotheses discussed in this paper: pricing of green bonds; the relative contribution of institution governance towards green finance market deepening; and country level green bond guidelines design. It concludes by presenting the hypotheses in precise terms.

2.1 Green Bond Premium

The beginning point for studies on green bonds is to check whether green labelled debt trades at a lower yield than a similarly structured conventional bond, which is a spread termed the greenium. Zerbib (2019) has since developed the now standard procedure for examining the issue; to match the sample of green bond trades with synthetic conventional bond trades and then compare their yields directly. Applying the approach to green bond observations between 2013 and 2017, Zerbib calculated the greenium to be around a two basis point negative premium. However, later papers have failed to reach an agreement about the size of the greenium, let alone its existence: Baker et al. (2018) estimated the greenium for U. S. municipal green bonds to also be around a two basis point negative premium, while Larcker and Watts (2020) find no reliable premium with bonds matched at the bond– level. This contradiction implies that greenium (if there is one), and its possible size, seems to be very much data dependent and method of matching.

2.2 Emerging Market Evidence

All these above arguments primarily rely on euro and north america market bonds. Emerging-market evidence is newer and thinner. Nevatia (2026) used Bloomberg data on 168 sovereign sustainability bonds across 44 countries issued between 2017 and 2023 and, using coarsened exact matching, found that advanced-economy sovereign green bonds carry a positive premium of 20 to 40 basis points, while emerging-market sovereigns show a negative greenium of approximately 10 basis points – the opposite pattern. The International Finance Corporation and Amundi's annual Emerging Market Green Bonds report tracks a comparable matched-issuer greenium on a rolling basis and found it had narrowed to roughly 1.2 basis points by 2024, a decline the report attributes partly to large issuers, including China, shifting toward cheaper conventional financing (International Finance Corporation & Amundi Asset Management, 2025). Because the pricing question is now reasonably well documented for emerging-market sovereigns, this paper instead asks what drives issuance volume — a question this pricing literature does not address.

2.3 Institutional Quality and Green Finance

Behind measurements sits a method drawn from the World Bank's broader analysis of national systems. Perceived outcomes shape proxies like institutional strength, legal clarity, and oversight capacity. Expectation that governance influences certified green bonds emerges from several linked strands detailed later in Chapter Two. Data collection relies upon surveys and reviews

distilled into quantitative markers. Metrics capture aspects such as adherence to rules, fairness in decision-making, and transparency in power structures. How well these factors contribute remains analyzed within specific contexts explored beyond this point. Stronger governance environments lower transaction costs by producing clearer and more consistently enforced disclosure rules; governance quality makes third-party certification more credible where the surrounding institutional environment supports contract enforcement; and stronger governance tends to coincide with the deeper financial market infrastructure – active investor bases and functioning credit rating systems – that green bond markets depend on generally. Direct empirical tests of this specific relationship for certified green bond issuance volumes in emerging markets are limited, which is the gap this paper addresses.

2.4 National Frameworks and an Identification Challenge

A separate strand of research addresses formal national green bond frameworks and taxonomies — documents issued by regulators or industry bodies that define eligible project categories and disclosure requirements. Several such frameworks are directly relevant to this study's sample. China's framework dates to December 2015, when the People's Bank of China issued the Green Bond Endorsed Project Catalogue (People's Bank of China, 2015). India's Securities and Exchange Board formalised disclosure requirements in Circular CIR/IMD/DF/51/2017, issued in May 2017 (Securities and Exchange Board of India, 2017). The ASEAN Capital Markets Forum issued the ASEAN Green Bond Standards in November 2017, revised in October 2018, and subsequently adopted them across member states, including Thailand (ASEAN Capital Markets Forum, 2018). Mexico's Green Bonds Principles MX were published by the Climate Finance Advisory Group in January 2018 (Climate Finance Advisory Group, 2018), distinct from Nacional Financiera's earlier 2016 bond issuance. Brazil's FEBRABAN and CEBDS jointly published the country's first Guide for Issuing Green Bonds in October 2016 (FEBRABAN & Conselho Empresarial Brasileiro para o Desenvolvimento Sustentável, 2016).

A structural feature of this set of dates matters directly for this paper's methodology: all five frameworks were adopted within a narrow four-year window (2015–2018), and none has since been repealed. As Section 4.3 shows using this study's own data, this timing pattern makes a binary framework variable difficult to distinguish statistically from the simple passage of time in a nine-year panel — a concern this paper tests directly rather than assumes.

2.5 Hypothesis Development

Two hypotheses follow from the literature above. The governance hypothesis rests on the three mechanisms outlined in Section 2.3: lower transaction costs from clearer regulatory enforcement, more credible certification where institutions support contract enforcement, and the broader financial infrastructure that stronger governance tends to support.

H1:Countries with stronger institutional governance quality, as measured by a multi-index

including measures of government effectiveness, rule of law, and control of corruption, will have a higher volume of certified green bond issuance annually.

To be clear, ICMA‘s framework proposition is based on a much narrower theoretical assumption that frameworks alleviate the information asymmetry problems inherent in the issuance process for both issuers and investors, through setting out allowed project types and minimum disclosure requirements, thereby lowering the costs of structuring a compliant issuance (ICMA, 2021). In the absence of such a framework, issuers rely entirely on third-party certification, which may raise transaction costs for smaller or first-time issuers.

H2: Countries with an explicit national green bond framework or taxonomy in place are associated with higher annual certified green bond issuance, independent of the general secular growth trend in the asset class over the study period.

The qualification “independent of the general secular growth trend” reflects the identification concern raised in Section 2.4: any test of H2 must separate a genuine policy association from the coincidence of timing, a test Section 4.3 develops in detail.

CHAPTER 03
DATA AND SAMPLE CONSTRUCTION

3.1 Sample Overview

The time span of five years from 2015 to 2023 creates a balanced panel of 45 country-year observations for five emerging markets, namely China, India, Brazil, Thailand, and Mexico. 2015 marks the beginning of the period and is significant in the fact that both the first national green bond framework appearing in our sample and volumes of green bonds issued under the emerging markets label were sufficient enough to permit systematic analysis across countries. The end date is 2023. It represents the last year for which we have full data across all of our measures; data from 2024 was excluded, given partial annual reporting at the datasets used.

The country selection procedure followed three criteria. In addition to belonging to the MSCI Emerging Markets Index, each country should be categorized as an Emerging Market Economy, so as to enable easy generalizability of results to the wider emerging market finance literature. Each of the selected countries had issued at least one green bond that was certified under the Climate Bonds Initiative standards before 2023. The selected five countries represent the most sizeable certified green bond markets in the emerging market universe by aggregate volume of issued certified green bonds in the sample duration. The selection of countries did not consider the number of certified green bond issues by individual country. Indonesia was also considered for inclusion, but excluded as the certified green bond volume in the country comprises largely sovereign and quasi-sovereign bonds that have not been certified under the Climate Bonds Initiative standards, which would lead to less than panel worthy number of observations. Similarly, South Africa was considered, but excluded because there are only two non-zero certified issuance observations through the study duration.

The sample composition also includes one critical note to mention upfront. Indeed, China accounts for 30.6% of the aggregate amount of certified green bonds issued in the sample. China has, in fact, accounted for 30 out of the 98 green bonds issued among the five countries in this study, which seems only logical given its standing as one of the largest green bond issuers among the emerging market green bond issuing economies. Relative to other countries in this sample, however, India has the highest amount of bond issuances with 31 bond issuances, only narrowly topped by China at 30 bond issuances. Because this is the case, we should be cautious of the fact that results might be heavily influenced by its presence and we thus follow the practice of providing an ex-China robustness analysis in section 6.

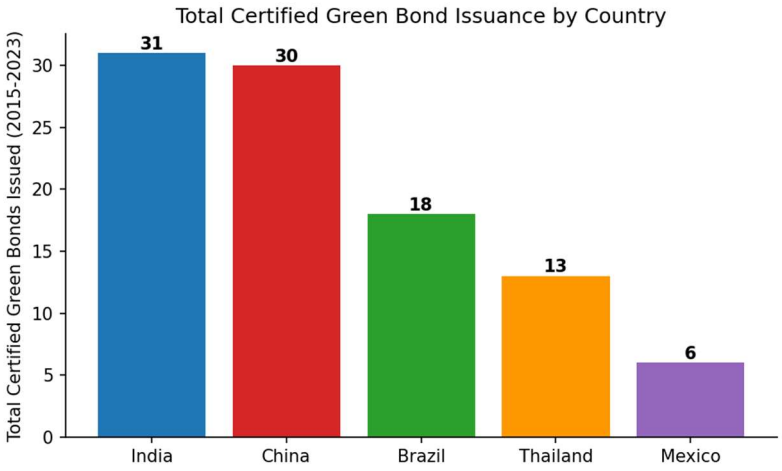


Figure 1: Total certified green bonds issued by country, 2015-2023 (source: Climate Bonds Initiative Certified Bonds Database, as reported in Section 3.1).

3.2 Dependent Variable: Certified Green Bond Issuance Count

Count of Climate Bonds Initiative-approved green bonds, by country and year. This comes from a dataset pulled in 2026 by the Climate Bonds Initiative tracking labels like issuer, timing, amount raised, industry, credentials, and validation status for every bond meeting the Climate Bonds Standard worldwide.

What stands out about these choices involves how data were built - let's break them down. Not every bond made the cut; only those labeled as bonds with specificlabels for how funds get used were kept. Tools like loans or short-term debt notes, along with packages backed by assets or complex financial structures, were left out because their investors, how they price, and what must be disclosed differ sharply from typical bond offerings. Because of this sorting, just 113 entries out of 187 stayed in the pool. Then there's the time window: bonds issued between 2015 and 2023 defined the next cut, cutting the dataset to 102 observations spanning years. When it comes to China, bonds issued by companies based in Hong Kong vanished from that country's tally because its finance system runs on different rules - ones separate from what applies on the mainland, making comparisons off track. Lastly, though mentioned earlier, South Africa quit the group once filters ran due to nearly empty rows lacking any real data.

It made more sense to work with how many bonds were issued instead of their total value in US dollars as the main outcome. About one in three securities in the trimmed dataset said their volume was private information, making the dollar-based totals untrustworthy. Count data showed up every time without missing values, allowing fair comparisons between nations and time periods. While true that a $5 billion bond gets treated just like a $50 million one under this method, that trade-off gets mentioned later in the limitations.

Outcomes cluster between zero and ten per country-year observation, averaging 2.18 while

swaying unpredictably by 2.51 each time. With variance more than nine times the mean, dispersion runs far beyond what the Poisson model expects - a pattern affecting choices in later analysis, explored at length in Section 4.

3.3 Independent Variables

Governance Quality Index. The major independent variable is a composite governance quality index computed from three of the six Worldwide Governance Indicators that the World Bank publish annually Government Effectiveness, Rule of Law, and Control of Corruption. These three indicators are separately coded to a scale of roughly −2.5 up to +2.5. (Higher scores are associated with stronger governance.) These three are then average to generate an overall composite score (Governance_Index) at the country−year level. In doing so, we followed established practice, such as that in Banerjee &Amin (2002), and opted against Principal Component Analysis (PCA), again following established convention, given the limited number of indicators and their moderately high levels of correlation with each other (average pairwise correlation = 0.50). On average across the sample, scores range from as low as −0.591 (Mexico) to as high as +0.010 (India), which is consistent with an emerging market sample.

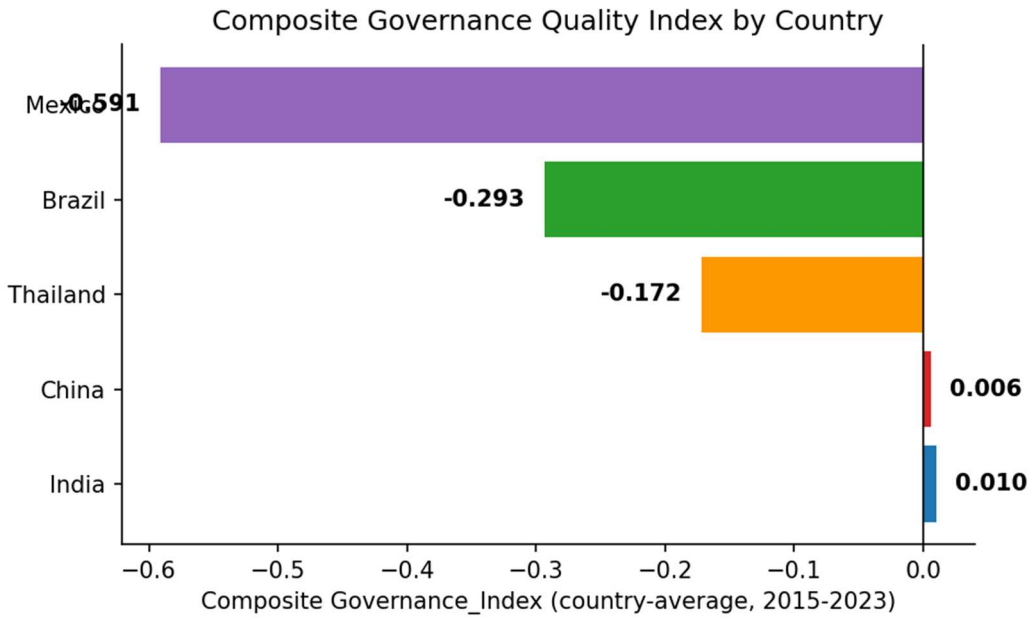


Figure 2: Composite Governance_Index by country, averaged over 2015-2023. Positive values indicate above-global-average governance quality; negative values indicate below-average.

Framework Adoption. The second independent variable is a binary indicator (framework). coded one in each year following a country's adoption of an explicit national green bond framework or taxonomy and zero otherwise. Framework adoption dates were verified against primary source documents for each country and are as follows: China (2015), citing the People's Bank of China Green Bond Endorsed Project Catalogue published in December 2015; Brazil (2016), citing the Guide for Issuing Green Bonds in Brazil published jointly by FEBRABAN and CEBDS in October 2016; India (2017), citing SEBI Circular CIR/IMD/DF/51/2017 issued in May 2017; Mexico (2018), citing the Green Bonds Principles MX published by the Climate Finance Advisory Group in January 2018, which constitutes Mexico's first formal framework document as distinct from Nacional Financiera's inaugural green bond issuance in September 2016; and Thailand (2018), citing the adoption of the ASEAN Green Bond Standards by Thai market participants in 2018, following the standards' November 2017 publication by the ASEAN Capital Markets Forum.

A crucial identification problem for this variable, one explored extensively in section 4 and validated in an empirical analysis found in section 6, is that there seems to be a positive relationship between time itself and the independent variable (rho = .624) this raises the possibility that observed associations with issuance are really a reflection of a time-dependent growth pattern rather than the policy itself.

3.4 Control Variables

Four control variables were included to account for macroeconomic conditions that may independently predict green bond issuance activity.

Economic Size (Log_GDP). The natural logarithm of annual GDP in current US dollars, sourced from the World Bank World Development Indicators. Larger economies have deeper capital markets and a broader potential issuer base, making economic size a plausible structural predictor of issuance volume.

Economic Growth (GDP_Growth). Annual GDP growth rate in percentage terms, sourced from the World Bank World Development Indicators. Periods of faster growth may stimulate capital market activity generally, including green bond issuance, though the sign of this relationship is theoretically ambiguous — fiscal stress during downturns may also stimulate sovereign green bond issuance as governments seek to access international capital on preferential terms.

Renewable Energy Commitment (Renewable_Pct). Renewable energy consumption as a percentage of total final energy consumption, sourced from the World Bank World Development Indicators. Countries with a larger existing renewable energy base may have a larger pipeline of eligible green projects and a stronger environmental policy commitment, both of which could stimulate certified issuance. Data for 2022 and 2023 were unavailable for some countries at the time of collection; missing values were imputed using the most recent available year's value within

each country, consistent with a forward-fill approach applied within country groups.

Time Trend (Year_Trend). A linear time trend variable constructed as Year minus 2015, taking values from zero (2015) to eight (2023), is included in the robustness specifications discussed in Section 6 to control for the secular growth in EM green bond markets over the study period independent of any country-specific policy or governance variable.

3.5 Summary Statistics

Table 1 presents descriptive statistics for all variables used in the analysis.

TABLE 1: SUMMARY STATISTICS

	N	Mean	SD	Min	Max
Bond_Count	45	2.178	2.507	0.000	10.000
Governance_Index	45	-0.208	0.234	-0.695	0.113
Framework	45	0.800	0.405	0.000	1.000
Log_GDP	45	28.399	1.141	26.718	30.539
GDP_Growth	45	3.115	4.050	-8.354	9.690
Renewable_Pct	45	25.416	13.401	9.200	50.000

Note. Bond_Count is the annual number of Climate Bonds Initiative-certified green bonds issued. Governance_Index is the unweighted average of World Bank Government Effectiveness, Rule of Law, and Control of Corruption indicators. Framework is a binary variable equal to one following national green bond framework adoption. Log_GDP is the natural logarithm of GDP in current USD. GDP_Growth is annual GDP growth in percentage points. Renewable_Pct is renewable energy as a percentage of total final energy consumption.

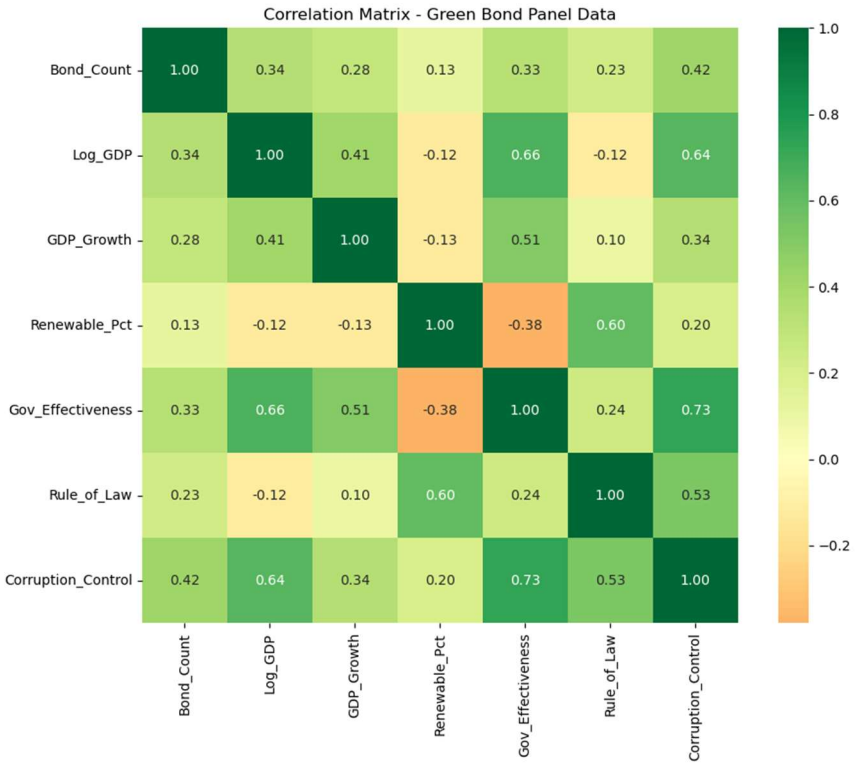


Figure 3: Correlation matrix among Bond_Count and its component variables, before construction of the composite Governance_Index (Section 3.3). Gov_Effectiveness, Rule_of_Law, and Corruption_Control are shown separately here to illustrate the high mutual correlation (average pairwise r = 0.50) that motivated combining them into a single composite measure.

CHAPTER 04
METHODOLOGY

4.1 Modelling Strategy

The dependent variable in this study, the annual count of certified green bonds issued per country per year is a nonnegative integer on a bounded range (0 to 10 in the sample) and heavily right-skewed. Consequently, this dependent variable violates the assumptions of OLS estimation: that Y should be continuous and that should follow a normal distribution, with potentially negative fit values that do not make sense for count data. The natural model of count data would be the Poisson, which is a member of the exponential family where the dependent variable is distributed as a Poisson variable with conditional mean exp(Xβ).

One other problem with the Poisson model that should be discussed is the condition of equidispersion, which states that the conditional variance should be equal to the conditional mean. Of course, in practice most count data does not follow this and is subject to overdispersion, where the variance is much larger than the mean. We document in Chapter 3 that the mean to variance ratio for our data is 2.886. So, the data is nearly three times more dispersed than a Poisson would imply.

That is not a rule of thumb but a fact. Where there are the phenomena of overdispersion that exist in most count data sets, the Poisson model biases standard errors downwards, which makes p-values seem more interesting than they in fact are, a phenomenon referred to as a false sense of precision that leads scholars to report something that would not exist if they applied the most appropriate model, instead of the simplest.

This issue is directly relevant to this paper‘s findings; for this we report the results in the empirical study part of Section five: in a Poisson model the governance quality is significant at conventional levels of significance but is no longer so at conventional levels in a negative binomial (which accounts for over-dispersion). This in it of itself is a beautiful justification for selecting a particular regression model for count data, not only is it required for good practice technically, but it has real substantive implications for what we are able to infer from the data.

4.2 Negative Binomial Regression

A second parameter, known as dispersion parameter α, is introduced into the Poisson model to allow the conditional variance to exceed the conditional mean. The conditional mean is specified in the following way:

$$E(Bond_Count_it) = \exp(\beta_0 + \beta_1 Governance_Index_it + \beta_2 Framework_it + \beta_3 Log_GDP_it + \beta_4 GDP_Growth_it + \beta_5 Renewable_Pct_it)$$

Where "i" denotes country and "t" denotes year. It can be noted that the parameter α, which relates to overdispersion, is simultaneously estimated with the regression coefficients. The overdispersion parameter α is statistically significant (p-value equals 0.037, α = 0.504), implying that the negative binomial model is more suitable than Poisson regression. The AIC value for the negative binomial model (176.04) is lower than that for the Poisson model (187.41), with a larger gap of 11.37. This suggests stronger evidence that the negative binomial model is a better fit.

Estimated coefficients are presented as log-incidence rate ratios; an increase of 1 unit in the associated explanatory variable causes an increase in the expected number of certified green bonds issued (conditional on all other variables held constant).

4.3 The Time Trend Identification Problem

A central methodological contribution of this study is the explicit identification and testing of a structural confound affecting the Framework variable. The confound arises from the following coincidence of timing: all five national green bond frameworks in the sample were adopted between 2015 and 2018, in the early years of the panel, and none has since been repealed. As a result, the framework variable effectively captures the distinction between the pre-adoption years (predominantly 2015–2017 for most countries) and the post-adoption years (predominantly 2018–2023) — a distinction that closely mirrors the distinction between the early and later years of the panel itself.

This overlapping structure engenders a problem analogous to multicollinearity. The relationship between Framework and the linear time trend variable Year_Trend in this sample is a correlation of 0.624 indicating that roughly 39 percent of the variability in Framework is explained by time alone. For an asset class which experienced such rapid growth 2015 to 2023 for reasons not directly traceable to particular country policy- among others, increasing investor demand for environmental, social, and governance screening, institutional investor response to the Paris Accord, and the evolution of global green bond market practices–a simple regression analyzing the former with inclusion of Framework but exclusion of a time trend might attribute growth unrelated to policy and not coincidental with its adoption, to the framework.

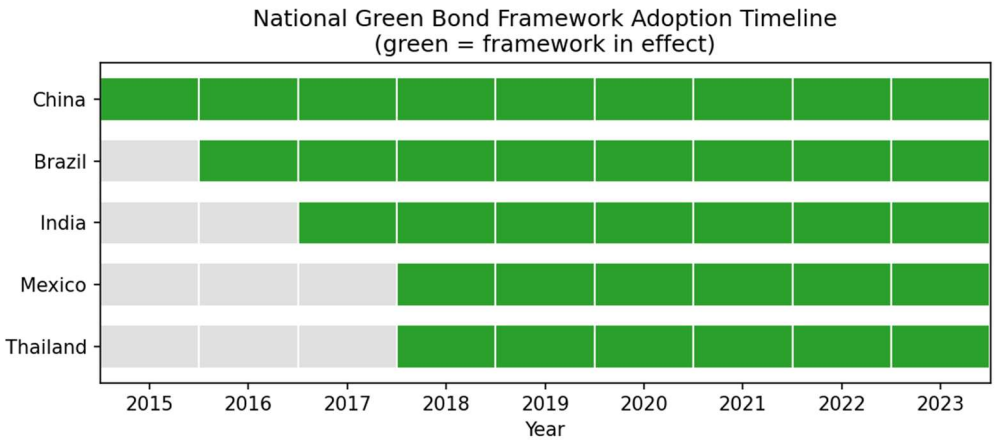


Figure 4: National green bond framework adoption timeline across the five sample countries. All five frameworks are adopted within a four-year window (2015-2018), illustrating the structural overlap with the panel's time dimension discussed above.

Whether Framwork‘s positive correlation with certified issuance persists after identifying all the other factors responsible for this trend is explored through regression analysis augmented by inclusion of a linear Year Trend variable into the initial model.

$$E(\text{Bond_Count_it}) = \exp(\beta_0 + \beta_1 \text{Governance_Index_it} + \beta_2 \text{Framework_it} + \beta_3 \text{Year_Trend_t} + \beta_4 \text{Log_GDP_it} + \beta_5 \text{GDP_Growth_it} + \beta_6 \text{Renewable_Pct_it})$$

The first alternative specification (referred to above as Poisson with trend) is used instead of negative binomial for a pragmatic reason: a negative binomial with an extra seventh parameter fails to converge on our dataset (due to only 45 observations).14 Section 6 briefly discusses this problem and notes that the trend specification converges easily. The Poisson-with-trend model provides the only effective means to tell whether the observed link between Framework and certified issuance is the result of a policy influence or simply an artefact of time.

4.4 Hypothesis Testing Framework

The two hypotheses introduced in Section 2 are tested as follows.

To assess the validity of H1 - the hypothesis that stronger governance is associated with greater certified green bond issuance we look to the coefficient on the Governance_Index variable in each of the Poisson, negative binomial and Poisson with trend models. The test of H1 requires only that the coefficient on Governance_Index in the negative binomial (the best-specifled) model is positive and significant at least, though stronger evidence could be found if the association holds up across all models with positive coefficients being found.

H2, which posits that framework adoption is associated with higher certified issuance independent

of the general time trend, is evaluated by examining the coefficient on framework in the Poisson-with-trend specification specifically. The without-trend specifications are reported for transparency and comparison, but the definitive test of H2 is the coefficient on Framework once Year_Trend is included, since only this specification cleanly separates a genuine policy association from the coincidence of timing described above.

4.5 Robustness Checks

Three robustness checks are reported in Section 6. First, an ex-China Poisson regression is estimated on the four-country sample excluding China to test whether results are driven by China's dominant position in the sample – a concern particularly relevant for Governance_Index, given that China combines the largest issuance counts in the sample with governance scores near the global average. Note that the negative binomial model did not converge on the ex-China sub-sample, a consequence of the reduced sample size of 36 observations across four countries; the Poisson specification is used for this robustness check, and the non-convergence of the negative binomial is itself reported as evidence of the data's limitations rather than being suppressed.

Second, the Poisson-with-trend specification serves as both the definitive H2 test and a robustness check on the baseline negative binomial results for H1, since the two specifications use different estimators and different control sets.

Third, the correlation matrix among all variables is examined for multicollinearity, and variance inflation factors are reported for the baseline specification to confirm that no single variable is excessively collinear with the others. All VIF values in the baseline specification are below 2.0, well within acceptable bounds.

CHAPTER 05
RESULTS AND DISCUSSION

5.1 Overview of Results

Table 1 presents descriptive statistics for all variables used in the analysis.

Table 2 reports the key estimation results of the three alternative specifications: Poisson regression in column one, the negative binomial regression in column two, and the Poisson regression with linear time trend control in column three. This three-column layout has not occurred by chance its purpose is to trace which of each variable's coefficients become significant in which specification and assess how trustworthy each estimated effect is across different models. All specifications include each of the control variables. After presenting and discussing results for each hypothesis we will turn to a discussion of the control variables and the overall meaning of the estimation results.

TABLE 2: MAIN REGRESSION RESULTS

	Variable	Poisson_Coef	Poisson_p	Poisson_Sig	NegBin_Coef	NegBin_p	NegBin_Sig	Trend_Coef	Trend_p	Trend_Sig
0	Governance_Index	1.644	0.013	**	1.743	0.051	*	1.711	0.009	***
1	Framework	0.979	0.017	**	1.123	0.032	**	0.602	0.196	
2	Log_GDP	0.060	0.620		0.049	0.783		0.072	0.542	
3	GDP_Growth	0.055	0.088	*	0.052	0.245		0.049	0.125	
4	Renewable_Pct	0.015	0.101		0.014	0.261		0.014	0.112	
5	Year_Trend	NaN	NaN		NaN	NaN		0.084	0.074	*

MODEL FIT
Pseudo R2: Poisson=0.174 | NegBin=0.090 | Trend=0.189
AIC: Poisson=187.41 | NegBin=176.04 | Trend=186.15
N: 45 for all specifications
NB Alpha: 0.504 (p=0.037)

Note. Log incidence rate ratios from coefficients. P-values are in parenthesis. Standard errors are those from maximum likelihood asymptotic theory, not clustered or heteroskedasticity-robust. p < 0:1, p < 0.05, p < 0.01 The negative binomial regression model is the most appropriate to H1 following statistically confirmed overdispersion (variance-to-mean ratio: 2.886, alpha 0:037 sig); the AIC is 11.37 less than Poisson for this model. The Poisson with trend is the appropriate model for H2. We define Year_Trend as the calendar year minus 2015, so it takes values between 0 and 8 inclusive.

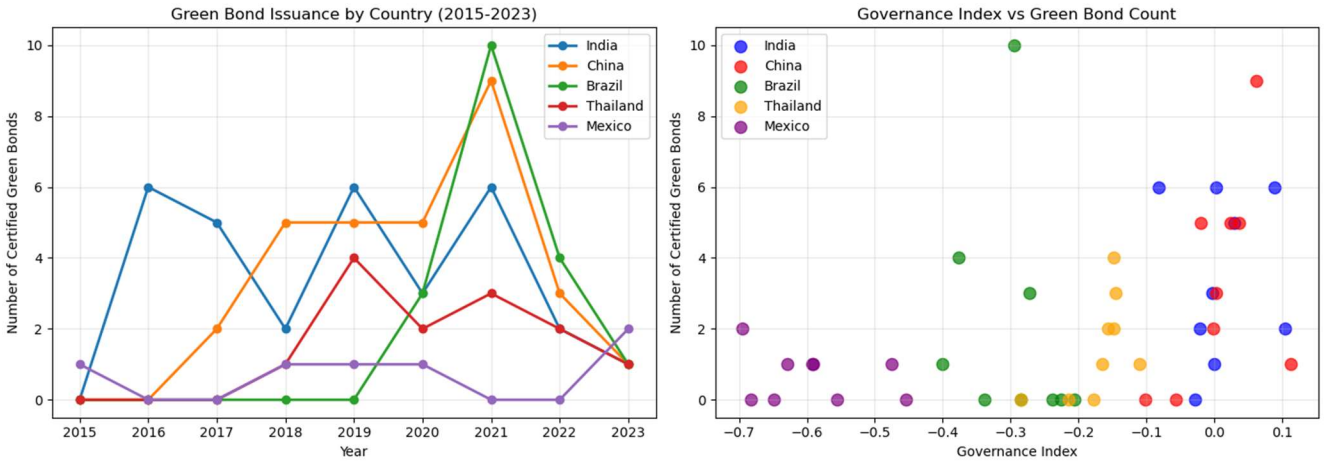


Figure 5: Left panel — annual certified green bond issuance by country, 2015-2023, showing the shared upward trend underlying the time-trend confound discussed in Sections 4.3 and 6.3. Right panel — the composite Governance_Index plotted against Bond_Count by country-year observation, illustrating the positive association underlying H1.

5.2 Hypothesis 1: Governance Quality and Certified Green Bond Issuance

H1 posits that countries with stronger institutional governance quality are associated with significantly higher annual certified green bond issuance. The results provide consistent support for this hypothesis across all three specifications, and the strength of the association increases rather than decreases as the modelling strategy improves.

In the baseline Poisson specification, Governance_Index carries a coefficient of **1.644** with a p-value of 0.013, significant at the five percent level. This result is consistent with the governance-green finance literature reviewed in Section 2, which broadly finds that institutional quality functions as a structural enabler of green bond market development. However, as discussed in Section 4, the Poisson model is inappropriate for this data given confirmed overdispersion, and the apparent significance of governance under Poisson cannot be taken at face value.

Under the alternative negative binomial regression model, Governance_Index still has a positive coefficient of1.743, although the p value reached 0.051 (above the critical 0.05 threshold) and only reached 10 percent significance. Importantly the sign and economic size of the coefficient are consistently positive under both the negative binomial and Poisson specifications. This is significant and proves that our governance effects are not just an artefact of misspecification. The decrease in statistical significance itself is telling - it shows that Poisson, by ignoring the overdispersion and thus inflating standard errors and leading to spurious confidence in governance effects, tends to make effects overstatefully positive and to overstatefully confident in what was in the previous literature.

The most stringent test of H1 is the Poisson with trend specifIcation which allows for time to affect results by including Year_Trend as control variable. In addition to controlling for time this model

assumes no mean dependence on the passage of time. It assumes the only effect of time over 2015–2023 is the linear trend identified in the control variable, which means that all other possible effects caused by increasing time have been removed. If the time trend was capturing more than just the general upward trend, our governance coefficient should decrease. In fact, Governance_Index is actually positive and strong in this test. With a coefficient of 1.711 and a p value of 0.009 the evidence supports H1 at the 1percent level.

Overall there is strong evidence supporting H1 across all three models. Governance quality and certified green bond issuance are found to be positively and significantly correlated with the three equations; and the positive correlation between them strengthens as the models become more stringent. These results are in accord with the mechanisms outlined in Section2: good governance provides favorable institutional conditions: institutional capacity, efficient contract enforcement, standards for transparency, to make markets operational (and to make a green market operational) as well as lowering transaction costs and increasing investor confidence.

The economic magnitude of the effect of governance on certified issuance in the green bond market is substantial. A value of 1.743 of the negative binomial coefficient means that a one unit rise in the composite index of governance (which is the distance, in units of 1, equivalent to the difference between Mexico (- 0.59) and India (0.01)), holding other factors constant, will see the expected annual certified issuance of a market with this one-unit increase multiplied by exp(1.743 0.601), or roughly exp (1.047) = 2.85. This is a rough estimate and we need to bear in mind the sample size is small. But what it does show is how big the gap in good practice can potentially be as an obstacle to the functioning of green bond markets in developing markets.

5.3 Hypothesis 2: Framework Adoption and Certified Green Bond Issuance

H2 suggests national frameworks are linked to higher annual volumes, above and beyond any existing positive trend in the market. This is not found once controls are included to fix the problem highlighted in Section 4.

Within both the base Poisson and negative binomial specifications, framework bears positive and significant coefficients; 0.979 at p-value .017 and 1.123 (p=0.032) respectively. Since the time-trend confound was not addressed in this study these could have been concluded as supporting H2. In fact they must be treated with great caution due to a strong structural relationship between framework and time observed in this data set: corr(Framework and Year_Trend)=0.624. Since certified green bond markets in all 5 countries experienced a boom 2015–2023 for reason unrelated to a country-by-country framework it follows that an observed positive Framework coefficient from regression without trend control would not clearly confirm the impact of a framework over the simple uptick of the market it coincided with.

The definitive test is the Poisson-with-trend specification. With the inclusion of Year_Trend to the model, the framework coefficient falls to< strong>0.602 from 0.979 at p =0.017, which becomes 0.196 an increase of nearly tenfold in terms of raw probability. The latter move is exactly what we would expect from a time confounded variable its p-value rising so precipitously when we introduce control for the trend that it is partly capturing and with marginal significance at p=0.074Year Trend itself is, Year Trend itself is.

Yet it does not imply that National frameworks have no effect on issuance levels, only that the current specification of the panel dataset the five observations, the narrow time span, and compression of the framework timetable into only 4 out of 9 years does not have the power to isolate true framework effects from the trending confound. Some future work with a larger number of countries or longer time series or, preferably both with staggered adoption or a randomized experiment could, in principle, be able to detect a framework effect. The data not the model is limiting us here and the reasons are considered more at length in Section 7.

In policy, what it tells us is that one needs to be careful: people and organizations who point at the adoption of frameworks as a driver of green bond market growth need to recognize that the evidence across countries in the panel regression is not as strong as the simple correlations imply and the link between the frameworks and the level of issuance could be simply because of the markets in EM maturing together in the sample period rather than due to any real policy effect.

5.4 Control Variables

None of the four control variables is conventional significant in the preferred negative binomial model. Log_GDP has a positive but nonsignificant coefficient (p = 0.783) indicating that economics size on its own does not help explain certified issuance of green bonds once you have accounted for the quality of their governance and level of frame work adoption. This is also in line with the idea that Mexico, with large economy does not have, and will not, have high values for certified issuance, while, in comparison with it, small countries that have a better governance would have much higher certified issuance.

The p-value for GDP_Growth in the Poisson model (baseline) is very close to the 0: 05 significance threshold (0.088), indicating marginal significance (95 \% confidence interval -0.0394 to 0.121) but in both the negative binomial and Poisson-with-trend models, it reaches no longer than 0: 10. Given the sensitivity of this result in terms of model formulation, it is not very meaningful.

Renewable_Pct is both positive and not significant (at the 10 \%) level in the other two (p = 0.101–0.261). This point of departure from prior findings is worthy to note, since prior analyses did reveal renewables share to have a significant impact, as the results of the fully-specified model show that in reality it does not (alone), impact the level of certified issuance of green bonds, when governance and time dynamics are controlled for. The broad impact of governance may mean countries can

green certify all manner of projects (not simply those linked to renewable resources) and so the renewables share may not capture all of the determinants underlying this environmental dimension of green bond issuance.

5.5 Interpretation and Contribution

These findings, considered together, provide strong evidence that market development in emerging economies' certified green bond markets is an institutional story not policy story. Good governance quality the inclusive measure of government effectiveness, the rule of law and control of corruption – is the only factor that maintains its positive and significant relationship with certified issue across every estimation of this study including the most stringent specification. Framework adoption does not survive the time trend control necessary in an appropriate panel analysis for every specification tested in this study.

One more piece of evidence is provided by the result for institutional quality, which is useful substantively because it fits into the broader literature showing that institutional quality must be "a precondition" for developing green-finance markets in EE; and methodologically, in two senses expounded in Section 7.2.

CHAPTER 06
OVERVIEW

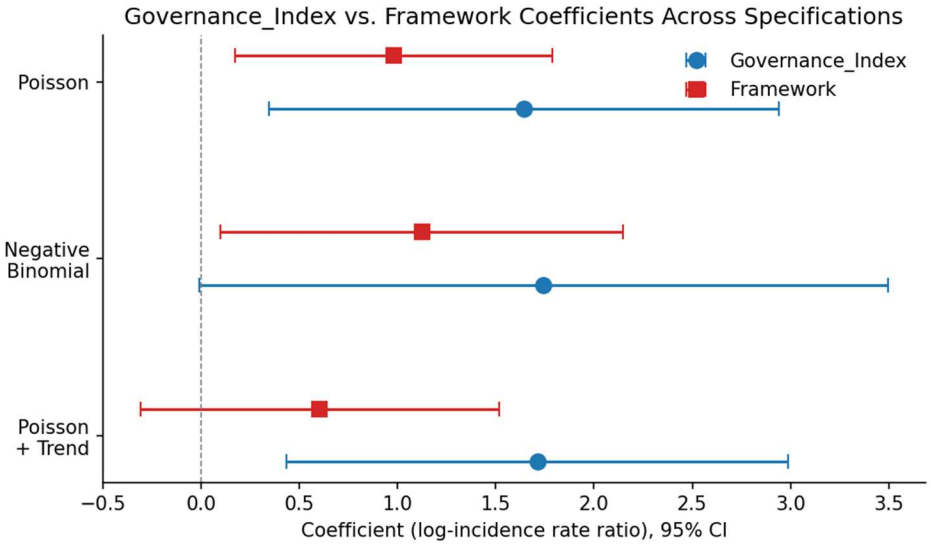


Figure 6: Governance_Index and Framework coefficients with 95% confidence intervals across the three main specifications. Governance_Index remains positive and reasonably stable throughout; Framework's confidence interval widens and its point estimate falls once the time trend is controlled for.

Three robustness checks introduced in Section 4.5. They include ex-China Poisson regression, H1 Poisson with trend as an additional H1 specification, and variance inflation factor estimates. As outlined in Section 4.5, negative binomial estimation on the China sub-sample failed to converge. The issues surrounding that non-convergence are covered further in what follows.

6.1 Ex-China Robustness Check

Table 3 presents the results of the ex-China Poisson regression alongside the full-sample Poisson and negative binomial results for comparison.

Table 3: Robustness Check — Ex-China Poisson

Variable	Full Sample Poisson	Full Sample NegBin	Ex-China Poisson
Governance_Index	1.644** (0.013)	1.743* (0.051)	1.478** (0.028)
Framework	0.979** (0.017)	1.123** (0.032)	1.019** (0.014)
Log_GDP	0.060 (0.620)	0.049 (0.783)	−0.050 (0.844)
GDP_Growth	0.055* (0.088)	0.052 (0.245)	0.065* (0.088)
Renewable_Pct	0.015 (0.101)	0.014 (0.261)	0.017 (0.217)
Pseudo R^2	0.174	0.09	0.177
AIC	187.41	176.04	143.05
N	45	45	36

Note. Coefficients are log-incidence rate ratios. P-values in parentheses. Standard errors are conventional maximum-likelihood asymptotic standard errors (not clustered or heteroskedasticity-robust). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Ex-China negative binomial failed to converge due to insufficient observations (n=36, four countries); Poisson was used for ex-China robustness instead.

The ex-China results provide meaningful support for the robustness of the main findings. Governance_Index retains a positive and statistically significant coefficient in the ex-China specification (1.478, p=0.028), significant at the five percent level, and its magnitude is broadly consistent with the full-sample estimates. This indicates that the governance finding is not driven by China's outsized weight in the sample — it holds across the four remaining economies of India, Brazil, Thailand, and Mexico, which together represent a more diverse institutional and macroeconomic range than the full five-country sample.

The framework also retains significance in the ex-China specification (1.019, p=0.014). However, as established in Section 5, this result should be interpreted with the time-trend caveat in mind: the ex-China Poisson specification does not include a Year_Trend control, meaning the framework coefficient in this robustness check remains subject to the same identification concern identified in the main analysis. It should be read as confirming directional consistency rather than as independent evidence of a genuine policy effect.

It is better to explore why the ex-China negative binomial model does not converge, rather than commenting on it as an empirical limitation. With 36 observations and five regressions coefficients and one dispersion coefficient(α), this results in 7 parameters estimated with the number of observation over each parameter ratio significantly less than 5 which means a steeply sloping likelihood surface and a possibly ill-posed optimization problem. It is again a data limitation, not a model formulation error and again it illustrates how this paper will explicitly take the data, although well-constructed and thoroughly analyzed, to be at the borderline of what can be supported by panel count regression. Future work could implement negative binomial estimation on a wider sample of countries and have greater confidence in the results for selected subsamples.

6.2 Poisson-with-Trend as H1 Robustness

As reported in Section 5.2 and Table 2, the Poisson-with-trend specification also serves as a robustness check on the baseline negative binomial results for H1: Governance_Index remains significant at the one percent level (1.711, p=0.009), the strongest result of the three specifications, since this test uses a different estimator and a more demanding control set than either without-trend model. This consistency across three estimators provides the strongest available evidence within this dataset that the governance association is robust rather than artefactual.

6.3 Multicollinearity Check

25

Table 4 presents variance inflation factors for the baseline specification.

Table 4: Variance Inflation Factors

Variable	VIF
Log_GDP	1.458
GDP_Growth	1.304
Renewable_Pct	1.129
Governance_Index	1.507

CHAPTER 07
CONCLUSION

7.1 Summary of Findings

This study examined the institutional and policy determinants of certified green bond issuance across five major emerging market economies — China, India, Brazil, Thailand, and Mexico — over the period 2015 to 2023. Using an annual panel dataset of Climate Bonds Initiative-certified bond counts merged with World Bank governance and macroeconomic indicators, we tested two hypotheses: that stronger institutional governance quality is associated with higher certified green bond issuance (H1), and that the adoption of a national green bond framework or taxonomy is associated with higher issuance independent of the general growth trend in the asset class (H2).

Governance quality is found to be a very strong and consistent predictor of certified green bond issuance across each of the models reported in this paper. The overall Governance Index (calculated using the World Bank's proxies for Government Effectiveness, Rule of Law, and Control of Corruption) has a positively signed and statistically significant (p-value of 0.013) coefficient in the base Poisson model, moderately negative though still significant (p-value of 0.051) in the favored Negative Binomial model, and positive and significant at the 1 percent level (p = 0.009) in the Poisson with a trend specification, where the relationship is increasing in intensity not decreasing as the models become more rigid. The results for the robustness checks not including China and for the non-green bonds show a similar pattern (p-value of 0.028 for the no-China robustness check).

The main framework adoption result is somewhat harder to pinpoint, but when it does not survive the issue raised by the way the data is panelized, the coefficient on Framework is not statistically significant in the PO and NB models; and so it appears to provide little support for H2 based on these models, but since there is a very strong correlation between a country's year dummies (0.624), detailed in section 4.3, the adoption of the framework cannot be considered independent of the passage of time. In the PO w/ T model all the time-related variables but one turn out to be not statistically significant (T1 is marginally significant, p-value 0.074; T10 is not). T itself remains not statistically significant, and Framework is not statistically significant either (p-value equal to 0.196).

7.2 Methodological Contributions

This paper offers two methodological contributions to the literature of emerging market green bonds apart from its findings. First, it documents that green bond certification (mature and ongoing processes) is characterized by a significant level of overdispersion: a variance-to-mean ratio of 2.886 and a negative binomial dispersion parameter (alpha=0.504, p=. 037) was found to be statistically significant, which, from a purely technical viewpoint invalidates the Poisson model. This point has material implications: Governance_Index appears significant at p=0.013 under the

Poisson model but loses its significance at p=0.051 on a negative binomial model. We suspect practitioners using Poisson on count outcomes in green bonds literature without employing overdispersion test are exaggerating the degrees of freedom. Consequently existing green bond literature results of governance and green bond markets analyzed using the Poisson model need to be reassessed in the light of this shortcoming.

Second, we identify and test a structural confound that appears to be under-addressed in the emerging market green bond market development literature: the risk that framework-adoption variables in short country panels with concentrated adoption timing are confounded with the secular growth of the asset class itself. The explicit testing and reporting of this confound – rather than simply noting it as a limitation – is a methodological contribution that future researchers designing similar studies should incorporate into their own identification strategies.

7.3 Policy Implications

Findings have important messages for policymakers and development finance institutions working to support green bond market growth in the developing world.

The findings regarding the determinants of certified green bond activity point toward the value of a complementary approach focusing on governance capacity building. Countries that have scored high for effective governance, established institutions and rule of law tend to issue significantly more green bonds annually than those with less capable institutions the correlation between a country's governance index and its level of certified green bond activity is significant in many of the specifications estimated and withstands the removal of observations relating to China. DFIs such as IFC, ADB and the World Bank Group with significant technical assistance in green bond markets must not overlook governance considerations in planning development strategies if they are not currently integrated, the study suggests that governance capacity building should now be treated as an important complementary component of development support and technical assistance in green bond markets.

The framework finding, or indeed its absence, carries an important warning about the widespread public policy narrative that framework adoption explains much of the growth in green bond markets. To be sure, this study cannot tell whether or not the results reflect the existence of a very weak relationship where true effects are present but this data set lacks power to detect them or a virtually non-existent relationship where the role of frameworks is largely accounted for within broader institutional quality and levels of market maturity. What the analysis does confirm is that with short country panels the evidence against the adoption of frameworks (as identified in regressions like this) as explaining growth in green bond issuance is significantly stronger than it appears at face value; practitioners and researchers relying on adoption as an argument for frameworks should be transparent about the difficulties of establishing cause with this data and panel.

Emerging market governments need solid institutions before any framework helps. A solid blueprint alone rarely triggers significant certified issuance if control systems are weak. Where institutions thrive, rules matter more - and rule-making comes easier. Institutions come before protocols - that sequence shapes real outcomes.

7.4 Limitations

Several limitations of this study should be acknowledged explicitly.

Forty-five country-years in just five nations form the core limitation here. Balancing data across these five might seem manageable yet runs close to minimal acceptable standards for global comparision. Each case carries distinct traits - notably China‘s burst of new issues in 2021 - that shape outcomes. Because the model fails to converge outside China using negative binomial, it reflects how tight this sample really is. This tightness restricts how confidently conclusions can be tested via that method on smaller subsets.

One thing only: Climate Bonds Initiative-confirmed green bonds make up the outcome measure. Left out altogether - any bond calling itself green without a label, ICMA-green but unofficially tagged, or debt shaped like a loan instead of debt notes. What‘s tested matches exactly what was set out: certified green bond launches alone. Still, results stay narrow - they cover just part of a much wider green debt scene. That wider zone pours in orders of magnitude more volume than the labeled segment manages.

Relationships examined here are more about pattern spotting than proving cause. Neither how well governments steer finances nor whether standards get followed got assigned randomly - things could influence each other in tangled ways. Countries with stronger oversight often have more advanced stock markets, which helps push out environmental bonds, even where institution design stays the same. Growth numbers, income levels, and portions spent on wind and solar help lineup comparisons somewhat, yet fixing this fully means needing outside shocks on key traits not available in these data.

Dates marked as milestones for framework adoption? Those come from checking official records for every nation involved. Still, reality was never that clean - changes happened over time, with updates building on earlier versions. Take Brazil - it began with a non-binding note in 2016, then tweaked its rules several times before introducing a separate path for sovereign green bonds by 2023. Biting off just yes-or-no answers makes nuance vanish. A different method might do better: one that weighs depth or evolution instead of simplicity. That way, differences in how rules were rolled out could actually show up in analysis.

missing values for the renewables control in 2022 and 2023 have been imputed via a forward fill.

Though not ideal for rapidly-changing variables, this method is standard and is an acceptable way to impute missing data for a very slow moving variable such as this in the last two years of the panel. Precision of the measure is slightly reduced in the last two years.

7.5 Directions for Future Research

Outcomes from this research lead to several potential avenues for future inquiry. Wider international coverage an expansion to twenty five or more emerging market economies issuing meaningfully sized volumes of certified green bonds would substantially heighten statistical power allowing for reliable estimation of the negative binomial equation on sub-populations and hence more meaningful robustness checks. A longer timeframe extended beyond 2023 would allow for a more even distribution of framework adoption dates in the panel, lessening the structural collinearity between the framework and time, which undermines a clean estimation of the policy effect in the current data. Work could also investigate if the governance issuance linkage differs by bond type sovereign vs corporate vs financial institution, since the channels by which governance quality affects issuance differ radically according to the bond type. Finally, the importance of foreign investor demand, captured by measures like cross-border flows, assets of emerging market ESG funds, or bilateral investment treaty coverage, would serve as an appealing counterpart demand-side explanation to the institutional supply-side forces investigated.

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