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Research article

Captured or credible? Issuer–reviewer repeat ties and the governance of green bond verification

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Appendix A. Coding protocol for hand-collected accountability variables

This appendix documents the coding protocol used to construct the hand-collected accountability variables employed in the issuer-year analysis. The purpose of the protocol is to ensure transparency, consistency, and replicability in the measurement of post-issuance accountability outcomes for green bond issuers. Because post-issuance reporting varies substantially in format, terminology, level of detail, and reporting location across issuers, a structured coding framework was developed to reduce subjectivity and to standardize how reporting quality and accountability signals are translated into empirical variables.

The coding process was conducted at the issuer-year level, but it relied on bond-level and framework-level source documents. For each issuer-year observation, all green bond–related public disclosures released during the fiscal year were collected and reviewed. These included green bond frameworks, allocation reports, impact reports, annual reports, sustainability reports, and stand-alone sustainable finance updates where relevant. When issuers maintained multiple green bond frameworks or multiple green bonds in the same year, all eligible disclosures released in that year were aggregated using the issuer-year aggregation rules described below. Only publicly available documents released by the end of the observation window were considered. When disclosure timing was central to the

variable definition, the release date stated in the report, website archive, stock exchange filing, or document metadata was used.

Three main hand-collected accountability variables were coded: allocation report timeliness, reporting specificity, and impact-reporting continuity. Environmental controversy incidence was obtained from external databases rather than hand-scored directly, although controversy events were cross-checked against issuer disclosures when inconsistencies were suspected. All coding decisions were recorded in a structured codebook that identified the variable name, issuer identifier, fiscal year, source document, page number, disclosure date, coding rule applied, and any adjudication notes where ambiguity arose.

Two trained coders independently coded a pilot subsample and then a validation subsample using a written codebook. Inter-coder reliability for the SPEC_SCORE components yielded Cohen's kappa values above 0.80, and disagreements were resolved through reconciliation against the source documents. SPEC_SCORE is constructed from four equally weighted components: quantified allocation amounts, project-level breakdown, KPI disclosure, and methodological transparency. Each component is coded 0 when absent, 1 when partially disclosed, and 2 when clearly disclosed, and the summed score is normalized to range from 0 to 1. ALLOC_TIME equals 1 when the required allocation report is released within the framework's stated reporting horizon. IMP_CONT equals 1 when an eligible framework continues impact reporting in year t. When multiple green bonds or frameworks exist in the same issuer-year, issuer-year outcomes are aggregated using issue-size weights. The final coding file records reviewer identity, review type, bond date, reporting dates, source-document references, and the scoring rationale for each issuer-year observation.

A1. Allocation report timeliness

Allocation report timeliness, coded as ALLOC_TIME, captures whether the issuer delivered allocation reporting within the time horizon promised in the relevant green bond framework or related issuance documentation. The variable is coded as 1 if the issuer released the required allocation report on or before the stated reporting deadline and 0 otherwise. If the framework stated that allocation reporting would occur "within one year of issuance" or "annually until full allocation", the first relevant allocation report was checked against that commitment. If multiple bonds were outstanding under the same framework, the coding was based on the reporting obligation applicable to the framework rather than to each individual bond separately.

When an issuer maintained more than one framework or had multiple relevant reporting obligations in the same year, the issuer-year coding followed a conservative rule. ALLOC_TIME was coded as 1 only if all material framework-level allocation reports due in year t were released on time. If at least one material report was delayed beyond the stated reporting horizon, the issuer-year observation was coded as 0. This approach treats timely reporting as a governance discipline outcome and avoids overstating accountability when only part of the reporting obligation is fulfilled. If no allocation report was due in a given year because all proceeds had been fully allocated and no further allocation updates were promised, the issuer-year observation was treated as not applicable and excluded from timeliness coding for that year.

A2. Reporting specificity score

Reporting specificity, coded as SPEC_SCORE, is constructed from four equally weighted components: quantified allocation amounts, project-level breakdown, KPI disclosure, and methodological transparency. Each component is coded from 0 to 3, where 0 indicates absence, 1 indicates generic or incomplete disclosure, 2 indicates partial but usable disclosure, and 3 indicates clear, detailed, and decision-useful disclosure. The summed score ranges from 0 to 12 and is normalized to range from 0 to 1.

The first component, quantified allocation detail, assesses whether the report provides numerical information on the amount of proceeds allocated. A score of 0 is assigned when no numerical allocation information is provided. A score of 1 is assigned when the report provides only broad or incomplete quantitative statements, such as approximate percentages without monetary amounts. A score of 2 is assigned when the report provides category-level quantified allocations but limited breakdown across uses. A score of 3 is assigned when the report provides clear monetary allocations across categories or projects with sufficient completeness to trace most proceeds.

The second component, project-level granularity, evaluates the level of disaggregation in the disclosure. A score of 0 is assigned when only broad narrative categories are mentioned without identifiable project groupings. A score of 1 is assigned when broad categories are disclosed, but with limited detail on implementation. A score of 2 is assigned when the report identifies subcategories, project types, regions, or implementation channels. A score of 3 is assigned when the report provides project-level or near project-level detail, including named programs, facilities, technologies, or clearly separated investment streams.

The third component, impact metric disclosure, assesses whether the issuer reports measurable environmental outputs or outcomes associated with the financed activities. A score of 0 is assigned when no impact metrics are provided. A score of 1 is assigned when impact claims are purely narrative or unquantified. A score of 2 is assigned when at least one quantified impact metric is reported, but coverage is partial or inconsistent. A score of 3 is assigned when multiple quantified impact indicators are reported with clear linkage to financed activities.

The fourth component, methodological transparency, captures whether the issuer explains how impact metrics and allocation figures are compiled. A score of 0 is assigned when methodology is not discussed. A score of 1 is assigned when methodology is mentioned only briefly or generically. A score of 2 is assigned when calculation approaches, assumptions, or standards are described in a limited but usable way. A score of 3 is assigned when the report provides explicit methodological notes, boundary definitions, assumptions, estimation procedures, or references to external standards or assurance practices.

The raw specificity score equals the sum of the four component scores and ranges from 0 to 12. The final variable is computed as follows:

$$\mathrm{SPEC_SCORE}_{i,t} = (\mathrm{QA}_{i,t} + \mathrm{PG}_{i,t} + \mathrm{IM}_{i,t} + \mathrm{MT}_{i,t}) / 12 \tag{A1}$$

where QA, PG, IM, and MT denote quantified allocation, project granularity, impact metrics, and methodological transparency, respectively. This normalization facilitates interpretation and comparability across models.

A3. Impact reporting continuity

Impact reporting continuity, coded as IMP_CONT, captures whether the issuer sustains annual impact reporting after the initial green bond issuance. The variable is coded as 1 when the issuer provides an impact report or equivalent impact update in year *t* for an outstanding green bond program that remains subject to continuing reporting expectations, and 0 otherwise. The purpose of this variable is to capture whether post-issuance accountability is maintained over time rather than delivered only in the first reporting cycle.

For issuers with multiple green bonds or frameworks, IMP_CONT was coded at the issuer-year level using a continuation rule. If at least one active framework required continuing impact reporting and the issuer released a substantive impact update in year *t*, the observation was coded as 1. If the issuer had an active reporting obligation but did not provide any meaningful impact update, the observation was coded as 0. When no active reporting obligation remained because all relevant frameworks had reached reporting completion or no continuing impact commitment had been made, the observation was treated as not applicable for that year and excluded from the continuity analysis. This rule prevents late-stage mature frameworks from being incorrectly treated as reporting failures.

A4. Issuer-year aggregation rules

Because several accountability measures originate in bond-level or framework-level documents, explicit aggregation rules were applied to construct issuer-year observations. For ALLOC_TIME, if multiple framework-level allocation reports were due in the same year, the issuer-year value equaled 1 only when all material due reports were timely. For SPEC_SCORE, when multiple green bond–related reports were issued in the same year, the issuer-year value was calculated as the issue size–weighted average specificity score across all eligible reports. For IMP_CONT, the issuer-year value equaled 1 if at least one active framework requiring annual impact reporting was updated in that year and 0 otherwise, conditional on an active reporting obligation existing.

For the explanatory variables used in issuer-year accountability regressions, relationship-intensity measures were also aggregated explicitly. RT_SHARE at the issuer-year level was computed as the issue size–weighted average of bond-level prior tie shares across all green bonds issued by the issuer in year *t*. If only one green bond was issued in year *t*, the issuer-year measure equaled that bond's value. REV_DEP at the issuer-year level was computed using the same issue size–weighted approach. This procedure ensures consistency between the bond-level design and the issuer-year panel while preventing a single small issue from driving the annual relationship measure.

A5. Coding procedure and source verification

All reports were coded using a structured template. For each issuer-year, coders recorded the issuer name, fiscal year, framework name, review date, document type, document title, page references, release date, and final coded values. Every coded value had to be traceable to a source page. When a report contained ambiguous language, the coder recorded a brief justification in a comments field and flagged the observation for secondary review.

Source verification was conducted in two stages. In the first stage, the primary coder extracted the relevant disclosure and assigned preliminary codes. In the second stage, a second reviewer independently checked a validation subset of observations, focusing especially on cases with low specificity, borderline timeliness, or unclear impact continuity. Disagreements were resolved by reference to the codebook and underlying source document, and where necessary by adjudication using the most conservative interpretation of the disclosure. If a disclosure could reasonably support two nearby scores, the lower score was assigned unless the report contained sufficiently explicit evidence for the higher category.

A6. Inter-coder reliability

To improve measurement reliability, a pilot coding round was conducted before full sample coding. The pilot sample included a diverse subset of issuer-years representing different countries, sectors, and reporting styles. Coding rules were refined after this phase to reduce ambiguity, especially in the distinction between generic impact language and quantified impact disclosure, and in the treatment of broad category-level allocation tables. After refinement, a second coding round was conducted on a validation subsample. Inter-coder agreement was assessed using exact agreement rates and Cohen's kappa for the categorical components of the specificity index and the binary variables. The final coding protocol was adopted only after agreement reached an acceptable level for all major components. Discrepancies were documented and used to update the adjudication notes within the codebook.

A7. Treatment of missing and ambiguous disclosures

Missing disclosure is not automatically treated as zero quality unless the variable definition requires it. For ALLOC_TIME, failure to release a due report within the promised horizon is coded as 0. For SPEC_SCORE, a score of zero on a component is assigned only when the report is actually silent on that component, not when the entire issuer-year is missing from the eligible sample. For IMP_CONT, non-disclosure is coded as 0 only when a continuing reporting obligation exists. If a report or framework was unavailable despite clear evidence that it should exist, the observation was flagged and rechecked using issuer websites, stock exchange announcements, and archived sustainable finance pages where possible. Observations that remained unverifiable after repeated source checks were excluded from the relevant hand-collected variable rather than assigned mechanically.

A8. Replication materials

The final replication package for the accountability variables consists of the coding template, source document register, scoring rubric, adjudication log, and the issuer-year aggregation file. Together, these materials allow another researcher to reproduce the construction of ALLOC_TIME, SPEC_SCORE, and IMP_CONT from the underlying disclosure documents.

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