

Tracking ESG Disclosures of European Companies with Retrieval-Augmented Generation

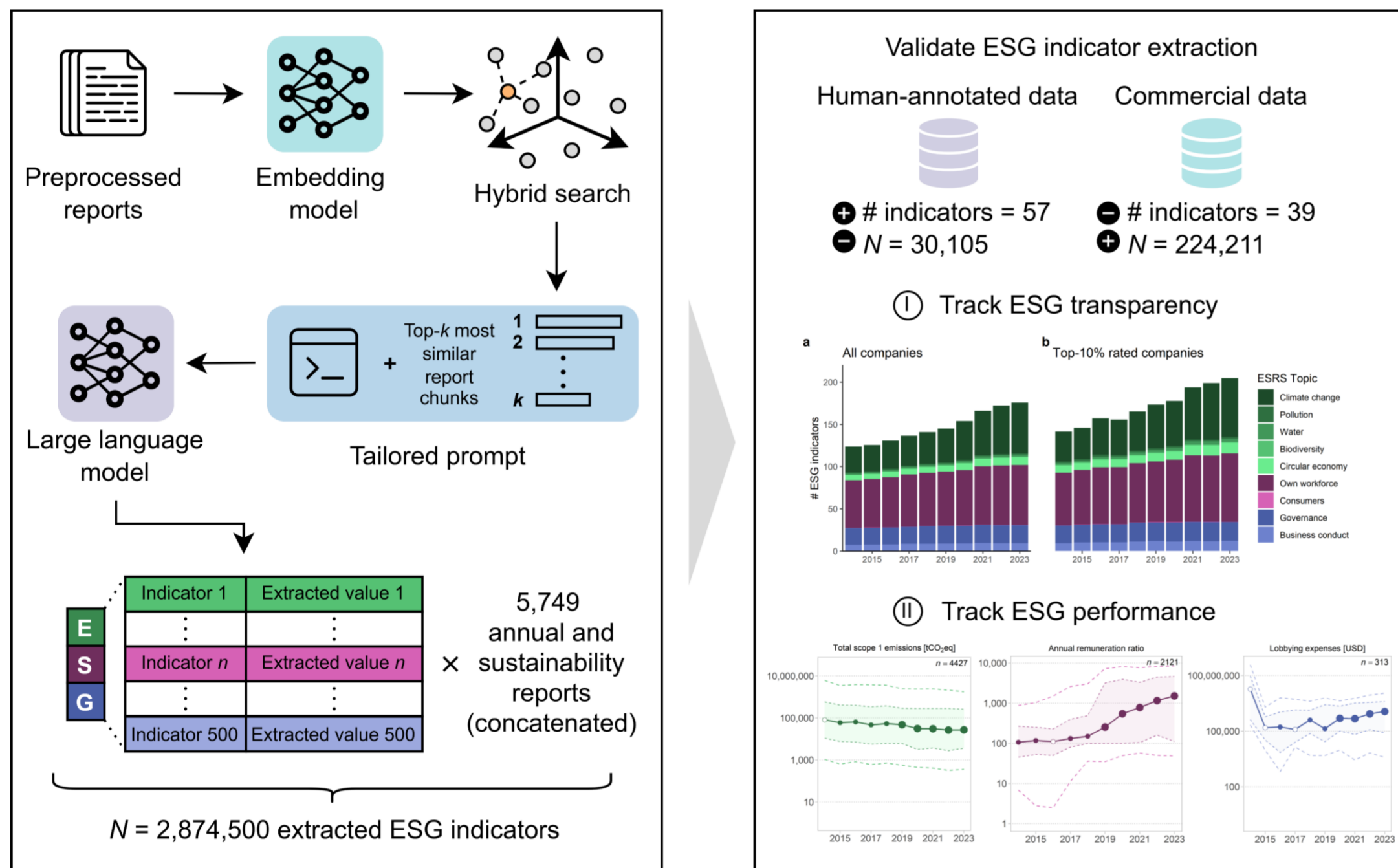
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Motivation

- Companies play a crucial role in **reaching global sustainability goals**, yet evidence of their progress along environmental, social, and governance (ESG) dimensions remains limited.
- We develop a machine learning (ML) framework to systematically track **$N = 2,874,500$ ESG indicators** from **corporate reports** of the 600 largest listed companies in Europe between 2014 and 2023.
- Our open-source ML framework enables policy-makers, financial stakeholders (banks, insurers, asset managers), and societal actors (consumers, NGOs, employees) to **systematically monitor corporate ESG efforts** and help drive progress toward global sustainability goals.

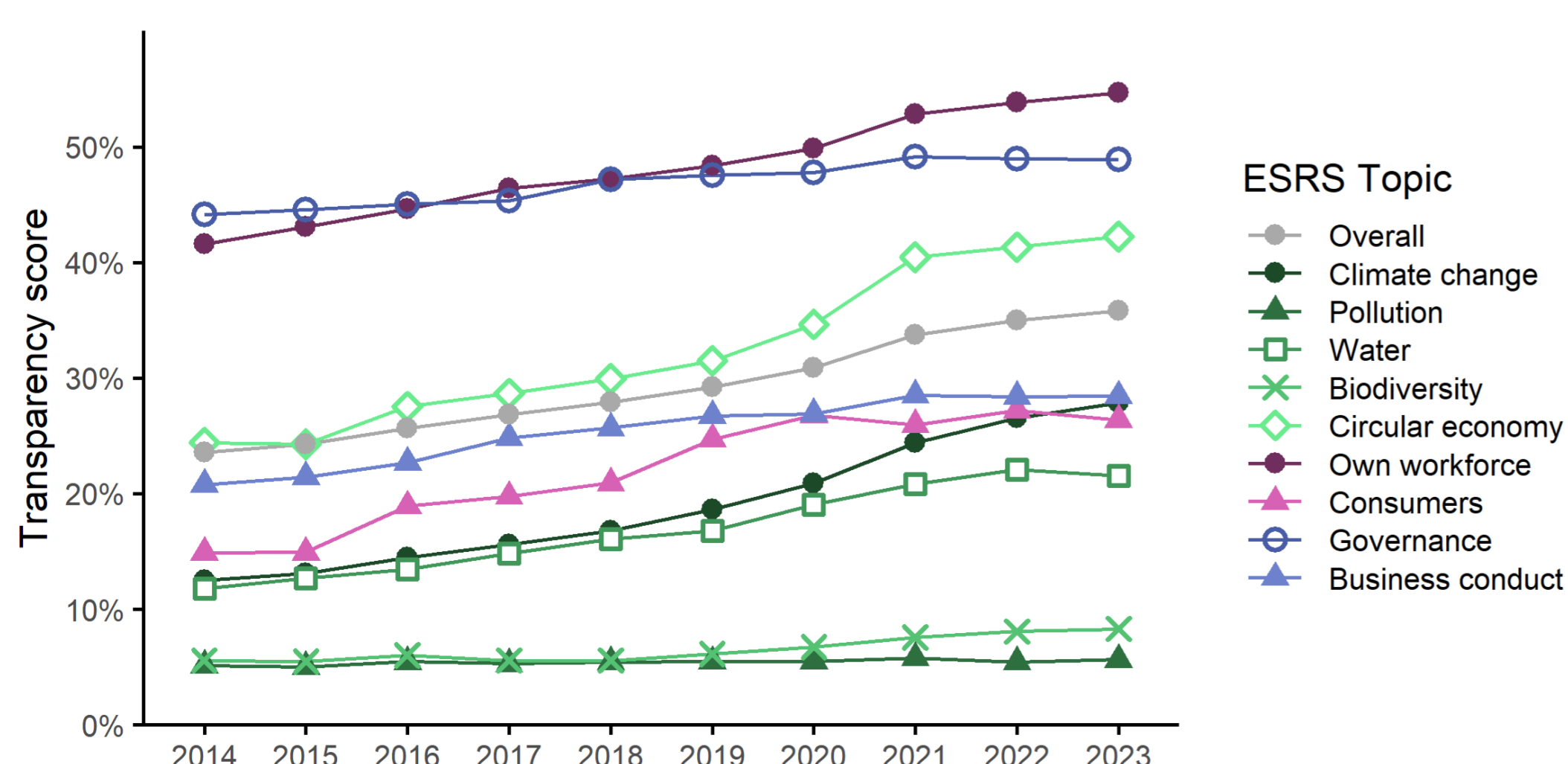
Machine learning framework



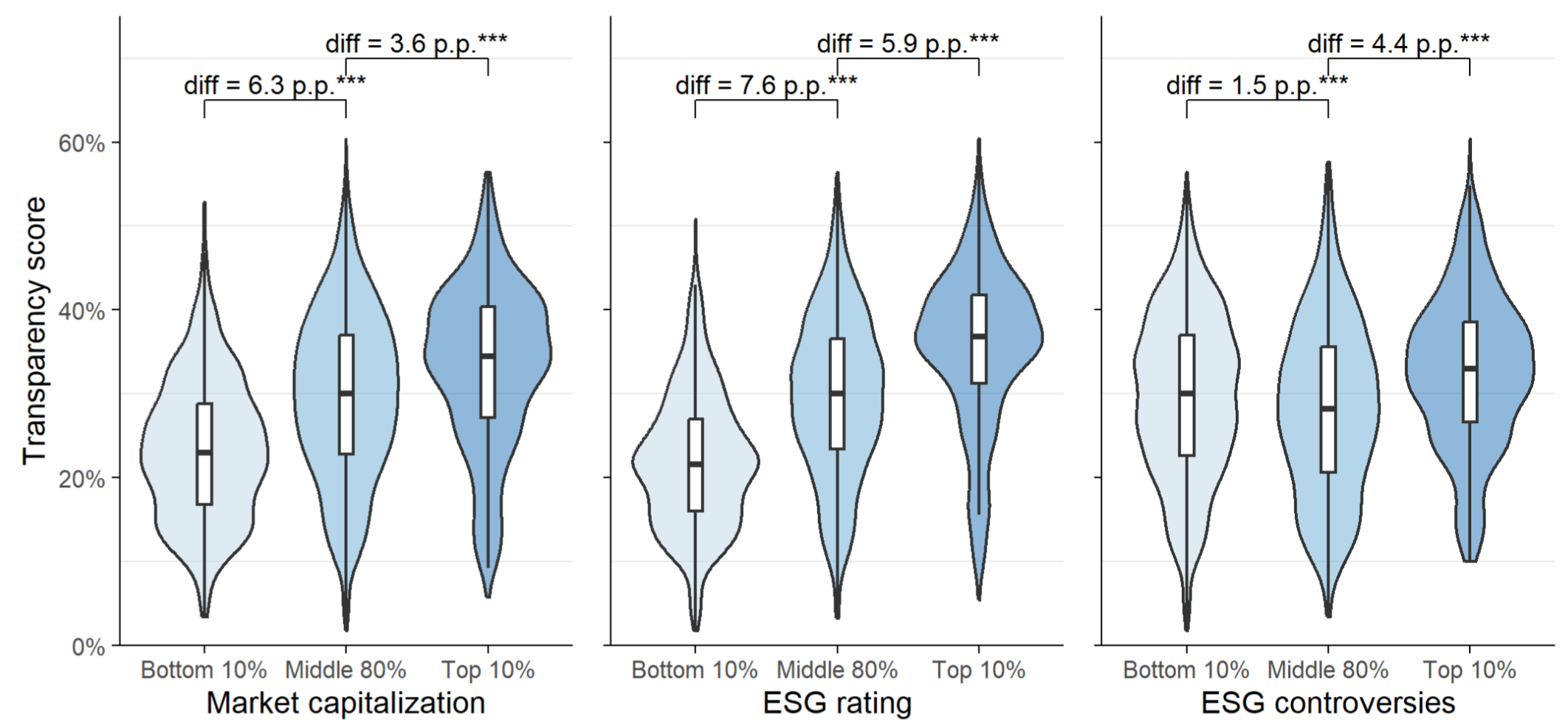
- We develop a **retrieval-augmented generation pipeline** to extract ESG indicators from 9,173 corporate annual and sustainability reports.
- We use **state-of-the-art methods**: hybrid search, sliding window retrieval, cross-encoder based reranking.

Results

ESG transparency over time

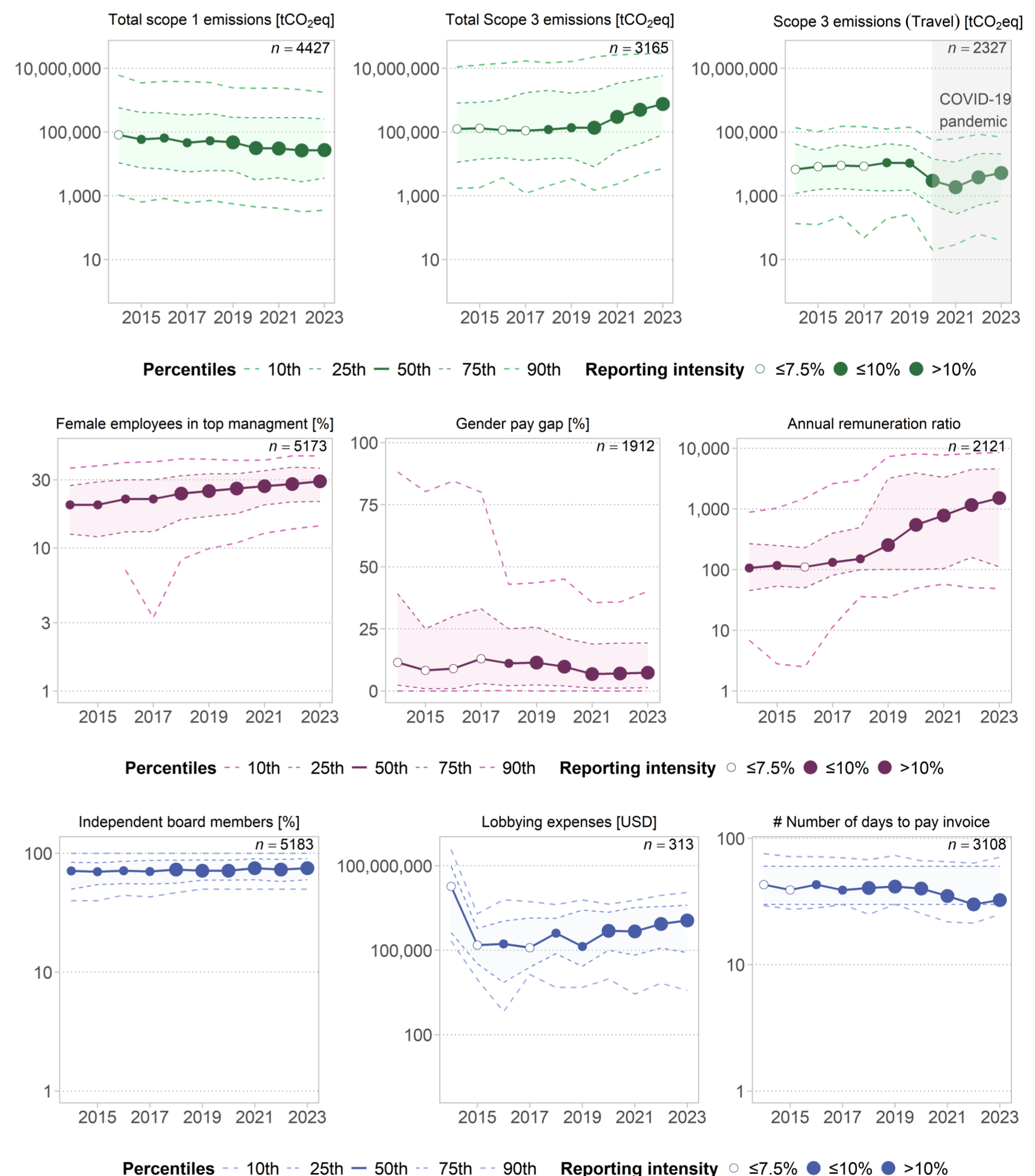


ESG transparency across company characteristics



- Our analysis points to **systematic over- and under-reporting** of certain topics across industries.
- We find **notable reporting gaps** subject to market capitalization, ESG rating, and ESG controversy.

ESG performance over time



- We find **uneven progress** across environmental, social, and governance indicators since 2014.
- Positive trends:** total scope 1 emissions, share of female employees in top management, share of independent board members.
- Negative trends:** total scope 3 emissions, annual remuneration ratio, lobbying expenses.