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Cheap talk and cherry-picking: What ClimateBert has to say on corporate climate risk disclosures

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ABSTRACT

Disclosure of climate-related financial risks greatly helps investors assess companies' preparedness for climate change. Voluntary disclosures such as those based on the recommendations of the Task Force for Climate-related Financial Disclosures (TCFD) are being hailed as an effective measure for better climate risk management. We ask whether this expectation is justified. We do so by training ClimateBERT, a deep neural language model fine-tuned based on the language model BERT. In analyzing the disclosures of TCFD-supporting firms, ClimateBERT comes to the sobering conclusion that the firms' TCFD support is mostly cheap talk and that firms cherry-pick to report primarily non-material climate risk information.

1. Introduction

Climate-related financial risks are underestimated by financial actors, and bear the risk of triggering the next financial crisis — this was the punchline in Mark Carney's famous speech "Breaking the tragedy of the horizon - climate change and financial stability" in 2015. Consequently, under Carney's auspices, the G20's Financial Stability Board (FSB) implemented the Task Force on Climate-related Financial Disclosures (TCFD). In 2017, the TCFD released its final report with recommendations for climate-related disclosures that could promote more informed investment, credit, and insurance decisions and, in turn, enable stakeholders to better understand the financial system's exposure to climate-related risks.[1]

As of today, more than 2700 institutions and firms officially support the TCFD, including various governments, central banks, and financial supervisors.[2] The TCFD recommendations have been incorporated into existing sustainability-related disclosure frameworks like the Carbon Disclosure Project (CDP), the Climate Disclosures Standards Board (CDSB), the Global Reporting Initiative (GRI), and the Sustainability Accounting Standards Board (SASB). The European Commission updated its guidelines on non-financial reporting

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[1] Without full transparency and sufficient standardization, markets might fail to correctly price-in forward-looking climate-related risks. This issue has been prominently raised by financial supervisory institutions such as, e.g., the European Systemic Risk Board (ESRB) (Gros et al., 2016), the Network for Greening the Financial System (NGFS) in 2019 (NGFS, 2019b), and the Bank for International Settlements (BIS) in 2020 (Bolton et al., 2020), and is analyzed by a rapidly growing body of literature, both for transition and physical risks, such as, e.g., Griffin et al. (2015), Dietz et al. (2016), Bansal et al. (2016), Bretschger and Soretz (2018), Bernstein et al. (2019), Goldstein et al. (2019), Hong et al. (2019), Karydas and Xepapadeas (2019), Kölbel et al. (2021), Baldauf et al. (2020), Bolton et al. (2020), Choi et al. (2020) and Krueger et al. (2020).

[2] https://www.fsb-tcfd.org/supporters/.

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Table 1
The core elements of recommended climate-related financial disclosures and their sub-elements according to TCFD (2017).

Governance	Strategy	Risk management	Metrics and Targets
Disclose the organization's governance around climate-related risks and opportunities.	Disclose the actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning where such information is material.	Disclose how the organization identifies, assesses, and manages climate-related risks.	Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material.
Recommended disclosures			
Describe the board's oversight of climate-related risks and opportunities	Describe the climate-related risks and opportunities the organization has identified over the short, medium, and long term.	Describe the organization's processes for identifying and assessing climate-related risks	Disclose the metrics used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management process.
Describe management's role in assessing and managing climate-related risks and opportunities.	Describe the impact of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning.	Describe the organization's processes for managing climate-related risks.	Disclose Scope 1, Scope 2, and, if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks.
	Describe the resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2 °C or lower scenario.	Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the organization's overall risk management.	Describe the targets used by the organization to manage climate-related risks and opportunities and performance against targets.

with a supplement on reporting climate-related information, explicitly building on the TCFD recommendations.[3] Recently, New Zealand, the United Kingdom, and Switzerland announced that TCFD reporting would become mandatory in their jurisdictions.

Researchers have recently started to use artificial intelligence (AI) to analyze company disclosures, primarily using bag-of-words approaches or variants. Although these approaches are prevalent in transforming textual into numerical data, they come with huge drawbacks and are error-prone, particularly for a complex topic such as climate change. For an overview, we refer to Varini et al. (2020).[4] To overcome these drawbacks, we introduce ClimateBERT, the first context-based algorithm to identify climate-related financial information from TCFD reports. ClimateBERT is a fine-tuned BERT model, a deep neural network currently seen as the state-of-the-art method for many tasks in natural language processing (NLP) (Devlin et al., 2019).[5]

We apply ClimateBERT to TCFD-supporting companies, for which we find annual reports spanning the fiscal years 2014 to 2019, i.e., our sample consists of 818 firms. Hence, we can assess whether climate disclosures improved after supporting the TCFD and analyze the development of TCFD disclosures for different sectors and various geographies. Our results show that supporting the TCFD seems to be cheap talk and is associated with cherry-picking disclosures on those TCFD categories containing the least materially relevant information. We interpret "cherry-picking" in the sense that material information, i.e., information related to strategy and metrics and targets, might not be disclosed to the extent required to enhance climate-related risk management by external actors, like investors and financial supervisors.

2. The TCFD recommendations

Adopting a holistic approach, the TCFD recommends to structure climate-related disclosures around four categories: governance, strategy, risk management, and metrics and targets. The governance category relates to the company's governance around climate-related risks and opportunities. In the strategy category, firms are required to assess the actual and potential impacts of climate-related risks and opportunities on the their businesses, strategy, and financial planning. In the risk management category, firms need to lay out their implemented processes to identify, assess and manage climate-related risks. In the last category, firms have to explain the metrics and targets used to assess and manage relevant climate-related risks and opportunities. The four TCFD categories complement and build on each other. To obtain an overview, we display the four main categories together with the sub-elements in Table 1.

Despite the complementary approach, two of the categories are more about qualitative, structural, and process-related information (governance, risk management), and two categories cover the disclosure of the specific qualitative and quantitative material information on actual and potential future downside risks and opportunities (metrics and targets, strategy). Without appropriate disclosures particularly in the metrics and targets category, stakeholders like investors and regulatory authorities cannot properly assess and quantify their own risk exposures towards the disclosing entity. While the first goal of the TCFD, better internal climate

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019XC0620(01).

[4] Varini et al. (2020) find that for topic classification of climate change, even a simple BERT model significantly outperforms keyword-based approaches, which tend to generate false positives, leading to low precision, particularly for the analysis of 10-K regulatory reports. Moreover, Kölbel et al. (2021) use a BERT model to show that they are superior to other keyword-based approaches like Sautner et al. (2020) to identify climate-relevant information that impacts CDS spreads.

[5] We extend our model to a climate-related language model in Webersinke et al. (2021).

Table 2
Descriptives of our training sample.

(a) Sectors		(b) Regions	
	N Firms		N Firms
Financials	100	Europe	113
Materials	34	Asia	71
Utilities	33	North America	53
Industrials	29	Oceania	26
Transportation	19	South America	16
Information technology	18	Africa	9
Consumer staples	11	Asia Pacific	6
Energy	11	Central America	3
Real estate	10	Global	2
Communication services	10	Caribbean	1
Consumer discretionary	9	Middle East	1
Other	7		
Government	5		
Health care	5		
Total	301		301

Table 3
Descriptives of our dataset on sentence and paragraph level.

	Sentences				Paragraphs			
	N	Num. of words			*N*	Num. of words		
		Min	Max	Mean		Min	Max	Mean
Governance	3 062	10	236	27	179	11	2 750	464
Metrics and Targets	2 564	10	240	26	149	15	3 121	465
Risk management	5 020	10	187	27	178	19	4 752	787
Strategy	6 684	10	289	28	185	19	10 272	1054
General language	300 964	10	499	27	91 016	50	2 736	93

risk management of disclosing institutions, can be well captured with disclosures on governance and risk management, sufficient information of high quality in the strategy and metrics and targets categories is of utmost importance to fulfill the second of the two main goals of the TCFD, i.e., to enable risk assessments and better risk management for investors and other financial institutions.[6]

3. Data

To train our algorithm, we collected in a first step a large sample of documents consisting of firms' annual reports, stand-alone sustainability-, climate-, or TCFD-reports, and firms' webpage. To obtain enough labeled sentences for each TCFD category, which reflect the various sectoral and regional specifics in wording and reporting styles, we identified a sub-sample of TCFD supporting firms, covering a wide range of regions and sectors (cf. Table 2). We aimed to represent 1/3 financial and 2/3 non-financial firms to account for different styles in TCFD reporting. We then identified and collected the most recent TCFD-related disclosures of each firm manually.

In a second step, we manually extracted the TCFD-related sentences for each TCFD sub-category. The extracted sentences were assigned the corresponding TCFD category label, i.e., governance, strategy, risk management, or metrics and targets. The label of a sentence was derived from the heading under which the sentence was written. Also, we extracted non-climate-related sentences from annual reports to capture the specific wording from company disclosures. Our training dataset eventually consisted of more than 17,300 human-labeled sentences for the TCFD categories and more than 300,000 general language sentences from annual reports (cf. Table 3). Over-weighting the general language has been essential to reflect the relative share of general language versus TCFD-related language in annual reports.[7]

4. Results

We analyze TCFD supporting companies across various sectors and geographies, for which we were able to find annual reports for the years 2015 (fiscal year 2014) to 2020 (fiscal year 2019), see Table 4. With this restriction, we are left with 818 firms. We have deliberately chosen to include the data prior to the introduction of the TCFD requirements, so that we can analyze the development of disclosure by TCFD supporters against the pre-TCFD recommendations baseline. We thereby enrich the findings of

[6] We remark that companies report on topics like, e.g., governance, risk management, and strategies, also in other contexts, not necessarily climate related. Hence, training an algorithm on such categories that are only related to climate, i.e., to the TCFD categories, becomes a particularly subtle task.

[7] For example, the algorithm would fail to differentiate any governance-related wording from the specific climate-related governance wording.

Table 4
Descriptives of our analysis sample.

(a) Sectors		(b) Regions	
	%of total firms (N = 818)		%of total firms (N = 818)
Financials	39.70	Europe	35.73
Materials	9.31	Asia	33.25
Industrials	9.18	North America	15.01
Utilities	6.08	Oceania	6.58
Consumer discretionary	4.84	Asia Pacific	3.23
Consumer staples	4.71	Global	2.48
Real estate	4.47	Africa	1.61
Energy	3.97	South America	1.61
Information technology	3.85	Latin America	0.25
Other	3.72	Central America	0.12
Government	3.60	Caribbean	0.12
Transportation	2.48		
Communication services	2.11		
Health care	1.99		

Table 5
Proportions of TCFD-related content in annual reports (mean % of total content). By *, **, and *** we denote p-levels below 10%, 5%, and 1%, respectively.

Year	2015 (FY2014)	2016 (FY2015)	2017 (FY2016)	2018 (FY2017)	2019 (FY2018)	2020 (FY2019)	Δ 2017–2020
Governance	2.43	2.43	2.53	3.09	3.32	3.29	0.76***
Strategy	0.96	0.96	1.00	1.12	1.30	1.54	0.54***
Risk management	1.99	2.16	1.99	2.15	2.26	2.42	0.43***
Metrics & Targets	1.03	1.35	1.23	1.24	1.38	1.70	0.47***
Total	6.41	6.90	6.75	7.61	8.26	8.94	2.19***

Table 6
Mean differences of proportions of TCFD-related content in annual reports (% of total content). By *, **, and *** we denote p-levels below 10%, 5%, and 1%, respectively.

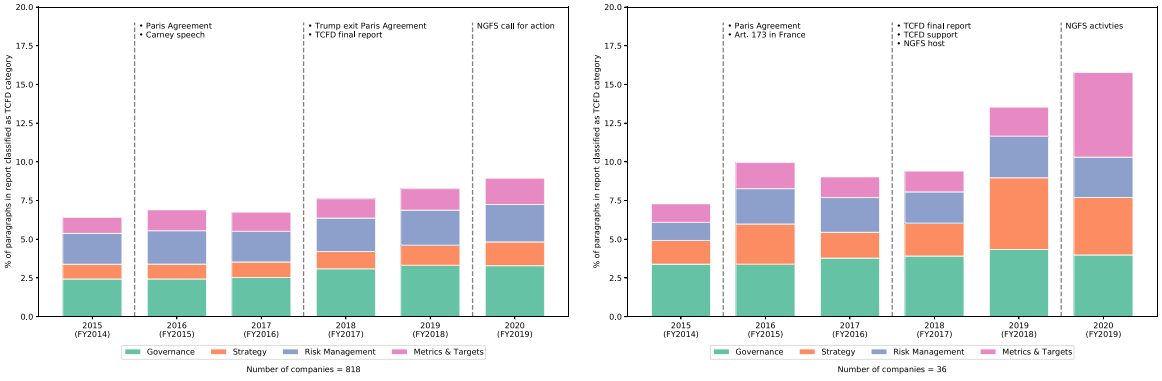
	France vs. others	TCFD 17/18 vs. 19/20	Energy/util. vs. others	Trans./finan. vs. others	Mater./industr. vs. others	North America/ Europe vs. Asia
Governance	0.96***	1.41***	−0.10	1.01***	−0.65***	1.44***
Strategy	1.48***	0.59***	2.04***	−0.23**	−0.31***	0.93***
Risk Management	−0.02	1.02***	1.12***	0.89***	−0.92***	1.52***
Metrics & Targets	0.98***	0.20**	2.32***	−0.64***	0.27***	0.23***
Total	3.39***	3.22***	5.38***	1.02***	−1.62***	4.12***

the TCFD's own status report by a quantitative measure instead of simple yes/no assessments and compare our findings to a baseline period (TCFD, 2020).[8] We first assess whether climate disclosures improved after releasing the TCFD recommendations in 2017 and after individually supporting the TCFD. We also assess the development of TCFD disclosures for different sectors and in various geographies.

4.1. General findings

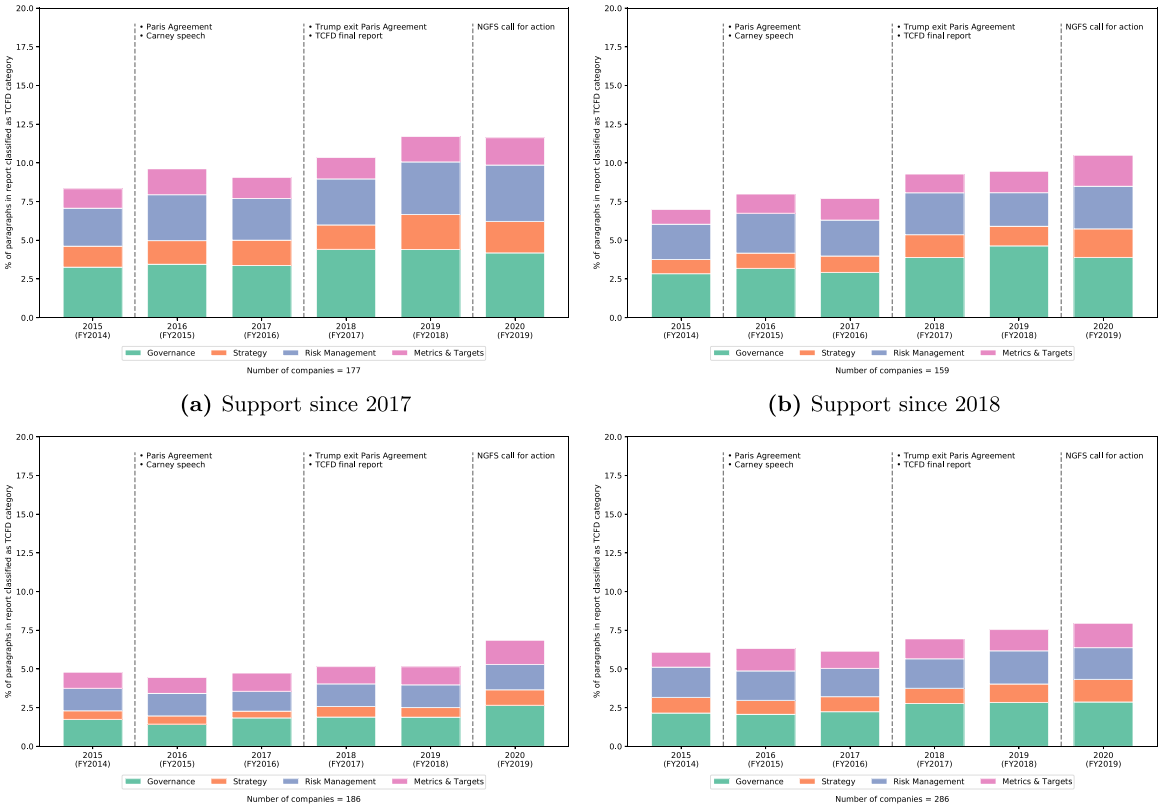
We make the following observations. First, we find only a slight or negligible increase of approximately 2.2 percentage points in information disclosed as required by the TCFD categories after the launch of the recommendations in 2017 until 2020, albeit statistically significant (Table 5). Second, Fig. 1(a) and Table 5 suggest that much of this overall increase is due to increased governance and risk management disclosure after the launch of the TCFD recommendations in 2017. However, strategy and metrics and targets remain at a comparatively low level with only small increases. Third, our overall analysis reveals a much lower quantitative increase in information compared to the TCFD's estimate of a six percentage points increase in their more superficial assessment of whether firms (supporters and non-supporting companies) provide TCFD-aligned disclosure, based on a simple yes/no analysis (TCFD, 2020). Also, it strikes us that much of the information has already been disclosed before the launch of the TCFD recommendations. This observation, which is left out in the TCFD status report, suggests that TCFD-supporting firms might not have increased their level of disclosures. Instead, they might simply have re-structured already existing information such that they comply with the TCFD recommendations.

[8] Moreover, the TCFD status report only looks at the period starting in 2017 but not before.



(a) Full sample (b) France

Fig. 1. Corporate climate risk disclosure by TCFD categories.



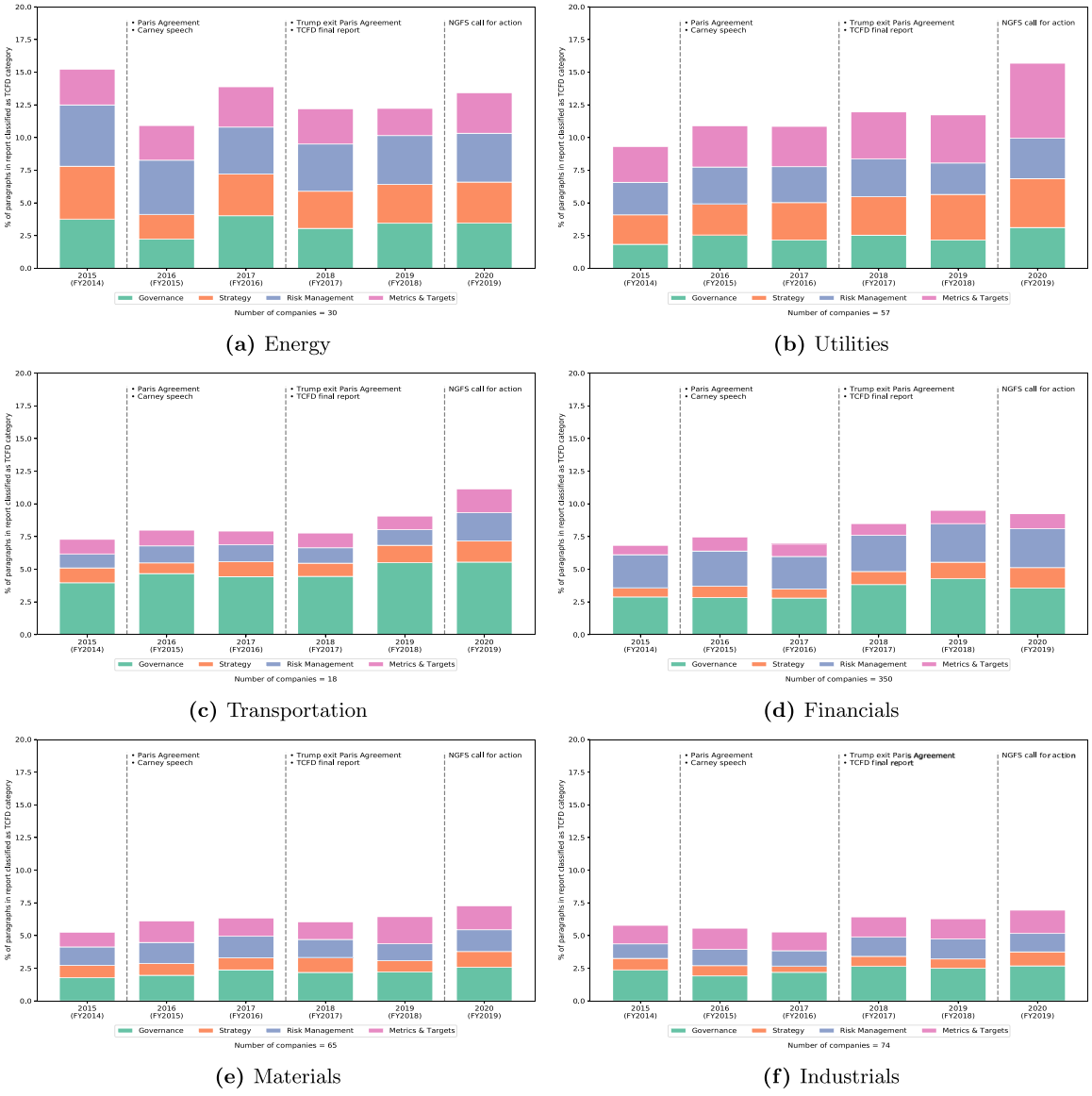
(a) Support since 2017 (b) Support since 2018

(c) Support since 2019 (d) Support since 2020

Fig. 2. Corporate climate risk disclosures from 2015 until 2020, by year of becoming official TCFD supporter.

Given this observation, one might question whether voluntary reporting as propagated by the TCFD has enough bite to initiate a change in climate-risk disclosure effectively. Therefore, we take a closer look at France. Today, France is the only country with detailed mandatory climate-risk reporting for large financial institutions via Article 173 of the French Energy Transition Law. Indeed, as shown in Fig. 1(b) and Table 6, we see a much higher level of overall disclosures. More importantly, we observe a much more prominent representation of the strategy and metrics and targets categories in 2020.

Fig. 2 also suggests a slight increase in overall disclosures but an underrepresentation of strategy and metrics and targets when we differentiate companies according to the year when they officially state their TCFD support. Interestingly, we find that companies that supported the TCFD recommendations directly in 2017 and 2018 exhibit relatively higher pre- and post-2017 disclosure levels



(a) Energy (b) Utilities

(c) Transportation (d) Financials

(e) Materials (f) Industrials

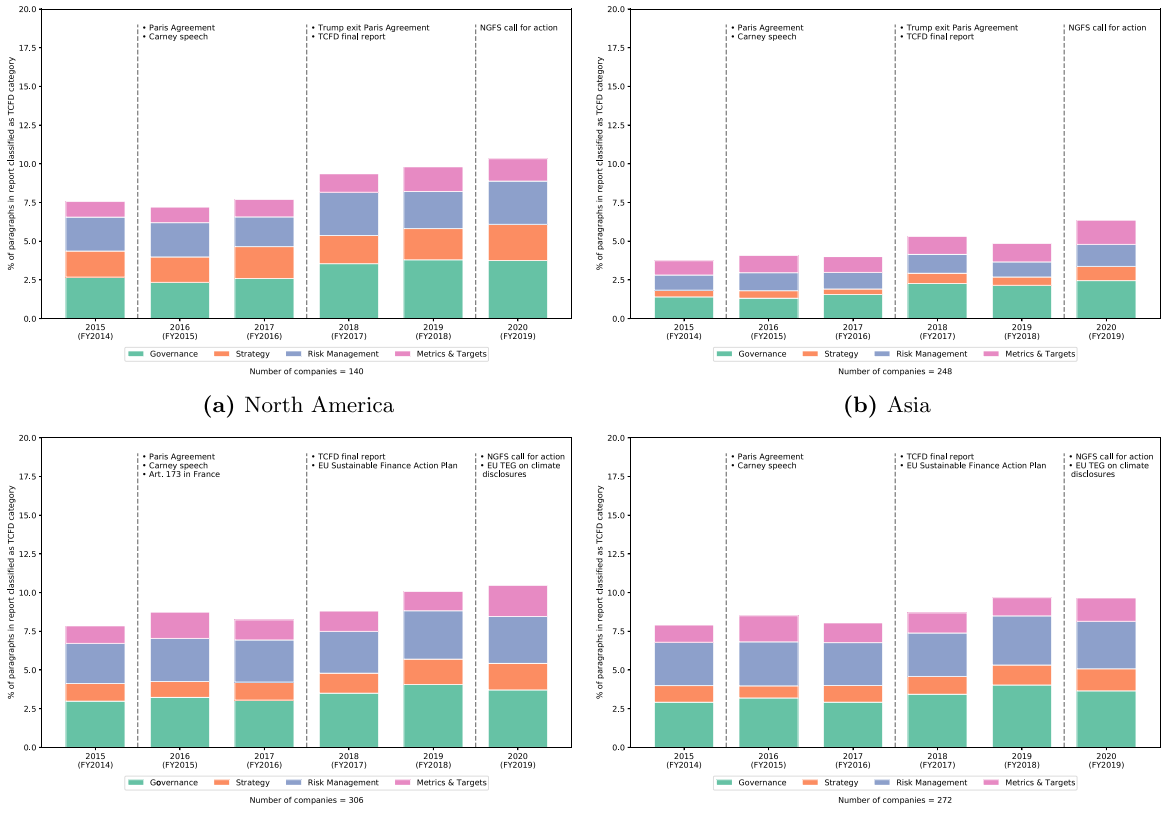
Fig. 3. Corporate climate risk disclosures from 2015 until 2020, by sectors.

than companies that supported the TCFD in 2019 and 2020. Given that these companies also exhibit higher pre-TCFD disclosure levels, these findings suggest that companies facing relatively less effort to implement the recommendations seem to have joined earlier than those with lower pre-TCFD climate disclosure levels. Companies joining in 2019 exhibit the most significant increase after supporting the TCFD.

4.2. Sectoral patterns

We find substantial differences in climate disclosures when we differentiate by sectors (Fig. 3 and Table 6). Confirming the TCFD's findings (TCFD, 2020), energy and utilities disclose the highest amount of climate-related information, followed by transportation and financials. Materials, industrials, and real estate exhibit lower than average disclosure levels for 2014 until 2020. As in the general overview above, disclosures on strategy and metrics and targets are generally lower than governance and risk management disclosures for all sectors, except for energy and utilities.

In the energy sector and utilities, disclosures on the individual categories are much less imbalanced than for the general sample and other sectors. For these sectors, the relevant greenhouse gas (GHG) emissions are relatively straightforward to track (so-called Scope 1 emissions). Hence, gathering this information is associated with fewer information costs and more confidence in the results.



(a) North America **(b)** Asia

(c) Europe **(d)** Europe without France

Fig. 4. Corporate climate risk disclosures from 2015 until 2020, selected regions.

Greenhouse gas emissions have been a long-standing starting to become a common reporting metric in most energy-intensive sectors, also before the arrival of the TCFD recommendations. We also identify higher strategy-related information, probably because any energy strategy-related wording is also linked to climate strategy-related wording. This observation is in line with our intuition since a key driver of climate risks is energy consumption and the associated carbon emissions.

In the energy sector, we see high fluctuations in disclosure levels. During 2015, the TCFD-supporting energy sector firms disclosed more climate-related information than after the implementation of the Paris Agreement. A reason might be that the Paris Agreement introduced the below 2 degrees target, which means, in contrast to the previous 2 degrees target, that full decarbonization would be required until 2050. Furthermore, all countries were subject to contribute mitigation activities, not only the industrialized countries. Consequently, the energy sector faced significantly higher material risks after the Paris Agreement decisions and might have become more reluctant to disclose climate-related information afterward (see Fig. 4).

4.3. Regional patterns

In terms of regional differentiation, we find that TCFD-supporting firms headquartered in North America and Europe disclose relatively more information than firms from Asia, which roughly report only half as much as their North American counterparts. Moreover, we find that the election of Trump and the subsequent withdrawal from the Paris Agreement did not provoke a negative effect on the reporting of the TCFD-supporting firms. Regarding the category imbalances, North American Firms tend to disclose slightly more information on strategy than firms from Asia and Europe. However, we observe for all regions that the strategy and metrics and targets categories are again underrepresented, undermining, at least partially, the TCFD's primary goal of providing full information transparency in the fight against climate change.

For Europe, we observe some slightly higher disclosure levels. However, we doubt that this observation relates to the sustainability-related disclosure obligations for large listed companies in the EU, based on the Non-financial Reporting Directive (NFRD). First, firms could voluntarily choose which environment-related topics to disclose and how. The NFRD does not prescribe the disclosure of climate-related information. Second, the requirements applied to firms from 2016 onward, and we do not observe a considerable increase in reporting activities after 2016. However, the TCFD-supporting firms from Europe might, in general, be firms being relatively aware of environmental risks. Also, they might have prepared earlier since the regulation had been introduced

in 2014. To assess whether the French firms drive the data for Europe due to the Art. 173, we also display Europe without France. As shown, the pattern of disclosures does not change. Just the overall level is slightly less.

5. Conclusion

We designed ClimateBERT, an algorithm that analyzes companies' climate-risk disclosures within the four main TCFD categories framework. We find that the arrival of the TCDF recommendations had a significant impact on disclosures of TCFD-supporting companies. Moreover, the disclosures on the TCFD categories strategy and metrics and targets continue to lag. Our findings bear important implications for financial supervisors and regulatory authorities. Voluntary disclosure commitments seem to suffer from cheap talk, in the sense that announcing TCFD support does not lead to an increase in disclosures, and cherry-picking, i.e., companies prefer disclosure on non-material categories.

CRediT authorship contribution statement

Julia Anna Bingler: Conceptualization, Methodology, Writing. **Mathias Kraus:** Conceptualization, Methodology, Software, Writing. **Markus Leippold:** Conceptualization, Methodology, Writing. **Nicolas Webersinke:** Methodology, Software, Formal analysis.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.frl.2022.102776. The supplementary material covers in detail the methodology behind our analysis in the online appendix.

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