

Automated Identification of Climate Risk Disclosures in Annual Corporate Reports

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Climate risks

Physical risks

- Acute: Risks from increase severity and/or frequency of extreme weather events, cyclones, floods, heat waves.
- Chronic: Risks from changes in precipitation patterns (droughts), rising mean temperatures, rising sea levels.

Transition risks

- Policy & Legal: Risks related to the potential introduction or strengthening of climate policies, such as carbon tax, emission reporting policy changes, regulation on products and services, litigation risk
- Technology & Market: Risks related to changing market environments because of climate change, such as changing customer behavior, uncertainty in market prices, increase of cost in raw material & natural resources. Also includes technology risks from climate change-related obsolescence of existing products & services, unsuccessful investments in new technologies, costs to transition in to lower emission technology.
- Reputation: Risks to the reputation of the corporation or its products/services because of climate change-related matters, such as changing customer preferences, stigmatization of sector (including by investors), hiring risk, increased stakeholder pressure.



In recent years disclosure policies have been introduced to improve climate-related risk reporting

Can we reliably identify and classify climate risk disclosures in annual reports?

- Previous work: Focus on structured reports (10-K); sentence level classification
- However: Annual reports as prevalent in Europe are unstructured with hundreds of pages

Our contribution:

- Classification of granular risk types (step towards *quality* of disclosure)
- Detect risks in free text at the *paragraph* level
- Ground truth evaluation metrics from fully manually labelled reports
- Step towards studying treatment effect of financial policies

Data

- Time: 2000-2020
- Company selection:
 - STOXX Europe 50 index (val, test)
 - STOXX Europe 600 index (train)
- Data sources:
 - Company websites
 - Refinitiv Eikon
- Sampling:
 - Val/test: stratified by years and industries from STOXX Europe 50
 - Train: Greedy selection from STOXX Europe 600
- Pre-select pages with keywords
- Student assistants helped labeling

	TRAIN	VAL	TEST
<i>Physical risks</i>			
ACUTE	133	15	28
CHRONIC	54	5	19
<i>Transition risks</i>			
POLICY & LEGAL	43	40	60
TECH. & MARKET	37	17	21
REPUTATION	23	14	14
UNIQUE POS. PARAGRAPHS	205	72	97
NEG. PARAGRAPHS	295	39'007	40'878
OF THESE <i>hard neg.</i>	295	73	55

Models and experiments

Models

- **TF-IDF + Support vector machine (SVM)** (baseline)
- **DistilBERT** (smaller, more efficient)
- **RoBERTa** (large, more training data)

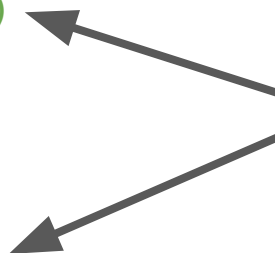
Tasks

- **Binary** (classification in “risk” or “no risk”)
- Multi-label with **two classes** (physical and transition risks)
- Multi-label with **five classes** (all risk categories)

Settings

- **Discriminatory:** Only positive paragraphs
- **Hard negative:** Only hard negative paragraphs
- **Realistic:** Including all negatives

Scenario for
model selection



Model performance

Table 2. Validation performance (F1-score macro-avg.)

EXPERIMENT	SVM	DISTILBERT	RoBERTa
<i>5 Classes</i>			
REALISTIC	0.204	0.241	0.356
HARD NEG.	0.457	0.431	0.528
DISCRIMINATORY	0.599	0.558	0.596
<i>2 Classes</i>			
REALISTIC	0.351	0.497	0.446
<i>Binary</i>			
REALISTIC	0.290	0.444	0.496

Table 3. Test performance for RoBERTa (best model) in the realistic setting for 5 classes and binary.

	PRECISION	RECALL	F1
<i>Physical risks</i>			
ACUTE	0.846	0.393	0.537
CHRONIC	0.833	0.263	0.400
<i>Transition risks</i>			
POLICY & LEGAL	0.291	0.383	0.331
TECH. & MARKET	0.400	0.476	0.435
REPUTATION	0.093	0.286	0.140
AVG. 5 CLASSES	0.493	0.360	0.369
AVG. BINARY	0.695	0.423	0.526

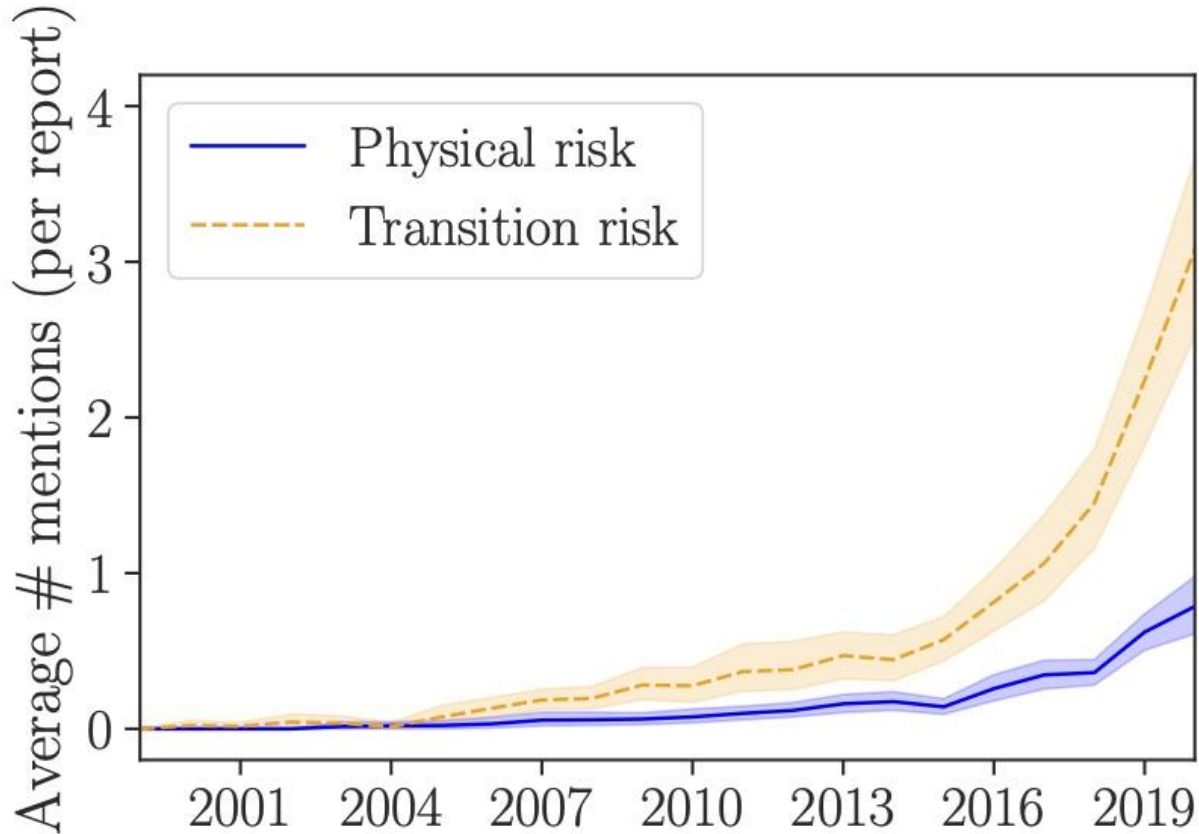


For more difficult tasks, the larger models outperform

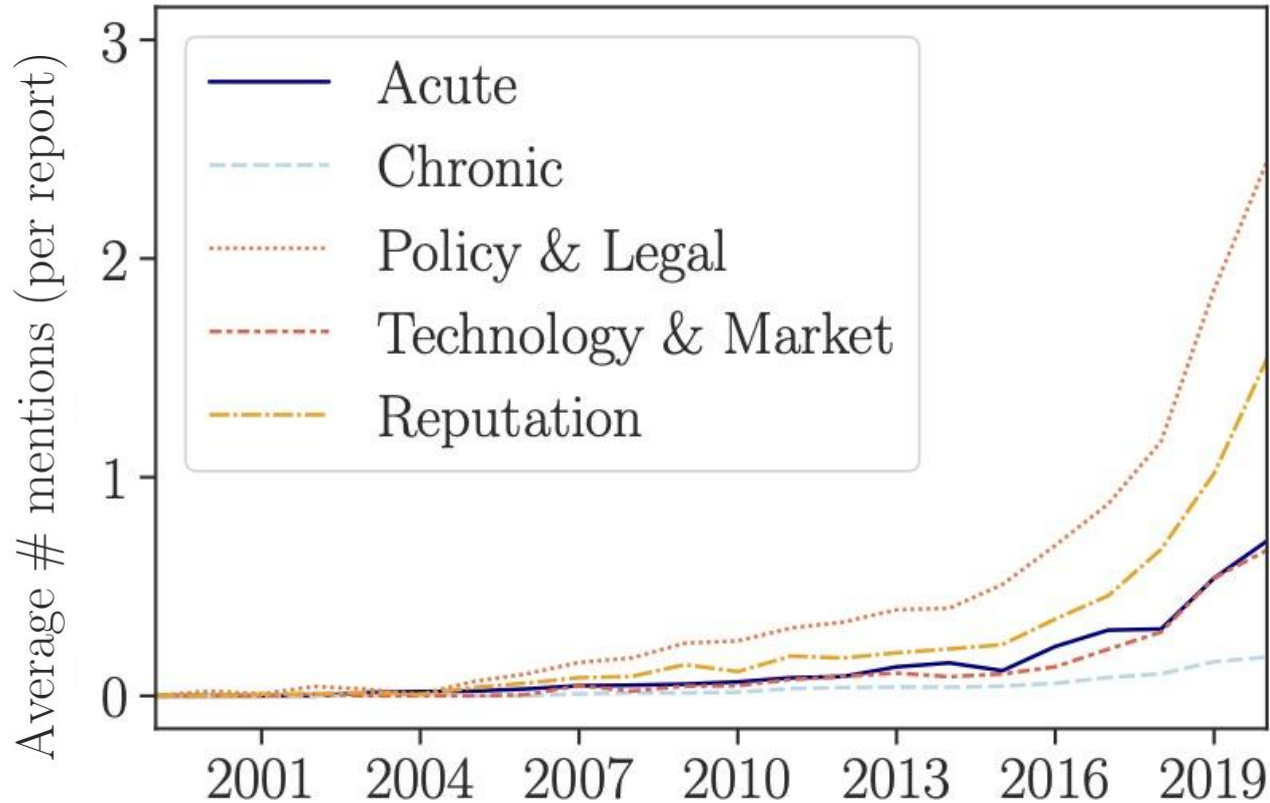


Between classes substantial variation in PR scores

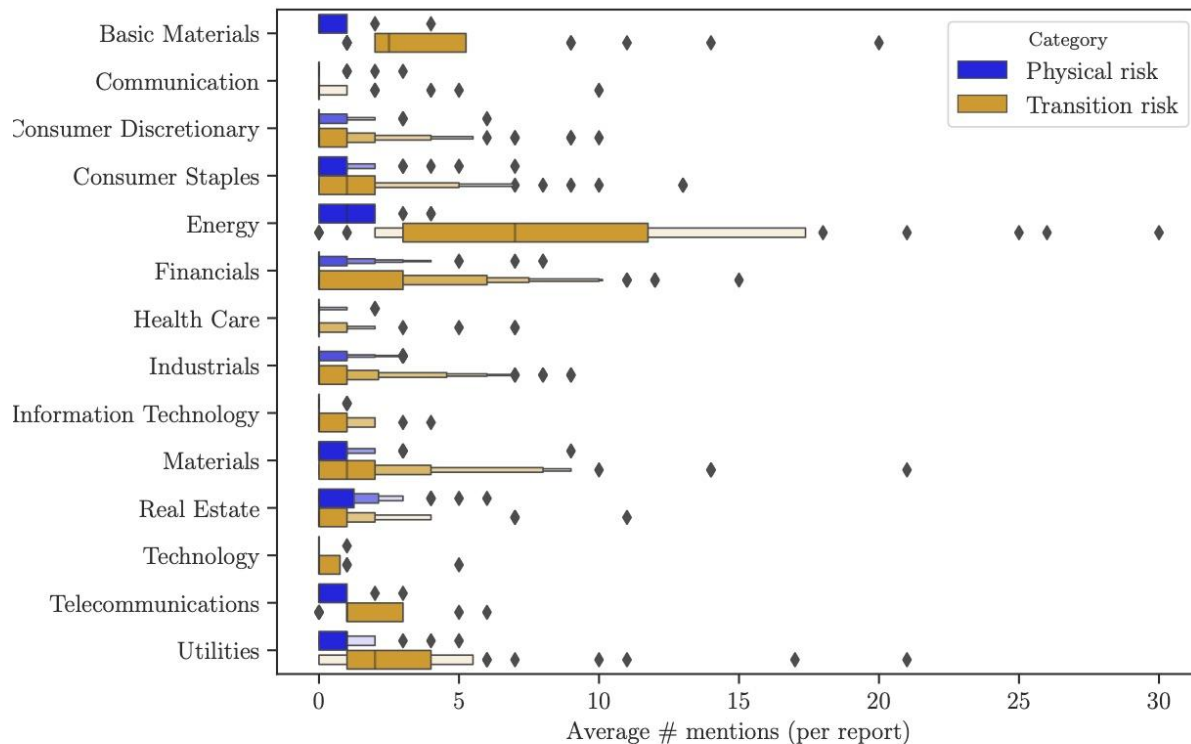
Comparing risk types



Comparing risk types



Distribution for industries



Backup slides

Previous work

- TCFD's "AI review" to identify compliance with the TCFD Recommended Disclosures (TCFD, 2019)
- Luccioni et al. (2020): question answering approach to identify passages that answer the 14 TCFD recommendations (trained model accessible as a tool)
- Bingler et al. (2021): "ClimateBERT" to analyze compliance with TCFD recommendations in a variety of corporate reporting globally (find mostly disclosure of non-material TCFD categories).
- Kölbel et al. (2020): fine-tuned BERT model to identify climate risk disclosure in 10-K (increase in disclosure of transition risks in 10-K reports that outpaced those of physical risks)
- Sautner et al. (2020): rule-based approach for identifying CRO-related language in corporate conference calls, using ML for expanding their set of keywords
- Our contribution:
 - First time classifying granular types of risks (step towards quality of disclosure)
 - Detecting risk types in free text
 - At paragraph-level instead of sentence-level

Human performance

Many countries are also pledging to stop using fossil fuels (specifically coal) in power generation, e.g. in 2017 25 countries and regions including the UK, France and Mexico undertook to do so by 2030.

Such adverse changes could result, in particular, from increases in raw material prices (including oil), increases in interest rates and adverse geopolitical events (such as natural disasters, acts of terrorism and military conflicts).

(2013) confirming the existence of a positive correlation between a company's environmental performance and financial performance.³⁰ On the other hand, where additional travel is conducted to generate additional business, the resulting increase in

Policy & legal

No climate risk

Reputation

Physical
Acute
Chronic

Transition
Policy & legal
Technology & market
Reputation

Human performance

Shell faces property and liability risks and does not insure against all potential losses.

Shell companies are exposed to property and liability risks, for example from natural disasters such as hurricanes, civil war or unrest, and terrorism, that can result in business interruptions and casualty losses, and we do not insure against all potential losses and, therefore, we could be seriously harmed by unexpected events or liabilities. We may be subject to losses that could affect our earnings or financial condition.

Climate change and water scarcity

All businesses, particularly those that rely on agricultural raw materials, are exposed to a variety of environmental issues associated with climate change, such as droughts, floods and biodiversity loss. These issues can affect a business,Â operations directly, or indirectly as a result of their impact on the wider value chain and associated communities.

Water scarcity is particularly important to us because water is our main ingredient. Our Water Blueprint, launched in April 2015, defines our strategic approach to water stewardship, and focuses specifically on stewardship in the water-stressed areas shown in the map below.

If we are unable to find economically viable, as well as publicly acceptable, solutions that reduce our GHG emissions and/or GHG intensity for new and existing projects or products, we could experience additional costs or financial penalties, delayed or cancelled projects,

No climate risk

Acute,
chronic

Technology &
market