



3rd Summer School on Sustainable Finance

JRC COMMUNITY of PRACTICE in FINANCIAL RESEARCH

Climate Finance and Natural Language Understanding

The Quest for AI-based Greenwashing Detection

Markus Leippold* - University of Zurich



University of
Zurich^{UZH}



Finance industry and the fight against climate change

- **Sustainable Finance** (SF) become *the buzzword* in the finance industry.
- *Amundi, Franklin Templeton, Sumitomo Mitsui Trust Asset Management, and HSBC Asset Management* are among the latest big investors to sign up to the **Net Zero Asset Managers** initiative launched last December:
 - Signatories have pledged to set short-term emissions reductions targets across their investment portfolios for 2030.
 - Signatories will work with clients who elect to reach net zero on their investments by 2050.
 - Investors are expected to report their exposure based on **Task Force for Climate-related Financial Disclosures** (TCFD)
- This latest move implies that **\$43tn in assets of a \$100tn total funds managed worldwide** (Willis Towers Watson) are committed to a net zero target!
- Has the investment industry reached a “**tipping point**”? (Financial Times, July 6, 2021)



Op-Eds About SF in the Financial Times

Strauß, N. (2021). [Framing Sustainable Finance: A Critical Analysis of Op-Eds in the Financial Times](#). *International Journal of Business Communication*.

Consensus on
climate change

1



Axel Weber
Chairman
UBS

2



Mark Haefele
Chief Investment
Officer
UBS

3



Zoë Knight
Managing Director,
Sustainable Finance
HSBC

4



Philipp Hildebrand
Vice-Chairman
BlackRock



Jessica Alsford
Global Head of
Equity Research
Morgan Stanley



David Solomon
CEO
Goldman Sachs



Consensus on Climate Change



- “The Decade to Deliver: A Call to Business Action” (2019)
 - Companies no longer see climate change as an issue for *future* leaders to manage. Climate change happens today.
 - 88% of 1,000 global executives believe our global economic systems need to refocus on equitable growth.

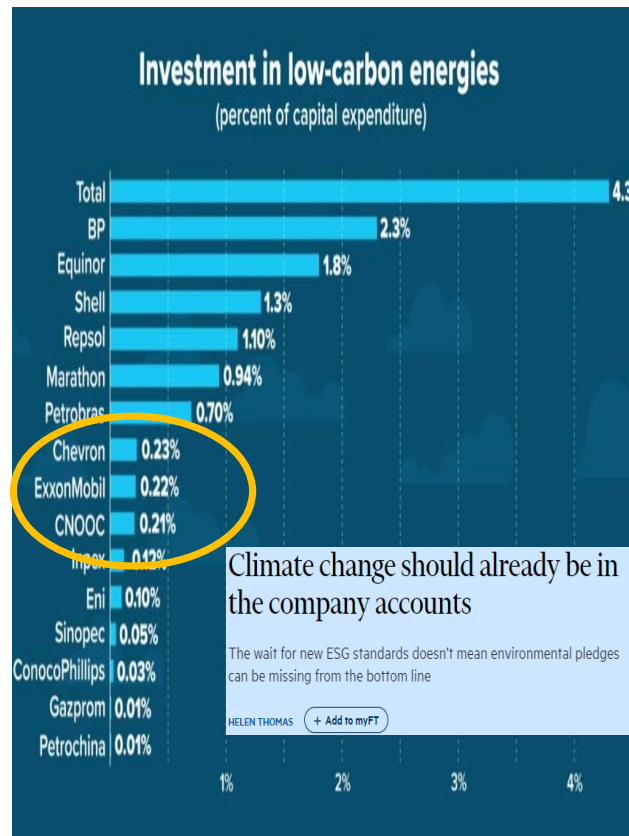
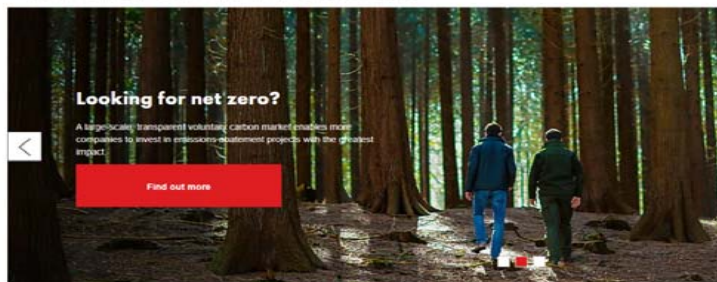


Is she the chief economist or who is she? I'm confused -
After she goes and studies economics in college she can
come back and explain that to us.

Steven Mnuchin

Even oil-companies start to move away from climate-denial – But...

greenhouse gas performance across all our business lines,” said Darren Woods, chairman and chief executive officer of Exxon Mobil Corporation. “We respect and support society’s ambition to achieve net zero emissions by 2050, and **continue to advocate for policies that promote cost-effective, market-based solutions to address the risks of climate change.**”



Swiss Politics

Swiss CO2 law defeated at the ballot box



▲ Opponents argued the new law would not help the environment as Switzerland is responsible for only 0.1% of global carbon emissions. Keystone / Ms

Hence, fact-checking becomes essential...

Mishra, Rahul and Gupta, Dhruv and Leippold, Markus

Generating Fact Checking Summaries for Web Claims (October 2020). Conference on Empirical Methods in Natural Language Processing (EMNLP), <https://ssrn.com/abstract=3713376>

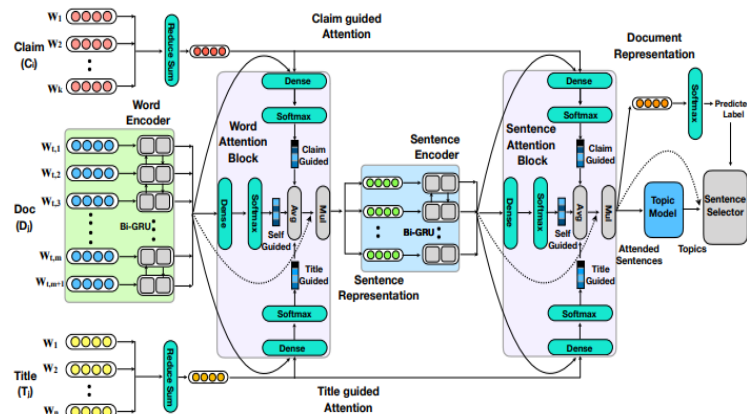


Figure 2: SUMO's neural network architecture for establishing the correctness of Web claims.

Claim: <i>Smoking may protect against COVID-19</i>		Label: False	Verdict: False
Summary:	The current evidence suggests that the severity of COVID is higher among smokers, prevent the health risk linked to the excessive consumption or misuse" of nicotine products by people hoping to protect themselves from COVID-19. Evidence from China, where COVID-19 originated, shows that people who have cardiovascular and respiratory conditions caused by tobacco use, or otherwise, are at higher risk of developing severe COVID-19 symptoms. HO urges researchers, scientists and the media to be cautious about amplifying unproven claims that tobacco or nicotine could reduce the risk of COVID-19. Smoking is also associated with increased development of acute respiratory distress syndrome, a key complication for severe cases of COVID-19.		
Claim: <i>Deforestation has made humans more vulnerable to pandemics</i>		Label: True	Verdict: True
Summary:	Deforestation can directly increase the likelihood that a pathogen will be transferred from wildlife species to humans through the creation of suitable habitats for vector species. Climate change, including deforestation which drives it, is a key driver of cross-species transmission which is where zoonotic emerging diseases come from . There is a correlation between deforestation and the rise in the spread of infectious diseases affecting humans. Deforestation forces various species into smaller, shared habitats and increases encounters between wildlife and humans. Habitat destruction and fragmentation due to deforestation can also increase the frequency of contact between humans, wildlife species, and the pathogens they carry . This can occur through direct transfer of pathogens from animals to humans or indirectly through cross-species transfer of pathogens from wildlife to domesticated species . Deforestation could be to blame for the rise of infectious diseases like the novel coronavirus.		

Thomas Diggelmann, Jordan Boyd-Graber, Jannis Bulian, Massimiliano Ciaramita, Markus Leippold (December 2020)

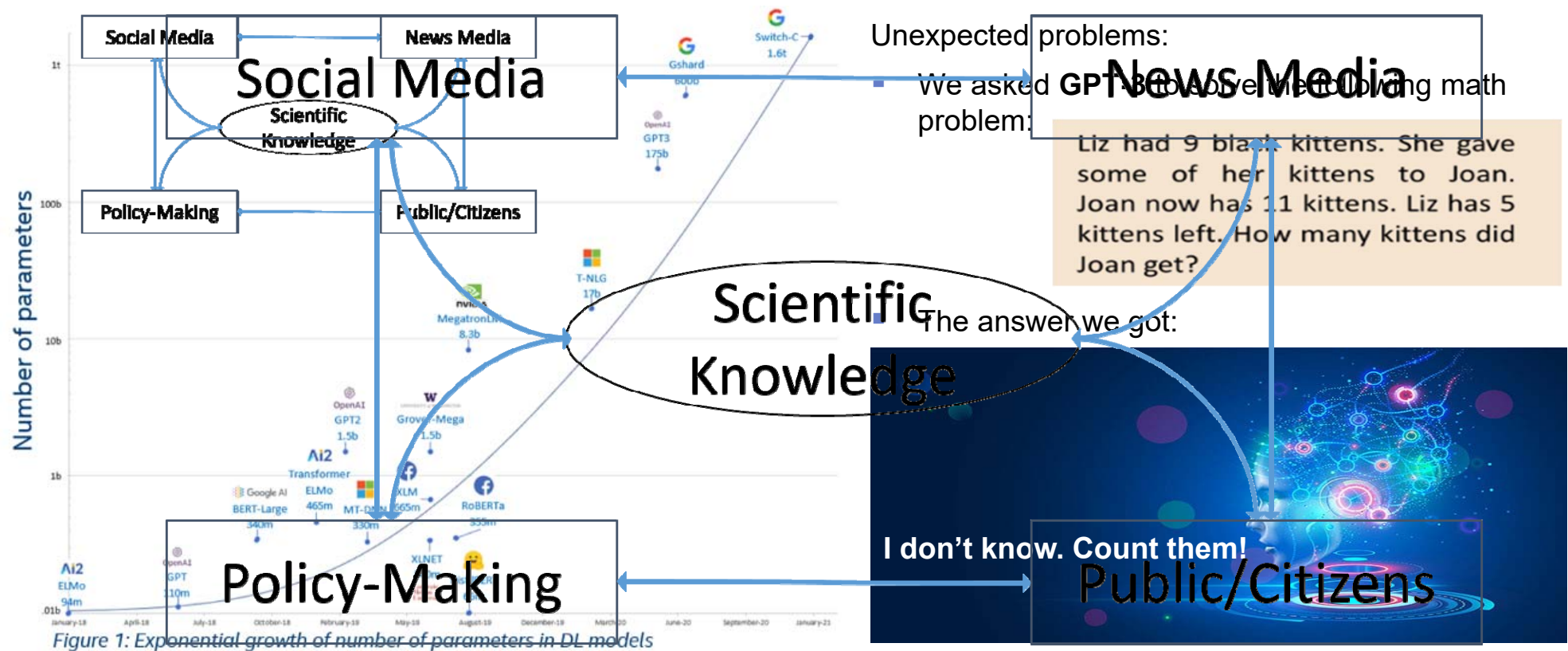
ClimateFEVER: A Dataset for Verification of Real-World Climate Claims

NEURIPS 2020, ClimateChange AI Workshop.

<https://arxiv.org/abs/2012.00614>



Current Project: Scientific-claim verification



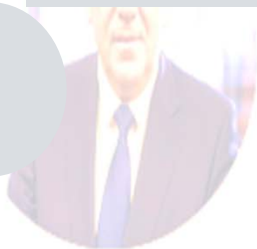


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Sustainability in the name of
profit and capital growth



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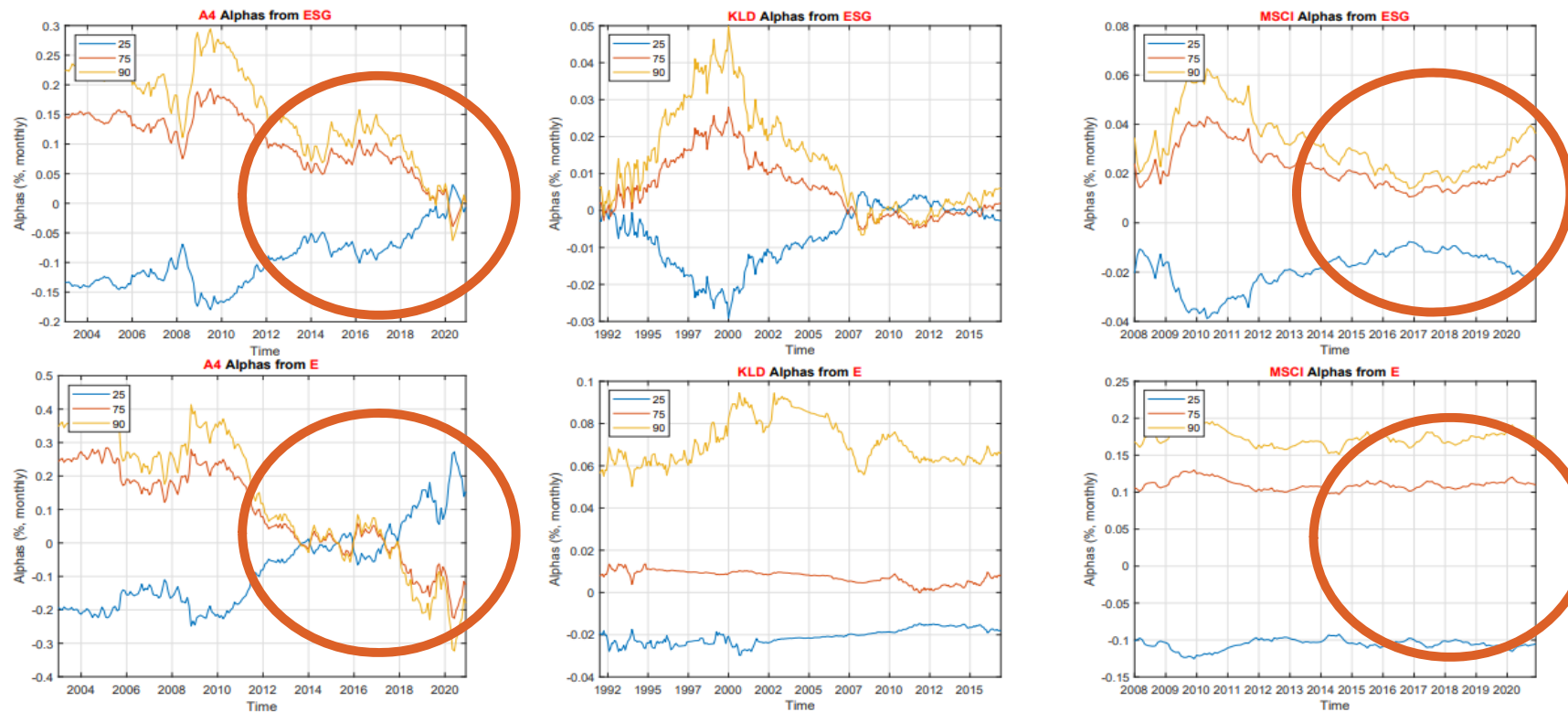
David Solomon
CEO
Goldman Sachs



Are sustainability returns sustainable?

Lioui, Abraham and Tarelli, Andrea, [Chasing The ESG Factor](#) (July 1, 2021). Available at SSRN

Alpha of ESG factors for alternative ESG ratings and conditional on firm characteristics



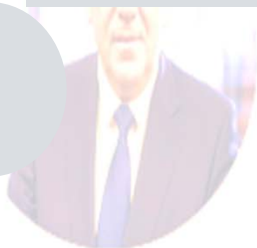


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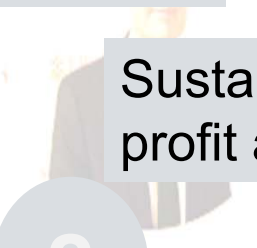
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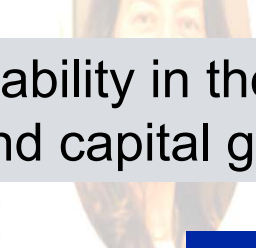
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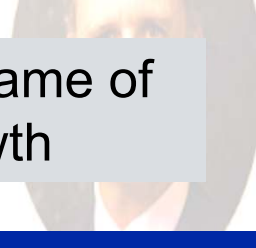
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Officer
UBS

Data and methodological
transparency

3



Zsófia Knittel
Director,
SF
HSBC



Vice-Chairman
BlackRock



Global Head of
Research
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4



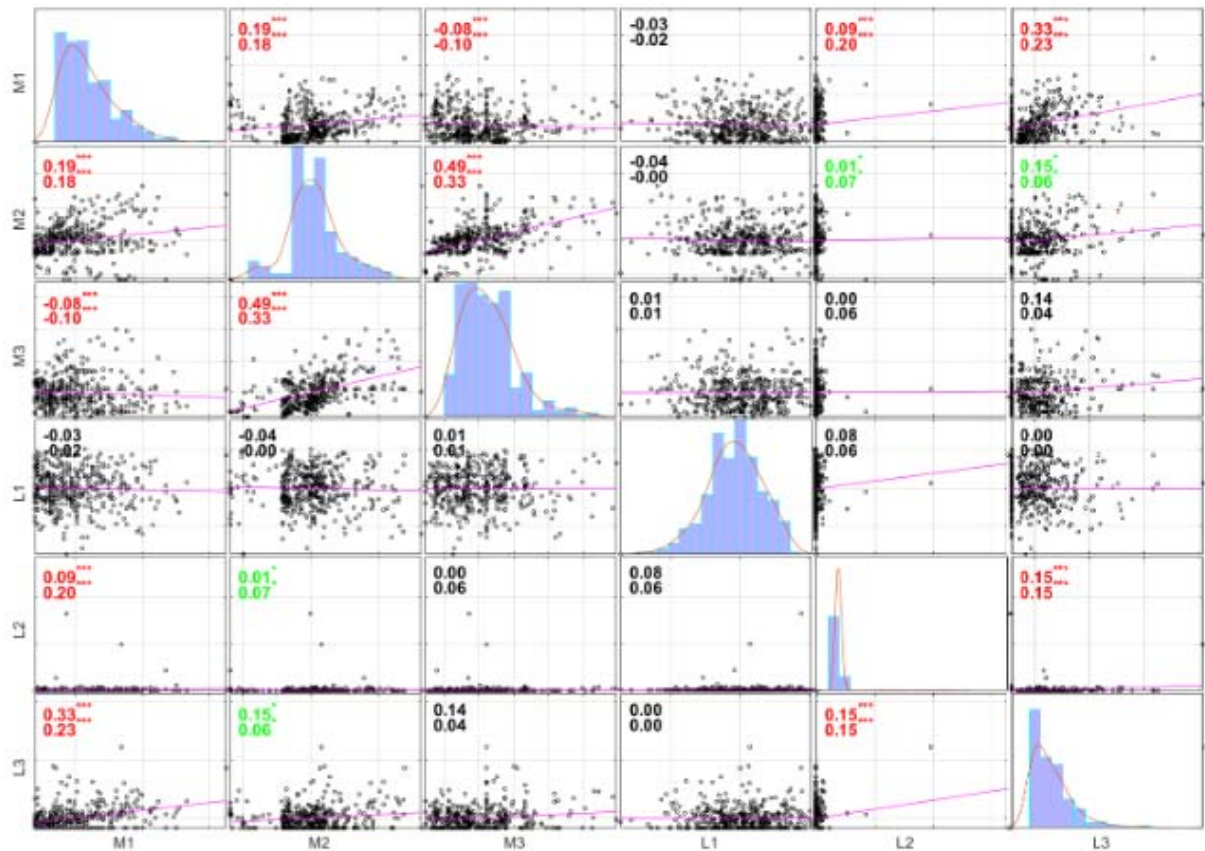
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Physical risk measures

Correlations for Horizon 2050, RCP8.5

- Trucost (M1)
- Carbon 4 Finance (M2)
- Southpole (M3)
- Truvalue Labs(L1)
- Firm-level Climate-Change Exposure (L2) (Sautner et al., 2020a)
- BERT-based climate risk measure (L3) (Koelbel et al., 2020).





Impact on sector ranking and portfolio sorts – make your choice!

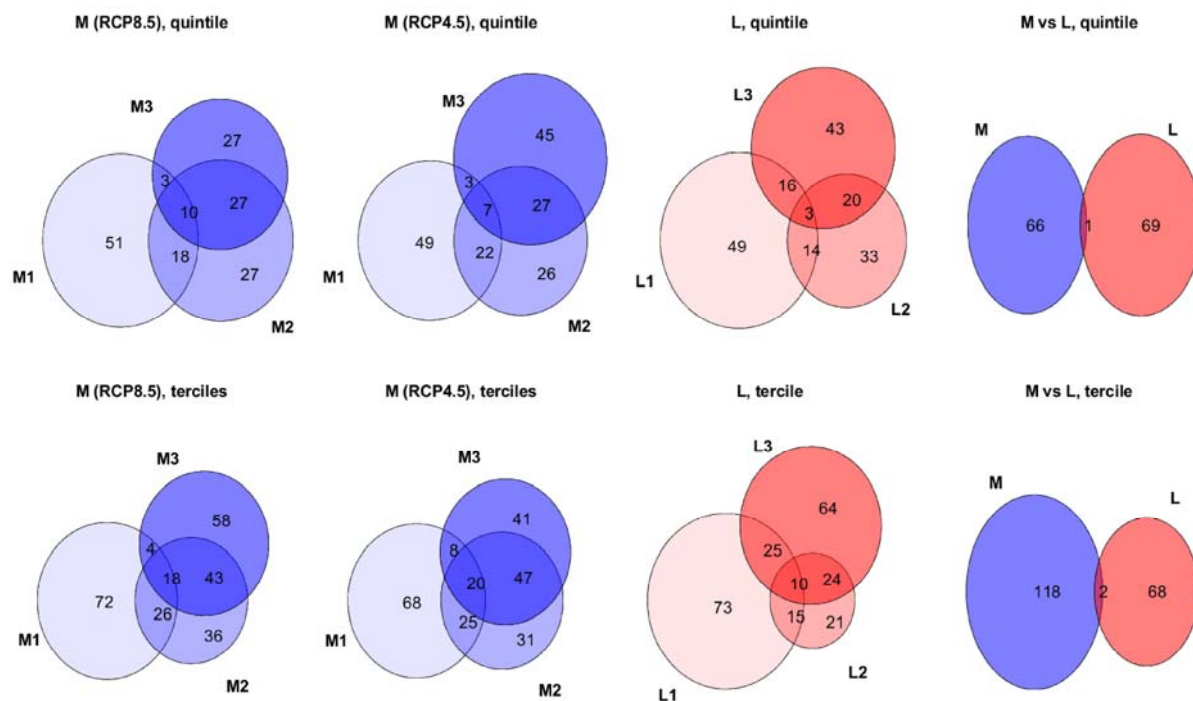
Sector rankings

Sector	M1	M2	M3	L1	L2	L3	Avg
Health Care	9	6	7	10	9	11	8.7
Consumer Staples	7	5	5	4	8	3	5.3
Consumer Discretionary	3	8	9	6	6	6	6.3
Information Technology	10	7	6	5	10	9	7.8
Energy	4	2	1	7	5	4	3.8
Materials	5	3	2	8	3	2	3.8
Industrials	6	4	8	2	2	7	4.8
Communication Services	8	10	10	3	11	10	8.7
Financials	11	9	3	1	7	8	6.5
Real Estate	2	11	11	9	4	5	7.0
Utilities	1	1	4	11	1	1	3.2

Legend

- Trucost (M1)
- Carbon 4 Finance (M2)
- Southpole (M3)
- Truvalue Labs(L1)
- Firm-level Climate-Change Exposure (L2) (Sautner et al., 2020a)
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Portfolio sorts





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Transparency and
responsibilities

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Chairman
UBS

Mark Haefele
Chief Investment
Officer
UBS

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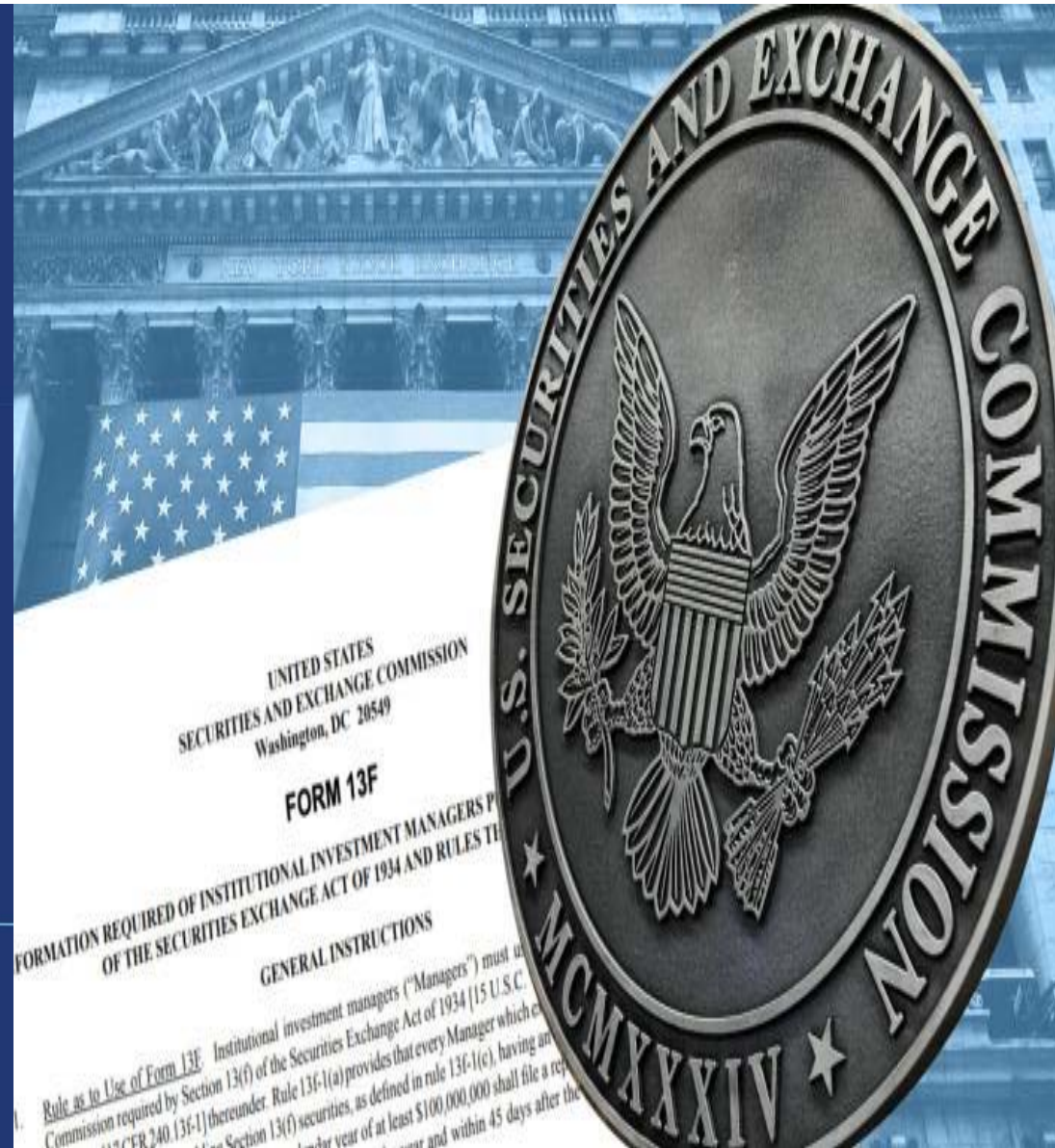
David Solomon
CEO
JP Morgan Chase

TCFD

Good Practice Handbook



Climate
Disclosure
Standards
Board

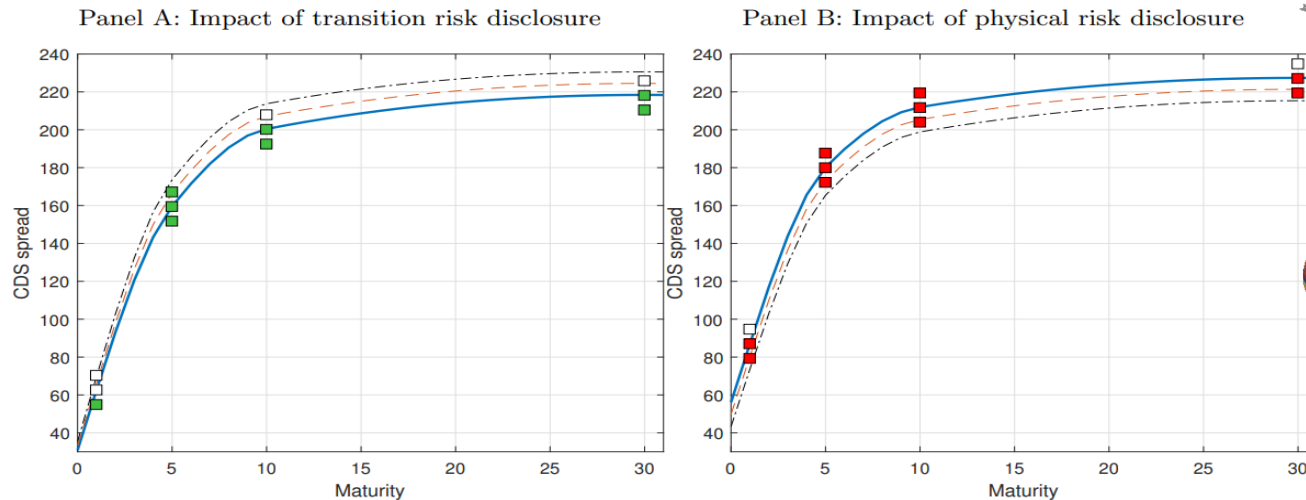




Regulatory disclosure of climate risk impacts CDS spreads

A. Statistical significance:

Bidirectional Encoder Representations from Transformers



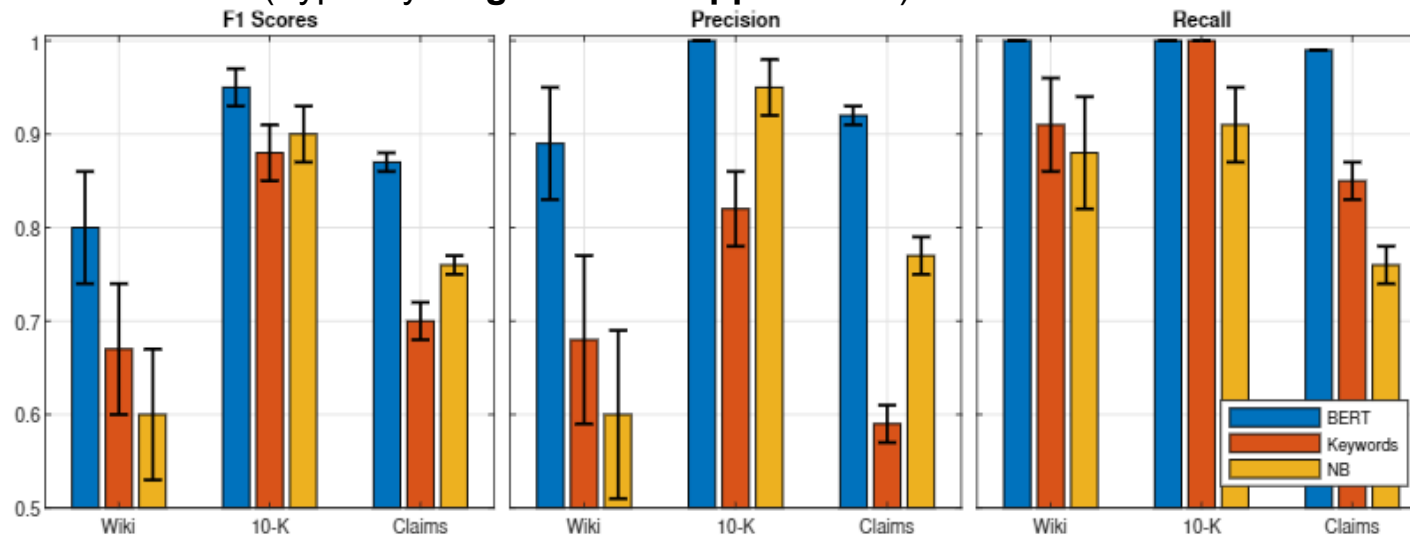
B. Economic significance:

- A one-standard-deviation increase in transition risk leads to an increase of **6.99bps** in the average five-year CDS spread for the post-Paris period or an **4.3% increase** in the average.
- A one standard deviation in physical risks results in a decrease of CDS spreads of **7.37bps**, which amounts to a **reduction of 4.1%** for the average 5 year CDS contract in our sample.



Why Bert (or Transformers)?

- Traditional approaches from NLP are based on a **pre-defined list of presumably relevant words** and then search for these words within the documents (Typically: **bag-of-words approaches**).





Using ClimateBERT for TCFD Disclosures

- ☞ >17,300 human-labeled sentences with TCFD categories.
- ☞ Extensions:
 - ☞ >600 paragraphs, 5 annotators.
 - ☞ Additional tasks (climate, sentiment, commitment, specificity).
- ☞ >300,000 general language sentences from annual reports for training. More than 1,400,000 sentences in total.
- ☞ Making ClimateBERT a language model.

Table 1. Descriptives of our training sample

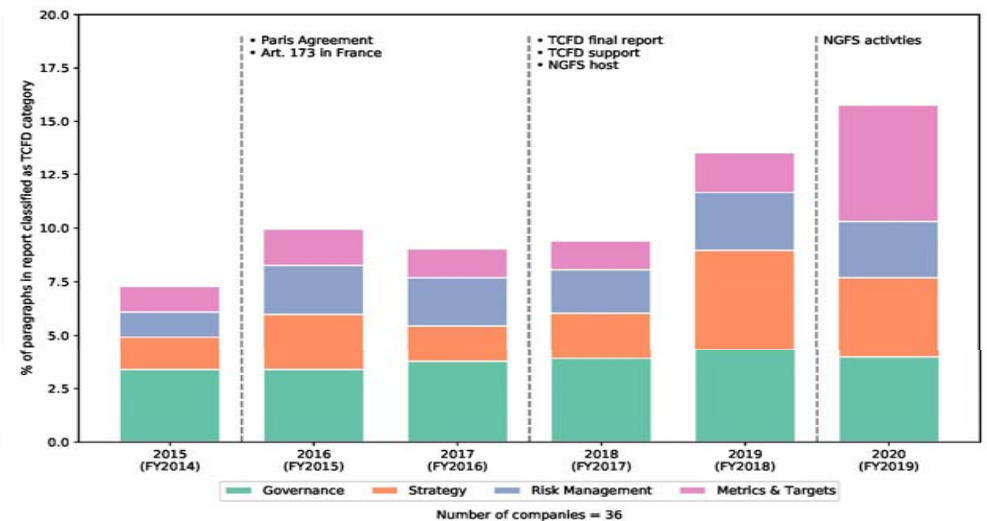
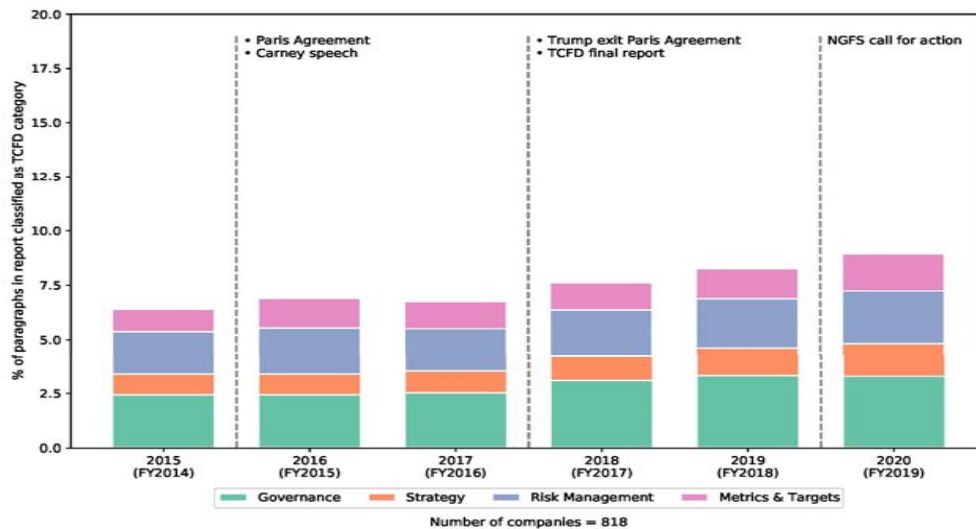
(a) Sectors		(b) Regions	
	N Firms		N Firms
Financials	100	Europe	113
Materials	34	Asia	71
Utilities	33	North America	53
Industrials	29	Oceania	26
Transportation	19	South America	16
Information Technology	18	Africa	9
Consumer Staples	11	Asia Pacific	6
Energy	11	Central America	3
Real Estate	10	Global	2
Communication Services	10	Caribbean	1
Consumer Discretionary	9	Middle East	1
Other	7		
Government	5		
Health Care	5		
TOTAL	301		301



Evaluation of classification performance

Table 3. Out-of-sample performance comparison between baseline models and our proposed ClimateBERT. Performance is reported in precision for each category.

	Governance	Strategy	Risk Management	Metrics & Targets	General Language	Overall Accuracy
Tf-idf	0.43	0.00	0.40	0.35	0.00	0.24
Sentence Enc.	0.19	0.57	0.15	0.24	0.00	0.23
RoBERTa Para.	0.26	0.25	0.25	0.25	0.07	0.22
RoBERTa Sent.	0.96	0.92	0.84	0.74	0.32	0.75
ClimateBERT	0.94	0.90	0.79	0.77	0.65	0.81





Introducing Commitment and Specificity

- We currently extend **ClimateBert** to make predictions about:

- Risk and opportunity
- Commitment
- Specificity

- **Examples:**

- Commitments:

“We rank among Europe’s market leaders in the grid and retail business and have leading positions in renewables. We intend to spend a total of between €6.5 billion and €7.0 billion in capital throughout the Group from 2017 to 2019.”

- Firm-specific statements:

“We emitted 13.4 million tonnes CO2 of Scope 2 (indirect emissions), being emissions arising from our consumption of purchased electricity, steam or heat. Our Scope 3 emissions include emissions from a broad range of sources, including shipping and land transportation. More details on our Scope 3 emissions will be available in our 2014.”

We make **ClimateBert** a Language-Model by extending the pre-training on a large corpus of text, including:

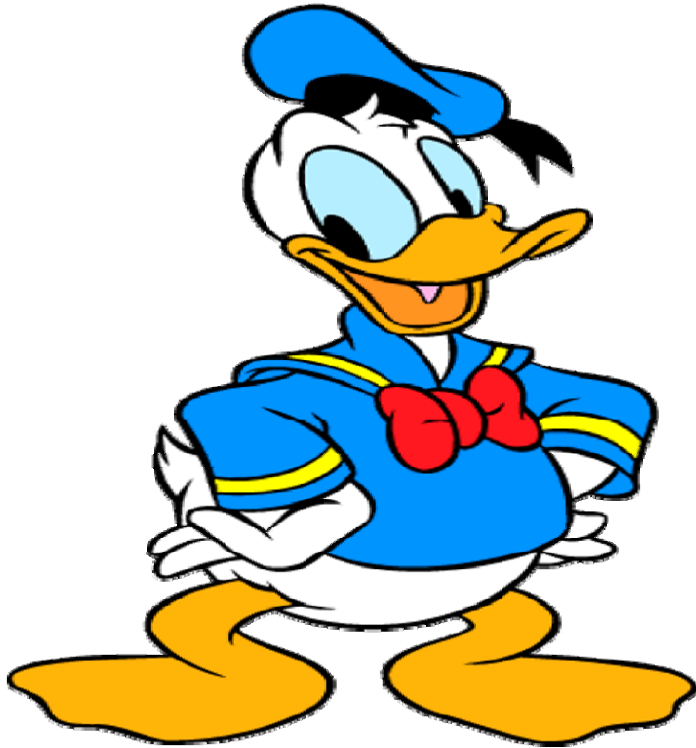
- Climate News (~50k articles)
- ~4000 Annual and ~400 Sustainability Reports 2014-2020
- > 150k Climate-Change Research Papers from Scopus and SSRN.





University of
Zurich^{UZH}

Conclusion





Conclusion



2100 WARMING PROJECTIONS

Emissions and expected warming based on pledges and current policies



May 2021 update

