Climate Risks and Economic Activity in France: Evidence from Media Coverage

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Outline

Introduction

- Climate change mainly raises two types of risk (NGFS, 2021):

  - Physical risks: risks stemming, e.g., from natural disasters (acute) and rising temperatures, sea-level, etc (chronic)

  - Transition risks: risks stemming, e.g., from government intervention via carbon taxation

Introduction

- The implementation of climate policies is raising substantial risks:

  - Withdrawal of the US from the Paris Accord in 2017
  - France revoked its fuel tax after the Yellow Vests protests
  - Australia and China have backpedalled on coal regulations in recent years

- Risks triggered by current and future climate regulations have sizable effects on investments in new equipments, on R&D and on CO2 emissions *inter alia*.

  - 43% (22%) of European (US) firms cite "**regulation risks**" as an important barrier to climate-related investment (EIB, 2021)

Introduction

- Moreover, policy events that potentially signify shifts in climate policies are often covered by **newspapers** (Yang et al., 2023)

  - The media serve as the primary source of information for households and investors about climate change (Nimark and Pitschner, 2019)

    $\Longrightarrow$ Consumers and investors' expectations and preferences can change with new information about climate risks.

- Against this background, we investigate the **role** that climate risks may have on economic activity using newspaper coverage frequency.

Related literature

Numerous ways of measuring and estimating the effect of climate risks:

- **Single risk factor:** Engle et al. (2020), Kapfhammer et al. (2020), Gavriilidis (2021) $\Longrightarrow$ Counts of articles
- **Multiple risk factors:**
  - Topic modelling: Ardia et al. (2022), Faccini et al. (2023)
  - Counts of articles: Bua et Al. (2022)

$\Longrightarrow$ Focus on Brown/Green premium and risk pricing

Related literature

- **Sentiment analysis:** Engle et al. (2020), Bessec and Fouquau (2021)
- **Macroeconomic effects:** Colacito et al. (2019), Kim et al. (2021), Ciccarelli and Marotta (2024)

$\Longrightarrow$ Comparative studies of the macroeconomic effects generated by different types of climate risks are particularly scarce and limited to a small number of variables

This paper considers all these dimensions in its empirical framework

Contribution

- Several drawbacks in the existing literature:

  - Particular interest is paid to US media/English contents
  - Articles' selection is based on very few keywords
  - The focus is on narrow economic sectors

- In this context, we contribute to the construction of climate risk indexes for France and we raise the following question:

  - How real and financial spheres respond to climate-related risks?

Climate change news articles

- We collect data from **three** major newspapers: *Le Monde*, *Le Figaro* and *Les Echos* for the period 1^{st} Jan. 2000 - 30^{th} Sep. 2023:

  - More than 5.5 million articles from Europresse

- We select climate articles according to the following strategy: {"risque*"} **and** in the same article {"change*" or "réchauffe*" or "dérègle*" or "dérégle*"} **and** preceded/followed in an interval of seven words by {"climat*" or "planète" or "planétaire" or "global"}

  - **16109 articles** are considered after duplicate checking and topic screening

The Climate Risk Index (CRI)

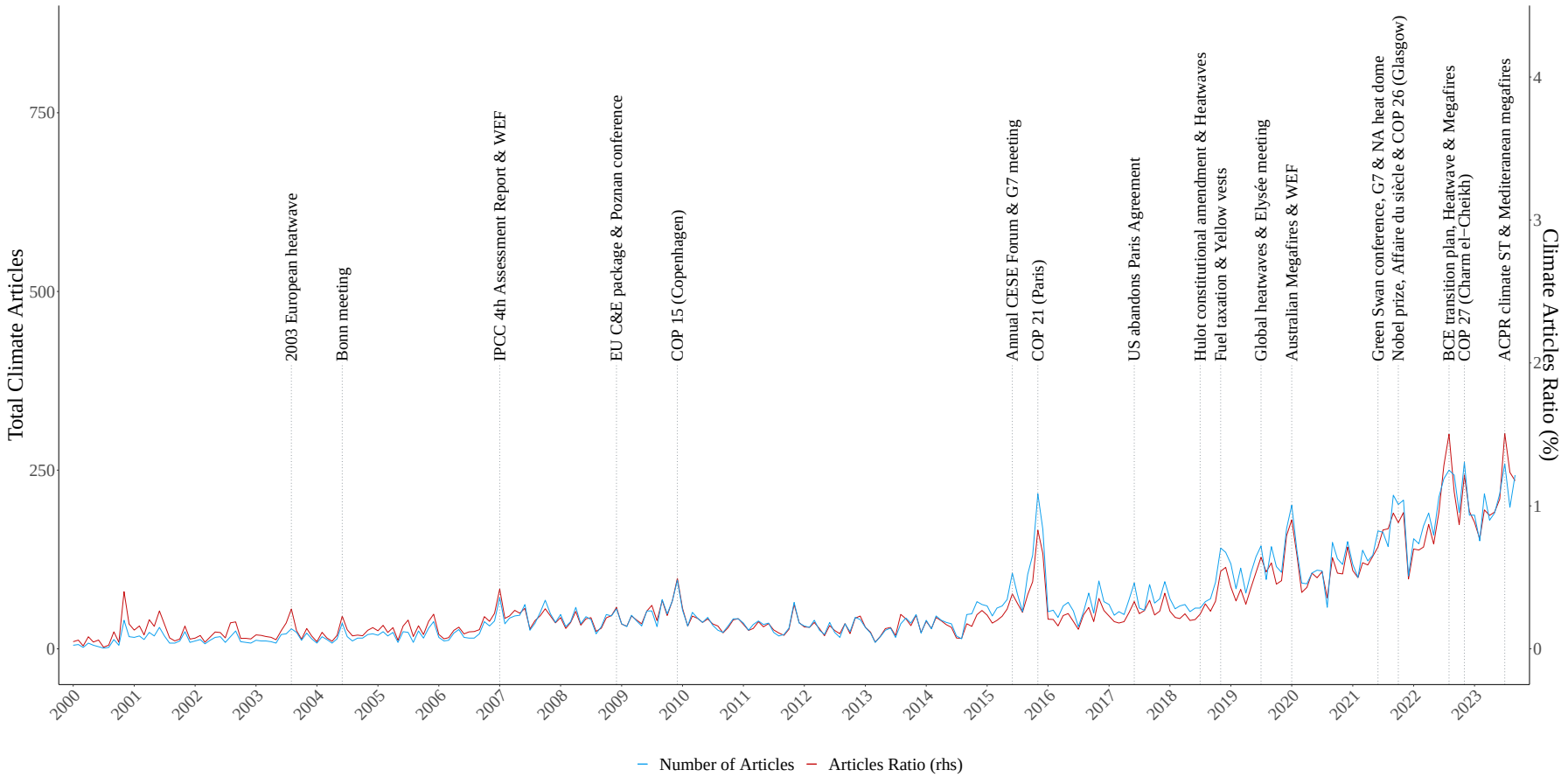


Figure 1 Total count of articles related to climate risk in blue (left axis) and their share over total published articles in red (right axis).

Methodology

- To measure the impact of the climate risk indexes on economic variables. We use local projections à la Jorda (2005):

$$\Delta \ln(y_{t+h}) = \alpha^h + \beta^h CRI_t + \sum_{j=1}^{J} \psi_j^h L^{j-1} \ln(y_{t-1}^{\Delta}) \qquad (1)$$

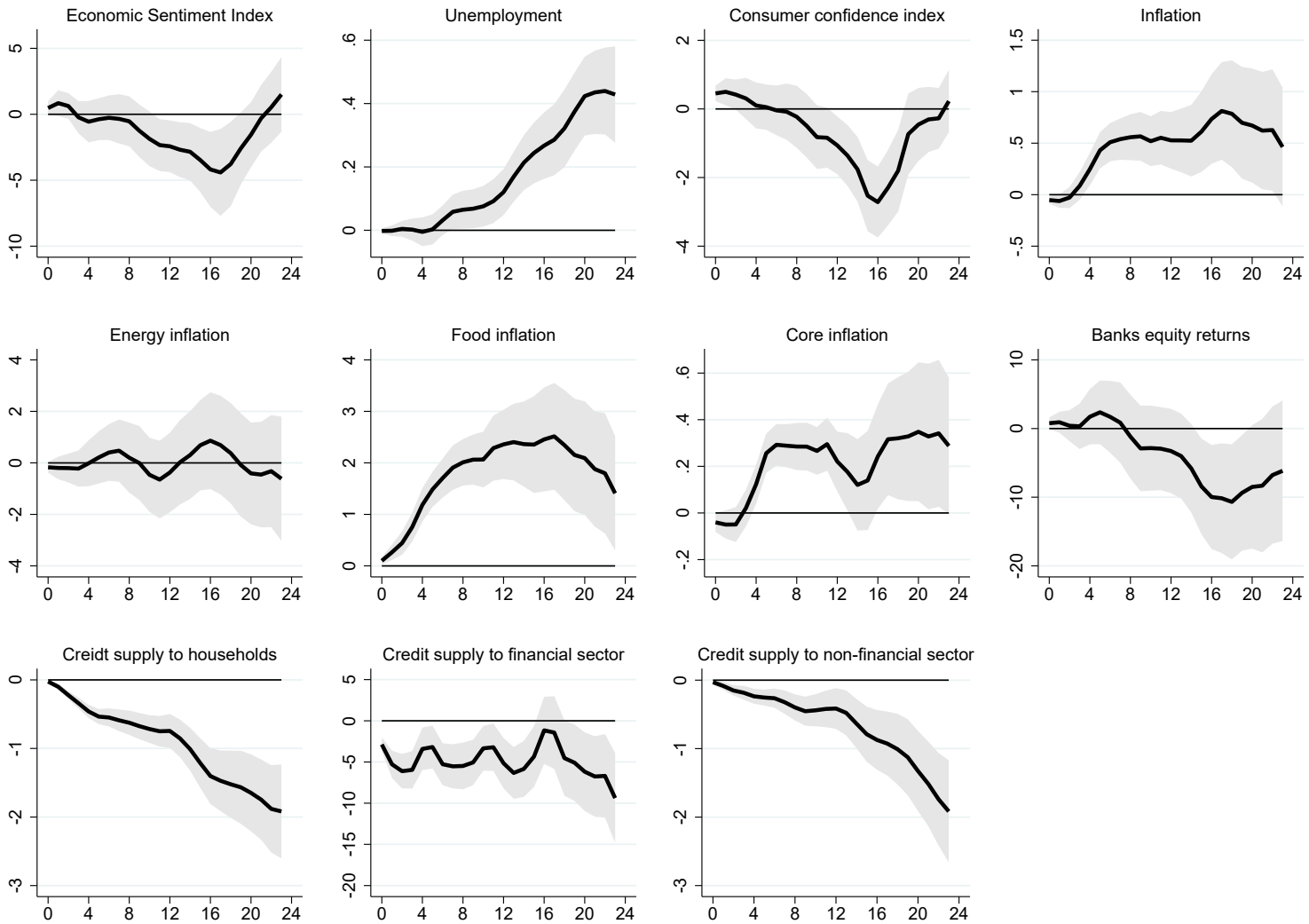
$$+ \sum_{j=1}^{J} \varphi_j^h L^{j-1} X_t + \varepsilon_t^h$$

- Eq. (1) is estimated with Newey-west standard errors to control for heteroskedasticity and serial correlation in the idiosyncratic error term.

Macroeconomic and financial data

- y is a set of economic variables including:
  - The Economic Sentiment Index (ESI);
  - The monthly unemployment rate (Unemp);
  - The Consumer Confidence Index (CCI);
  - The Harmonized Index of Consumer Prices (HICP) / Sectoral prices;
  - The Banks' equity returns.
  - Credit supply to Households / Non financial corporations / Financial sector
- The set of control variables X comprises:
  - The Economic Policy Uncertainty index (EPU);
  - The 10-Year government bond yield (i_m^{10y}).

Figure 2 Cumulative IRFs for shocks in CRI



Notes: Solid black lines show impulse responses of a one standard deviation in the CRI. Gray-shaded areas indicate 68% confidence bands.

Climate change is not a single risk factor

Le Monde

Le Monde
Planète, samedi 10 juin 2023 960 mots, p. 7

Aussi paru dans 8 juin 2023 - Le Monde (site web)

Le réchauffement planétaire s'accroît à un rythme sans précédent

La quantité de gaz à effet de serre à ne pas dépasser pour limiter le réchauffement à 1,5 °C a été divisée par deux par rapport à la précédente estimation

Audrey Garric

Le réchauffement climatique non seulement n'offre pas de répit, mais s'amplifie. Ce que chacun peut observer directement, qu'il s'agisse des vagues de chaleur en Asie ou des incendies immenses au Canada, est confirmé par une nouvelle étude scientifique publiée dans *Earth System Science Data*, jeudi 8 juin, par un groupe international d'une cinquantaine de scientifiques de renom.

Ces chercheurs mettent à jour les principaux indicateurs climatiques du rapport du groupe de travail 1 du Groupe d'experts intergouvernemental sur l'évolution du climat (GIEC) paru en 2021, consacré aux bases physiques du changement climatique. *« Le rapport du GIEC, qui est publié tous les sept ans environ, méritait d'être mis à jour dans un contexte de climat qui change très rapidement et pour éclairer les négociations climatiques »* , explique Aurélien Ribes, chercheur au Centre national de recherches météorologiques et coauteur de l'étude.

The Correlated Topic Model (CTM)

- Unsupervised machine-learning algorithms that infers latent correlated topics among a collection of texts
- The method, rather than the user (dictionary methods), detects textual heterogeneity and dissects it into topics
- We use the CTM of Blei and Lafferty (2007), which considers each document as a mixture of K topics, and each topic as a mixture of v words

The Correlated Topic Model (CTM)

The CTM estimates:

1. The distribution over words for each topic: words' co-occurrence;
2. The proportion of a specific topic in each document (intensity);
3. The correlations between topics.

Table 1
Document-term matrix

	$Word_1$	$Word_2$	...	$Word_J$
Doc_1	2	1	...	3
Doc_2	1	0	...	4
$\vdots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$
Doc_N	5	0	...	1

The optimal topics' number

Figure 3 Semantic coherence (horizontal axis) vs. Exclusivity (vertical axis) for various numbers of topics: K $\in \{10, 15, ..., 60\}$

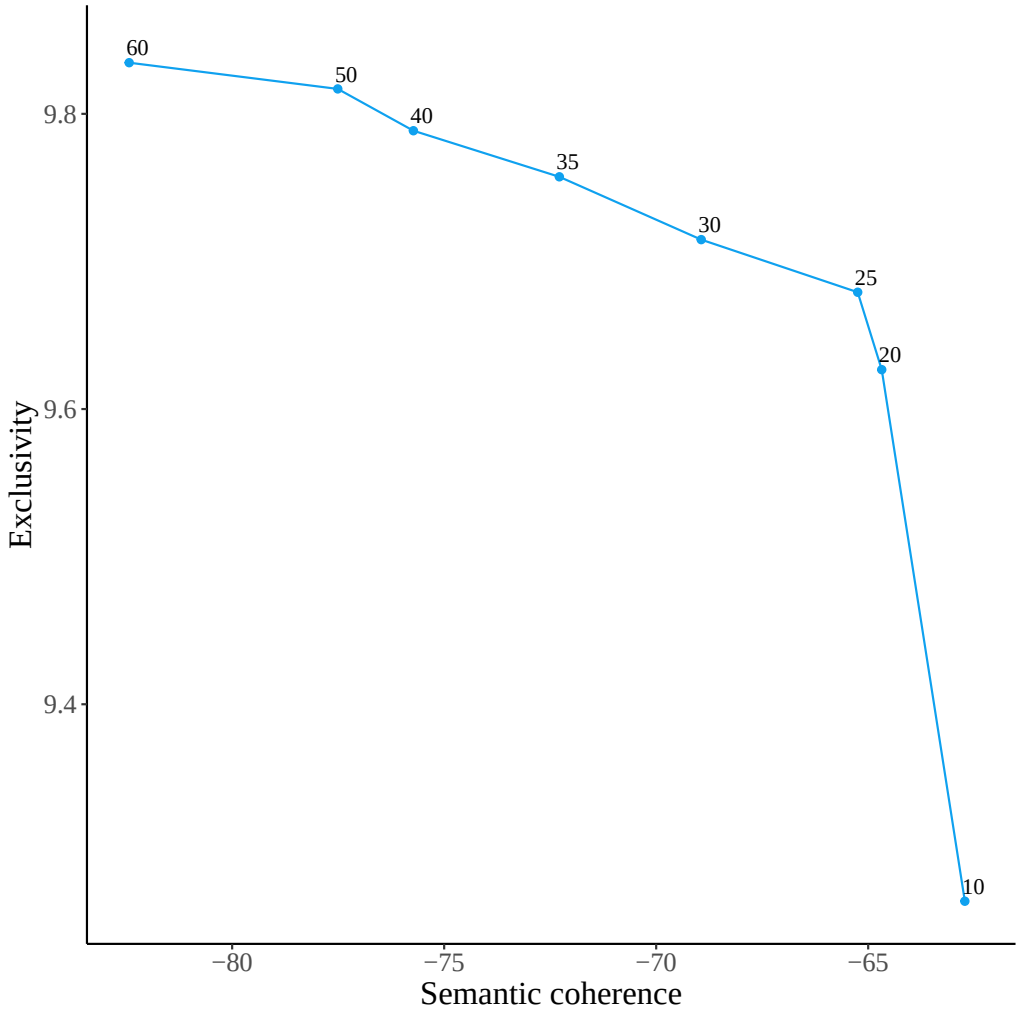


Figure 4 List of topics with most frequent words

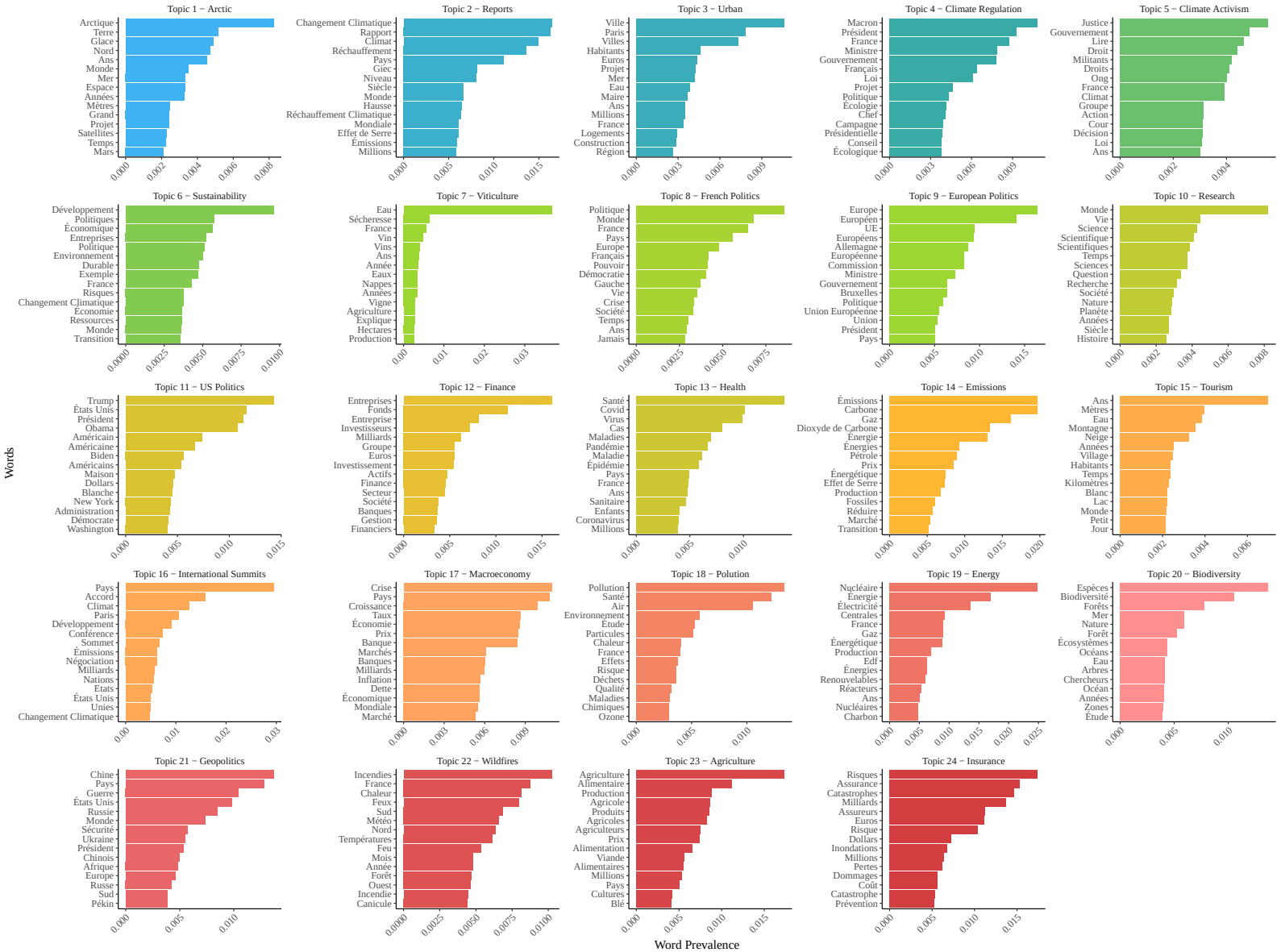


Figure 5 Word cloud for Topic 22 - **Wildfires**

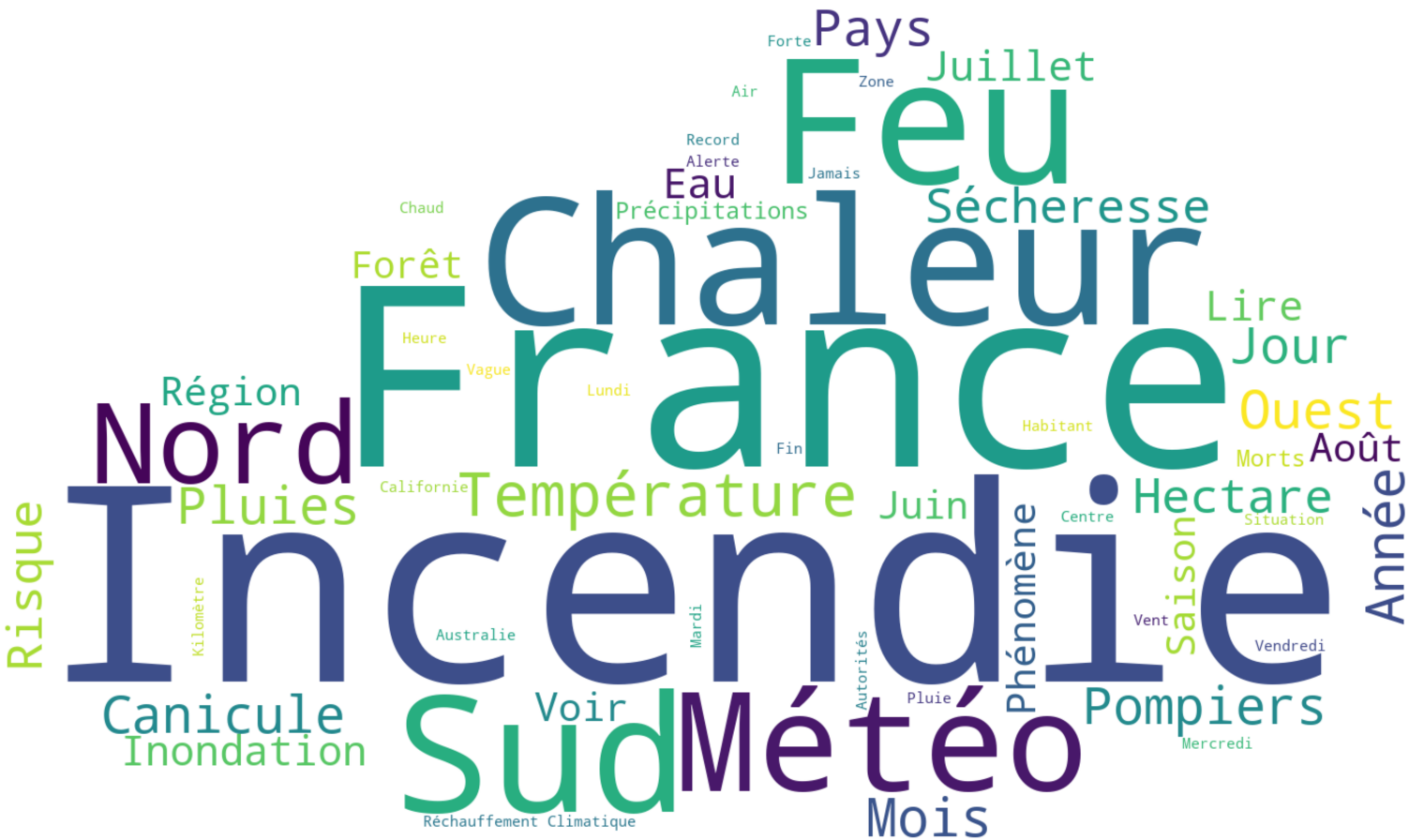


Figure 6 Word cloud for Topic 16 - **International Summits**

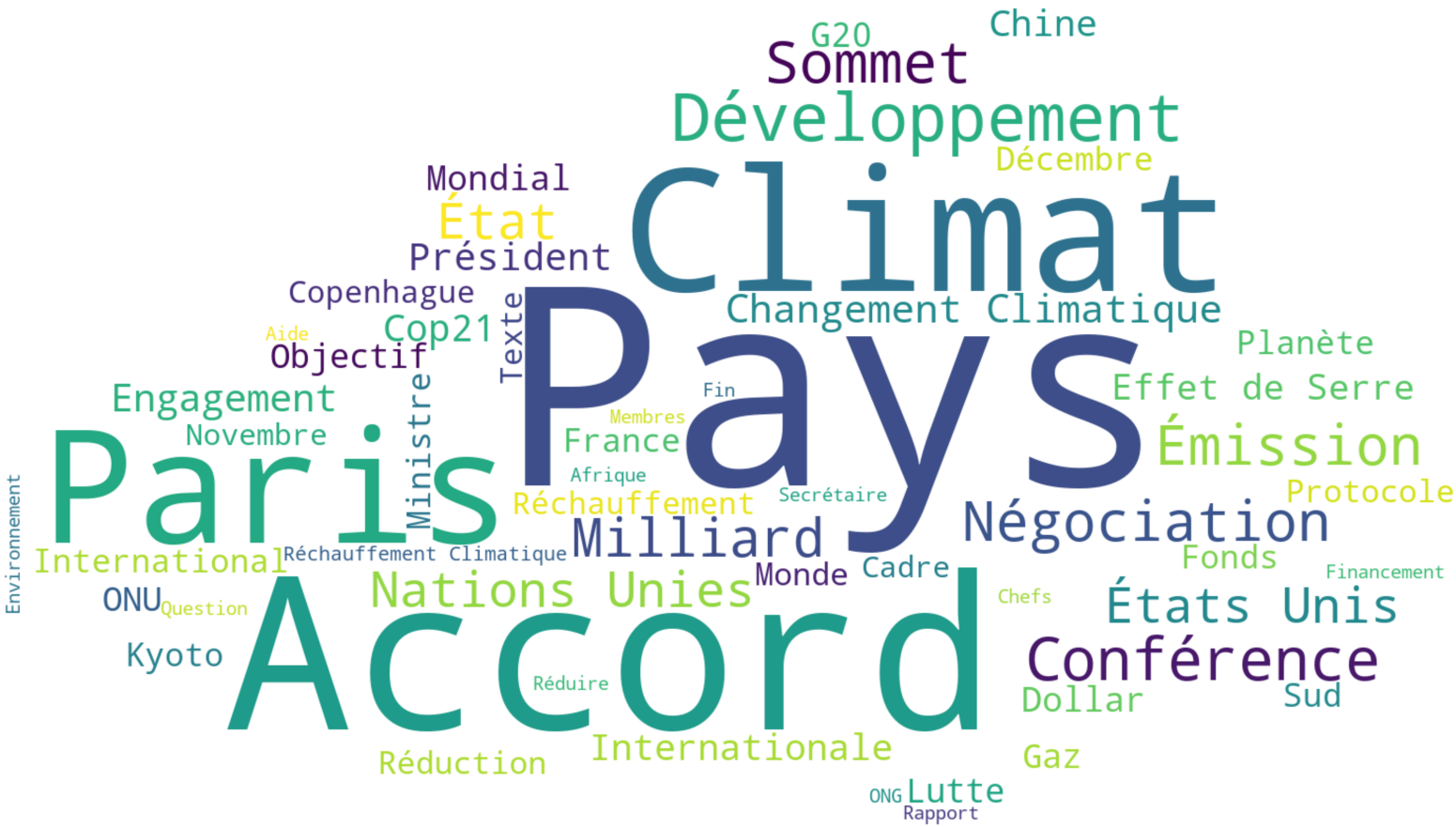
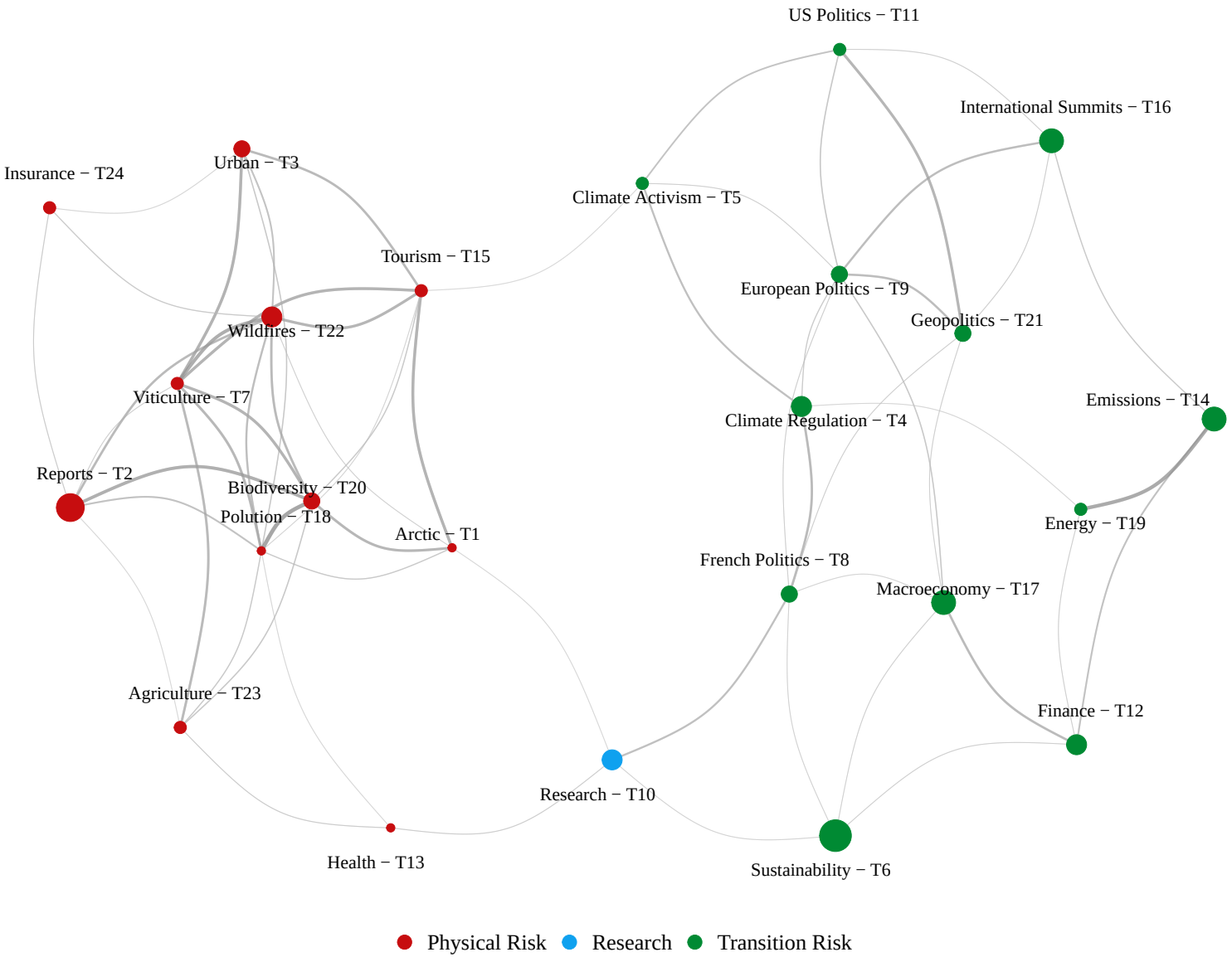


Figure 7 Network of climate topic correlations



Summary of topics

Table 2

List of topics together with their unconditional prevalence and top five keywords in terms of probability

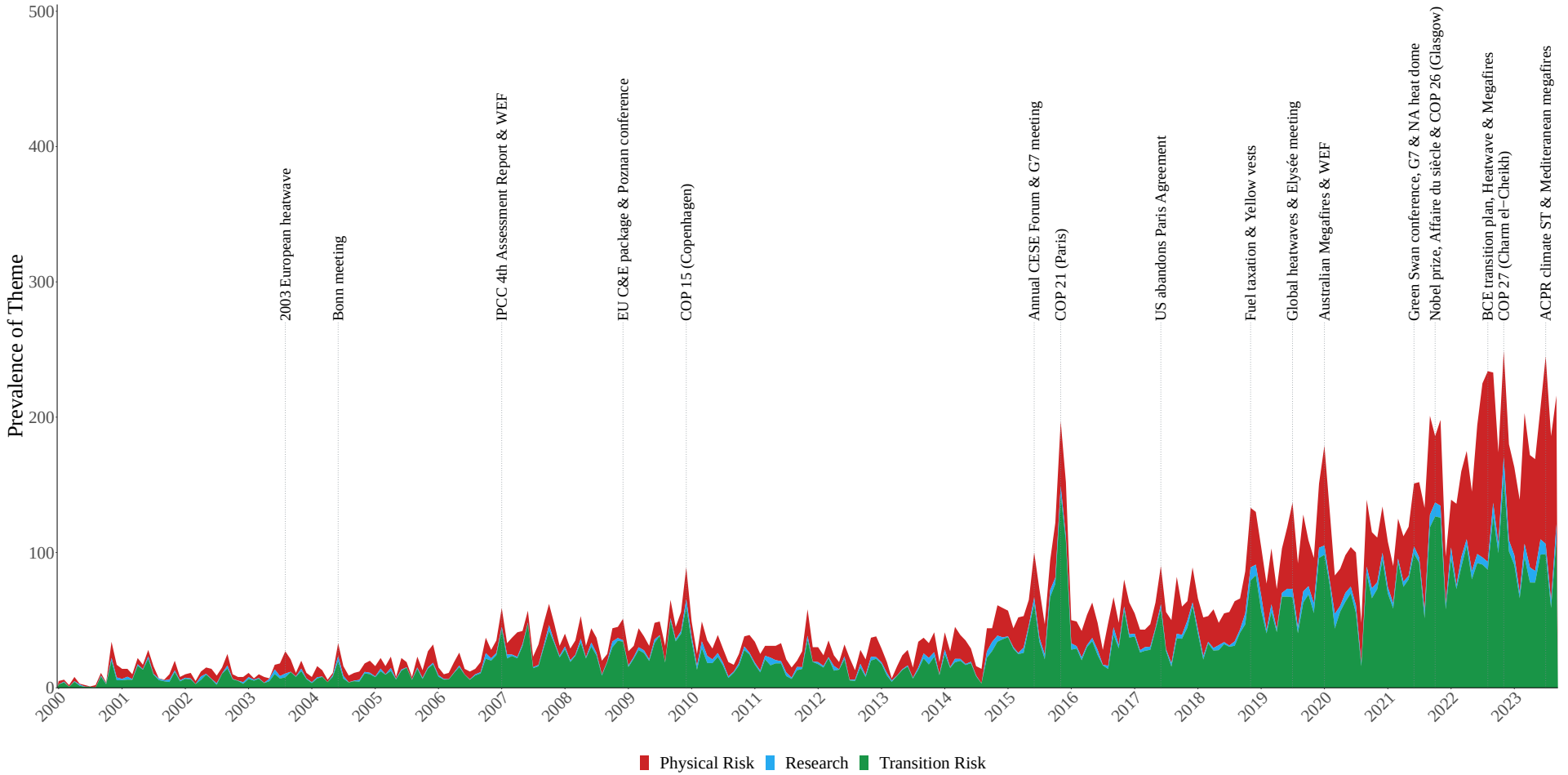
Topic	Prevalence θ	Top five keywords in term of probability ϕ
Theme 1: Transition risk	**57.48**	
Sustainability - T6	8.25	development, politics, economic, firms, environment
International Summits - T16	6.39	country, agreement, climate, Paris, development
Emissions - T14	6.21	emissions, carbon dioxide, gas, energy, oil
Macroeconomy - T17	5.78	crisis, country, growth, rate, economy
Finance - T12	5.35	firm, fund, investor, billion, group
Climate Regulation - T4	4.87	Macron, president, France, minister, government
Geopolitics - T21	4.05	China, country, war, US, Russia
European Politics - T9	3.70	Europe, European, UE, Germany, commission
French Politics - T8	3.59	Politics, world, France, country, Europe
Energy - T19	3.31	nuclear, energy, electricity, plant, France
US politics - T11	3.22	Trump, US, president, Obama, American
Climate Activism - T5	2.70	justice, government, rights, militants, NGO
Theme 3: Research	**4.88**	
Research - T10	4.88	world, life, science, time, question

Table 3

List of Topics Together with Top five Keywords in Terms of Probability and Topics' Unconditional Prevalence

Topic	Prevalence θ	Top five keywords in term of probability β
Theme 2: Physical risk	**37.64**	
Reports - T2	6.65	climate change, report, warming, country, IPCC
Wildfires - T22	5.40	fires, France, heat, south, weather
Biodiversity - T20	4.45	species, biodiversity, forests, sea, nature
Urban - T3	3.53	city, Paris, inhabitant, euros, project
Viticulture - T7	2.96	water, drought, wine, France, year
Agriculture - T23	2.69	agriculture, food, production, farmer, price
Insurance - T24	2.67	risk, insurance, disaster, billions, floods
Tourism - T15	2.52	year, meter, water, mountain, snow
Arctic - T1	2.40	arctic, earth, ice, north, year
Health - T13	2.30	health, Covid, virus, case, disease
Pollution - T18	2.03	pollution, health, air, environment, study

Figure 8 Articles' shares by climate risk Theme



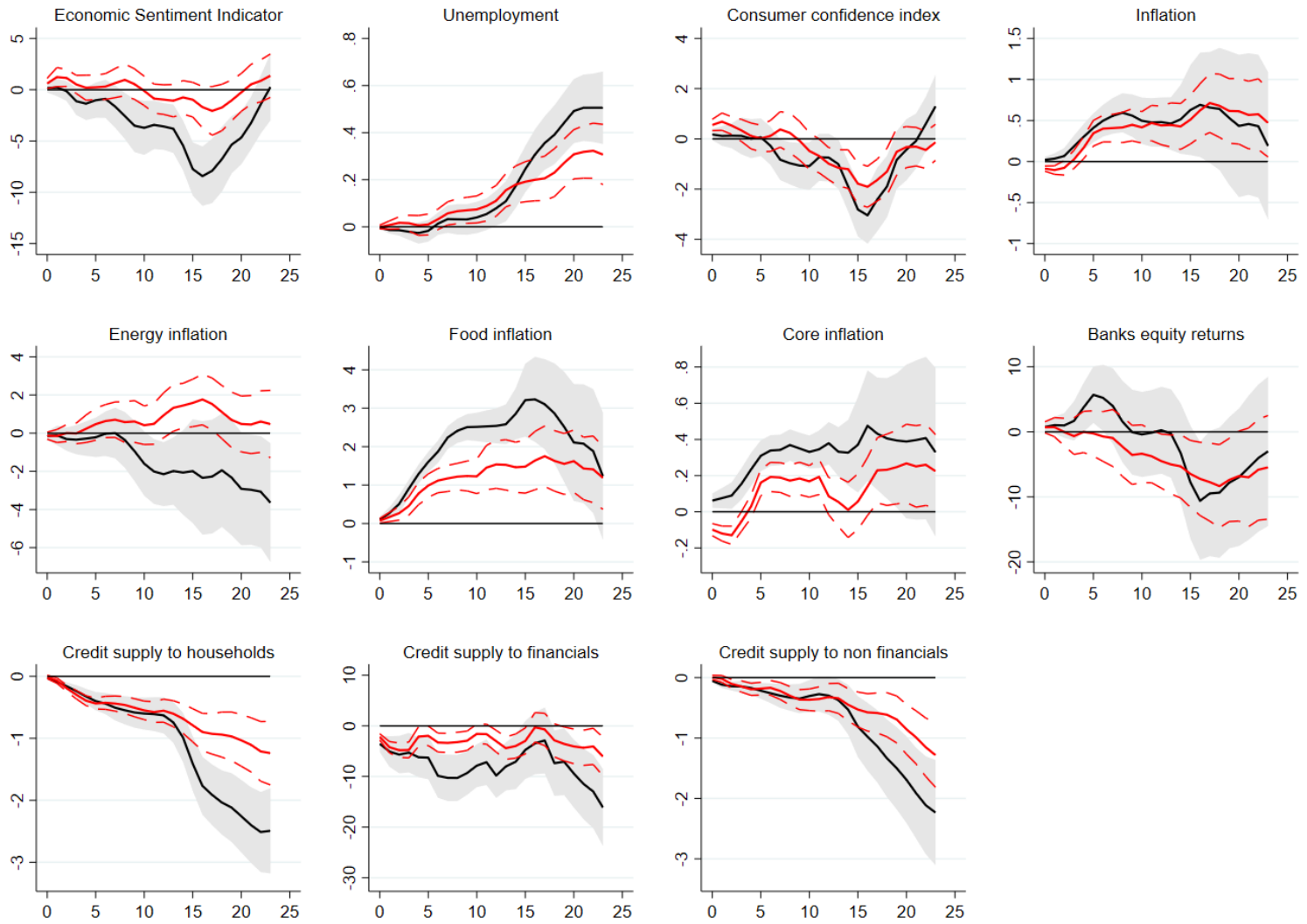
Themes with major events

Impact of climate themes

- Physical and transition risks might have a different impact on economic activity.

- Hence, we re-estimate Eq. (1) using the prevalence of **physical and transition** risks in the climate articles to disentangle their effects.

Comparative effects of Physical and Transition risks



Notes: Solid black lines show impulse responses of a one standard deviation in the PRI. Solid red lines represent the corresponding IRFs of a one standard deviation in the TRI. Gray-shaded areas (red dashed lines) indicate 68% confidence bands.

Tone of climate risk articles

- The sentiment/tone conveyed in climate articles might exacerbate and/or attenuate the effect of news on investors and households (Ardia et al. 2022).
- We use the Lexicoder Sentiment Dictionary (LSDFr) developed by Duval and Pétry (2016) to estimate the sentiment of climate risk articles.
- Duval and Pétry (2016) identify 1288 (2870) words as depicting a positive (negative) sentiment in the French language.

Figure 9 Example Computation of Tone Score

*« Le coût lié aux **catastrophes** naturelles est exponentiel. De 30 milliards de 1988 à 2007, il devrait avoisiner les 60 milliards les vingt années suivantes, selon la mission **risques** naturels de la FFSA. En cause un double phénomène : une densité plus **forte** de la population dans les zones les plus **exposées** - comme le Sud-Est, selon l'étude - mais aussi un changement climatique qui va doubler, selon les experts, "la fréquence des événements **extrêmes**". Cette étude qui dresse une projection **inquiétante** de notre proche avenir doit être réactualisée avec des résultats communiqués dès novembre prochain. »*

Notes: Example of utterances conveying a positive (in blue) or a negative (in red) sentiment, according to the DP dictionary. Source: Negroni, A., « Intempéries : la facture ne cesse de s'alourdir pour les compagnies d'assurance », *Le Figaro*, 6 October 2015.

Tone of climate articles

- The polarized tone index is computed across each document d as follows:

$$Tone_d = \frac{Pos_d - Neg_d}{Pos_d + Neg_d} \tag{2}$$

  where Pos_m and Neg_m are the positive and negative words identified by Duval and Pétry (2016), respectively.

- Therefore, the polarised score of the extract above is negative and equals $\frac{1-5}{6} = -0.67$.

Tone of climate articles

- Then, we take the monthly average of each tone score over all articles in the corpus, as in Eq. (3):

$$Tone_m = \frac{1}{N_m} \sum_{d=1}^{N_d} Tone_d, \tag{3}$$

with $Tone_m$ the monthly tone score and N_m the total monthly number of articles in the corpus.

- The final Climate Tone Index (CTI) is negative overall.
- We re-estimate Eq. (1) including $Tone_m$ as RHS.

Figure 10 The Climate Tone Index (CTI)

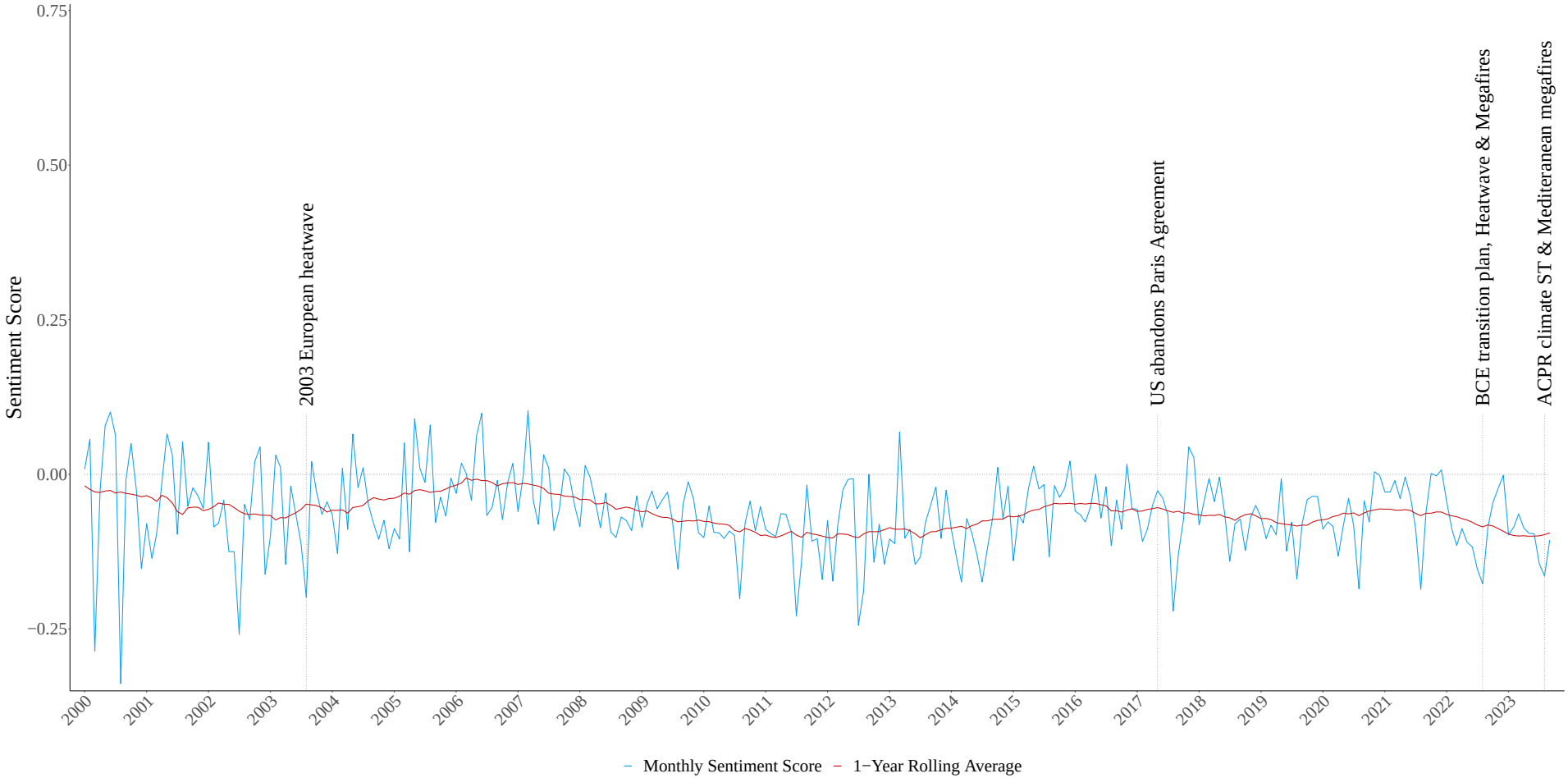
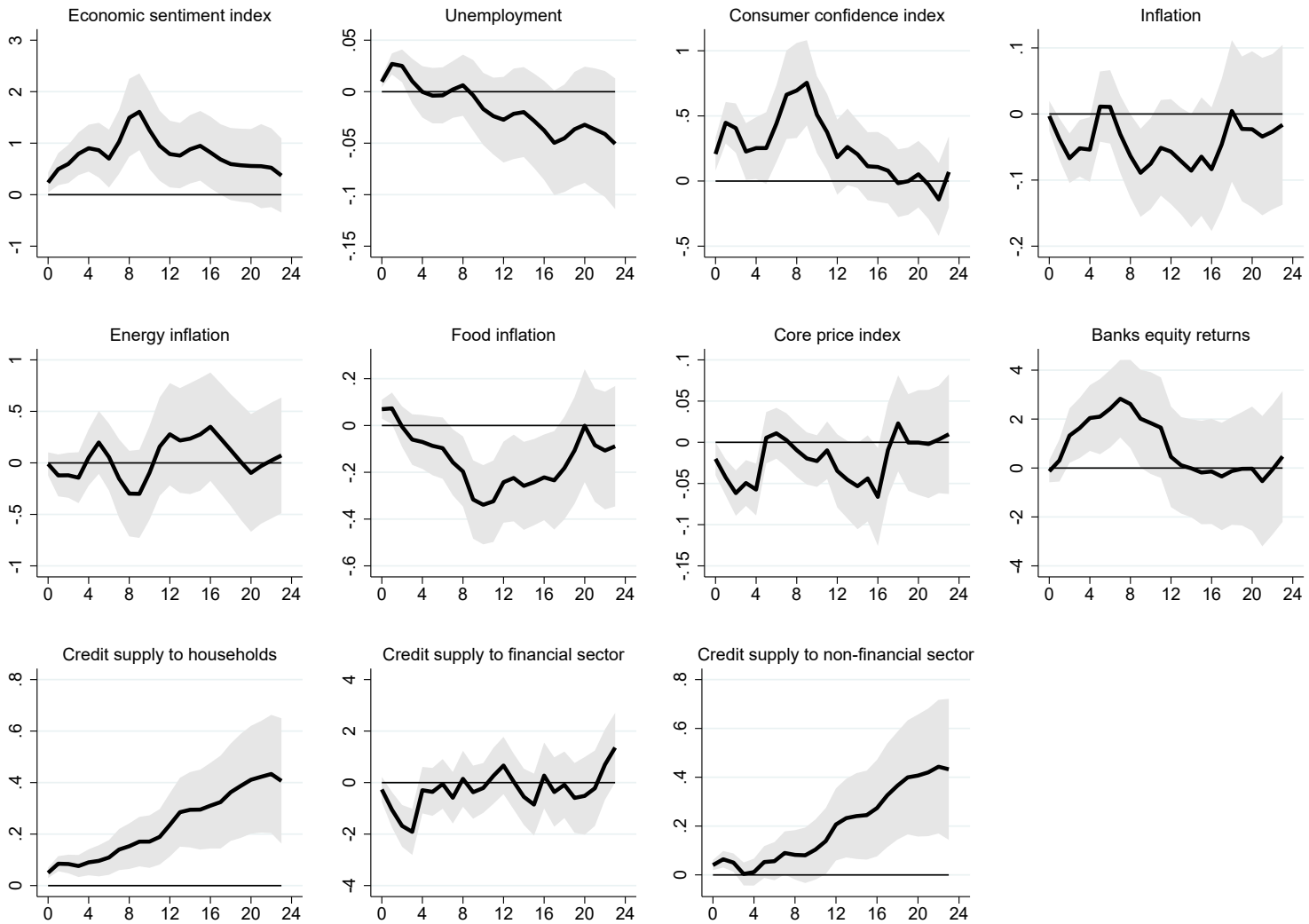


Figure 11 Cumulative IRFs for shocks in CTI



Notes: Solid black lines show impulse responses of a one standard deviation in the CTI. Gray-shaded areas indicate 68% confidence bands.

Robustness checks

- We modify our news articles selection strategy by:
  - Varying the distance between the second and third groups of keywords within a range from 5 to 10 words;
  - Adding an uncertainty dimension: we add words such as {"incertitude*" or "incertain*"}.
- We use alternative measures of climate risks:
  - The climate-related articles share over total published articles;
  - The number of climate words used by the articles published every month.
- Concerning the LP estimation:
  - We modify the lags of variables included in Eq. (1) ranging from 1 to 6 lags;
  - We use the Industrial Production Index instead of the ESI measure.

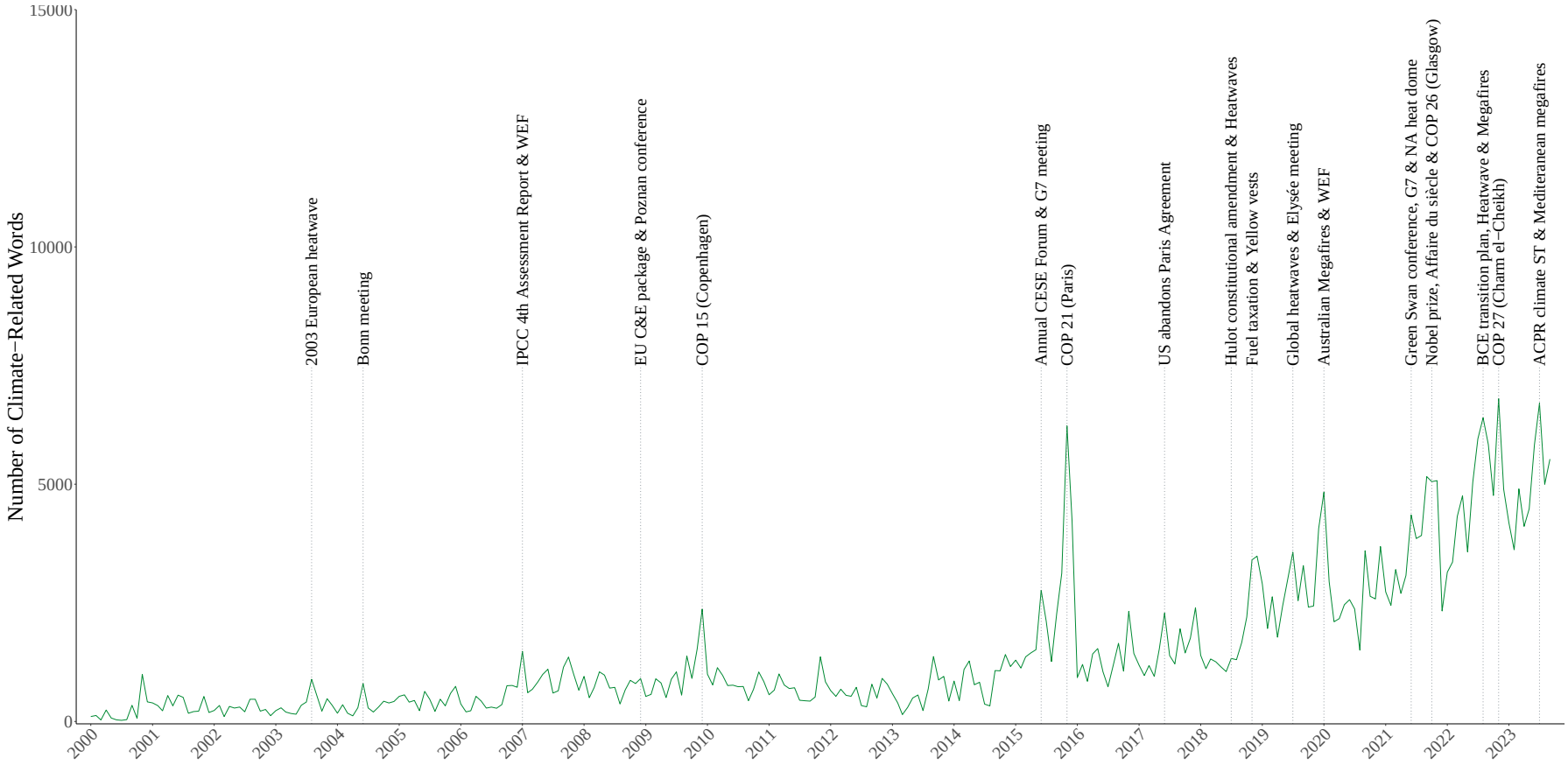


Figure 12 Total counts of climate-related words

Conclusions

Contributions:

- We estimate **novel climate risk indexes for France** using textual analysis, and investigate their impact on economic variables.
- **First time evidence** on the impact of sub-categorical climate risks on French macro-dynamics.
- **Provide** possible explanation for the results.

Conclusions

Results:

- We show that our indexes captures several key climate change events that are likely to increase climate change risks, and negatively impact the economy.
- We shed light on the heterogeneity in the response of the considered economic variables to physical / transition risks from 2000 to 2023.
- The dictionary-based approach establish that positive media sentiment related to climate articles are associated with better economic conditions.

Further research avenues

Methodological avenue:

- A supervised machine learning to compute the sentiment of climate articles;

- Calculate the total number of words in all published articles;

Data avenue:

- Introduction of other macroeconomic/financial data: sectoral returns, investment on R&D...

- Consider specific environmental data: Scope emissions, ESG scores...

Thank you for your attention!

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A focus on Morocco: Textual analysis

Figure 13 The Moroccan Climate Risk Index

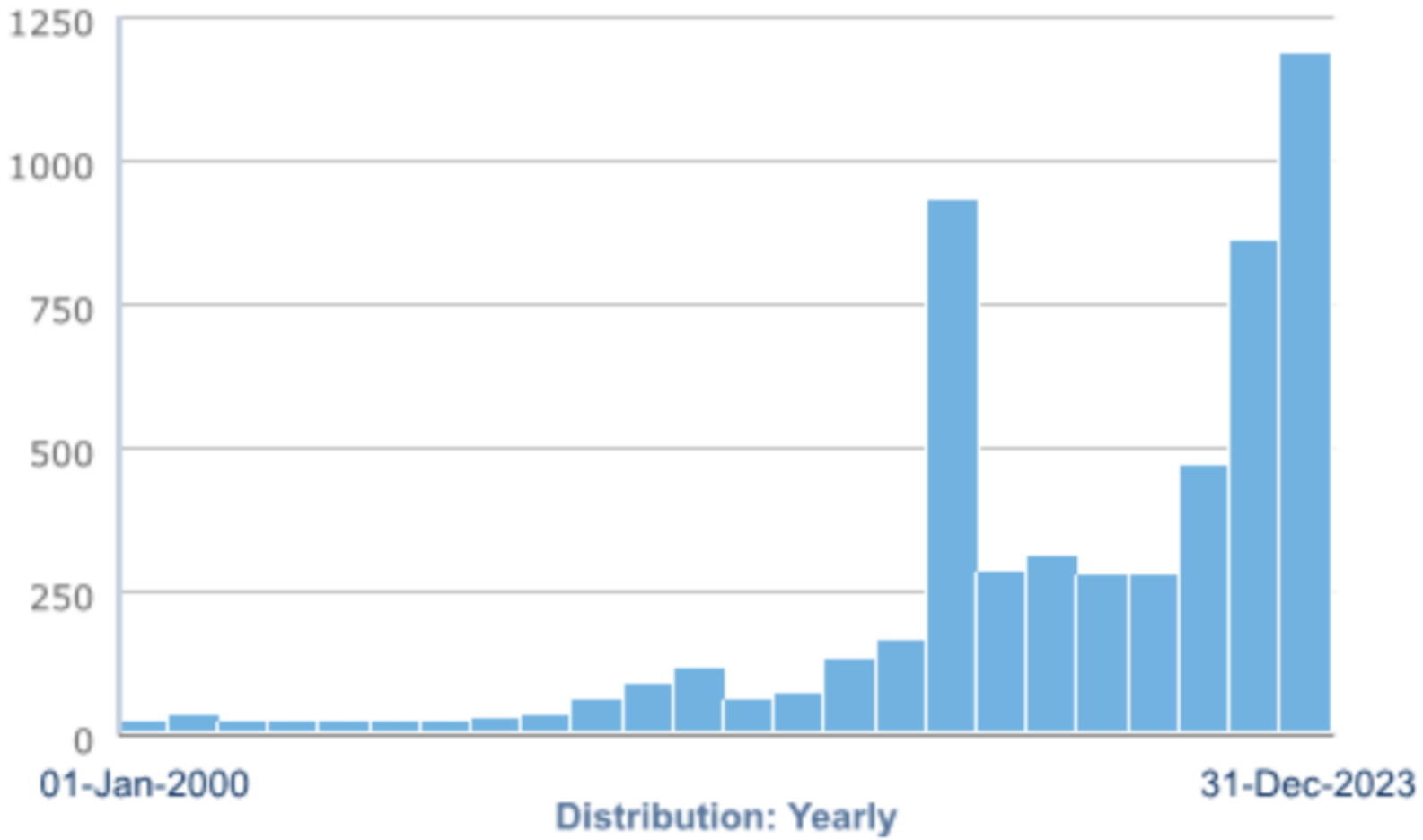

Figure 14 Sources of the MCRI

A focus on Morocco: Physical risk

- Consider physical variables:
  - Temperature, precipitation or cloud cover disturbances
  - Climate uncertainty (FAVAR models)...
  - Standardised Precipitation-Evapotranspiration Index (SPEI)

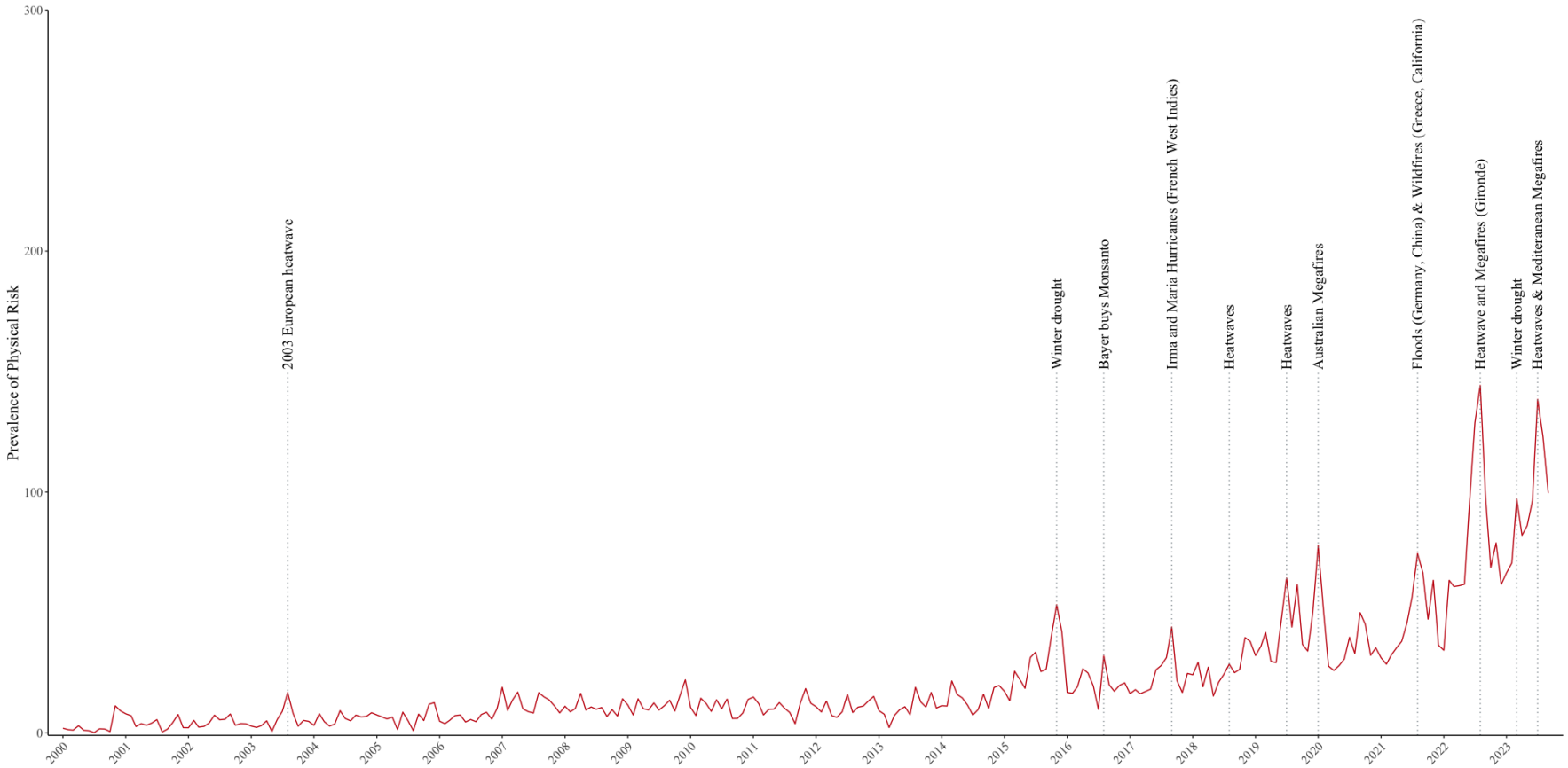

Figure 15 Physical risks prevalence

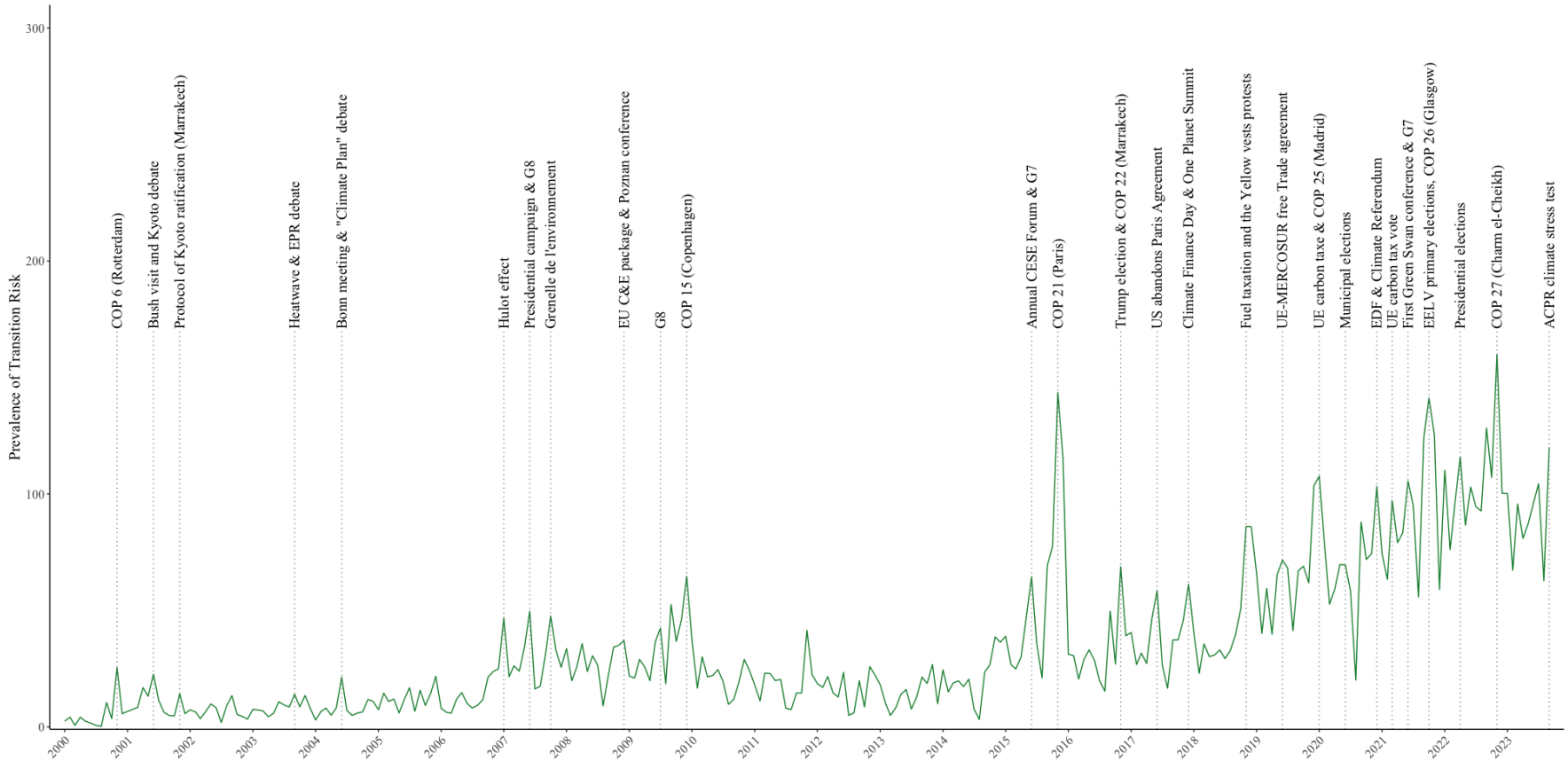

Figure 16 Transition risks prevalence

Go back