The Interactions of Social Norms about Climate Change: Science, Institutions and Economics

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Overview

Introduction

Related literature

Evolution of mentions to climate change

A simple theoretical framework

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Conclusion

Motivation

Figure: The sound of music (1965)

Motivation

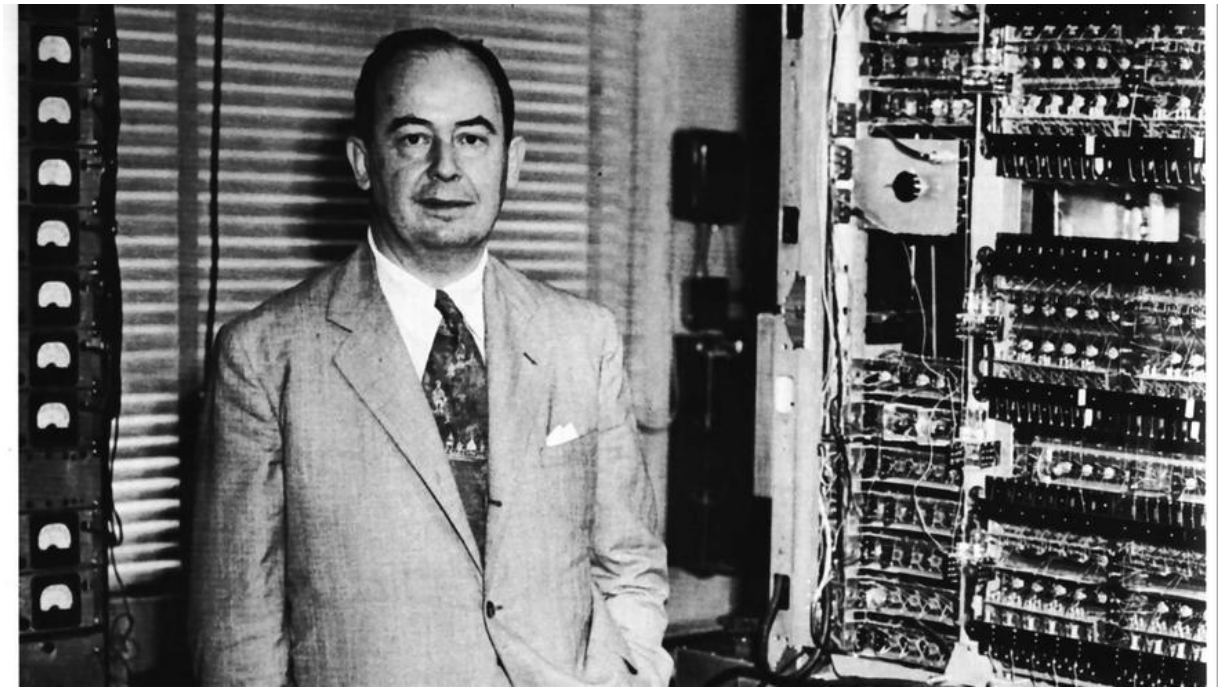

Figure: Even John von Neumann makes mistakes

Motivation

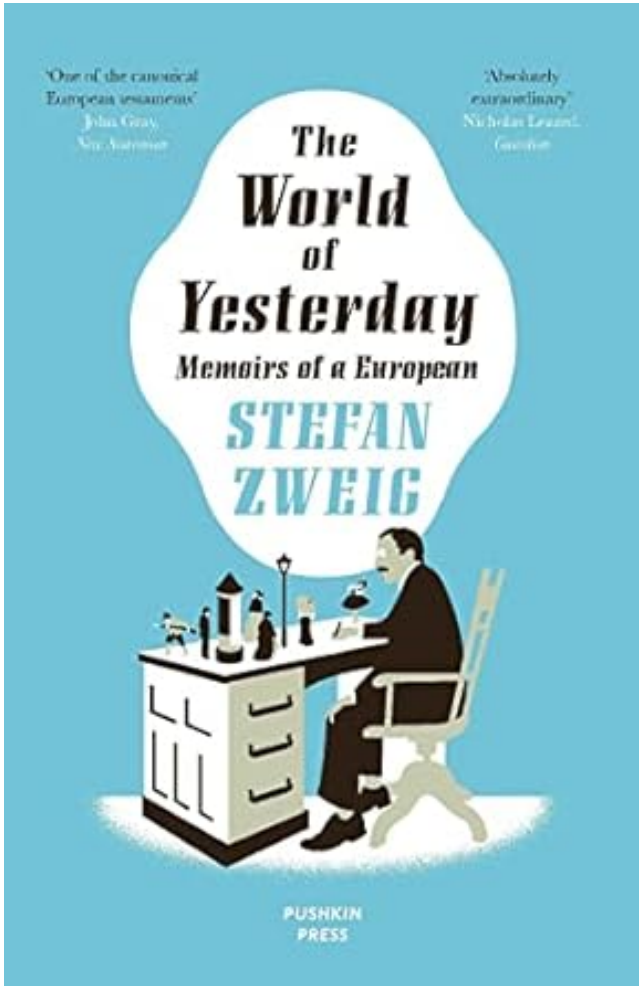

Figure: Stefan Zweig memoir's warning

Motivation

"The furnaces of the world are now burning about 2,000,000,000 tons of coal a year. When this is burned, uniting with oxygen, it adds about 7,000,000,000 tons of carbon dioxide to the atmosphere yearly. This tends to make the air a more effective blanket for the earth and to raise its temperature. The effect may be considerable in a few centuries.". August 14, 1912, Rodney & Otamatea Times "Science Notes and News".

Huntington (1917) in the *Quarterly Journal of Economics* already claimed that climate change (not necessarily anthropogenic) partially explained the fall of Rome.

Social norms

- So why does it seem that climate action is not happening sufficiently quickly?
- Our hypothesis is that the evolution of social norms is a slow process, and their transmission between different social groups is also complicated.
- As Carney (2015) pointed out monetary policy horizon is 2-3 years. Financial stability at most a decade. For climate, the view that goes perhaps to half a century or more.

Our approach

- To answer our question we first propose a network model of social norms transmission in the spirit of Ballester et al. (2006)).
- The model's parameters can be estimated with a VAR.
- The data for the VAR is indices of mentions to climate change in media, general interest science journals, the economics top 5, European Parliament questions, and European Central Bank presidential speeches, since the 1990s. We also use GDP.

Results

- Natural scientists had been concerned with the problem since more than 30 years ago, academic economists are generally unconcerned even now,
- The mainstream media and the European Parliament started worrying about the turn of the century,
- The ECB increased their concern in very recent years.
- The model's parameters can be estimated with a VAR.
- Media and the parliament are mutually affected.
- We also find strong interactions with GDP fluctuations.
- We cannot find influences of science on media or parliament.

Related literature

- *Social norms.*
  - Fehr and Schurtenberger (2018) conditional cooperation. Kimbrough and Vostroknutov (2016) and Kölle et al. (2020), Szekely et al. (2021) norm-following leads to cooperation.
  - Social norms to solve social dilemmas (Ostrom (2000); Bicchieri (2005); Biel and Thøgersen (2007)) in general, and climate change in particular Riehm et al. (2020).
- *Media, policy and science communication of climate change.*
  - Media. Wilson (2013), Gavin (2009)
  - Science. Nielsen and Schmidt Kjærgaard (2011), Ladle et al. (2005), Oswald and Stern (2019),
  - Policy and central banks. Willis (2017), Willis (2018), Olovsson (2018), Skinner (2021).
- *Index.* Baker et al. (2016) and Ghirelli et al. (2021)
- *Theory.* Ballester et al. (2006)

Developing a Climate Change Index of Public Interest

- We develop a Climate Change Index (CCI) with universe of news in top European and United States newspapers using the keywords "climate change".
- Following Baker et al. (2016), Standardize 12 monthly shares newspaper-level series to unit standard deviation from 1995 to 2021.
- Then average across the 12 European papers by month.
- Finally, we divide this average by the mean and multiply by 100 for the same period to obtain the normalized series.

Index of Public Interest

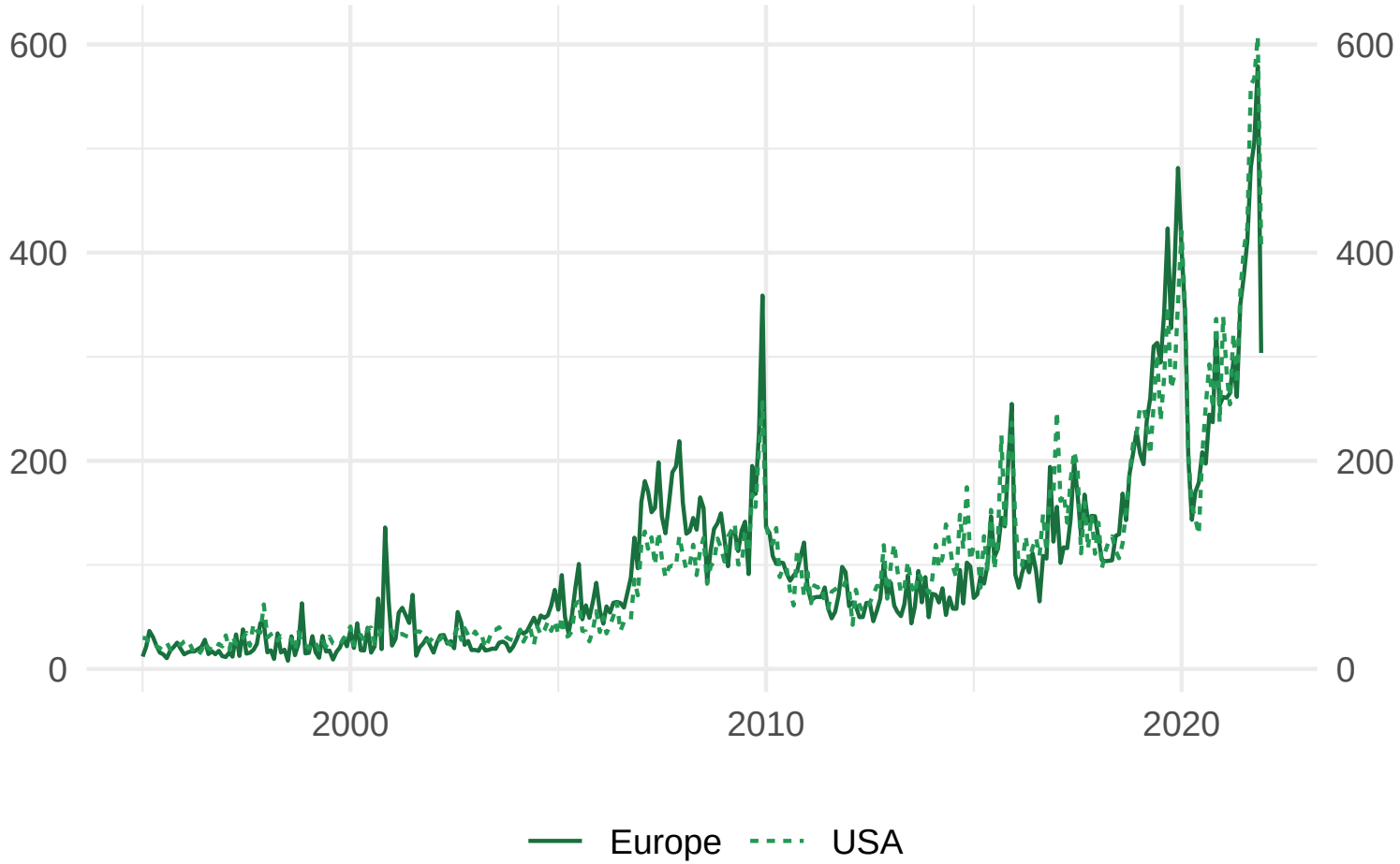

Figure: Monthly Climate Change Index for Europe and the USA.
$Corr = 0.947$

More general index of public interest

- **Other Terms:**
  Abrupt Climate Change, Black Carbon Aerosol, Carbon Capture and Sequestration, Carbon Cycle, Carbon Dioxide Equivalent, Carbon Footprint, Carbon Sequestration, Climate Change, Climate Feedback, Climate Model, Climate Sensitivity, Climate System (or Earth System), Coal Mine Methane, Coalbed Methane, Coral Bleaching, Emissions Factor, Energy Efficiency, Feedback Mechanisms, General Circulation Model (GCM), Global Average Temperature, Global Warming, Greenhouse Effect, Greenhouse Gas (GHG), Indirect Emissions, Ocean Acidification, Perfluorocarbons (PFCs), Relative Sea Level Rise, Sea Surface Temperature, Soil Carbon, Sulfate Aerosols, Sulfur Hexafluoride (SF6), Thermohaline Circulation.
- **Correlation:** 0.95 US and 0.99 UK

Climate Change and General Interest Scientific Journals

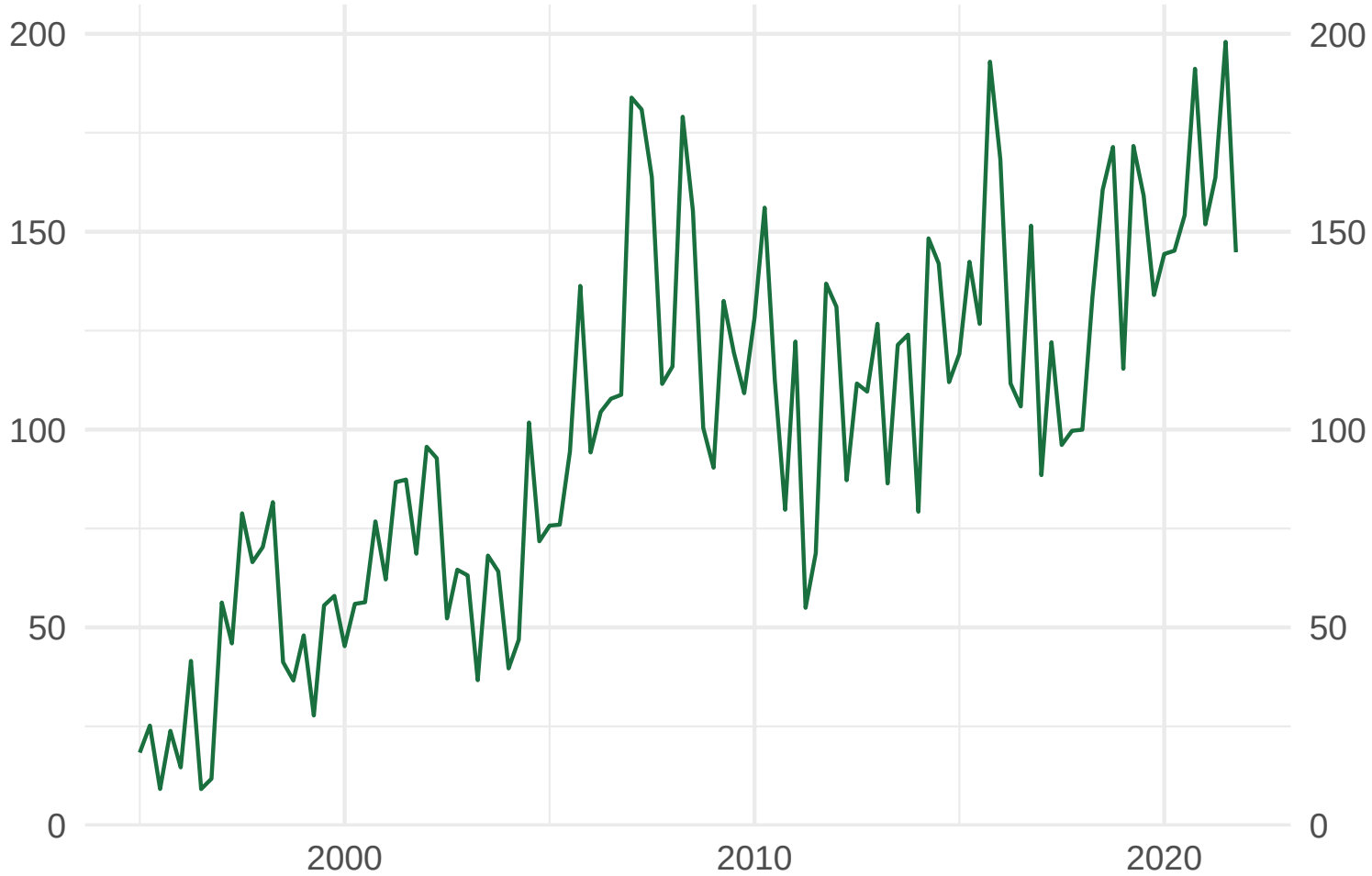

Figure: Quarterly Climate Change Index for the General Interest Science Journals, Nature and Science: 1995-2021.

Climate Change and Science

Scientific research on carbon dioxide and climate has been going on for 150 years. In the mid-nineteenth century, Irish experimentalist John Tyndall first established that CO2 is a greenhouse gas—meaning that it traps heat and keeps it from escaping to outer space. ...in the early twentieth century, when Swedish geochemist Svante Arrhenius realized that CO2 released to the atmosphere by burning fossil fuels could alter the Earth's climate, and British engineer Guy Callendar compiled the first empirical evidence that the "greenhouse effect" might already be detectable. In the 1960s,
Oreskes, Naomi; Conway, Erik M.. Merchants of Doubt (p. 170). Bloomsbury Publishing. Kindle Edition.

Climate Change and Top 5 journals in Economics

	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21
Climate Change	0	0	0	0	0	0	0	0	1	0	0	0	1	2	0	1	2	2	0	0	1	1	0
Global Warming	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Systemic Risk	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	0	0
Environmental	2	3	3	0	0	4	1	3	1	2	2	1	2	7	2	2	2	3	1	4	3	4	5
Pollution	0	0	1	1	1	0	2	1	0	2	3	1	2	2	1	1	1	4	2	4	2	2	3
Carbon Tax	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	1	1	1	1	0
Optimal Taxation	0	0	1	0	0	0	0	1	2	1	1	2	0	0	0	0	0	3	0	0	2	2	0
Countercyclical	2	2	0	1	1	4	2	1	3	0	2	1	0	8	2	3	1	2	5	5	1	2	1
Gold Standard	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Corruption	1	1	0	2	2	0	2	1	3	1	1	0	1	0	1	2	3	2	0	2	0	2	2
Unemployment	3	2	5	2	4	7	5	5	8	7	6	9	7	5	7	6	7	11	13	12	6	9	7
Marketing	0	0	2	0	2	1	0	2	0	0	1	2	2	3	0	1	0	1	1	1	1	1	1
Monetary Policy	2	4	3	5	10	4	10	4	3	4	4	5	6	7	4	3	3	10	7	8	8	15	7
Game Theory	1	2	0	3	2	1	1	1	3	0	0	1	2	1	1	0	1	2	0	0	0	0	1
Optimal Policy	3	1	1	1	1	0	1	1	1	4	2	4	2	5	2	1	1	4	0	2	3	2	1
Inflation	1	6	8	7	12	3	12	7	7	7	9	2	10	3	3	2	5	4	7	8	12	6	7
Tax	9	4	7	9	10	4	13	10	5	11	13	8	9	11	21	11	16	20	19	14	28	16	21
Inequality	10	11	6	11	10	12	7	10	5	5	9	10	7	4	11	7	8	14	15	15	10	17	9
Transportation	0	0	1	0	0	2	1	0	1	1	2	0	2	1	0	0	0	1	0	2	2	1	0
Institutions	5	3	2	7	5	3	7	6	6	7	7	7	10	8	7	8	7	8	7	3	9	6	3
WWII	0	0	0	1	1	0	0	1	0	1	0	0	1	0	1	0	0	1	0	0	0	1	0

Table: Count of words in the Top-5 Journals in Economics

For a general list of Econ journals the current share is 2.5%

Economists

White House Office of Science and Technology started asked the National Academy of Sciences for a report in 1980: "Climate change wouldn't produce new kinds of climate, Schelling argued, but would simply change the distribution of climatic zones on Earth. This suggested ... that we could continue to burn fossil fuels without restriction and deal with the consequences through migration and adaptation. Schelling acknowledged that these historic migrations occurred in eras with few or no national boundaries, very unlike the present, but he nevertheless suggested that adaptation would be the best response."
Oreskes, Naomi; Conway, Erik M.. Merchants of Doubt (p. 175). Bloomsbury Publishing. Kindle Edition.

Economists

"A significant reduction in the concentration of CO2 will require very stringent policies, such as hefty taxes on fossil fuels ... The strategies suggested later [in the report] by Schelling—climate modification or simply adaptation to a high CO2 and high temperature world—are likely to be more economical ways of adjusting ... Whether the imponderable side effects on society—on coastlines and agriculture, on life in high latitudes, on human health, and simply the unforeseen—will in the end prove more costly than a stringent abatement of greenhouse gases, we do not now know."
Oreskes, Naomi; Conway, Erik M.. Merchants of Doubt (p. 179). Bloomsbury Publishing. Kindle Edition.

European Parliament

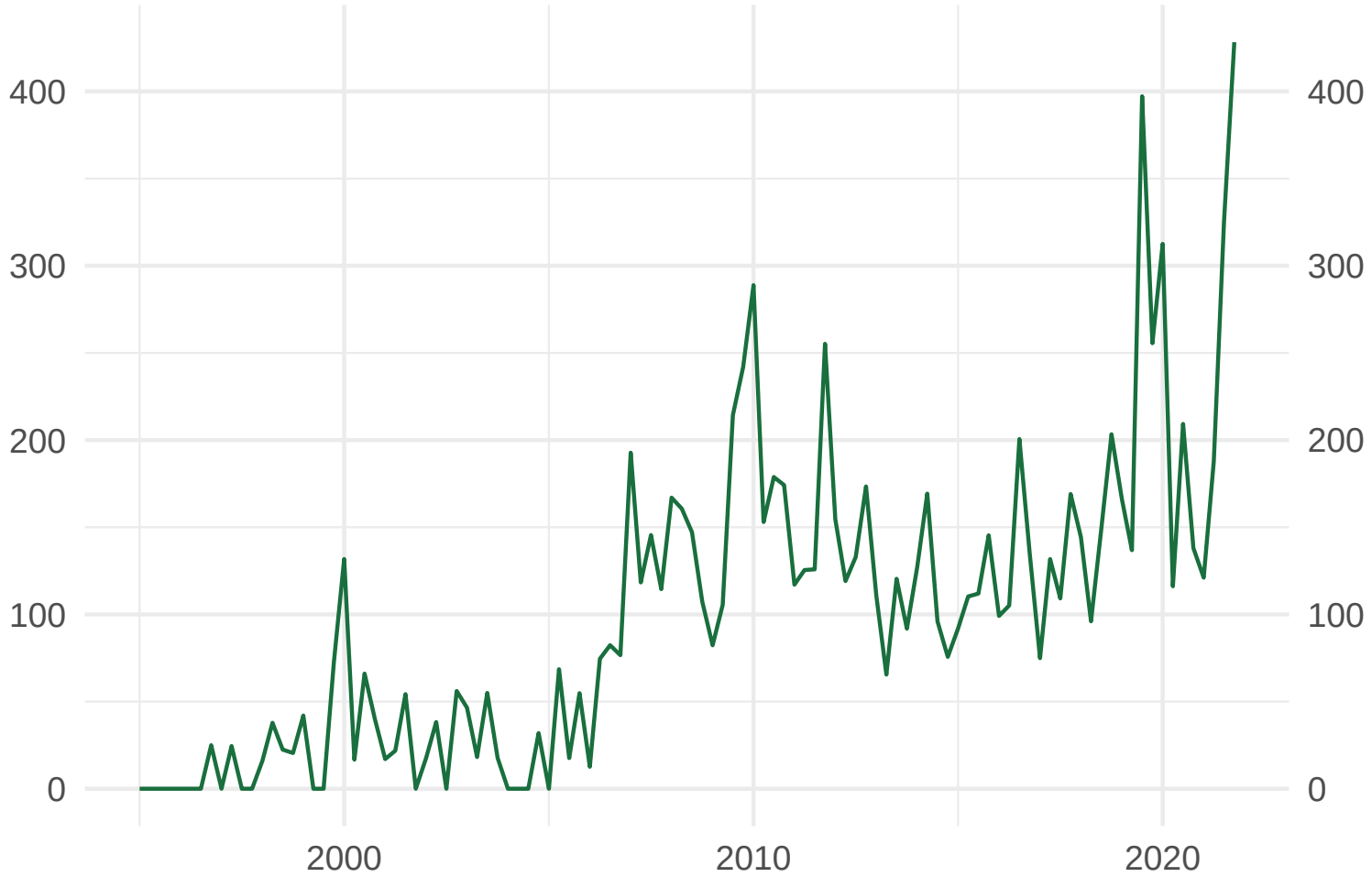

Figure: Quarterly Climate Change Index for the European Parliament: 1995-2021

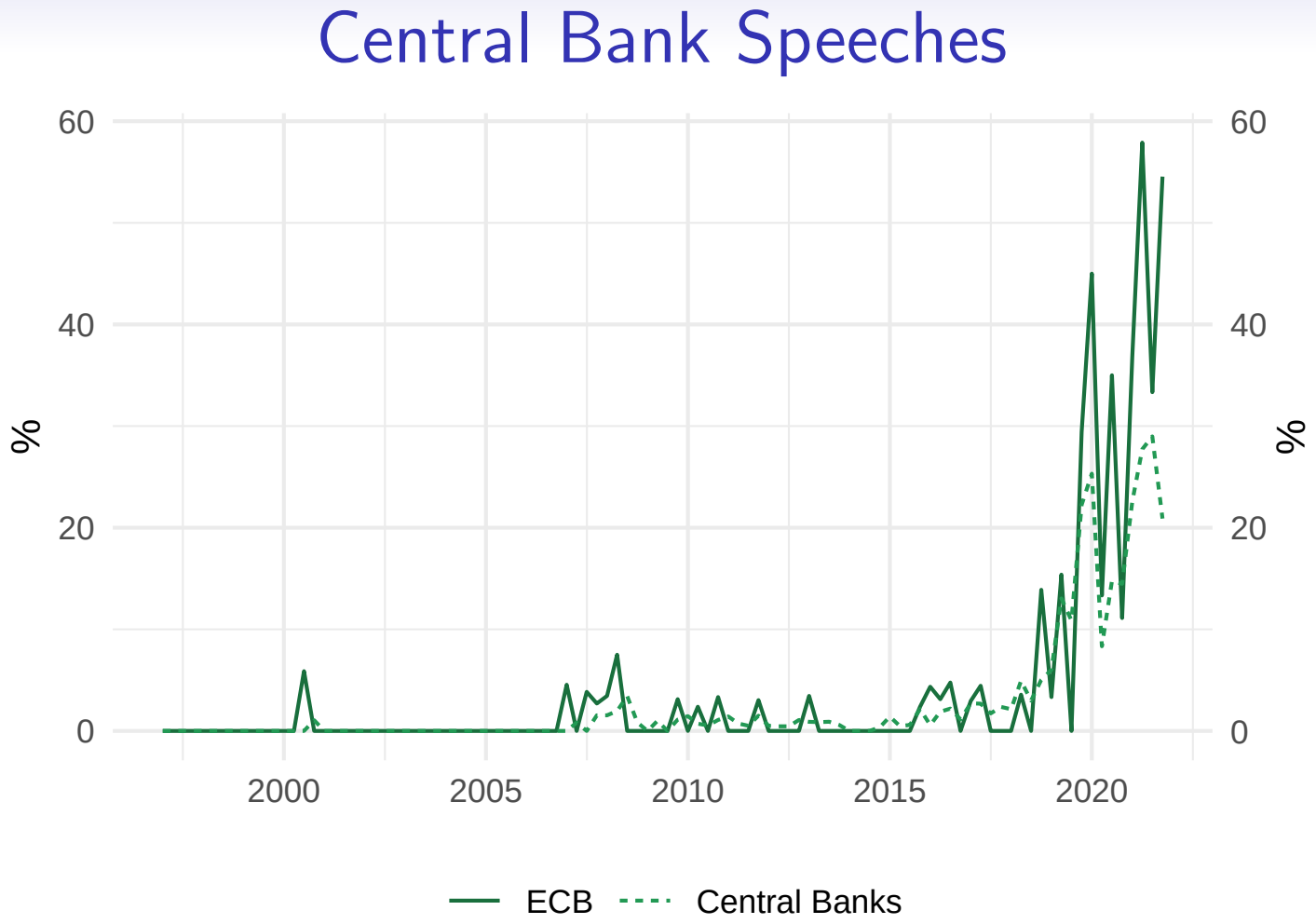

Figure: Share of Speeches containing the words "Climate Change": 1997 (creation)-2021. Comparing with taxes and inequality: taxes were always there, inequality starts earlier. FOMC minutes 1993-2020, two mentions.

Theory

$\lambda_{G_i G_j}$ how a group i person cares about a group j person. Intrinsic interest in the policy b_i. Costly action a_{i_t} with a cost per unit c_i.

$$U_i\left(a_{i_t}, \mathbf{E}(\mathbf{a_{-i_t}})\right) = a_{i_t}\left(b_i + \sum_{j \in R} \lambda_{G_i G_j} E(a_{j_t})\right) - \frac{c_i}{2} a_{i_t}^2$$

Then, if $E(\mathbf{a}_t) = f(\mathbf{a_{t-1}}, \mathbf{a_{t-1}}, ...)$, the optimal action can be written as:

$$a_{it} = \frac{1}{c_i}\left(b_i + \sum_{j \in R} \lambda_{G_i G_j} f(a_{j_{t-1}}, a_{j_{t-2}} ...)\right)$$

Individual actions can be aggregated (linearity, common group λ).

VAR model estimation

- The model in Section 4 can be written as $X_t = \Pi(L)X_t + \epsilon_t$.
- X_t a set of endogenous variables, Π a matrix of VAR coefficients, and $\epsilon_t : N(0, \Sigma)$ is a vector of shocks.
- x_1 is mentions of climate change in the media (CCI).
- x_2 is mentions in the European parliament questions (normalized).
- x_3 is mentions in science journals (CCI).
- x_4 is GDP for the Euro Area (normalized).
- Table 2 results. ARx(y,z): "x" is the lag, "y" the index of the variable whose effect we measure, and z is the index of the variable affected by it.
- Data is quarterly.

Results

- At one quarter all variables are affected by their own lags. The Euro Parliament positively affects the media.
- At two quarters there are no own effects. We also find a negative effect of Euro Parliament on media. There is also a reciprocal negative effect of media on Euro parliament.
- At three quarters the only own effects are given by scientific journals and GDP. There is a negative effect of GDP in the Euro Parliament.
- At four quarters the only own effect is given by GDP, and there is only one positive effect from GDP to the Euro parliament.
- Generally speaking, we find that media is affected by the parliament, and parliament is affected by the media. Other than that, we also find very strong interactions with GDP fluctuations.
- The model does not pick up science influence. There may be subtler than it can capture.

Table: VAR: ARx(y,z) "x" is the lag, "y" is affecting, and "z" is affected

	Value	Standard Error	TStatistic	PValue
Constant(1)	-101.51	56.43	-1.8	0.07
Constant(2)	-92.19	78.69	-1.17	0.24
Constant(3)	-93.88*	41.64	-2.25	0.02
Constant(4)	1.54	2.59	0.6	0.55
AR1(1,1)	0.82***	0.12	6.91	0
AR1(2,1)	0.61***	0.17	3.69	0
AR1(3,1)	0.01	0.09	0.15	0.88
AR1(4,1)	0	0.01	-0.39	0.7
AR1(1,2)	-0.07	0.08	-0.88	0.38
AR1(2,2)	0.24**	0.11	2.08	0.04
AR1(3,2)	0	0.06	0.01	0.99
AR1(4,2)	-0.01	0	-1.55	0.12
AR1(1,3)	0.06	0.14	0.42	0.68
AR1(2,3)	-0.17	0.19	-0.88	0.38
AR1(3,3)	0.39***	0.1	3.88	0
AR1(4,3)	0.01	0.01	1.48	0.14
AR1(1,4)	3.23	2.23	1.45	0.15
AR1(2,4)	0.3	3.11	0.1	0.92
AR1(3,4)	0.91	1.65	0.55	0.58
AR1(4,4)	0.79***	0.1	7.76	0

Table: VAR: ARx(y,z) "x" is the lag, "y" is affecting, and "z" is affected

	Value	Standard Error	TStatistic	PValue
AR2(1,1)	0.23	0.15	1.57	0.12
AR2(2,1)	-0.44*	0.21	-2.1	0.04
AR2(3,1)	0.11	0.11	0.96	0.34
AR2(4,1)	0	0.01	-0.57	0.57
AR2(1,2)	-0.25	0.08	-2.97	0
AR2(2,2)	0.16	0.12	1.35	0.18
AR2(3,2)	-0.02	0.06	-0.38	0.71
AR2(4,2)	0	0	-0.38	0.71
AR2(1,3)	0.2	0.14	1.43	0.15
AR2(2,3)	-0.1	0.2	-0.48	0.63
AR2(3,3)	-0.12	0.11	-1.12	0.26
AR2(4,3)	0.01	0.01	1.28	0.2
AR2(1,4)	-4.44	2.55	-1.74	0.08
AR2(2,4)	1.21	3.56	0.34	0.73
AR2(3,4)	-2.39	1.88	-1.27	0.2
AR2(4,4)	0.02	0.12	0.2	0.84

Table: VAR: ARx(y,z) "x" is the lag, "y" is affecting, and "z" is affected

	Value	Standard Error	TStatistic	PValue
AR3(1,1)	-0.11	0.15	-0.72	0.47
AR3(2,1)	0.22	0.21	1.08	0.28
AR3(3,1)	-0.15	0.11	-1.32	0.19
AR3(4,1)	0	0.01	0.45	0.65
AR3(1,2)	-0.1	0.09	-1.21	0.23
AR3(2,2)	-0.07	0.12	-0.62	0.54
AR3(3,2)	0.01	0.06	0.15	0.88
AR3(4,2)	-0.02***	0	-4.2	0
AR3(1,3)	-0.14	0.14	-1	0.32
AR3(2,3)	0.26	0.2	1.3	0.19
AR3(3,3)	0.26*	0.11	2.46	0.01
AR3(4,3)	0	0.01	-0.39	0.7
AR3(1,4)	3.37	2.52	1.34	0.18
AR3(2,4)	3.45	3.51	0.98	0.33
AR3(3,4)	2.77	1.86	1.49	0.14
AR3(4,4)	0.38**	0.12	3.27	0

Table: VAR: ARx(y,z) "x" is the lag, "y" is affecting, and "z" is affected

	Value	Standard Error	TStatistic	PValue
AR4(1,1)	0.12	0.13	0.97	0.33
AR4(2,1)	-0.04	0.18	-0.22	0.83
AR4(3,1)	0.09	0.1	0.94	0.35
AR4(4,1)	0	0.01	0.43	0.67
AR4(1,2)	0.15	0.09	1.79	0.07
AR4(2,2)	0.13	0.12	1.06	0.29
AR4(3,2)	-0.04	0.06	-0.58	0.56
AR4(4,2)	0.02***	0	4.68	0
AR4(1,3)	0	0.14	-0.03	0.98
AR4(2,3)	0.06	0.2	0.28	0.78
AR4(3,3)	-0.04	0.1	-0.43	0.67
AR4(4,3)	-0.01	0.01	-0.87	0.39
AR4(1,4)	-1.03	2.17	-0.47	0.64
AR4(2,4)	-3.85	3.03	-1.27	0.2
AR4(3,4)	0.19	1.6	0.12	0.91
AR4(4,4)	-0.21*	0.1	-2.1	0.04

Conclusion

- We document the evolution of mentions of climate change in different environments: policy, sciences, and the general public (proxied by news media).
- We also postulate a model about how those different environments influence one another and then estimated the model's parameters.
- We find large fluctuations of interest and interesting cross influences. A particularly salient one is related to how GDP evolution affects the interest in climate change.
- These observations could be a useful tool for timing activists and other groups interested in influencing social debate.
- Future research could expand our results by doing a more fine grained analysis of the connections inside the different groups, potentially using tools from social complex network analysis.

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