Heard the News? Environmental Policy and Clean Investments

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Motivation and objective

How has media attention to environmental policy evolved over the years?
How does information about environmental policy affects the decision-making of clean investors?

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  1. general index of environmental policy
  2. 25 topic-specific indexes

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How has media attention to environmental policy evolved over the years?
How does information about environmental policy affects the decision-making of clean investors?

- **Using text-mining techniques**, we construct newspaper-based measures of US environmental policy over the last 40 years:
  1. general index of environmental policy
  2. 25 topic-specific indexes

To answer the question: Does more media attention to EnvP ($\neq$ policy stringency) make clean firms more attractive to investors?

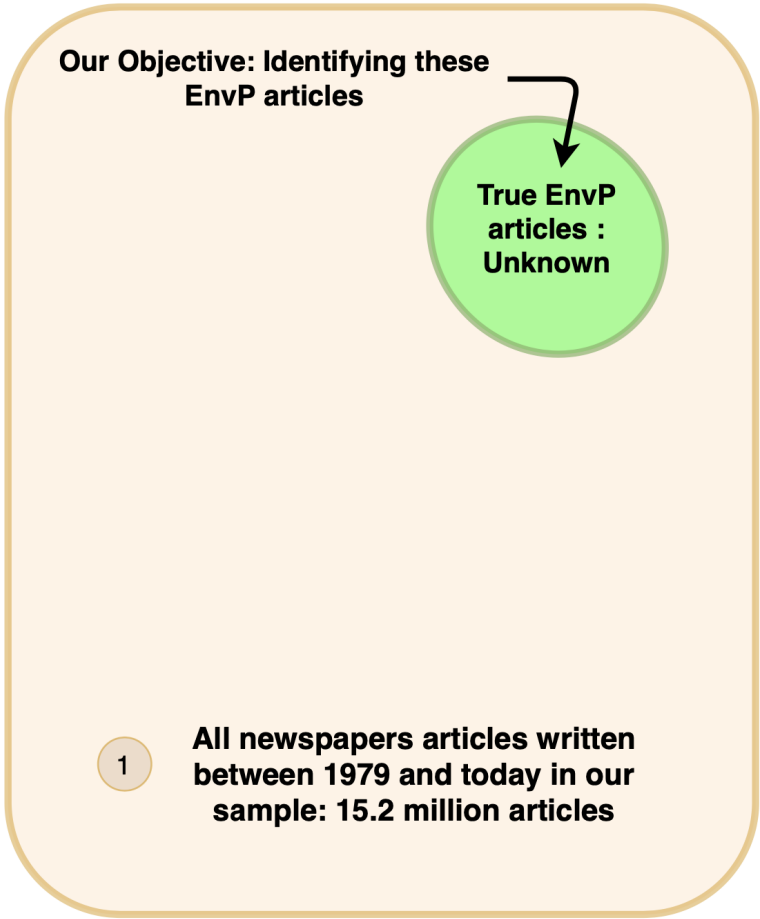
Outline

Data

- News articles extracted from 10 US newspapers over 1981-2019.
- Weekly/monthly counts of articles relating to environmental and climate policy (EnvP) + total volume of articles.
- Source: automated access to Factiva, Dow Jones.

Newspapers	**Share**
New York Times	22.5%
Washington Post	15.3%
Houston Chronicle	13.8%
Tampa Bay Times	11.5%
Dallas Morning News	10.8%
Wall Street Journal	9.8%
San Francisco Chronicle	6.2%
Boston Herald	5.0%
San Jose Mercury News	3.4%
San Diego Union Tribune	1.7%

Identifying EnvP articles through text-mining (1)



1. 15.2 million articles (10 newspapers) accessed on Factiva. $\rightarrow$ only a subset are 'true' EnvP articles.

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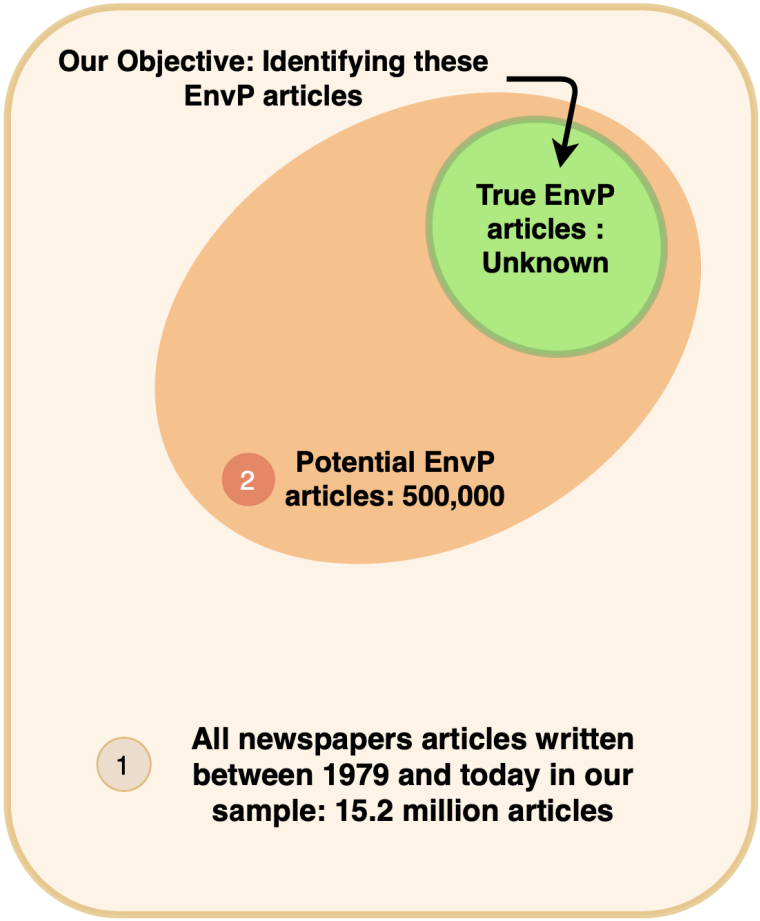

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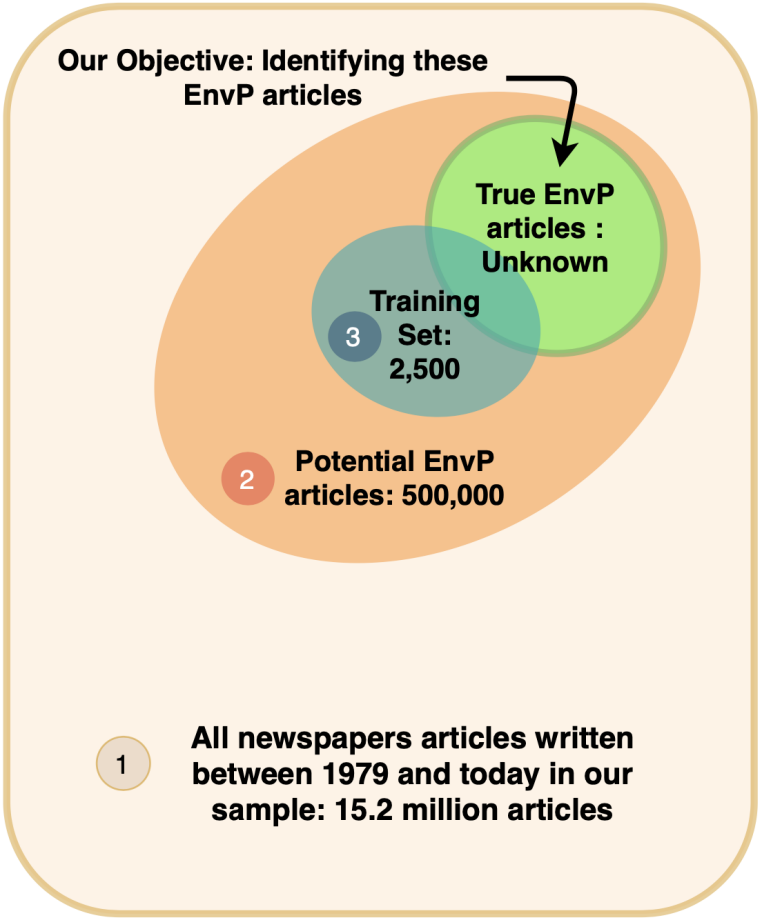

1. 15.2 million articles (10 newspapers) accessed on Factiva. $\rightarrow$ only a subset are 'true' EnvP articles.
2. Broad environmental policy query to narrow down the universe of articles (i.e. 500,000)
3. Training set: random draw of 2,500 articles that we label manually. An article is coded as irrelevant in our codebook if:
   - **No environment** : *"Brexit has caused changes in the business climate."*
   - **No policy** : *"New technological breakthrough for solar cells."*

▸ Excerpt of our codebook

Identifying EnvP articles through text-mining (2)

Training a supervised ML algorithm for text classification

- Training set (2'500 articles) as input into a support vector machine (SVM) classifier. ▸ What is SVM?
- Algorithm produces a rule predicting whether an article is about EnvP, based on words in a given article.

Identifying EnvP articles through text-mining (2)

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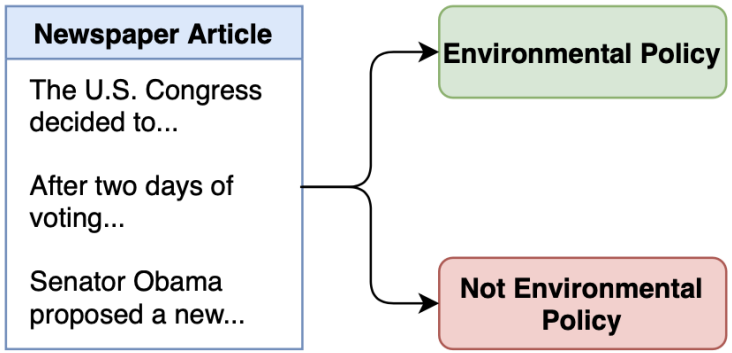
Classifying our newspaper articles

- Using SVM prediction rule on our set of 500,000 articles, we identify 84,000 news articles as "true" EnvP.



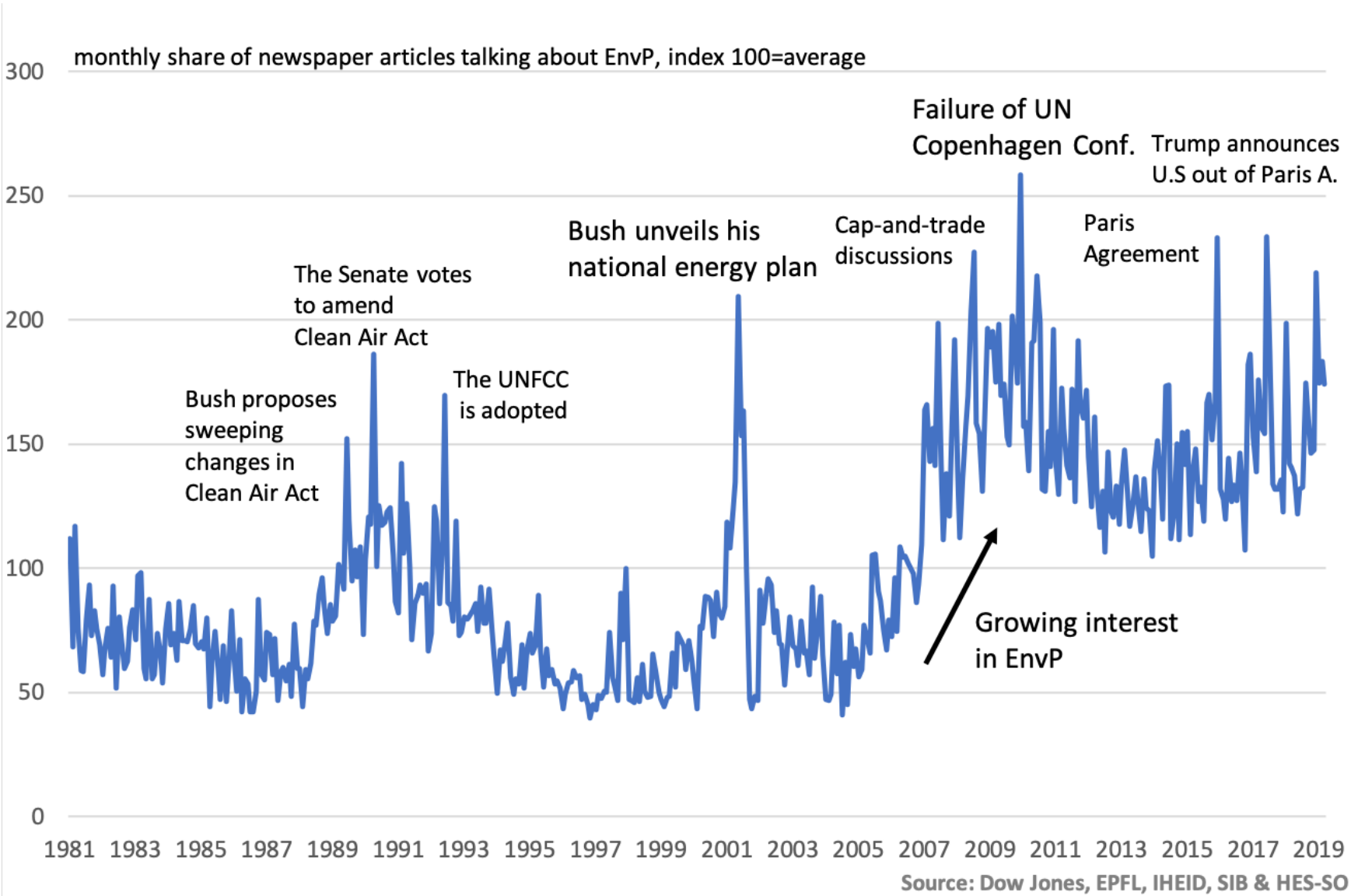
A glimpse into SVM top features

Table: 50 most discriminating words for predicting our EnvP index according to the trained SVM classifier.

Word	Weight	Word	Weight	Word	Weight
energy	3.073	coal	1.189	carbon	0.976
emissions	2.784	standards	1.185	env. protection	0.96
environmental	2.718	global warming	1.122	regulations	0.941
solar	1.907	greenhouse	1.093	administration	0.94
obama	1.904	recycling	1.091	legislation	0.934
pollution	1.876	house	1.068	gasoline	0.927
clean	1.813	cars	1.065	utilities	0.911
air	1.525	volkswagen	1.06	electric	0.901
power	1.514	renewable	1.038	protection	0.897
warming	1.469	clean air	1.038	vehicles	0.896
waste	1.353	fuel	1.037	congress	0.875
epa	1.316	federal	1.035	agency	0.873
climate	1.295	ethanol	1.033	drilling	0.869
mr obama	1.234	program	0.995	cleanup	0.843
climate change	1.234	ozone	0.991	reef	0.835
plants	1.23	countries	0.982	gas	0.832
global	1.194	state	0.976		

▸ Top SVM articles

General EnvP Index



▸ Comparison between our index and Climate Change Index

Identifying EnvP topics

Unsupervised ML algorithm for topic identification

- 84,000 EnvP articles over 1981-2009.
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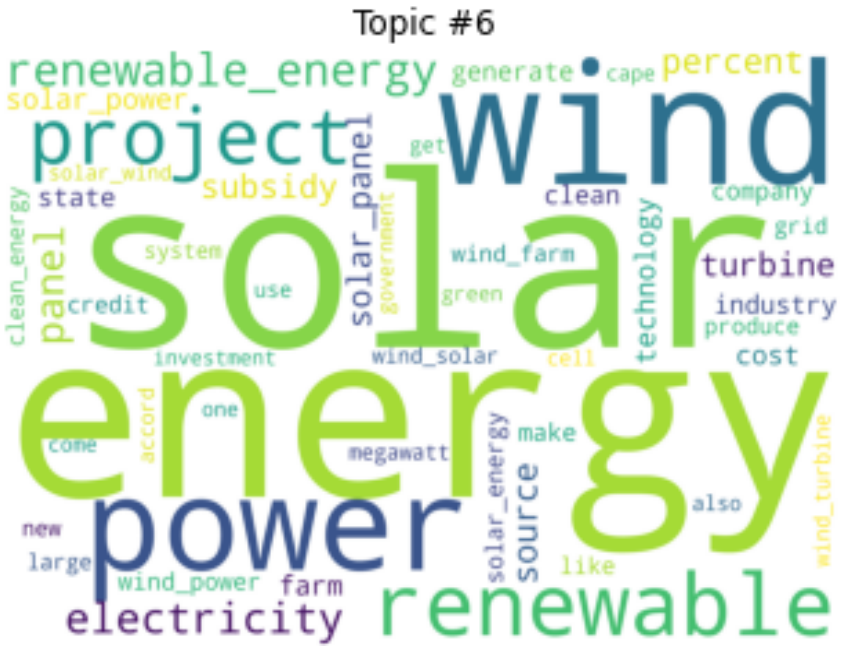

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Unsupervised ML algorithm for topic identification

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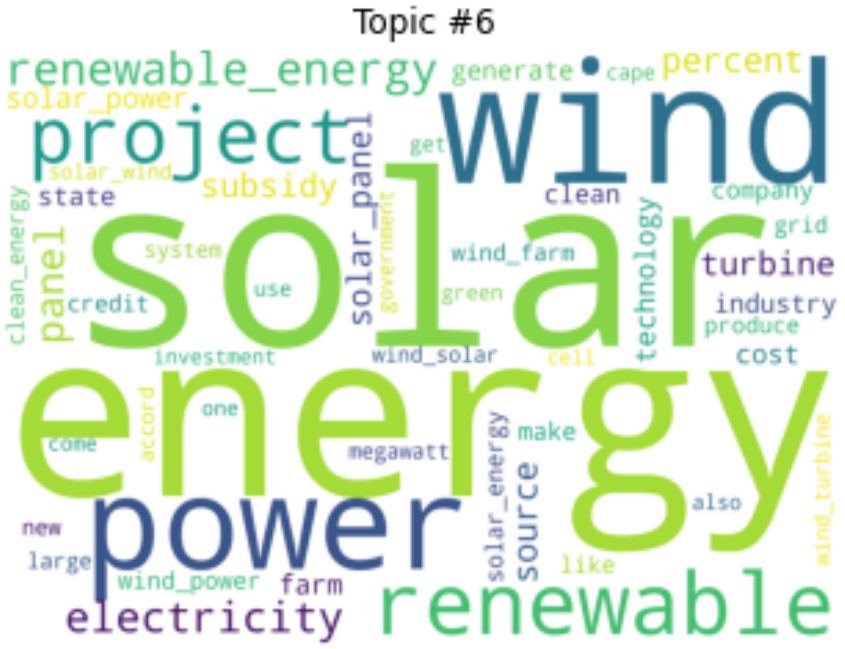
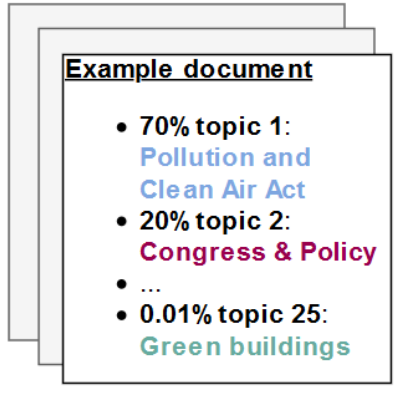
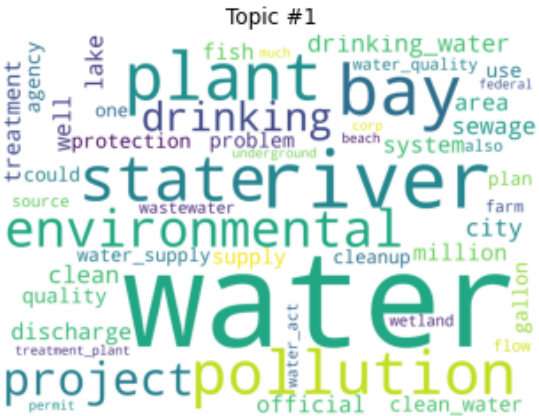
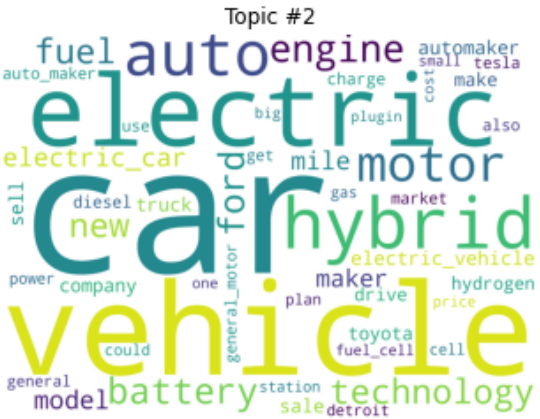
- Topic modeling using Latent Dirichlet Allocation (LDA).
- LDA identifies topics based on co-occurrence of terms.
- Each news article is associated with multiple topics.

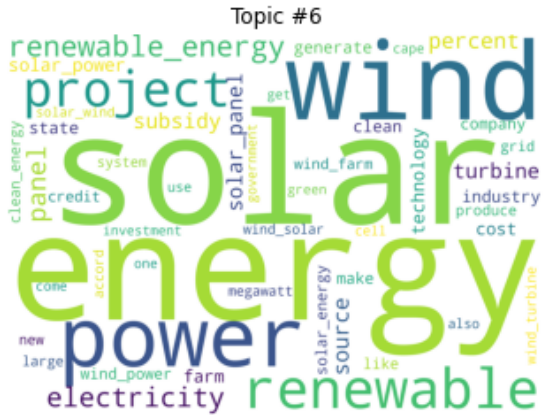


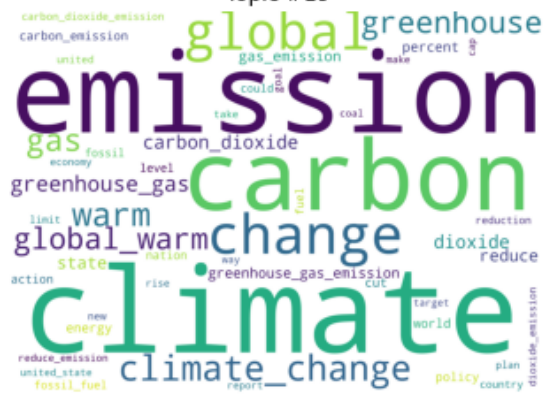


Wordclouds EnvP topics



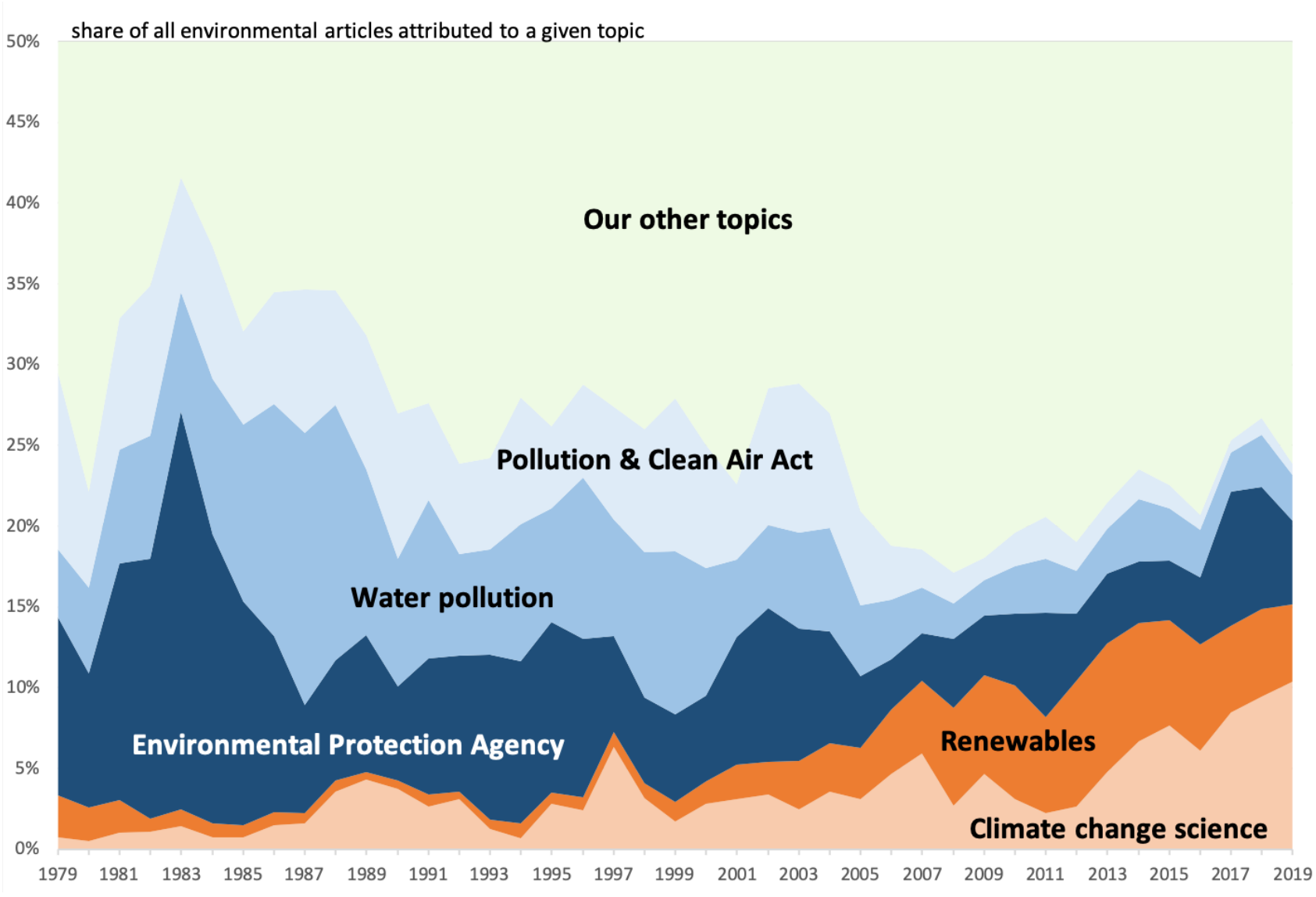




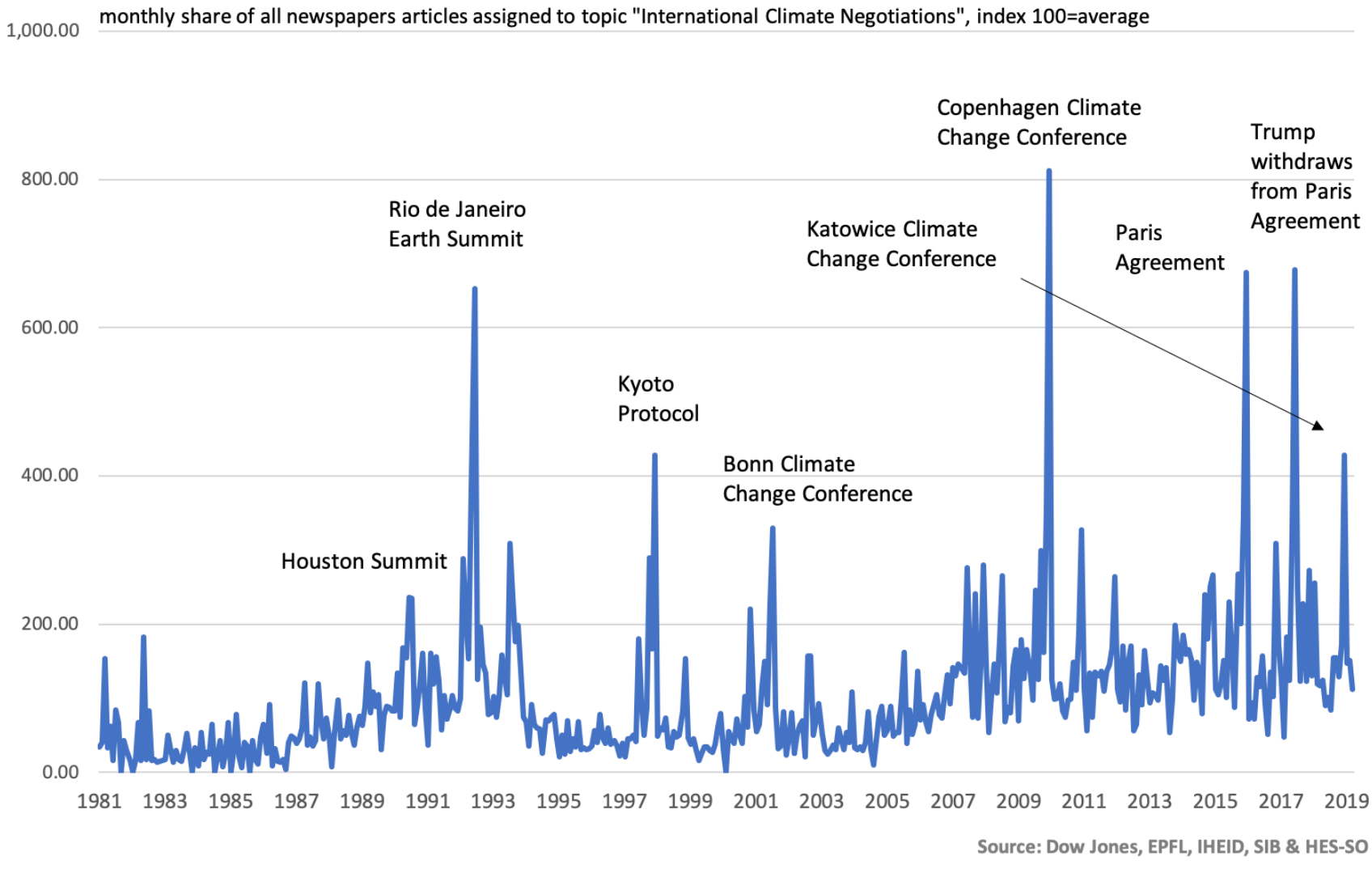


▸ Full topics list

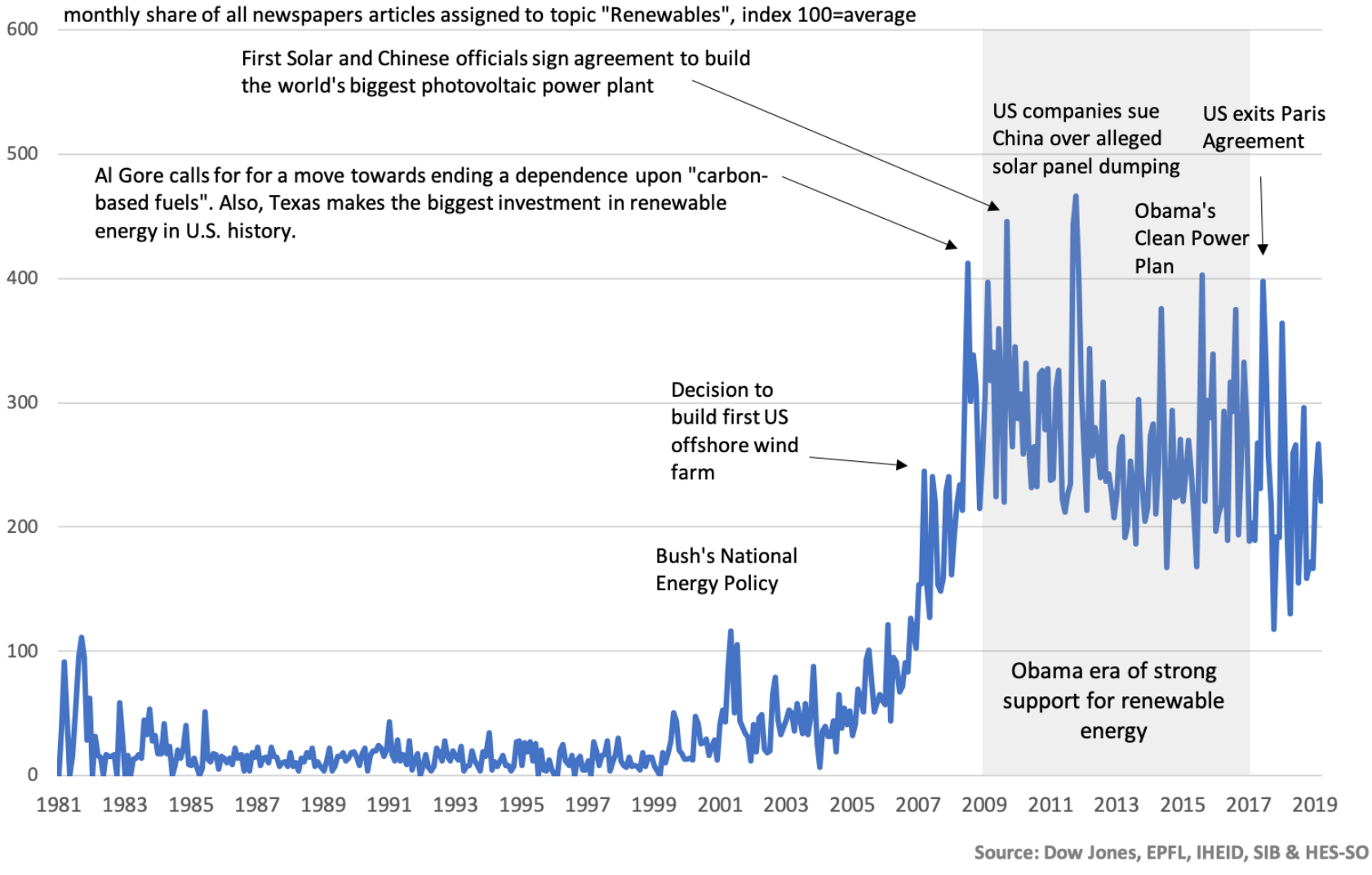
Evolution of topic sub-indexes over time



Topic International Agreements



Topic Renewables - EnvP-RE



EnvP news and clean investments

- How do our news-based environmental policy indexes relate to clean markets? In particular, venture capital deals and stock returns

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- How do our news-based environmental policy indexes relate to clean markets? In particular, venture capital deals and stock returns
- Does more media attention to EnvP ($\neq$ policy stringency) make clean firms more attractive to investors?
  - increase awareness of investment opportunities in clean markets

Our results: Aggregate (VAR)

Dynamic relationship between our news index and aggregate VC deals and Exchange Traded Fund (ETF) index in clean energy in VAR models

We find that a a positive shock to EnvP-RE is associated with:

- an increase in VC deals in renewable energy in the medium term
- an increase in demand for the main benchmark clean-energy ETF

Our results: Firm-level (Panel)

Firm-level regressions – identification strategy differentiate firms by exposure to environmental policy

We find that an increase in EnvP and EnvP-RE is associated with:

- an increase in the probability of VC funding for cleantech startups, with little to no impact on other startups
- a decrease in stock returns of the most polluting firms (which we assume are most exposed to media attention)

Conclusions

- We are able to capture the evolution of media attention to various aspects of environmental policy
- We find that our news-based indexes are positively associated with clean investments

Supplementary Slides

Our codebook

0	Article is about foreign (non US) environmental policy (and is not discussed/compared to or in relation to US env policy)	
	RELEVANT below	
1	Article is about environment/climate, with minor but significant (=explicit and specific, not a general statement) reference to environmental policy. (even if it's a opinion piece) - Article is about local environmental impacts in a very specific geographical area, with some reference to *state or federal* env/climate policy - Note: env policy implies legislation, laws, but also the financing of large demonstration projects, renewable power plants, etc by a (local) public authority.	

Figure: Excerpt from our codebook

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Support Vector Machines (SVM)

SVM maximizes the distance between the two closest articles on both sides of the decision boundary:

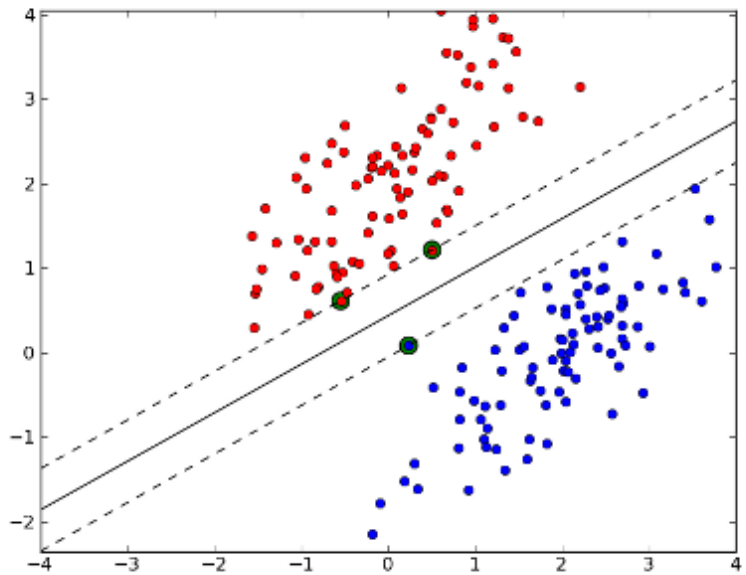

Figure: Support Vector Machines

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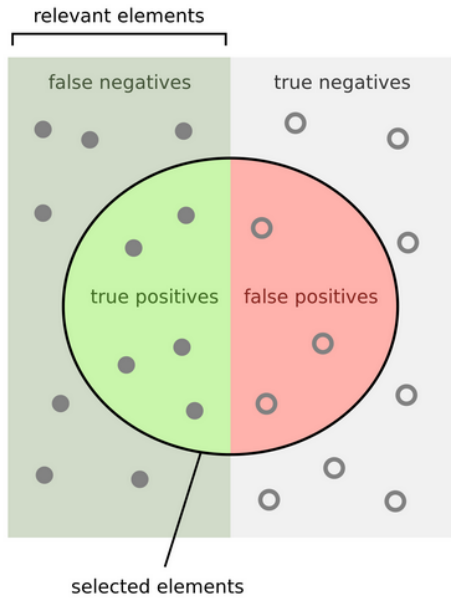
Precision & Recall



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Articles with highest SVM score

Title	Date	SVM	Newspaper	Excerpt
Time to Confront Climate Change	Dec 28, 2012	4.78	New York Times	"That ruling, known as the endangerment finding, made possible the administration's historic new emissions standards for cars and light trucks. It also provided the basis for the first steps toward regulating emissions from new power plants, and, possibly, further steps requiring existing plants to reduce global warming pollution."
Environmentalists, Industry Air Differences on Pollution	Oct 17, 1999	4.66	Washington Post	"As a result, environmental groups are pressing states and Congress for specific environmental protections against increased pollution, financial incentives for energy efficiency and renewable energy, and federal pollution guidelines to be part of the overall deregulatory effort."
Trump can't do much to worsen climate change	Apr 2, 2017	4.64	Washington Post	"Trump does not want to regulate carbon or other fossil-fuel -related pollutants under the Clean Air Act, but the statute and the Supreme Court say that he must. As Trump repeals the Clean Power Plan and updated limits on mercury, coal ash and smog, he will face legal challenges that he may well lose."
On Environmental Rules, Bush Sees a Balance, Critics a Threat	Feb 23, 2003	4.55	New York Times	"Whether rejecting a treaty on global warming, questioning Clinton-era rules on forest protection or pressing for changes in landmark environmental laws, Mr. Bush has imposed a distinctive stamp on a vast landscape of issues affecting air, water, land, energy and the global climate."
Candidates Agree World Is Warming, but Talk Stops There	Oct 26, 2012	4.48	New York Times	"Mr. Obama has supported broad climate change legislation, financed extensive clean energy projects and pushed new regulations to reduce global warming emissions from cars and power plants."

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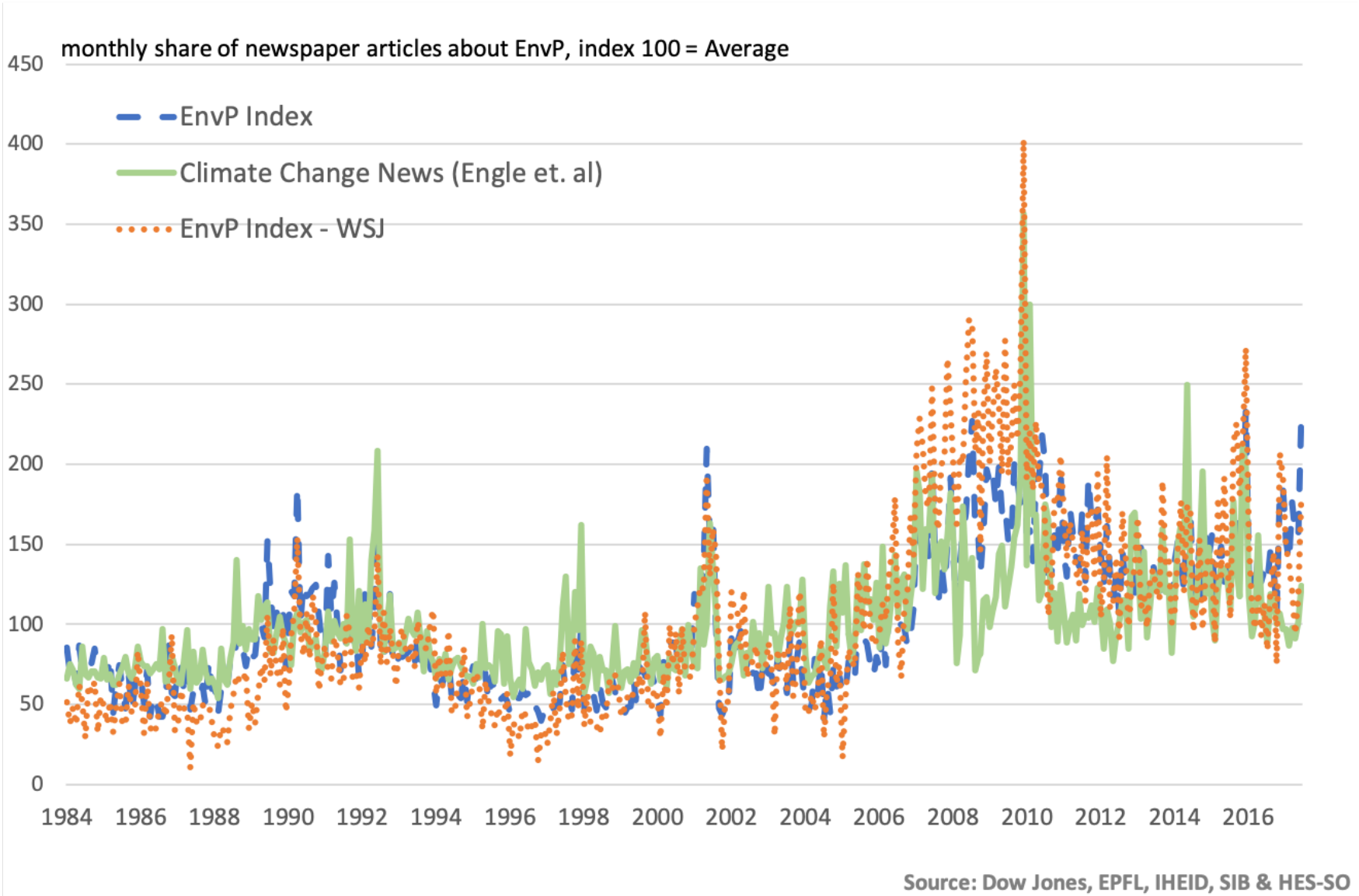
EnvP versus Climate Change Index



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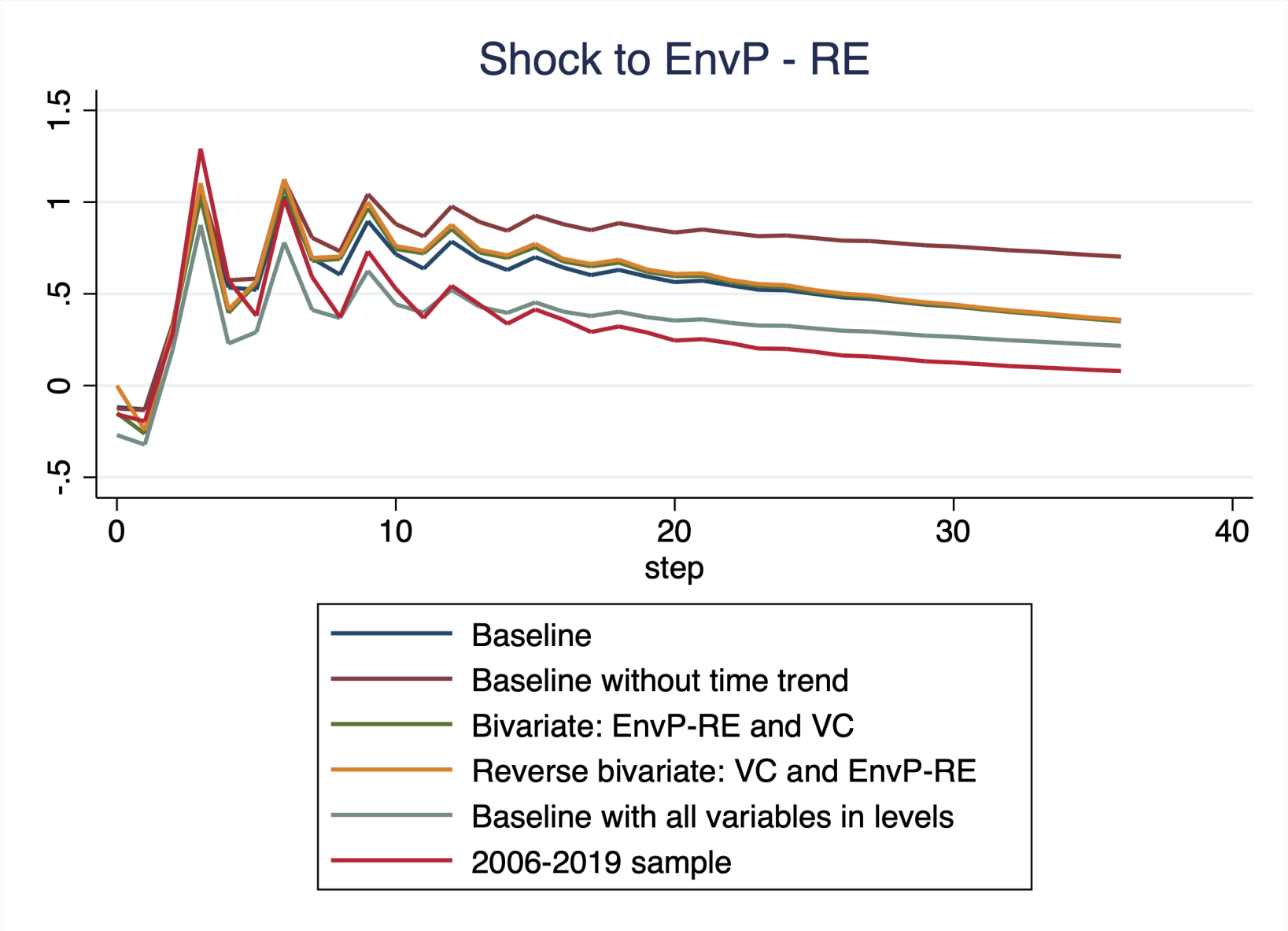
Robustness VAR VC



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Variables and Cholesky ordering in VAR VC deals

Table: Baseline VAR VC deals

Variables	**Version used**	**Cholesky ordering**
Our EnvP-RE policy index	Levels	1
US West Texas Intermediate crude oil spot price	Log diff	2
GDP	Log diff	3
Federal funds effective rate	First diff	4
Number of VC deals in clean energy	Levels	5

Time trend; 3 lags.

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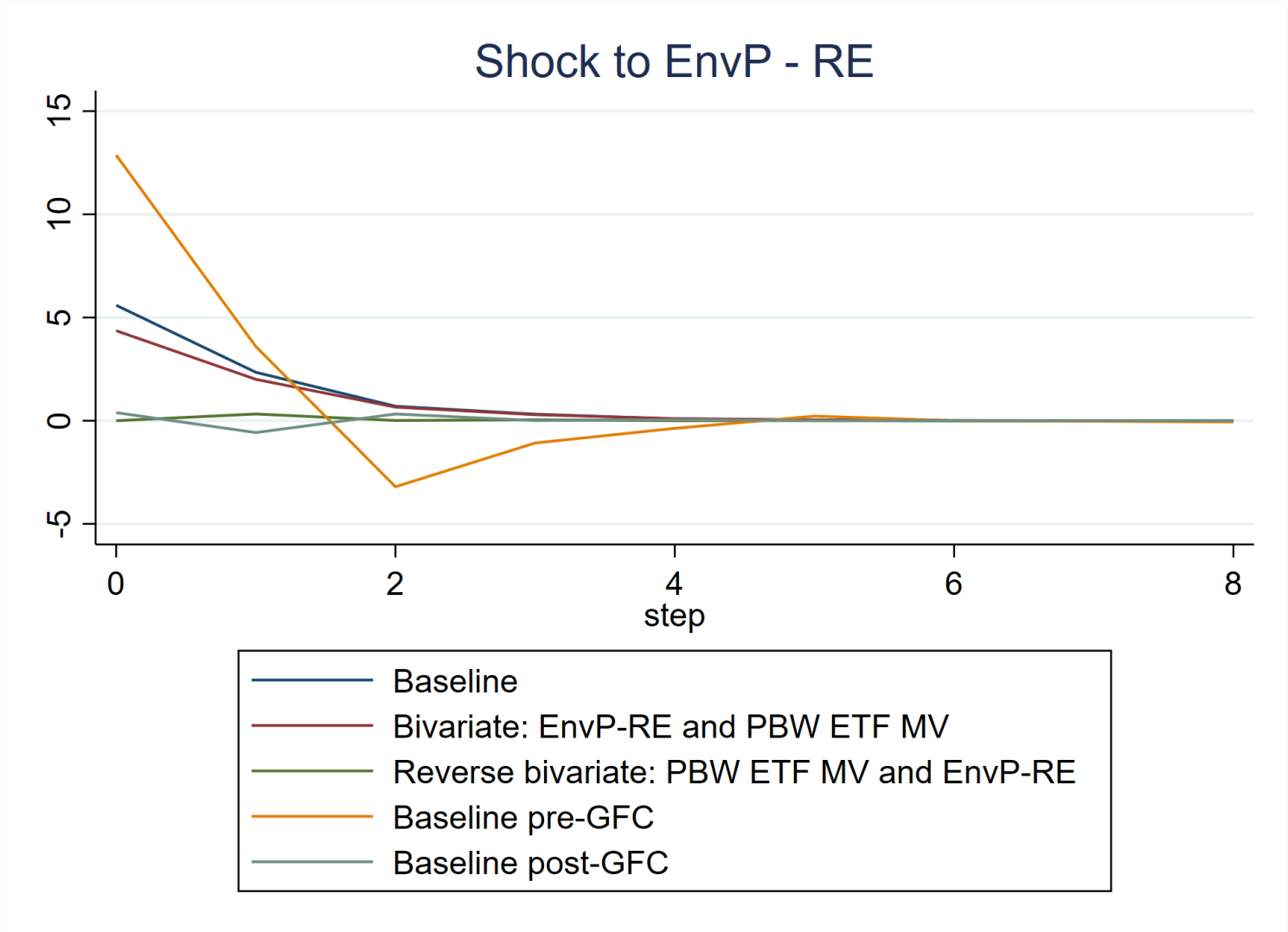
Robustness VAR stock



Estimated effect of a shock in EnvP-RE news index on PBW-ETF market cap changes, monthly

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Variables and Cholesky ordering in VAR stock

Table: Baseline VAR stock

Variables	**Version used**	**Cholesky ordering**
Our EnvP-RE policy index	Log diff	1
US West Texas Intermediate crude oil spot price	Log diff	2
Federal funds effective rate	First diff	3
NYSE Arca Technology Stock Index	Log diff	4
WilderHill Clean Energy Stock Index	Log diff	5

No time trend; 2 lags.

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Firm-level stock returns (4)

Robustness with constant and predetermined exposure to EnvP news

	(1) ln(r_excess)	(2) ln(r_excess)	(3) ln(r_excess)	(4) ln(r_excess)	(5) ln(r_excess)	(6) ln(r_excess)	(7) ln(r_excess)
EnvP	0.0574***	0.0445***	0.0779***	-0.0021***	0.0204***		0.0671***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		(0.000)
EnvP × AVG Emissions	-0.0060***	-0.0041***					-0.0024***
	(0.000)	(0.000)					(0.000)
Quartile of emissions=2 × EnvP			-0.0263***				
			(0.000)				
Quartile of emissions=3 × EnvP			-0.0386***				
			(0.000)				
Quartile of emissions=4 × EnvP			-0.0443***				
			(0.000)				
EnvP × Pre-sample Emissions				-0.0006***			
				(0.000)			
EnvP × AVG Emissions					-0.0016***		
					(0.000)		
EnvP net sentiment						0.0115***	
						(0.000)	
EnvP net sentiment × AVG Emissions						-0.0005***	
						(0.005)	
Green Revenue Share							0.0027
							(0.285)
EnvP × Green Revenue Share							0.0124***
							(0.000)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	No	Yes	Yes	Yes	Yes	Yes	Yes
Risk factors	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	56017	28868	28868	62632	34938	28868	7305
Firms	1.401	614	614	268	621	614	230
R^2	0.95	0.97	0.97	0.83	0.96	0.97	0.93

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Topics list

Topic	#	Topic	#	Topic	#
Climate Change	19	Oil & Gas production	15	Vehicle Fuels	12
EPA & Federal Gov.	5	Intl. Climate Negotiations	18	Waste & Recycling	26
Cleanups & Courts	17	Texas	11	Green Buildings	25
Government Budgets	3	Renewables	6	North-East Region	8
Air Pollution	9	Env. Conservation	4	Offshore Oil Drilling	7
Congress & Policy	13	Water Pollution	1	Nuclear Power	21
Businesses & Investments	22	Climate Science	16	Coal Industry	10
Presidents & Campaigns	23	California	14		
Power & Utilities	24	Automobile Industry	2		

Table 4: Topic interpretation and classification (ranked by size). Topic # refers to labels in Figures 5 and 6.

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