Does finance benefit society? a language embedding approach

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Washington University in St. Louis

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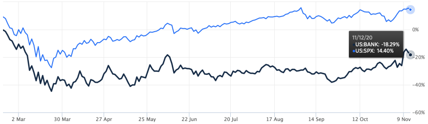
Aftermath of COVID-19

- Compared to 2008 crisis, how is the financial intermediaries perceived after COVID-19?



Source: wsj.com

Motivation

"As finance academics, we should care deeply about the way the financial industry is perceived by society. Not so much because this affects our own reputation, but because there might be some truth in all these criticisms, truths we cannot see because we are too embedded in our own world. And even if we thought there were no truth, we should care about the effects that this reputation has in shaping regulation and government intervention in the financial industry. Last but not least, we should care because the positive role that finance can play in society depends on the public's perception of our industry."

Luigi Zingales (2015, AFA presidential address)

Public perceptions of finance matter

- Survey evidence shows
  - Trust in bankers fell following the 2007–2008 financial crisis (Sapienza-Zingales 2012)
  - Public perceptions often diverge from those of economists (Sapienza-Zingales 2013)
  - Low trust can hinder insurance market efficiency (Gennaioli-Porta-Lopez-de-Silanes-Shleifer 2020)
- Shortcoming: Short time dimension limits our understanding of public perception of finance

Our questions

1. How does finance sentiment change over time and differ across countries?
2. How does it respond to severe disasters like the currently spreading pandemic?
3. How do such changes relate to economic and financial outcomes?

Our approach

- Measure sentiment toward finance in an annual panel
- 8 large economies matched to languages from 1870–2009
- Computational linguistics approach applied to the text of millions of books

Our findings

- Persistent differences across languages/countries with ample time-series variation
- Finance sentiment declines after uninsured disasters (epidemics and earthquakes), but rises following insured ones (droughts, floods, and landslides)
- Shocks to finance sentiment have long-lasting effects on economic and financial growth

Related literature

- Measurement of public attitude toward the financial sector (Stulz-Williamson 2003; Guiso-Sapienza-Zingales 2008; Gurun-Stoffman-Yonker 2018; D'Acunto-Prokopczuk-Weber 2019; Levine-Lin-Xie 2019)
    - Construct a new sentiment toward finance panel spanning centuries and several large economies
- Culture and its effects on economic outcomes (Guiso-Sapienza-Zingales 2006; Spolaore-Wacziarg 2013; Mokyr 2016; McCloskey 2016)
    - Find natural disasters provide one exogenous cause for cultural changes
- Text used to analyze culture, economics, and finance (Michel et al. 2011; Gentzkow-Kelly-Taddy 2019; Loughran-McDonald 2020)
    - bag-of-words / dictionary-based: missing semantic meaning
    - Kozlowski-Taddy-Evans (2019) show embeddings capture cultural associations better
    - We provide a more efficient method using a pre-trained model (BERT)
        - Transfer learning: perform better than neural network; saving time; no need lots of data

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Data

- Text from Google Books corpus
  - Annual sentence (5-gram) counts 1870–2009
  - 8 languages: Chinese, German, French, Italian, Russian, Spanish, UK English and US English
  - About 1 billion sentences mentioning “finance
- Natural disasters data
  - Emergency Events Database from CRED 1900–2009
- Macro data
  - Jorda-Schularick-Taylor macro data for advanced economies
  - Barro-Ursua macro data for Russia and China

Word/Sentence embeddings

- Bidirectional Encoder Representations from Transformers (BERT, Devlin et al. 2018) to measure if "finance" mentions are on average closer to positive versus negative sentences
- Use BERT to embed sentences in a low dimensional numerical vector (~800d)
- Word Embedding Analogies:
  - e.g. $\overrightarrow{king} - \overrightarrow{man} + \overrightarrow{woman} \approx \overrightarrow{queen}$
- BERT is particularly good at distinguishing *context*
- Different from Dictionary-based approach which is widely used in economics and finance
  - Tetlock (2007), Loughran-McDonald (2014), Baker et al. (2016)
  - word lists are subjective and restricted
  - single word fails to capture semantic meaning throughout context

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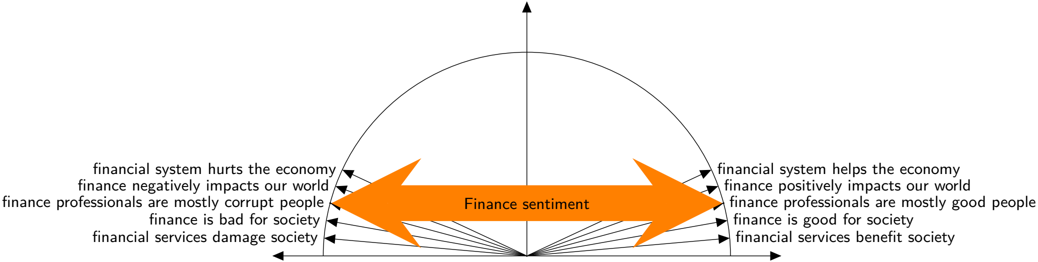
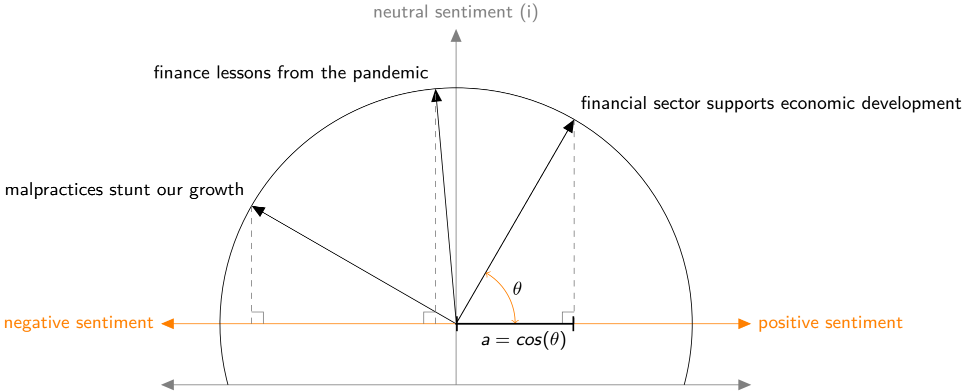
Measuring of finance sentiment

Step 1: Define positive–negative sentiment dimension



Measuring of finance sentiment

Step 2: Project "finance" mentioning sentence j in language i embeddings on the positivity dimension



Finance sentiment for language i in year t is mean cosine similarity across mentions

Measuring of finance sentiment

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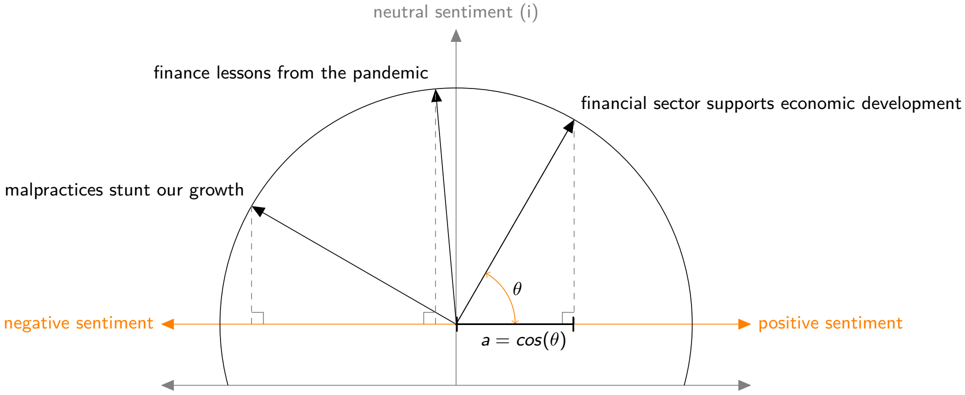


Finance sentiment for language i in year t is mean cosine similarity across mentions

Positive – negative defining sentences (English)

Positive sentences	Negative sentences
financial services benefit society	financial services damage society
finance is good for society	finance is bad for society
finance professionals are mostly good people	finance professionals are mostly corrupt people
finance positively impacts our world	finance negatively impacts our world
financial system helps the economy	financial system hurts the economy

Positive – negative defining sentences (Chinese)

金融服务有益社会	金融服务损害社会
金融对社会好	金融对社会不好
财务专业人员大多很好	财务专业人员大多邪恶
金融对世界产生积极影响	金融对世界产生消极影响
金融系统帮助经济	金融系统有害金融

Sentences assigned most positive and negative finance sentiment (English)

Positive sentiment sentences	Negative sentiment sentences
financial support of the science	turmoil in the financial markets
financial management of the school	instability in the financial markets
financial support of the research	lack of money to finance
financial management of the business	a financial panic
financial support of this project	the financial panic
financial management initiative	financial panic in the united
financial support of the work	international financial instability
understanding of the financial system	lack of funds to finance
finance for small and medium	my finances falling short
finance graduate school of	the financial deficit

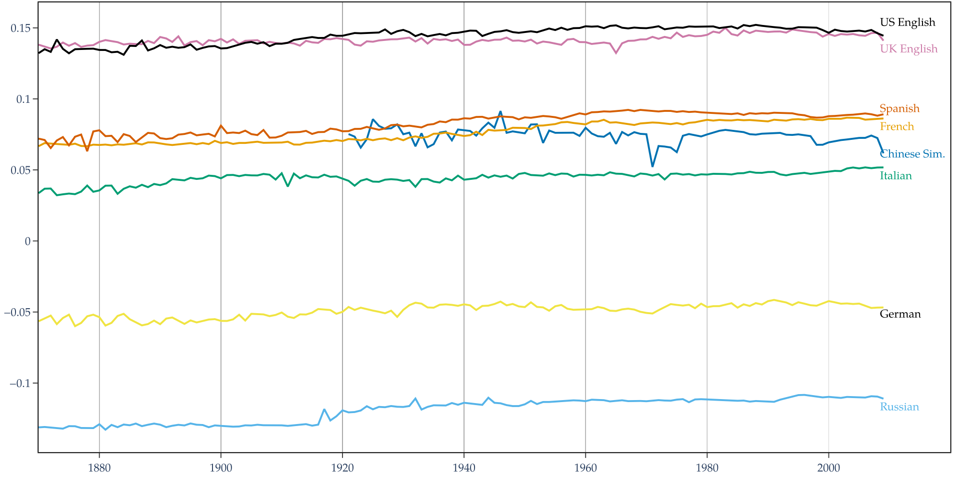
Repeat for all 8 languages

Sentences assigned most positive and negative finance sentiment (Chinese)

Chinese	English Translation
严重 扰乱 了 金融 秩序	Seriously disturbed the financial order
扰乱 了 国家 金融 秩序	Disrupt the national financial order
严重 扰乱 了 金融	Seriously disrupting the financial
扰乱 了 正常 的 金融	Disrupt the normal financial
扰乱 了 金融 秩 序	Disrupt the financial order of rank
扰乱 了 金融 秩序	Disrupt the financial order
扰乱 了 金融 市场	Disrupt the financial markets
干扰 了 金融 秩序	Disturb financial order
既 不 利于 金融	Not only is not conducive to financial
扰乱 了 金融 序	Disrupt the financial order
⋮	⋮
经济 发展 提供 金融	Economic development has provided financial
农村 发展 提供 金融	Rural Development provides financial
金融 推动 发展	Promote the development of financial
金融 服务 促进 农村	Promotion of rural financial services
金融 务 促进	Promote financial affairs
服务 促进 金融	Promoting financial services
金融 立足	Financial foothold
服务 农村 金融	Financial services in rural areas
金融 服务 社会	Financial services community
服务 规范 发展 金融	Regulate the development of financial services

Sentiment toward finance 1870–2009

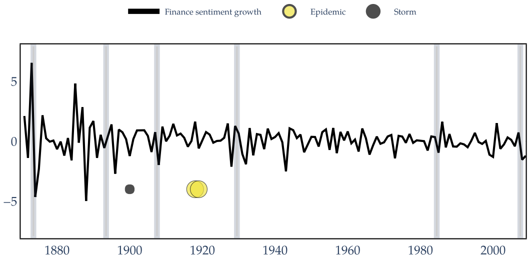
Persistent differences across languages/countries despite ample time-series variation



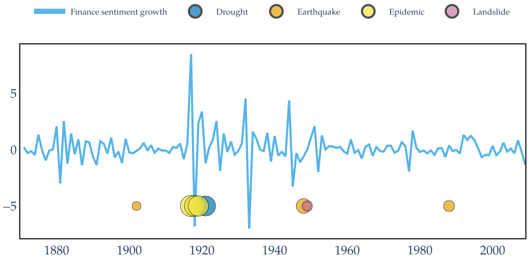
Finance sentiment growth

absolute percentage growth

$$\Delta f_{it} = \frac{f_{i,t} - f_{i,t-1}}{|f_{i,t-1}|} \times 100$$



USA



Russia

Natural disasters as exogenous shocks

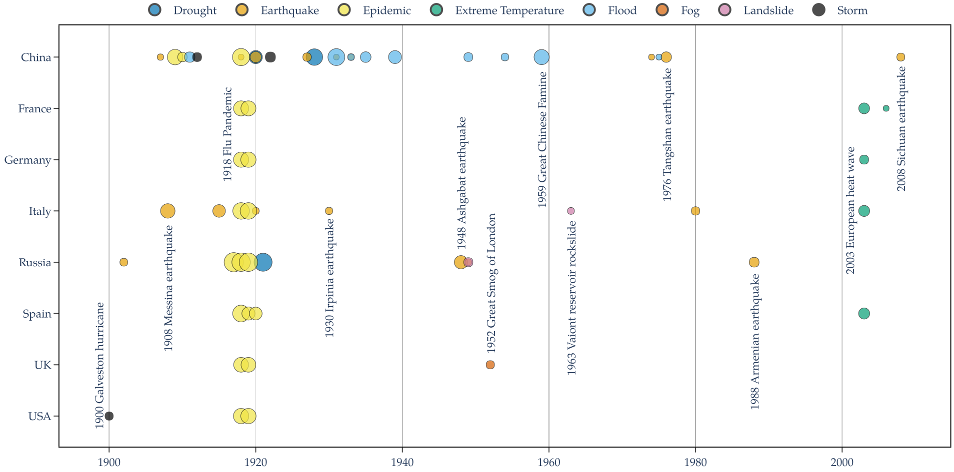
Classify disaster as severe if it kills at least 20 per million population

Epidemics, droughts, earthquakes, volcanos are largely uninsured

Disaster Group	Type	Obs.	Severe	Mean Killed	Damage, $M	Insured, %	Pub. Lag
Biological	Epidemic	46	19	378133			0.58
Climatological	Drought	20	3	783922	1830		0.00
	Wildfire	53	0	41	504	37.22	
Geophysical	Earthquake	150	18	7534	1744	21.23	0.28
	Volcano	5	0	206	431		
	Mass move.	8	0	79			
Hydrological	Flood	189	9	38949	859	42.97	0.00
	Landslide	66	2	321	224		3.50
Meteorological	Storm	217	3	951	1132	101.20	0.00
	Extreme Temp.	70	5	1068	2233	36.26	0.00
	Fog (Smog)	1	1	4000			0.00
All				35175	1116	83	0.38

Severe natural disasters 1900–2009

Systematic sources of risk may not provide risk sharing opportunities ⇒ high insurance premia and low take-up



Natural disasters affect future finance sentiment

	Finance sentiment growth$_{t+1}$					
	(1)	(2)	(3)	(4)	(5)	(6)
Natural Disaster$_t$	-0.88**	-0.88**	-0.89**			2.01**
	(0.32)	(0.33)	(0.33)			(0.70)
War$_t$		0.10	0.08			
		(0.40)	(0.42)			
Natural Disaster$_t$ $\times$ Low Insured$_t$						-4.44**
						(1.70)
logKilled$_t$			0.10		0.12	
			(0.09)		(0.09)	
Drought$_t$				3.27*	3.60*	
				(1.39)	(1.55)	
Earthquake$_t$				-4.57**	-4.64**	
				(1.88)	(1.92)	
Epidemic$_t$				-4.13**	-4.16**	
				(1.64)	(1.69)	
Extremetemp$_t$				-0.07	-0.05	
				(0.35)	(0.37)	
Flood$_t$				2.39**	2.42***	
				(0.68)	(0.68)	
Landslide$_t$				5.20***	5.41***	
				(1.08)	(1.26)	
Storm$_t$				-5.87	-5.93	
				(4.90)	(5.19)	
Fog$_t$				3.31	3.37	
				(2.57)	(2.50)	
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.13	0.13	0.13	0.16	0.17	0.14
Obs	851	851	851	851	851	851

Natural disasters effect heterogeneity

- Finance sentiment declines by 1% one year after a severe natural disaster
- Hides ample heterogeneity across disaster types
  - Uninsured disasters, epidemics or low insured disasters, earthquakes reduce it by 4%
  - Insured disasters (floods, landslides) increase it by 2–5%

Potential explanation #1

Bankers, love them ex-ante, hate them ex-post

- Finance facilitates risk sharing through insurance, securitization or derivatives
- But financial contracts and intermediaries are often designed to prevent ex-post renegotiation (Diamond-Rajan 2001; Agarwal et al. 2017)
- When insured disasters hit, economic costs are shared broadly, across households and generations

Potential explanation #1

- But COVID-19 pandemic illustrates uninsured disasters
  - damage can be concentrated in parts of the population (Mongey, Pilossoph, and Weinberg, 2020)
  - destroy fragile businesses (Chetty, Friedman, Hendren, and Stepner, 2020)
  - generate resentment against financial intermediaries

Potential explanation #2

Insurance claim disputes can affect finance sentiment

- Insurance claims are frequently disputed and result in rejections or lower payments (Gennaioli, Porta, Lopez-de-Silanes, and Shleifer, 2020)
- Sentiment toward insurers may worsen if households learn they are uninsured only after disaster strikes

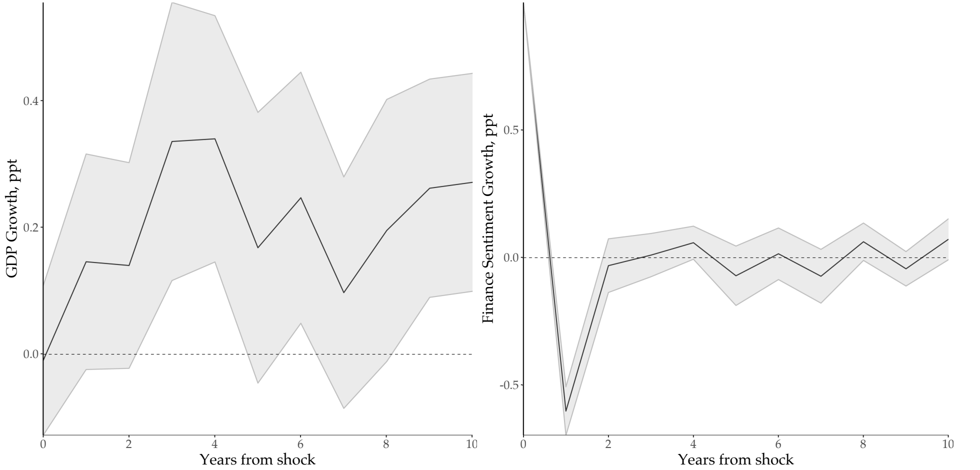
Does finance sentiment affect economic growth?

- To answer, we estimate impulse responses for GDP and credit growth using local projections (Jorda 2005)
- We calculate the cumulative effect of the finance sentiment shock to economic growth controlling for 3 lags of GDP, credit, and sentiment growth, and for country fixed effects

$$\Delta_h y_{i,t+h} = \alpha_i^h + \sum_{k=1}^{3} \beta_k^h \Delta f_{i,t-k} + \sum_{k=1}^{3} \gamma_k^h X_{i,t-k} + \epsilon_{i,t+h}, \quad h = 0, ..., H,$$

Impulse response of economic growth and finance sentiment

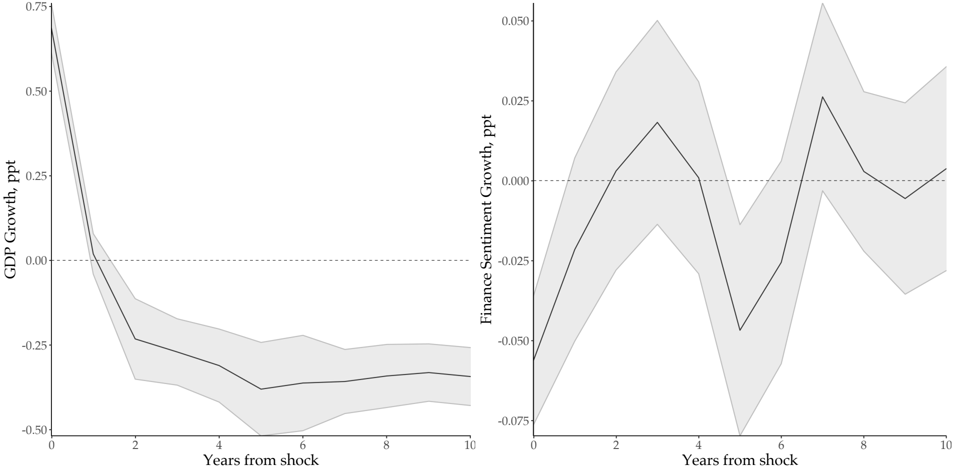
Finance sentiment shock is followed by higher future GDP growth (left)
Finance sentiment oscillates (right)



Finance sentiment growth shock

Impulse response of economic growth and finance sentiment to shocks

Positive GDP growth shock reduces contemporaneous finance sentiment

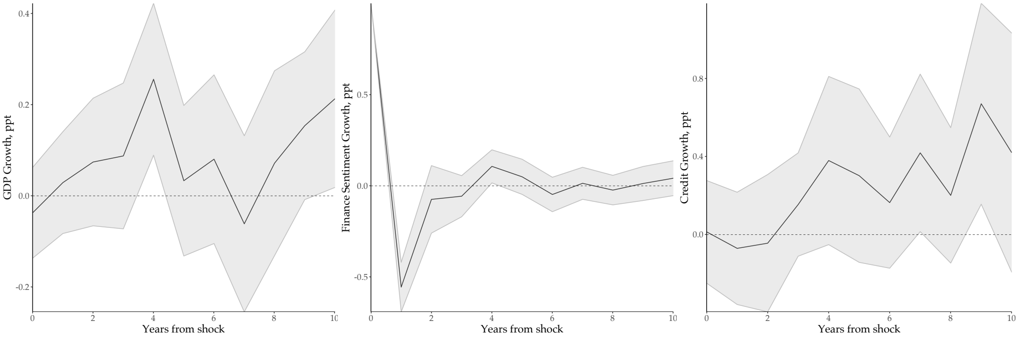


GDP growth shock

Impulse response of economic, credit growth and finance sentiment

Excluding China and Russia

Finance sentiment shock is followed by higher future GDP and Credit growth



Finance sentiment growth shock

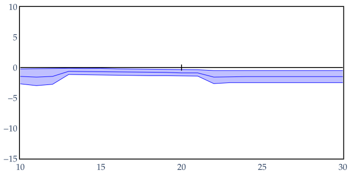
COVID-19 implications

- Beyond the health crisis, COVID-19 may have long-lasting effects on popular sentiment toward finance
- If like previous severe epidemics, all else equal we expect
  - 4pp decline in finance sentiment growth within a year
  - 1pp lower GDP growth over next five years
  - 2pp lower credit growth over next five years

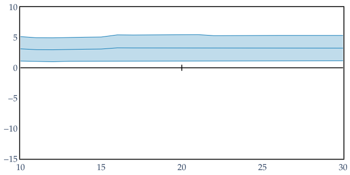
Conclusion

- Books allow us to travel through time and across borders, and to document several new facts about finance sentiment
- Persistent differences across languages/countries with ample time-series variation
- Finance sentiment declines after uninsured disasters but rises after insured ones
- Long-lasting effects on economic and financial growth
- Word embeddings are underutilized in economics and finance but show promise

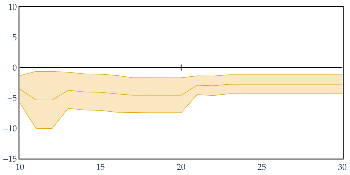
Effects on finance sentiment growth robustness to severe disaster cutoff



Natural disaster (any)

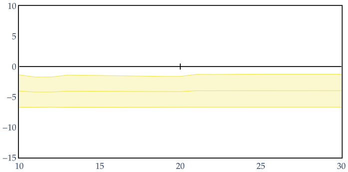


Drought

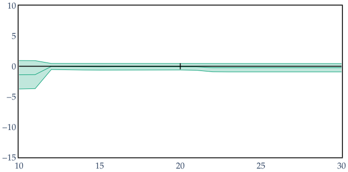


Earthquake

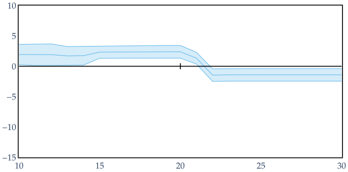
Effects on finance sentiment growth robustness to severe disaster cutoff



Epidemic

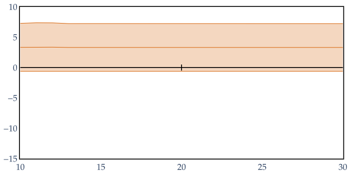


Extreme Temperature

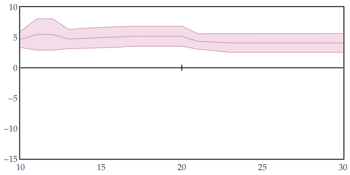


Flood

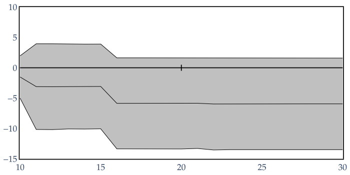
Effects on finance sentiment growth robustness to severe disaster cutoff



Fog



Landslide



Storm