

Measuring Geopolitical Risk

Dario Caldara Matteo Iacoviello

Federal Reserve Board

October, 2021 - West Virginia University

DISCLAIMER: The views expressed are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or of anyone else associated with the Federal Reserve System.

Geopolitical Risks Receive a Lot of Attention

Geopolitical risks are often cited by policy-makers, investors, and media as key determinants of economic decisions.

- 75% of investors worry about geopolitical risk (Gallup Survey 2017).
- Geopolitical risk salient risk to outlook for [BoE](#), [ECB](#), [IMF](#), [WB](#).

Higher geopolitical risks can:

1. Heighten perception of disastrous outcomes
2. Make investment in risky projects less attractive.
3. Lower consumer confidence

Do Geopolitical Risks Have Economic Consequences?

What We Do: Definition and Measurement

1. Construct text-based indicator of geopolitical risk—GPR Index—measuring frequency of articles in leading newspapers discussing adverse geopolitical events.
 - ▶ Focus on wars, terrorism, tensions between states;
2. Separate **threats** of adverse geopolitical events from their **realization and escalation**.

GPR Index highly correlated with narrative measure of geopolitical risk.

GPR Index correlated with firms' own assessment of geopolitical risks.

What We Do: Empirical Evidence

- Aggregate analysis:

Higher GPR reduces investment, employment, and stock returns.

Effects driven both by **threat** of adverse geopolitical events and by their **realization**.

Higher GPR is also associated with increased probability of disaster outcomes, and has disproportionately large effects on the tail of the GDP distribution.

- Firm-level analysis:

Reduction in firm-level investment stronger for firms highly exposed to aggregate GPR.

Idiosyncratic GPR reduces firm-level investment

Definition: Geopolitics and Geopolitical Risk

- Geopolitics: how geography affects politics and relations among states.
- **Geopolitical Risk** is the “the threat, realization, and escalation of adverse events associated with wars, terrorism, and any tensions among states and political actors that affect the peaceful course of international relations.”
- Our index is a continuous measure of risk. Higher values measure:
 - ▶ higher current intensity of negative events (e.g. more wars)
 - ▶ higher probability of negative events in the future
 - ▶ higher expected intensity of future negative events

Measurement: Newspaper Searches

- The geopolitical risk (GPR) index is measured by the **frequency** of newspaper articles mentioning high or rising geopolitical tensions.

$$GPR \propto \frac{\mathcal{G}}{\mathcal{U}}$$

where \mathcal{G} : articles mentioning geopolitical tensions;

\mathcal{U} : total number of articles

- **Recent index (from 1985)**: Chicago Tribune; Los Angeles Times; NYT; WSJ; WaPo; Phil.Enquirer; Daily Telegraph; FT; Guardian; The Globe and Mail.
- **Historical index (since 1900)**: NYT, Chicago Tribune, and WaPo
- Risks as covered/perceived by the English-speaking press.

Measurement: Selecting Terms in set \mathcal{G}

- We create a search query comprising two bags of words, the first bag containing topic words (e.g. war words, nuclear words, terrorism words), the second bag containing either “threat” or “act” words for each topic.
- The selection of topic words is based on:
 - ▶ definition of the phenomenon itself;
 - ▶ human reading and textual analysis of 44,000 front pages of NYT from 1900 through 2020;
 - ▶ extensive analysis of key dates and language used by the newspapers of that period in describing geopolitical events and their synonyms.
- Notes:
 - ▶ We exclude from searches articles containing words (such as movie, anniversaries, obituaries, books) associated with false positives.
 - ▶ We account for the evolution of language over time.

The Search Terms

A. Search categories and search queries

	Category	Search Query	Peak (Month)
War Threats	1. War risks	War_words N/2 Risk_words	Sudetenland German occupation (September 1938)
	2. Peace threats	Peace_words N/2 Peace_disruption_words	Iran Crisis of 1946 (April 1946)
	3. Military buildup, sanctions, embargoes	Military_words AND buildup_words	Iraq invades Kuwait (August 1990)
	4. Nuclear Threats	Nuke_bigrams AND Risk_words	Nuclear Ban Treaty Negotiations (August 1963)
	5. Terrorist Threats	Terrorism_words N/2 Risk_words	9/11 (October 2001)
War Acts	6. Beginning of war	War_words N/2 War_begin_words	Pearl Harbor (December 1941)
	7. Escalation of war	Actors_words N/2 Actors_fight_words	Battle of Normandy (D-Day) (June 1944)
	8. Terrorist Acts	Terrorism_words N/2 Terrorism_act_words	9/11 (September 2001)

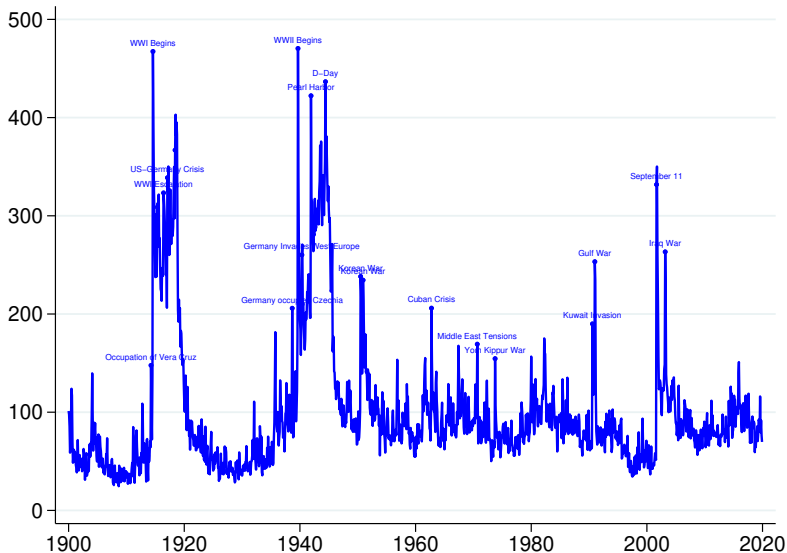
The Search Terms

B. Search words

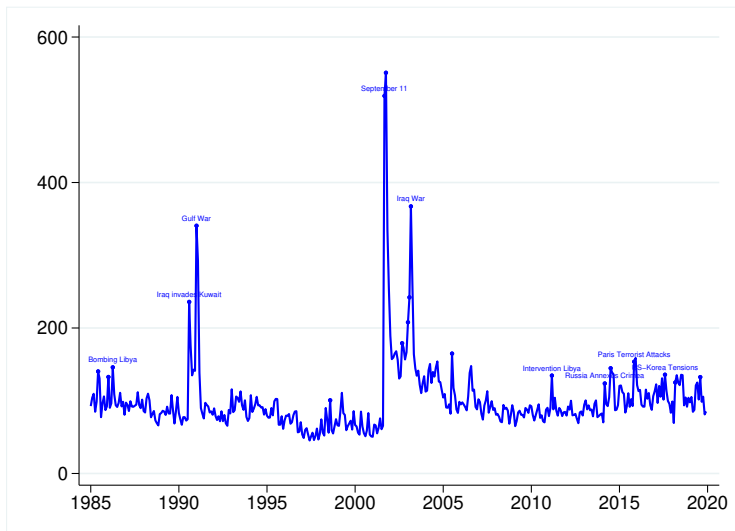
<i>Topic Bags</i>	<i>Exact Phrases</i>
War_words	war OR conflict OR hostilities OR revolution* OR insurrection OR uprising OR revolt OR coup OR geopolitical
Peace_words	peace OR truce OR armistice OR treaty OR parley
Military_words	military OR troops OR missile* OR "arms" OR weapon* OR bomb* OR warhead*
Nuke_bigrams	"nuclear war*" OR "atomic war*" OR "nuclear missile*" OR "nuclear bomb*" OR "atomic bomb*" OR "h-bomb*" OR "hydrogen bomb*" OR "nuclear test"
Terrorism_words	terror* OR guerrilla* OR hostage*
Actor_words	allie* OR enem* OR insurgen* OR foe* OR army OR navy OR aerial OR troops OR rebels

<i>Risk/Act Bags</i>	<i>Exact Phrases</i>
Risk_words	risk* OR warn* OR fear* OR threat* OR concern* OR danger* OR doubt* OR crisis OR trouble* OR disput* OR tension* OR imminen* OR inevitable OR footing OR menace* OR brink OR scare OR peril*
Peace_disruption_words	threat* OR menace* OR reject* OR peril* OR boycott* OR disrupt*
Buildup_words	buildup* OR build-up* OR sanction* OR blockad* OR embargo OR quarantine OR ultimatum OR mobiliz*
War_begin_words	begin* OR start* OR declar* OR begun OR began OR outbreak OR "broke out" OR breakout OR proclamation OR launch* OR wage*
Actor_fight_words	advance* OR attack* OR strike* OR drive* OR shell* OR offensive OR invasion OR invad* OR clash* OR raid* OR launch*
Terrorism_act_words	attack OR act OR bomb* OR kill* OR strike* OR hijack*

The Historical Geopolitical Risk Index



The Recent Geopolitical Risk Index

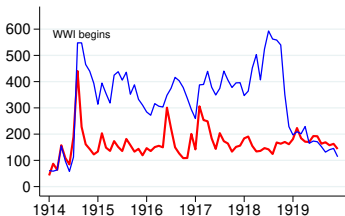


Geopolitical Threats vs. Geopolitical Acts

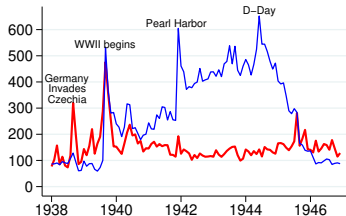
- GPR index captures a convolution of shocks to various moments of the distribution of geopolitical events.
- We break the index down into:
 - ▶ Geopolitical Threats (GPT): Search categories 1 to 5;
 - ▶ Geopolitical Acts (GPA): Search categories 6 to 8.
- **Main idea:** Many spikes in GPT and GPA associated with realization of geopolitical acts...
- ... Yet, some movements in GPT may happen when no underlying act materializes.

Geopolitical Threats vs. Geopolitical Acts

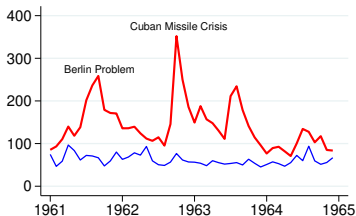
World War I



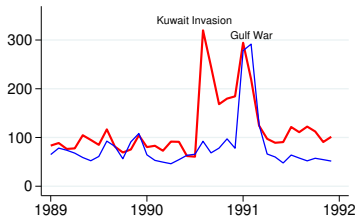
World War II



1960s



Gulf War



Is the Index Plausible?

- Does the Index Pass a Plausibility Test?
- Could Changes in the Use of Language Matter?
- How Does the Index Compare with Other Indicators of War Risk?

Newspaper Headlines

"All the News That's Fit to Print."

The New York Times.

LATE CITY EDITION
Published by The New York Times Company, 1230 Avenue of the Americas, New York 10020-1298.
Telephone: (212) 512-2000.
Second-class postage paid at New York, N.Y., and at additional mailing offices.
Postmaster: Send address changes in New York City to The New York Times, Attention: Fulfillment Manager, 1230 Avenue of the Americas, New York, N.Y. 10020-1298. Outside New York City, send address changes to The New York Times Company, Attention: Fulfillment Manager, 1230 Avenue of the Americas, New York, N.Y. 10020-1298.

VOL. LXXXIX—No. 31,641
SATURDAY, JUNE 30, 1945
THIRD CLASS PERMIT NO. 175
NEW YORK, N.Y.

HITLER DEMANDS FULL FRENCH SURRENDER; BORDEAUX CONSIDERING 'YES OR NO' REPLY; U. S. OUTLINES ECONOMIC WAR FOR AMERICAS

BOOK FOR WILLIAMS Senate Hearings Ordered
REPLACES IN THE ARMY On Stimson's Nomination

DEFENSE IN TRADE BRITAIN IS BOMBED

The International Situation
In Europe and Africa

CEREMONY IS BRIEF

"All the News That's Fit to Print."

The New York Times.

LATE CITY EDITION
Published by The New York Times Company, 1230 Avenue of the Americas, New York 10020-1298.
Telephone: (212) 512-2000.
Second-class postage paid at New York, N.Y., and at additional mailing offices.
Postmaster: Send address changes in New York City to The New York Times, Attention: Fulfillment Manager, 1230 Avenue of the Americas, New York, N.Y. 10020-1298. Outside New York City, send address changes to The New York Times Company, Attention: Fulfillment Manager, 1230 Avenue of the Americas, New York, N.Y. 10020-1298.

VOL. LXXXIX—No. 31,641
FRIDAY, AUGUST 3, 1945
THIRD CLASS PERMIT NO. 175
NEW YORK, N.Y.

DEMOCRATS ELECT FLYNN CHAIRMAN TO SUCCEED FARLEY

200,000 Children Seek Haven; Drive Here Asks Funds for Them

JAPAN'S NEW ORDER EXPANDED TO COVER GREATER EAST ASIA

GOVERNOR CREATES A DEFENSE COUNCIL FOR STATE SPEED-UP

AERIAL WARFARE SLACKENS BUT EACH SIDE RAIDS A CITY; MOLOTOFF SEES U. S. IN WAR

BRITAIN EXPECT TROUBLE

HAKE NO TIME TO LOSE

THE WAR IN EUROPE

HANOVER IS BOMBED

CIVILIANS CHIEF VICTIMS,
NAZI SAY—NORWICH

"All the News That's Fit to Print."

The New York Times.

LATE CITY EDITION
Published by The New York Times Company, 1230 Avenue of the Americas, New York 10020-1298.
Telephone: (212) 512-2000.
Second-class postage paid at New York, N.Y., and at additional mailing offices.
Postmaster: Send address changes in New York City to The New York Times, Attention: Fulfillment Manager, 1230 Avenue of the Americas, New York, N.Y. 10020-1298. Outside New York City, send address changes to The New York Times Company, Attention: Fulfillment Manager, 1230 Avenue of the Americas, New York, N.Y. 10020-1298.

VOL. LXXXIX—No. 31,641
SUNDAY, JANUARY 15, 1945
THIRD CLASS PERMIT NO. 175
NEW YORK, N.Y.

OPEN DOOR IN CHINA PLEADED BY TERRIBLE A LONG WAR IS SEEN

Violent Magnetic Storm Disrupts Short-Wave Radio Communication

Transoceanic Services Transfer Phone and Other Traffic to Long Wave Lengths as Sun Spot Disturbance Strikes

CITY BUDGET SUIT DEMANDS FULL PAY FOR DISPUTED JOBS

Income Tax on a Million Was Paid in 1934

U. S. STEEL PLANS \$30,000,000 OUTLAY ON PLANT RENEWAL

FREE COOPERATION URGED

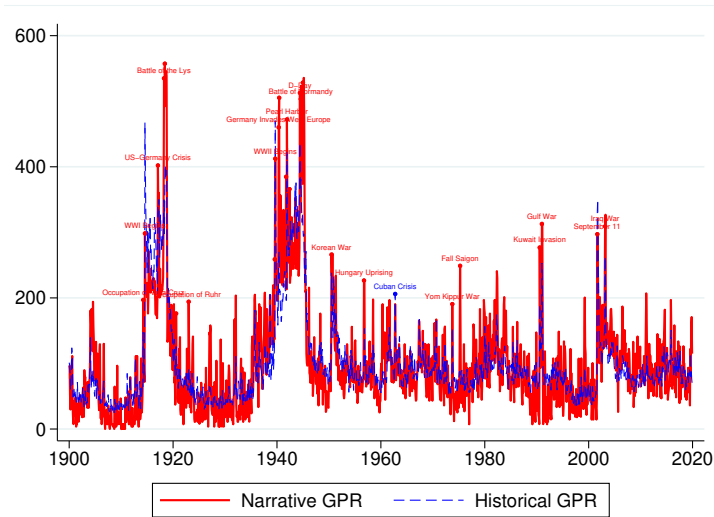
REPORT HIS LOSSER HIGH

RID OF TANNARY HINTED

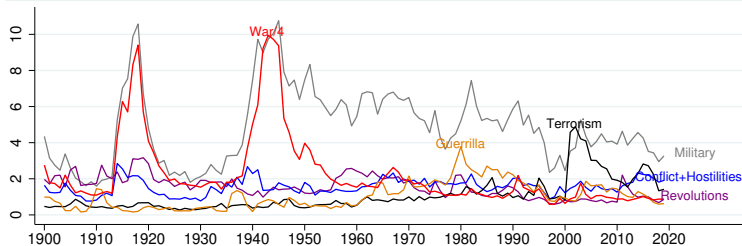
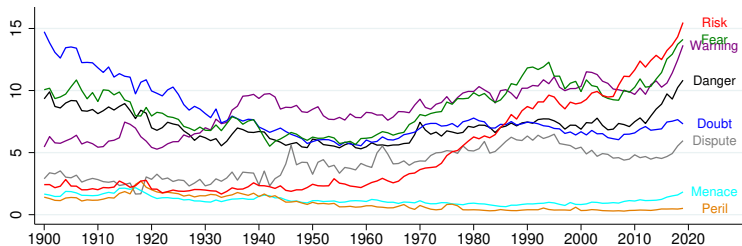
LINKS PRICES TO PAY RISE

The Narrative GPR Index

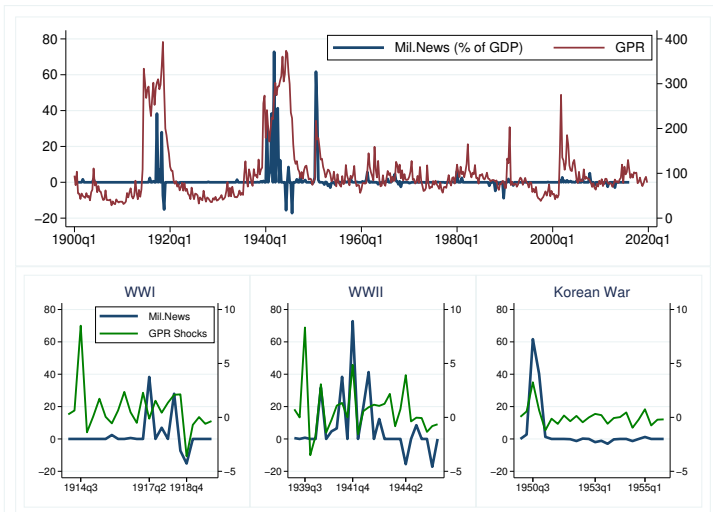
We read 44,000 daily front pages of NYT and code them 0, 1, 2, or 5 depending on coverage of geopolitical events



Use of Words over Time



GPR and Military News



NOTE: Time-Series Comparison of GPR Index and GPR shocks with Military News variable from Ramey (2011).

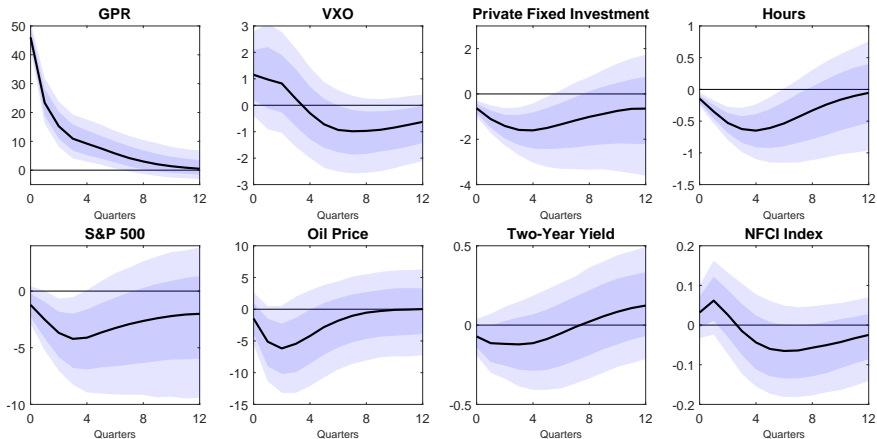
Geopolitical Risk and Economic Activity

1. VAR Evidence for the United States since 1985: Threats matter as much as acts
2. Panel Quantile Regressions since 1900: GPR affects entire distribution of economic variables
3. Panel Logit Regressions since 1900: GPR predicts economic disasters

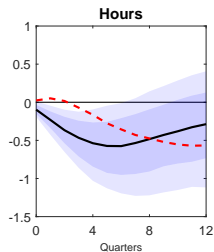
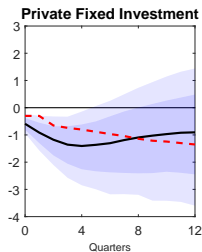
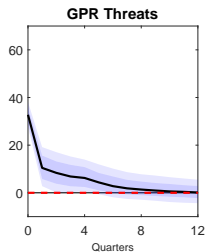
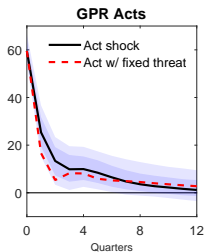
Quarterly VARs: Threats and Acts

- **GPR Specification**: LGPR, VIX, BFI, EMP, S&P500, OIL, T02YR.
- **Acts vs. Threats**: Replace LGPR with LGPA & LGPT
- Identification (I): Cholesky with GPR indexes ordered before economic variables \Rightarrow **Contemporaneous** exogeneity.
- Identification (II): LGPA ordered 1st and LGPT 2nd in Cholesky
 - ▶ **GPA shocks** mostly capture the realization of adverse geopolitical events.
 - ▶ **GPT shocks** mostly capture increased risk about adverse geopolitical events.
- Sample: 1985Q1-2019Q4

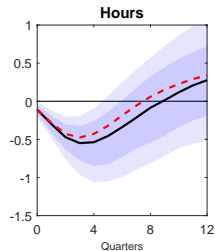
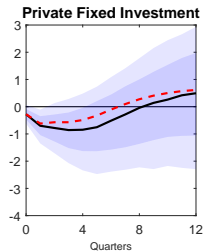
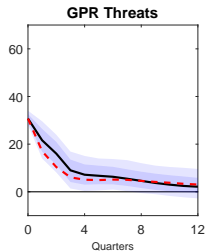
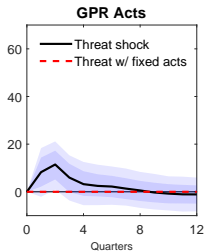
Quarterly VAR: 2-SD GPR Shock



Quarterly VAR: 2-SD GPA Shock



Quarterly VAR: 2-SD GPT Shock

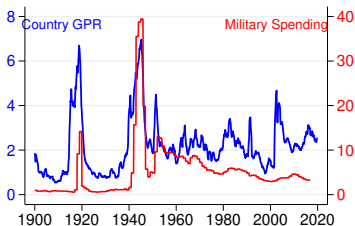


Geopolitical Risk and Quantile Regressions

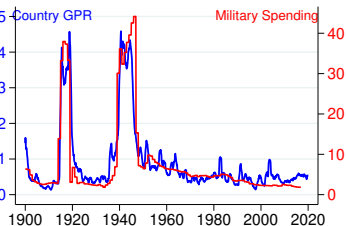
- Does GPR affects the entire conditional distribution of macroeconomic variables?
- We use yearly data for a panel of 26 countries. Sample runs from 1900 through 2019.
- For each country, we construct a country-specific measure of geopolitical risk controlling for relative intensity of GPR in that country.
- Country-specific GPR is share of newspaper articles simultaneously (1) mentioning GPR and (2) naming country in question.

Country-Specific GPR

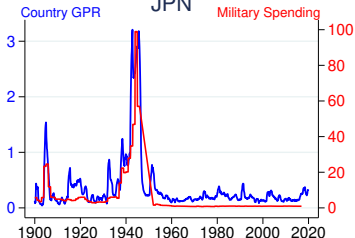
USA



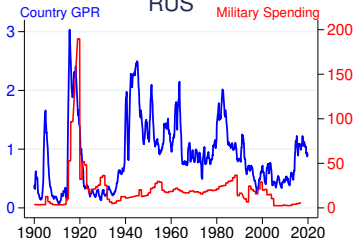
GBR



JPN



RUS



Geopolitical Risk and Quantile Regressions

- Does GPR affects the shape of the conditional distribution of macroeconomic variables?

Table 3: Quantile Regression Effects of Country-Specific Geopolitical Risk

	(1)	(2)	(3)
	GDP Growth(t+1)	TFP Growth(t+1)	Military Exp.(t+1)
OLS	-0.72*** (0.11)	-0.39** (0.15)	1.15*** (0.24)
Quantile			
q50	-0.51*** (0.07)	-0.23* (0.09)	0.13* (0.05)
q10	-1.14*** (0.26)	-1.14*** (0.22)	0.02 (0.03)
q90	-0.29 (0.18)	0.17 (0.22)	1.46*** (0.44)
Observations	3,046	2,242	2,663
Countries	26	19	26

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Geopolitical Risk and Economic Disasters

- Is higher GPR associated with higher probability of economic disaster?

Table 4: Logit Disaster Models

	(1)	(2)	(3)	(4)
	Disaster Dummy	Disaster Dummy	Disaster Dummy	Disaster Dummy
GDP Growth t-1	0.96*** (0.01)	0.96** (0.01)	0.95*** (0.01)	0.96*** (0.01)
GPR	2.52*** (0.13)	2.66*** (0.16)		2.18*** (0.12)
Country GPR		1.28*** (0.06)		1.25*** (0.07)
GPR Spikes			3.21*** (0.28)	
Country GPR Spikes			1.36*** (0.07)	
Mil. News				1.10 (0.05)
Dummy Pre-1946				0.48** (0.13)
Dummy 1946-1972				0.27*** (0.08)
Dummy Post-1972				0.06*** (0.02)
Constant	0.26*** (0.01)	0.22*** (0.07)	0.17*** (0.06)	
Observations	3,047	3,047	3,047	2,947
Pseudo-R ²	0.17	0.24	0.23	0.32
Countries	26	26	26	26
Country Fixed Effects	No	Yes	Yes	Yes

Exponentiated coefficients. Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Firm-Level Effects of Geopolitical Risk

- Two questions:
 - ▶ Do firms in **industries** more exposed to aggregate geopolitical risks experience a larger decline in investment? Yes
 - ▶ Are there **idiosyncratic** geopolitical risk events that drive variation in investment at the firm level? Yes
- Conceptual framework:

$$GPR_{i,t} = GPR_t + GPR_t \Lambda_k + Z_{i,t}.$$

- ▶ Λ_k is industry-exposure to aggregate GPR
- ▶ $Z_{i,t}$ is idiosyncratic geopolitical risk.
- ▶ Goal: To measure the effects of $GPR_t \Lambda_k$ and $Z_{i,t}$ on firm investment

Industry Effects of Geopolitical Risk

Construction of Industry Exposure

- Construct stock-market based measure of Fama-French 48-group **industry** exposure to geopolitical risk using daily regressions of industry excess returns on GPR:

$$R_{k,t} = \alpha_k + \beta_k \Delta GPR_t + \varepsilon_{k,t},$$

- $\Lambda_k = -\text{sign}(\beta_k - \bar{\beta})$
 - ▶ More exposed (negative beta): Entertain, Transportation, Textiles.
 - ▶ Less exposed (positive beta): Gold, Oil, Defense.
- We estimate:

$$\log ik_{i,t+2} = \alpha_i [+ \alpha_t] + \beta_h (\Lambda_k \Delta \log GPR_t) + d X_{i,t} + \varepsilon_{i,t+2} \quad (1)$$

Firm-Level Effects of Geopolitical Risk

Construction of Firm-Level Exposure

Two steps:

1. Search the earnings call transcripts for geopolitical (*GP*) terms
 - ▶ E.g., *war**, *militar**, *terror**, *conflict**
 - ▶ Frequency of *GP* matches indicates the intensity of geopolitical risks in a conference call
2. Search transcripts for risk (*R*) terms in close proximity to *GP* terms
 - ▶ E.g., *risk**, *threat**, *tension**, *uncertain**
 - ▶ Must appear within **10** words

$GPR_{i,t}$ = Number of joint instances of *GP* and *R* (normalized by number of words in the call)

Firm-Level GPR on Investment

- Estimate:

$$\log ik_{i,t+2} = \alpha_i + \alpha_{k,t} + \gamma Z_{i,t} + d X_{i,t} + \varepsilon_{i,t+2} \quad (2)$$

- α_i and $\alpha_{k,t}$: firm and industry-time fixed effects
 γ : response of $\log ik$ in $t + 2$ to change in firm-level GPR ($Z_{i,t}$) in quarter t
- $X_{i,t}$: firm cash flows and Tobin's Q, $\log ik_{i,t-1}$.

Effects of GPR at firm level

Table 5: Geopolitical Risk and Firm-Level Investment

$IK(t+2)$	1	2	3	4
DGPR x Dummy Exposure	-0.567 (0.214)**	-0.589 (0.210)***		
GPR Firm-Level			-0.828 (0.294)***	
Political Risk HHLT				-0.762 (0.241)***
DGPR	-1.513 (1.235)			
Cash Flow	2.681 (0.468)***	2.747 (0.468)***	2.543 (0.395)***	2.427 (0.313)***
Tobin's Q	8.985 (1.676)***	8.001 (1.555)***	8.966 (1.063)***	9.492 (0.975)***
$IK(t-1)$	0.311 (0.009)***	0.298 (0.009)***	0.240 (0.008)***	0.261 (0.009)***
Observations	375,935	375,935	88,755	112,297
Firm FE	Yes	Yes	Yes	Yes
Time Effects	No	Yes	Yes	Yes
R-squared	0.452	0.471	0.594	0.582
Sample	85Q1-19Q4	85Q1-19Q4	05Q1-19Q4	05Q1-19Q4

Conclusions

- Geopolitical risk has adverse negative effects on real activity
 - ▶ The effect on investment varies across firms and industries.
- Adverse effects of geopolitical risk are driven by the threat and by realization of adverse geopolitical events.
- On our GPR webpage—together with all data for the US—you can also find GPR index for many other countries.