

Measuring Geopolitical Risk

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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 (destruction of human and physical capital, disruption of supply chains, expropriation risk)
2. Make investment in risky projects less attractive.
3. Lower consumer confidence

But Should They?

To many, concerns about adverse geopolitical events seem overstated as many events should have little direct economic impact for the United States (e.g. 9/11; Russia-Ukraine tensions; US-North Korea tensions).

Do geopolitical risks have economic consequences for the United States?

Answering this question requires definition & measurement of geopolitical risk, and empirical analysis

What We Do: Definition and Measurement

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

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

GPR index available at daily & monthly frequencies.

GPR index better than many existing indicators that are not amenable to empirical analysis. **Examples**

What We Do: Empirical Evidence on GPR

- Aggregate analysis:

GPR exogenous to U.S. macroeconomic conditions.

Higher GPR reduces investment, employment, and stock returns.

Effects mostly driven by **threat** of adverse geopolitical events rather than their realization.

- Firm-level analysis:

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

Idiosyncratic GPR reduces firm-level investment

Plan of the Talk

1. Introduction
2. Construction of the GPR Index:
 - ▶ Definition.
 - ▶ Measurement.
 - ▶ Audit.
3. Aggregate analysis:
 - ▶ Exogeneity
 - ▶ Predictive regressions on US investment.
 - ▶ VAR models.
4. Firm-level analysis on US investment.
5. Conclusions.

Definition: Geopolitics and Geopolitical Risk

- We define **Geopolitical Risk** as the “risk associated with wars, terrorist acts, and tensions between states that affect the normal and peaceful course of international relations.”
- Geopolitical risk captures both risk that these events materialize and new risks associated with escalation of existing events.

Measurement: Newspaper Searches

- The geopolitical risk (GPR) index is the **frequency** of articles in 11 newspapers 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

- **Benchmark index (from 1985)**: Boston Globe; Chicago Tribune; Los Angeles Times; NYT; WSJ; WaPo; Daily Telegraph; FT; Guardian; Times; The Globe and Mail.
- **Historical index (from 1899)**: NYT, Chicago Tribune, and WaPo
- Risks as covered/perceived by the English-speaking press.

Measurement: Selecting Terms in set \mathcal{G}

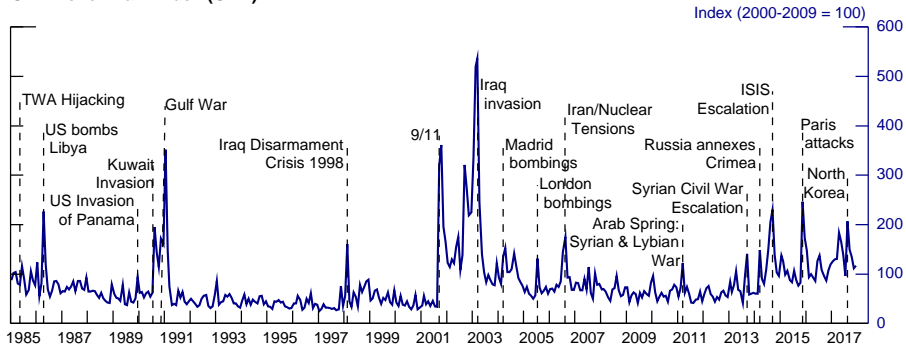
- Start with a **pilot audit** of articles *likely* mentioning geopolitical risks, by reading and coding \mathcal{E}^0 or \mathcal{E}^1 a set of articles \mathcal{E} containing *Geopolitics* or *War* or *Military* or *Terrorism/t* —the most **RECURRING WORDS** in geopolitics books.
- Most articles in \mathcal{E}^1 contain additional words related to risks or threats, tensions between states, beginning of wars.
- Based on the content in \mathcal{E}^1 , we construct the terms in set \mathcal{G} .
- Notes:
 - ▶ We exclude from searches phrases overwhelmingly associated with false positives (\mathcal{E}^0) (e.g. movies, anniversaries, obituaries, end of the war)
 - ▶ We try to account for the evolution of language and content over time.

Measurement: The Search Terms

Search Category	Words
1. Geopolitical Threats	Geopolitical AND (risk* OR concern* OR tension* OR uncertainty*) "United States" AND tensions AND (military OR war OR geopolitical OR coup OR guerrilla OR warfare) AND ("Latin America" OR "Central America" OR "South America" OR Europe OR Africa OR "Middle East" OR "Far East" OR Asia)
2. Nuclear Threats	("nuclear war" OR "atomic war" OR "nuclear conflict" OR "atomic conflict" OR "nuclear missile*") AND (fear* OR threat* OR risk* OR peril* OR menace*)
3. War Threats	"war risk*" OR "risk* of war" OR "fear of war" OR "war fear*" OR "military threat*" OR "war threat*" OR "threat of war" ("military action" OR "military operation" OR "military force") AND (risk* OR threat*)
4. Terrorist Threats	"terrorist threat" OR "terrorist threats" OR "menace of terrorism" OR "terrorism menace" OR "threat of terrorism" OR "terrorist risk" OR "terror risk" OR "risk of terrorism" OR "terror threat" OR "terror threats"
5. War Acts	(beginning OR outbreak OR onset OR escalation OR start) "of the war" (war OR military) AND ("air strike" OR "heavy casualties")
6. Terrorist Acts	"terrorist act" OR "terrorist acts"

The Benchmark Geopolitical Risk Index

GPR Benchmark Index (GPR)



GPR Index updated monthly and available at

<https://www2.bc.edu/matteo-iacoviello/gpr.htm>

Audit: Reading and Manually Coding Articles

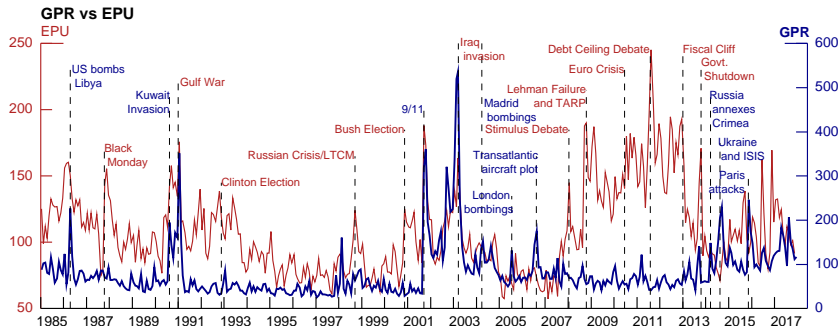
- **Full Scale Audit:** Sample 6,125 articles from \mathcal{E} , code them as 0/1.
- Goal: comparison of GPR index with “human GPR”:

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

$$human_GPR = \frac{\mathcal{E}^1}{\mathcal{E}} \frac{\mathcal{E}}{\mathcal{U}}$$

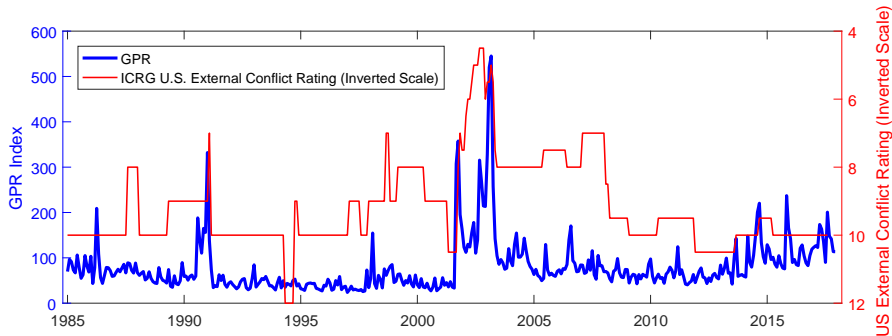
- Correlation between GPR and “Human GPR”: 84%.
- **Ex post Audit:** Sample 2,500 articles from set \mathcal{G} :
 - ▶ 87% mention high or rising geopolitical tensions.
 - ▶ 4% mention low or decreasing geopolitical tensions.
 - ▶ Correlation between GPR and audited-GPR is 0.98

GPR and EPU



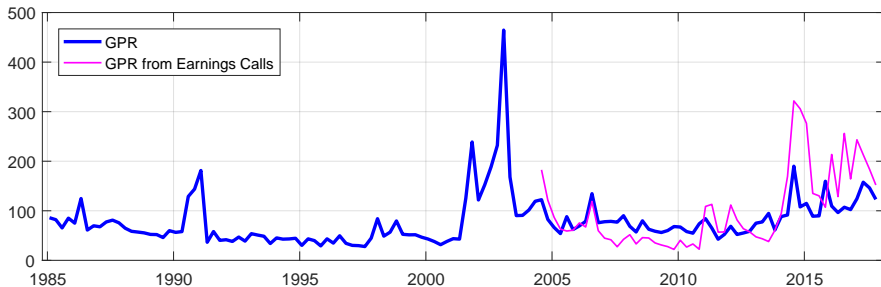
GPR Index shows little correlation with EPU Index, except around 9/11 and the Iraq War.

GPR and ICRG U.S. Conflict Index



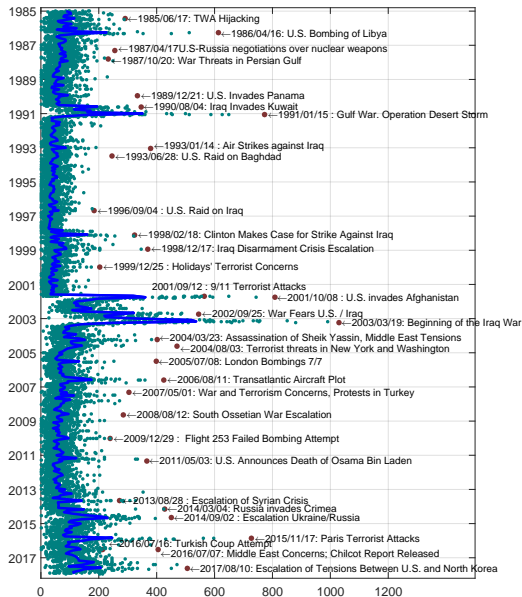
GPR Index displays more high-frequency variation relative to other proxies of war risk, allowing to establish the importance of GPR for stock returns over relatively short samples.

GPR and GPR from Firms' Earnings Calls



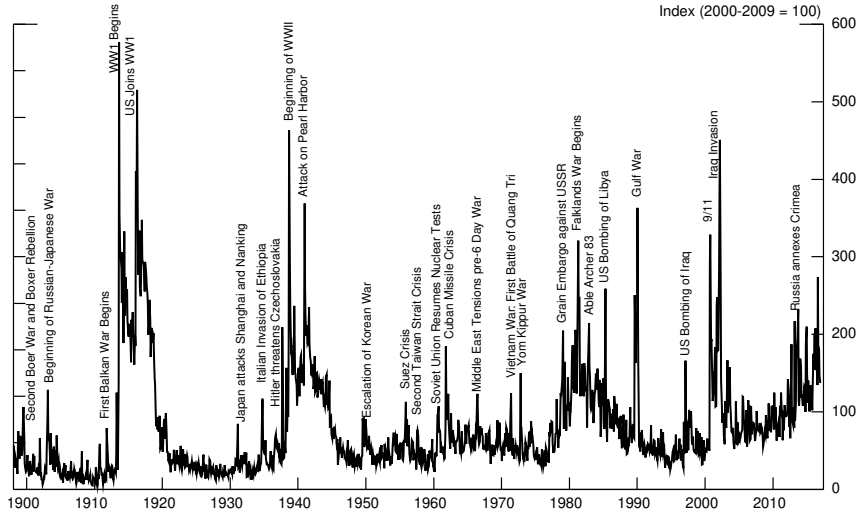
GPR Index highly correlated with firms' own assessment of geopolitical risk, constructed using same search terms in transcripts of listed firms' quarterly earnings calls with analysts.

The Daily GPR Index



The Historical Geopolitical Risk Index

GPR Historical

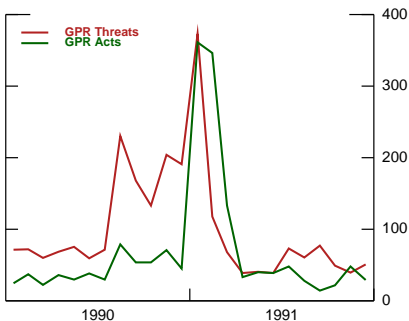


Geopolitical Threats vs. Geopolitical Acts

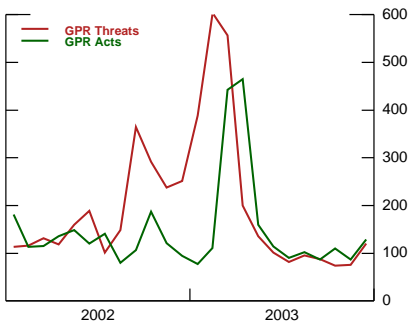
- GPR index captures a convolution of shocks to first and higher order moments of the distribution of geopolitical events.
 - ▶ Spikes in risk often coincide with realization of big events.
- We break the index down into:
 - ▶ Geopolitical Threats (GPT): Search categories 1 to 4;
 - ▶ Geopolitical Acts (GPA): Search categories 5 to 6.
- **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 Acts in 1991 and 2003

Gulf War



Iraq Invasion



Geopolitical Risk and Economic Activity

- GPR is Exogenous.
- GPR predicts economic activity (forecasting regressions and VAR).
- Threats matter more than acts (VAR).
- Effects of GPR stronger in industries more exposed to GPR.

Granger Tests: Specification

- Granger-causality tests based on:

$$LGPR_t = \alpha + \sum_{i=1}^p \beta_i LGPR_{t-i} + \sum_{i=1}^p \Gamma'_{M,i} M_{t-i} + \sum_{i=1}^p \Gamma'_{F,i} F_{t-i} + \sum_{i=1}^p \Gamma'_{U,i} U_{t-i} + \varepsilon_t^{GPR}$$

- A test that x_t does not Granger-cause $LGPR_t$ is an F-test of $H_0 : \Gamma_{x,i} = 0, \forall i$.
- Macro variables (M_t): ΔIP , Δ employment, real oil price.
- Financial variables (F_t): Return on S&P500, 2-year Treasury yield.
- Uncertainty variables (U_t): LEPU, LVXO.
- Sample: 1985M1-2017M12; $p = 3$.

Granger Tests: Results

Table 1: Exogeneity of Geopolitical Risk

<i>Variables</i>	(1) LGPR	(2) LGPR A	(3) LGPR T
Macro	1.18 [0.31]	0.94 [0.49]	1.38 [0.20]
Financial	1.33 [0.24]	0.82 [0.55]	1.26 [0.28]
Uncertainty	1.08 [0.38]	0.72 [0.63]	1.46 [0.19]
LGPR	139.67*** [0.00]		
LGPR A		27.67*** [0.00]	1.22 [0.30]
LGPR T		3.21** [0.02]	121.46*** [0.00]
Adj. R^2	0.66	0.39	0.67

- Macro, financial and uncertainty variables do not predict GPR.

Forecasting Regressions: Specification

- Do shocks to GPR predict future changes in investment?
- Estimate univariate forecasting specification:

$$\Delta BFI_{t+h} = \alpha + \beta_h^{GPR} \varepsilon_t^{GPR} + \sum_{i=1}^p \Gamma_{t-i} X_{t-i} + v_{t+h}$$

- ΔBFI_{t+h} : Change in log quarterly business fixed investment between $t-1$ and $t+h$.
- $X_t = EPU_t, \Delta BFI_t, \Delta EMP_t$; $p = 2$.
- ε_t^{GPR} is the residual from exogeneity regression under $\Gamma_{M,i} = \Gamma_{F,i} = \Gamma_{U,i} = 0 \forall i$.

Forecasting Regressions: Results

Table 2: Geopolitical Risk and Business Fixed Investment

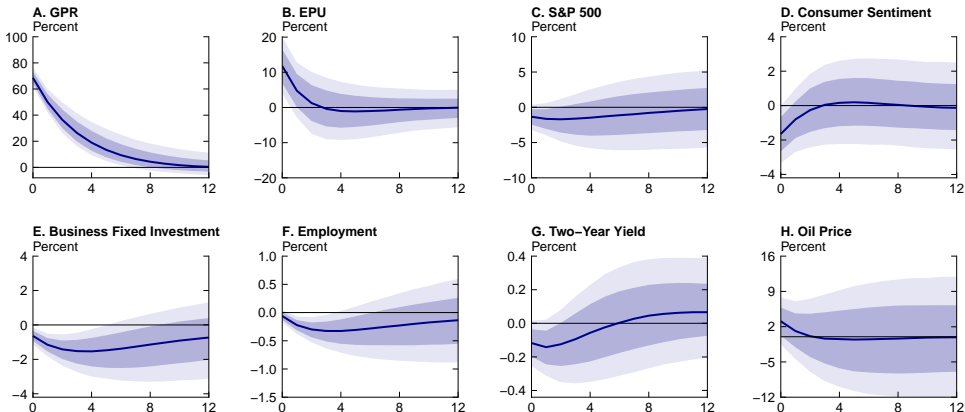
<i>Business Fixed Investment</i> (ΔBFI_{t+h})	(1) $h = 1$	(2)	(3) $h = 2$	(4)	(5) $h = 4$	(6)
GPR	-0.97*** [2.84]		-1.27*** [2.86]		-1.81*** [2.89]	
GPRA		-0.48 [1.34]		-0.46 [0.72]		-0.02 [0.02]
GPRT		-0.79** [2.28]		-0.99** [2.27]		-1.64** [2.49]
Controls	YES	YES	YES	YES	YES	YES
N	128	128	127	127	125	125

Coefficients in the table report the impact of a 2-SD rise in ε_t^{GPR} .

Quarterly VARs: Specification and Identification

- To get a broader perspective on the transmission of changes in GPR, we estimate quarterly VAR models.
- **GPR Specification:** LGPR, LEPU, BFI, EMP, S&P500, T02YR.
- **Acts vs. Threats:** Replace LGPR with LGPRA & LGPRT
- Identification (I): Cholesky with GPR indexes ordered before economic variables \Rightarrow **Contemporaneous** exogeneity.
- Identification (II): LGPRA ordered 1st and LGPRT 2nd in Cholesky
 - ▶ **GPR shocks** can be a convolution of shocks to first and higher moments of geopolitical events distribution.
 - ▶ **GPR shocks** capture primarily shocks to uncertainty and risk.
- Sample: 1985Q1-2017Q4

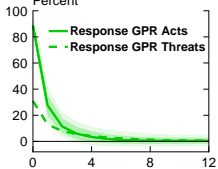
Quarterly VAR: 2-SD GPR Shock



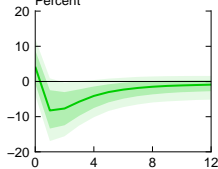
Quarterly VAR: 2-SD GPRA Shock

A. GPR Acts & Threats

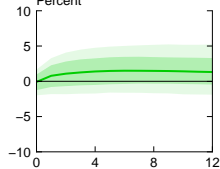
Percent

**B. EPU**

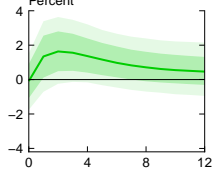
Percent

**C. S&P 500**

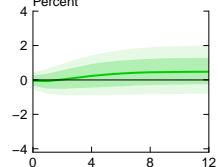
Percent

**D. Consumer Sentiment**

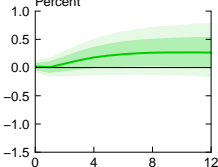
Percent

**E. Business Fixed Investment**

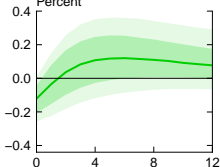
Percent

**F. Employment**

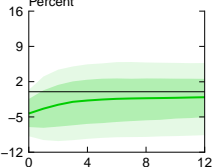
Percent

**G. Two-Year Yield**

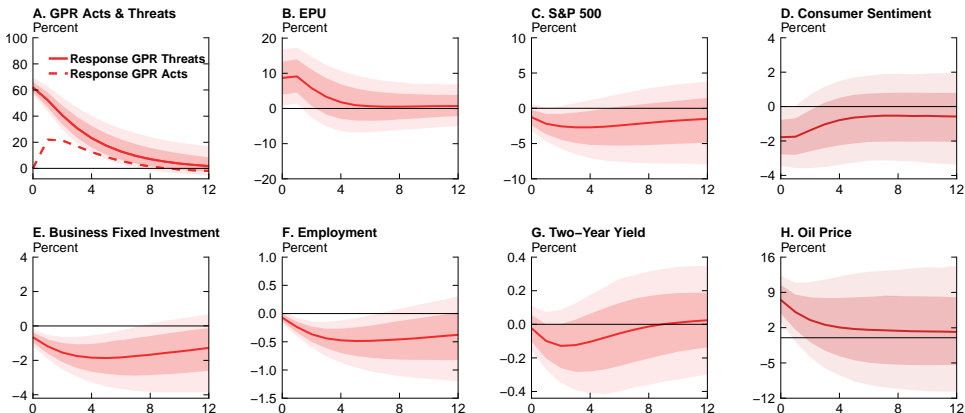
Percent

**H. Oil Price**

Percent



Quarterly VAR: 2-SD GPRT Shock



Firm-Level Effects on Investment

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

- Conceptual framework:

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

- $\Lambda_{k,t}$ is industry-exposure to aggregate GPR
- $Z_{i,t}$ is pure idiosyncratic risk.
- We want to measure the cross-industry and within-industry effects of $GPR_t \Lambda_{k,t}$ and $Z_{i,t}$ on firm investment

Industry Effects of Geopolitical Risk

Construction of Industry Exposure

- Construct stock-market based measure of **industry** exposure to geopolitical risk using daily regressions:

$$R_{k,s} = \alpha_k + \beta_k \Delta GPRT_s + \gamma_k RM_s + \varepsilon_{k,s},$$

- 10-year window rolled one quarter at time.
- Use Fama-French 48 industry groups.
- $\Lambda_{k,t}$: Minus beta lagged by one quarter.
 - ▶ Most exposed (negative beta): Entertain, Transportation, Textiles.
 - ▶ Least exposed (positive beta): Gold, Oil, Defense. **Industry Exposure**

Industry Effects of Geopolitical Risk

Industry Regressions

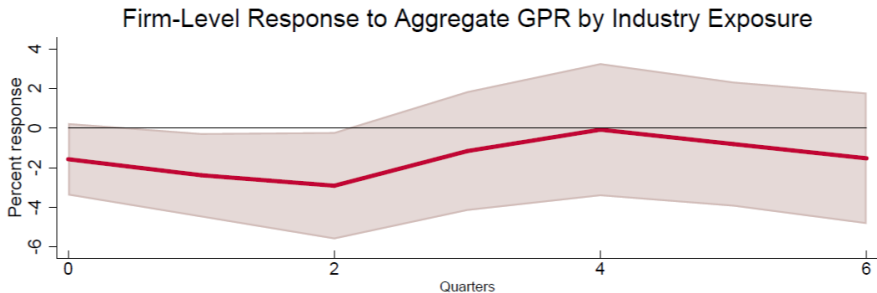
- Let ik denote firm CapEx divided by property, plant and equipment. We estimate, for $h = 0, \dots, 6$:

$$\log ik_{i,t+h} - \log ik_{i,t-1} = \alpha_i + \alpha_t + \beta_h (GPR_t \Lambda_{k,t}) + \mathbf{X}_{i,t} + \varepsilon_{i,t}$$

β_h : differential response of $\log ik$ in $t + h$ to GPR in quarter t

- α_i and α_t : firm and time fixed effects
- $\mathbf{X}_{i,t}$: firm cash flows and Tobin's Q.
- Drop financial firms and utilities, HQ outside US, small firms (PPENTQ less than \$5 million).

Industry Effects of Geopolitical Risk



- Experiment: 2sd aggregate GPR shock hitting a firm in an industry with 1sd exposure above average.
- In the four quarters after the shock, firm experiences a differential decline in investment about 2 p.p. larger than the average decline.

Industry Effects of Geopolitical Risk

- From VAR: A 2sd GPR shock reduces aggregate investment by 1.8%.
- From firm-level regressions calculate differential effects across industries:
 - ▶ Entertainment industry: 3.8 % decline in investment (-1.8% -2%)
 - ▶ Defense industry: 0.2 % increase in investment (-1.8% +2%)
- Effects of GPR can be twice as large as the VAR for industries 1sd more exposed, and close to zero for industries 1sd less exposed.

What Drives Industry Exposure $\Lambda_{k,t}$?

1. **Macro Exposure.** Firms in cyclical sectors may be more vulnerable if geopolitical risks weigh on aggregate demand.
(Cyclicality = industry sensitivity of investment to aggregate demand)
2. **Openness.** Geopolitical risks may lead to embargoes, expropriation, trade wars, reducing demand for foreign-oriented firms.
3. **Leverage.** If geopolitical risks increase disaster probability, levered industries could be more impacted (Gourio, 2013). Disaster-Risk

Regressing Industry Exposure on these three variables gives:

$$\Lambda_{k,t} = \underset{(0.096)}{0.203} MacroExp_k + \underset{(0.091)}{0.177} Openness_{k,t-4} + \underset{(0.074)}{0.234} Leverage_{k,t-4}$$

Measuring Firm-Level GPR: Textual Analysis

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 trade policy discussions in a conference call
2. Search for risk (*R*) terms in close proximity to *GP* terms
 - ▶ E.g., *risk**, *threat**, *tension**, *uncertain**
 - ▶ Must appear within **10** words

$GPR_i = \text{Number of joint instances of } GP \text{ and } R \text{ (normalized by number of words in the call)}$

Firms' Earnings Calls

Terrorist Attacks in 2005 (2005Q3):

- Terrorism including the London bombings have impacted our consumer travel businesses. Whether it is declining consumer confidence or an actual slowdown in the travel economy, it is too soon to tell. But the impact is slower growth across our segments of the markets. **Cendant Corporation**

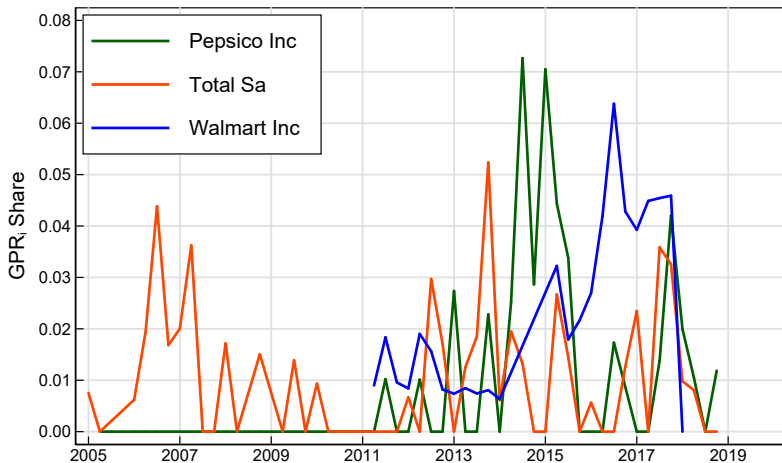
Russia - Ukraine tensions (2014 Q3):

- As a global company, we continuously monitor the changing geopolitical environments in areas in which Capstone is doing or plans to do business. The largest potential impact is definitely Russia and the ongoing tensions in the Ukraine. **Capstone Turbine Corp**

North Korea - US tensions (2017 Q2):

- And there's still tremendous **geopolitical** uncertainty around the world that we're keeping our eye on and want to make sure I think before we would take another step that we're comfortable about sustainability of the order rates versus what we saw in the first quarter. **Caterpillar**

Firm-Level Geopolitical Risk



Quantifying the Effects of Firm-Level GPR on Investment

- We estimate, for $h = 0, \dots, 6$:

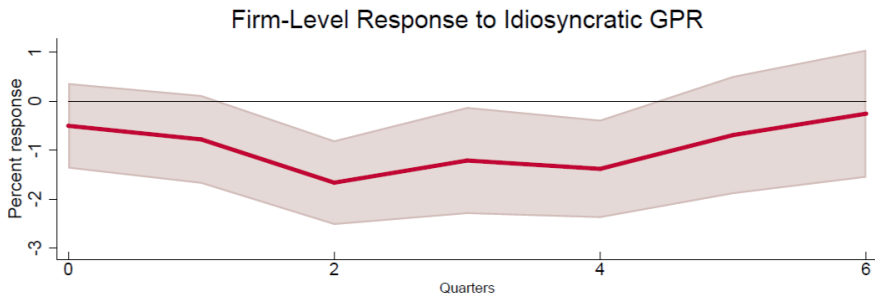
$$\log ik_{i,t+h} - \log ik_{i,t-1} = \alpha_i + \alpha_{k,t} + \gamma_h Z_{i,t} + \mathbf{X}_{i,t} + \varepsilon_{i,t}$$

- α_i and $\alpha_{k,t}$: firm and industry-time fixed effects

γ_h : response of $\log ik$ in $t + h$ to change in TPU in quarter t

- $\mathbf{X}_{i,t}$ are firm-level controls: cash flows and Tobin's Q.

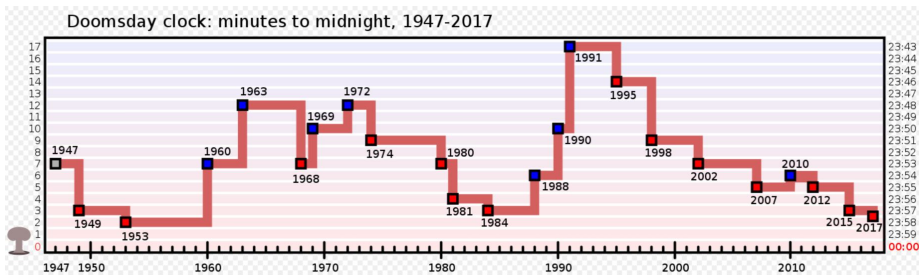
Firm-Level Response to Idiosyncratic GPR



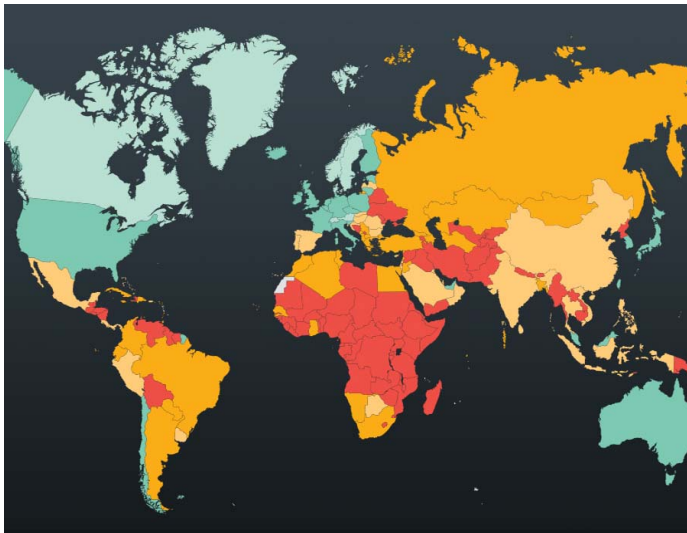
Conclusions

- We construct a quantitative measure of geopolitical risk.
- Geopolitical risk is largely exogenous to the US economy.
- Geopolitical risk has adverse negative effects on real activity in the United States, including investment.
 - ▶ The effect on investment varies across firms and industries.
- Adverse effects of geopolitical risk are mostly driven by the threat of adverse geopolitical events.
- On our GPR webpage—together with all data for the US—you can also find a beta version of the GPR index for many other countries.

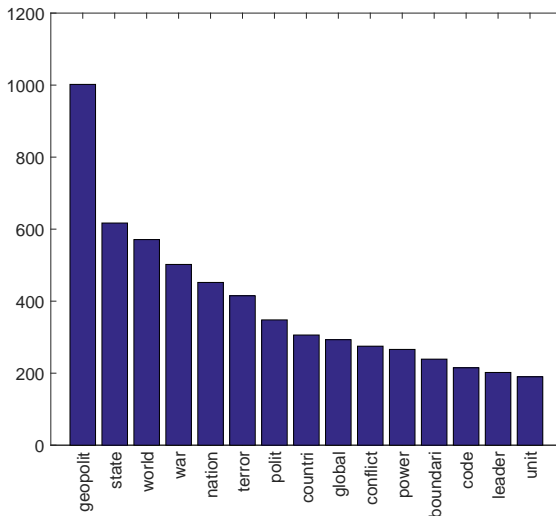
Available Indices 1: Doomsday Clock



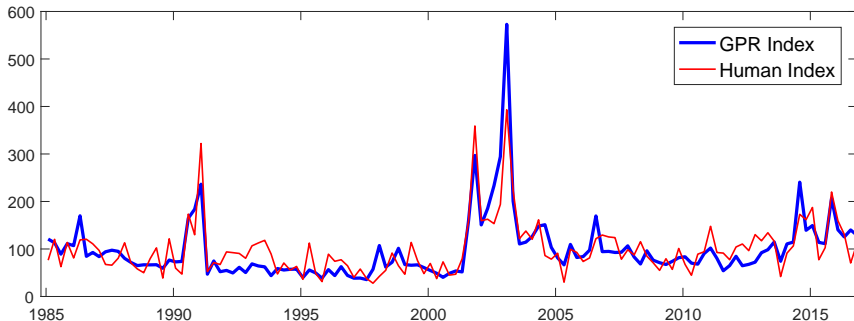
Available Indices 2: Geopolitical Heat Maps



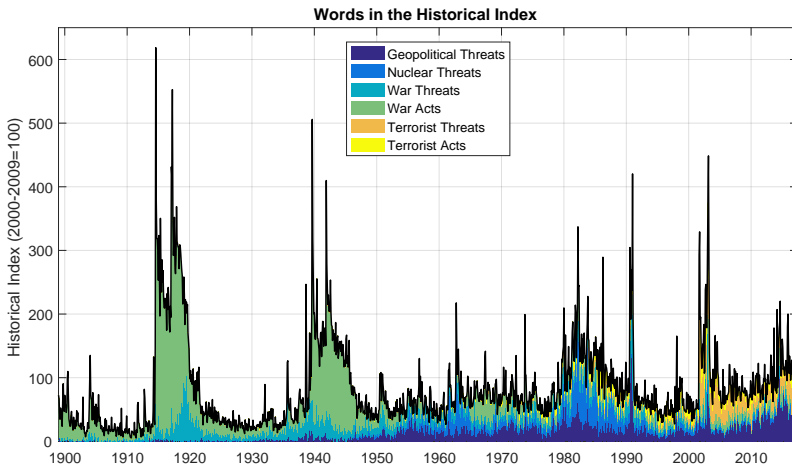
Frequent Unigrams in Flint's Geopolitics Textbook



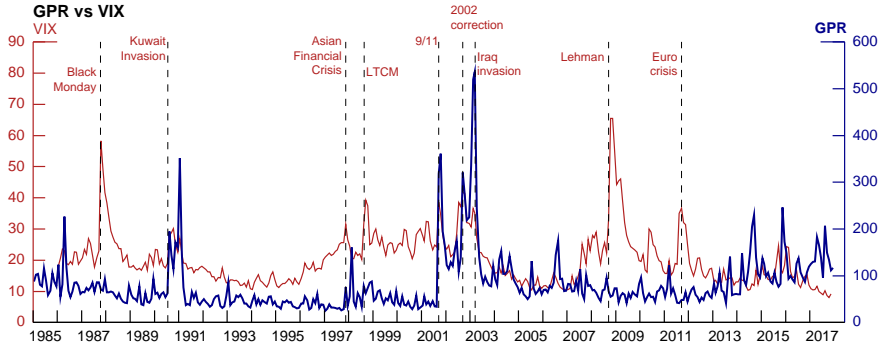
Human vs GPR Index



The Historical Geopolitical Risk Index: Components

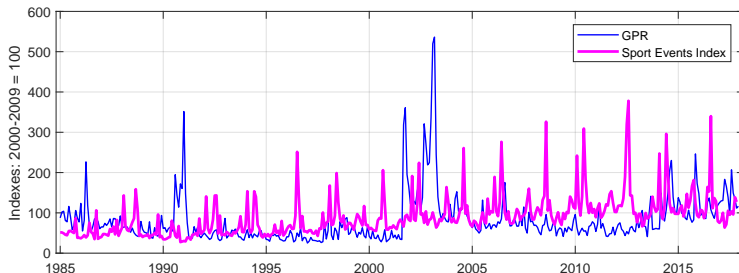


GPR and VIX



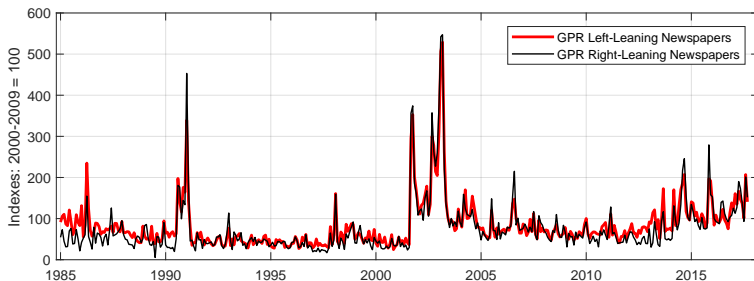
GPR and Sports Event Index

Sorry, I could not refrain from throwing in some coverage of the World Cup at some point...



GPR index uncorrelated with other newsworthy predictable (World Cup, Olympics, SuperBowl) and unpredictable events.

GPR and Newspaper Slant



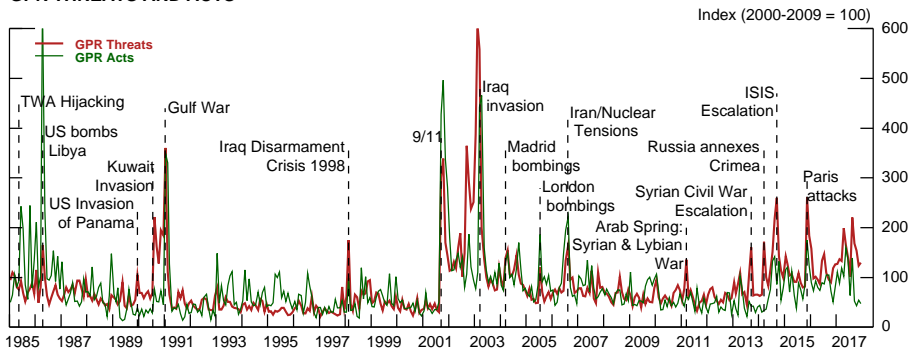
GPR Index does not reflect newspaper political slant.

[Back](#)

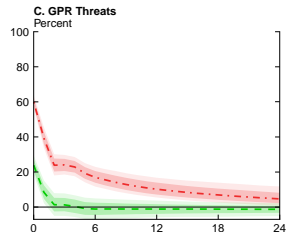
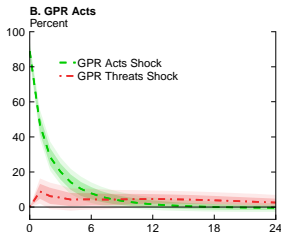
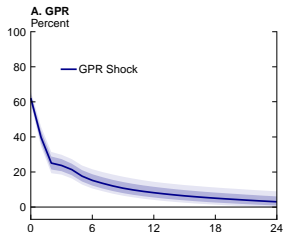
Geopolitical Threats vs Geopolitical Acts

Correlation coefficient: 0.60

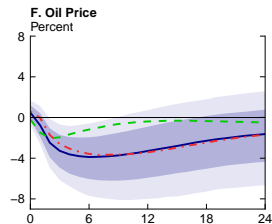
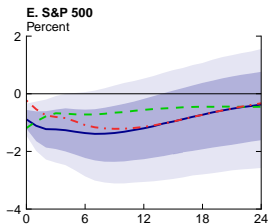
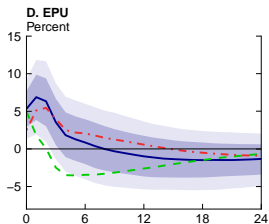
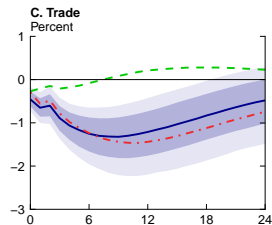
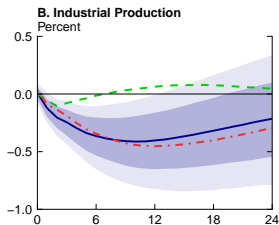
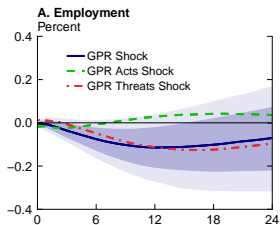
GPR THREATS AND ACTS



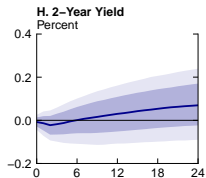
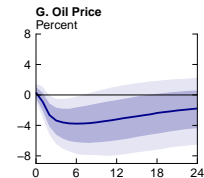
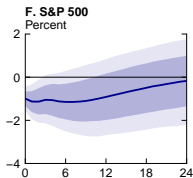
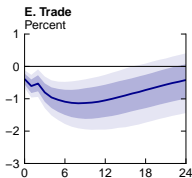
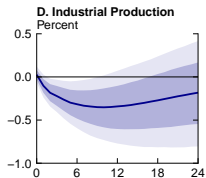
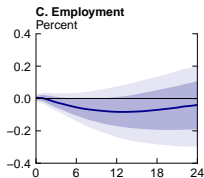
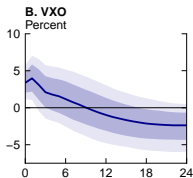
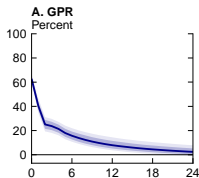
Monthly VAR: Shocks and Persistence



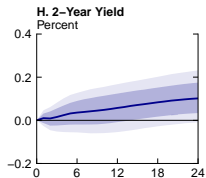
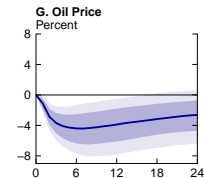
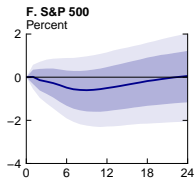
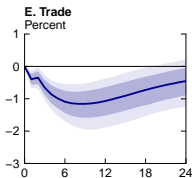
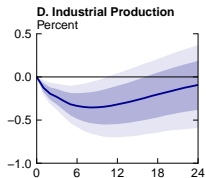
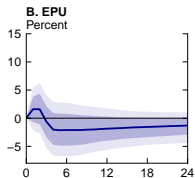
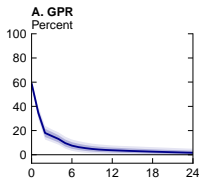
Monthly VAR: Macro and Financial Effects



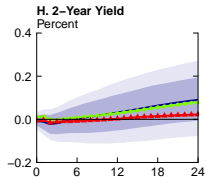
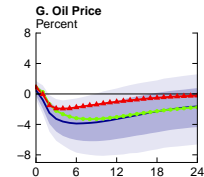
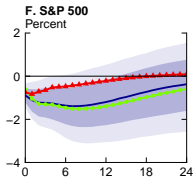
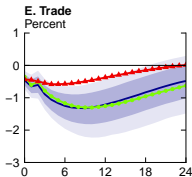
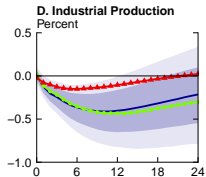
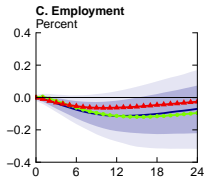
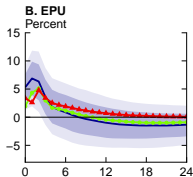
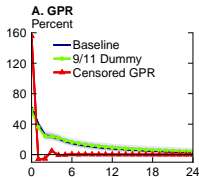
Monthly VAR Robustness: VXO



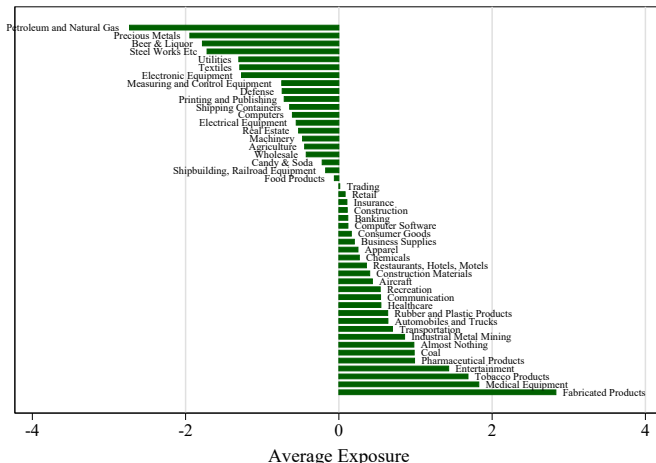
Monthly VAR Robustness: GPR Ordered Last



Monthly VAR Robustness: Exclude 9/11



Industry Exposure to GPR



Average 1995-2017, standardized. Higher values indicate larger decline in industry daily stock returns after increase in daily GPR. [Back](#)

Geopolitical Risk and the Berlin Wall

Newspaper coverage in November 1989

Joy for Germans, W

By ERIC PACE

New York Times (1923-C

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Academics Ask, What's N

Joy for Germ

By ERIC PACE

Specialists on Germany and other European countries have expressed surprise and pleasure at the latest events in East Berlin and East Germany. But they warned that the far-reaching changes promised there could also bring problems and pain.

Fritz Stern, Seth Low Professor of History at Columbia University and an expert on Germany, said the vast demonstrations by East Germans that led to the reform measures, including the relaxation of travel restrictions, had gone against conventional wisdom.

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New York Times (1923-Current file); Nov 12, 1989; ProQuest Historical New

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Family Says Of the West, 'It's a Dream'

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Special to The New York Times

For All, East and West, A Day Like No C

By SERGE SCHMEMANNSpecial to The New Yc

New York Times (1923-Current file); Nov 12, 1989

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Clamor in the East: How the Other Hal

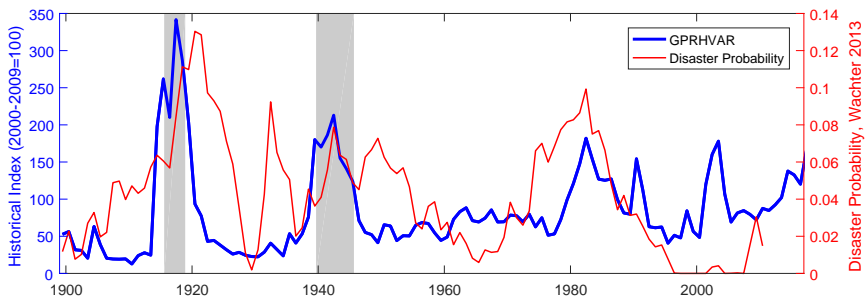
Reunion in West Berlin

For All, East and West, A Day Like No Other

By SERGE SCHMEMANN

Special to The New York Times

Historical GPR Index and Disaster Probability



Annualized Historical GPR and Annualized Time-Varying Disaster Probability constructed by Wachter (2013) using the price-dividend ratio.