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?
How Do We Measure Them?
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 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 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.

- The GPR 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
The geopolitical risk (GPR) index is measured by the frequency of newspaper articles discussing adverse geopolitical events. 

\[ GPR \propto \frac{G}{U} \]

- **G**: articles mentioning adverse geopolitical events;
- **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 $G$

- We create 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

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

### B. Search words

<table>
<thead>
<tr>
<th>Topic Bags</th>
<th>Exact Phrases</th>
</tr>
</thead>
<tbody>
<tr>
<td>War_words</td>
<td>war OR conflict OR hostilities OR revolution* OR insurrection OR uprising OR revolt OR coup OR geopolitical</td>
</tr>
<tr>
<td>Peace_words</td>
<td>peace OR truce OR armistice OR treaty OR parley</td>
</tr>
<tr>
<td>Military_words</td>
<td>military OR troops OR missile* OR &quot;arms&quot; OR weapon* OR bomb* OR warhead*</td>
</tr>
<tr>
<td>Nuke_bigrams</td>
<td>&quot;nuclear war&quot;* OR &quot;atomic war&quot;* OR &quot;nuclear missile&quot;* OR &quot;atomic bomb&quot;* OR &quot;hydrogen bomb&quot;* OR &quot;nuclear test&quot;</td>
</tr>
<tr>
<td>Terrorism_words</td>
<td>terror* OR guerrilla* OR hostage*</td>
</tr>
<tr>
<td>Actor_words</td>
<td>allie* OR enem* OR insurgen* OR foe* OR army OR navy OR aerial OR troops OR rebels</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk/Act Bags</th>
<th>Exact Phrases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk_words</td>
<td>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*</td>
</tr>
<tr>
<td>Peace_disruption_words</td>
<td>threat* OR menace* OR reject* OR peril OR boycott* OR disrupt*</td>
</tr>
<tr>
<td>Buildup_words</td>
<td>buildup* OR build-up* OR sanction* OR blocked* OR embargo OR quarantine OR ultimatum OR mobilize*</td>
</tr>
<tr>
<td>War_begin_words</td>
<td>begin* OR start* OR declar* OR begun OR began OR outbreak OR &quot;broke out&quot; OR breakout OR proclamation OR launch* OR wage*</td>
</tr>
<tr>
<td>Actor_fight_words</td>
<td>advance* OR attack* OR strike* OR drive* OR shell* OR offensive OR invasion OR invad* OR clash* OR raid* OR launch*</td>
</tr>
<tr>
<td>Terrorism_act_words</td>
<td>attack OR act OR bomb* OR kill* OR strike* OR hijack*</td>
</tr>
</tbody>
</table>
The Historical Geopolitical Risk Index
The Recent Geopolitical Risk Index

GPR available at https://www.matteoiacoviello.com/gpr.htm
**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;

- **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
- WWI Begins
- US Enters War
- Occupation
- Vera Cruz

World War II
- WWII Begins
- Pearl Harbor
- D-Day
- Germany Invades Czechia

Early 1960s
- Berlin Problem
- Cuban Crisis

Gulf War
- Kuwait Invasion
- Gulf War

9/11 and Iraq War
- 9/11
- Iraq War

2016–2020
- US−North Korea
- US−Iran
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 Conflict and War News?
Newspaper Headlines

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

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

- OPEN DOOR IN CHINA PLEDGED BY HIROTA;
  A LONG WAR IS SEEN
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.
NOTE: Time-Series Comparison of GPR Index and GPR shocks with Military News variable from Ramey (2011) and with war deaths.
Geopolitical Risk and Economic Activity

1. VAR Evidence for the United States since 1985: Threats matter as much as acts

2. Panel Regressions since 1900: GPR predicts economic disasters across countries

3. Panel Quantile Regressions since 1900: How GPR affects distribution of economic variables across countries
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 ⇒ *Contemporaneous* exogeneity.

- **Identification (II)**: LGPA ordered 1st and LGPT 2nd in Cholesky
  - GPA shocks capture realization of adverse geopolitical events.
  - GPT shocks capture higher threat of adverse geopolitical events.

- **Sample**: 1985Q1-2019Q4
Quarterly VAR: 2-SD GPR Shock
Quarterly VAR: 2-SD GPA Shock

GPR Acts
- Act shock
- Act w/ fixed threat

GPR Threats

Private Fixed Investment

Hours
Quarterly VAR: 2-SD GPT Shock

GPR Acts
- Threat shock
- Threat w/ fixed acts

GPR Threats

Private Fixed Investment

Hours
Geopolitical Risk and Economic Activity

1. VAR Evidence for the United States since 1985: Threats matter as much as acts

2. Panel Regressions since 1900: GPR predicts economic disasters across countries

3. Panel Quantile Regressions since 1900: How GPR affects distribution of economic variables across countries
Geopolitical Risk and Tail Risks

- Does GPR affects probability of economic disaster / conditional distribution of macroeconomic variables? Yes

- 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

GPRC: share of articles simultaneously: (1) mentioning GPR and (2) naming country in question.
Country-Specific GPR (continued)

GPRC: share of articles simultaneously: (1) mentioning GPR and (2) naming country in question.
Geopolitical Risk and Economic Disasters

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

Table 3: Geopolitical Risk and Economic Disasters

<table>
<thead>
<tr>
<th></th>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
<th>Column 4</th>
<th>Column 5</th>
<th>Column 6</th>
<th>Column 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP Growth t-1</td>
<td>-0.0071*</td>
<td>-0.0062*</td>
<td>-0.0056</td>
<td>-0.0065</td>
<td>-0.0056*</td>
<td>-0.0009</td>
<td>0.0012</td>
</tr>
<tr>
<td></td>
<td>(0.0030)</td>
<td>(0.0030)</td>
<td>(0.0030)</td>
<td>(0.0032)</td>
<td>(0.0026)</td>
<td>(0.0010)</td>
<td>(0.0010)</td>
</tr>
<tr>
<td>GPR</td>
<td>0.1753***</td>
<td>0.1144***</td>
<td>0.0337</td>
<td>0.1001***</td>
<td>0.0180</td>
<td>-0.0175</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0223)</td>
<td>(0.0214)</td>
<td>(0.0469)</td>
<td>(0.0236)</td>
<td>(0.0237)</td>
<td>(0.0094)</td>
<td></td>
</tr>
<tr>
<td>Country GPR</td>
<td>0.0940***</td>
<td>0.0842***</td>
<td>0.0794***</td>
<td>0.0664*</td>
<td>-0.0090</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0160)</td>
<td>(0.0170)</td>
<td>(0.0175)</td>
<td>(0.0295)</td>
<td>(0.0105)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dummy WWI/WWII</td>
<td>0.3328</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.1761)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPR Spikes</td>
<td>0.1692***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0246)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country GPR Spikes</td>
<td>0.0821***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0122)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dummy Pre-1946</td>
<td></td>
<td>0.2437***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0490)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dummy 1946-1972</td>
<td></td>
<td>0.1152*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.0467)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.2309***</td>
<td>0.2289***</td>
<td>0.1947***</td>
<td>0.1762***</td>
<td>0.1112**</td>
<td>0.0401*</td>
<td>0.1180***</td>
</tr>
<tr>
<td></td>
<td>(0.0252)</td>
<td>(0.0273)</td>
<td>(0.0341)</td>
<td>(0.0302)</td>
<td>(0.0320)</td>
<td>(0.0185)</td>
<td>(0.0130)</td>
</tr>
<tr>
<td>Observations</td>
<td>3,056</td>
<td>3,056</td>
<td>3,056</td>
<td>3,056</td>
<td>3,056</td>
<td>2,447</td>
<td>609</td>
</tr>
<tr>
<td>R²</td>
<td>0.20</td>
<td>0.20</td>
<td>0.21</td>
<td>0.18</td>
<td>0.26</td>
<td>0.13</td>
<td>0.02</td>
</tr>
<tr>
<td>Countries</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Country Fixed Effects</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Standard errors in parentheses clustered by country and year.

* p < 0.05, ** p < 0.01, *** p < 0.001
Geopolitical Risk and Quantile Regressions

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

Table 4: Quantile Regression Effects of Country-Specific Geopolitical Risk

<table>
<thead>
<tr>
<th></th>
<th>GDP Growth(t+1)</th>
<th>TFP Growth(t+1)</th>
<th>Military Exp.(t+1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OLS</strong></td>
<td>-0.35</td>
<td>-0.22</td>
<td>2.15***</td>
</tr>
<tr>
<td></td>
<td>(0.22)</td>
<td>(0.27)</td>
<td>(0.39)</td>
</tr>
<tr>
<td><strong>Quantile</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>q50</td>
<td>-0.24</td>
<td>-0.04</td>
<td>0.63**</td>
</tr>
<tr>
<td></td>
<td>(0.22)</td>
<td>(0.14)</td>
<td>(0.19)</td>
</tr>
<tr>
<td>q10</td>
<td>-1.44*</td>
<td>-1.86***</td>
<td>0.16***</td>
</tr>
<tr>
<td></td>
<td>(0.63)</td>
<td>(0.45)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>q90</td>
<td>0.30</td>
<td>1.53**</td>
<td>7.08***</td>
</tr>
<tr>
<td></td>
<td>(0.30)</td>
<td>(0.55)</td>
<td>(0.55)</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>3082</td>
<td>2261</td>
<td>2681</td>
</tr>
<tr>
<td><strong>Countries</strong></td>
<td>26</td>
<td>19</td>
<td>26</td>
</tr>
</tbody>
</table>

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:

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

- \( \Lambda_k \) 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:

\[ R_{k,t} = \alpha_k + \beta_k \Delta GPR_t + \epsilon_{k,t}, \]

- \( \Lambda_k = -\text{sign} (\beta_k - \bar{\beta}) \)
  - Less exposed (positive beta): Gold, Oil, Defense.

- We estimate:

\[ \log ik_{i,t+2} = \alpha_i[+\alpha_t] + \beta_h (\Lambda_k \Delta \log GPR_t) + d X_{i,t} + \epsilon_{i,t+2} \]
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*, attack*
   - Must appear within 10 words

\[ GPR_i, t = \text{Number of joint instances of GP and R (normalized by number of words in the call)} \]
Estimate:

\[
\log ik_{i,t+2} = \alpha_i + \alpha_{k,t} + \gamma Z_{i,t} + d X_{i,t} + \epsilon_{i,t+2}
\]  

(2)

- \( \alpha_i \) and \( \alpha_{k,t} \): firm and industry-time fixed effects
- \( \gamma \): 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

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta GPR \times \text{Dummy Industry Exposure}$</td>
<td>-0.67*</td>
<td>-0.69*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.27)</td>
<td>(0.26)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta GPR$</td>
<td>-1.37</td>
<td></td>
<td></td>
<td>-0.76**</td>
</tr>
<tr>
<td></td>
<td>(1.19)</td>
<td></td>
<td></td>
<td>(0.25)</td>
</tr>
<tr>
<td>Political Risk Hassan et al.</td>
<td></td>
<td></td>
<td></td>
<td>-0.76**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.25)</td>
</tr>
<tr>
<td>Cash Flow</td>
<td>2.71***</td>
<td>2.78***</td>
<td>2.64***</td>
<td>2.47***</td>
</tr>
<tr>
<td></td>
<td>(0.46)</td>
<td>(0.46)</td>
<td>(0.37)</td>
<td>(0.30)</td>
</tr>
<tr>
<td>Tobin’s Q</td>
<td>8.92***</td>
<td>7.94***</td>
<td>8.94***</td>
<td>9.48***</td>
</tr>
<tr>
<td></td>
<td>(1.68)</td>
<td>(1.56)</td>
<td>(0.95)</td>
<td>(0.90)</td>
</tr>
<tr>
<td>$IK(t - 1)$</td>
<td>0.31***</td>
<td>0.30***</td>
<td>0.24***</td>
<td>0.26***</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Observations</td>
<td>375,300</td>
<td>375,300</td>
<td>94,978</td>
<td>112,262</td>
</tr>
<tr>
<td>Firm Fixed Effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Time Effects</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.45</td>
<td>0.47</td>
<td>0.59</td>
<td>0.58</td>
</tr>
<tr>
<td>Sample</td>
<td>85Q1-19Q4 85Q1-19Q4 05Q1-19Q4 05Q1-19Q4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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