27th Annual DNB Research Conference

The Macroeconomic Effects of Geopolitical Uncertainty

DeNederlandscheBank

EUROSYSTEEM

Are Geopolitical Risks Financial Market Risks?

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Are Geopolitical Risks Financial Market Risks?

Caldara and Iacoviello (2022) (CI):

- Important work that develops a **geopolitical risk (GPR) index**
- Index based on newspapers' coverage of geopolitical events and threats
- VAR evidence in CI: **positive GPR** index shocks are associated with **lower** investment, employment, stock prices

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- Moreover, a lot of **disparate market-relevant news** can be revealed in a **single day**
  - Example: 9/27/02 US stocks ↘ 3.7% while GPR index spikes ↗ b/c of "Iraq war fears"...
  - ...but **financial press** credited **profit warnings** (Philip Morris), corp **downgrades** (GE), **layoffs** (SBC) for the day's decline

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- **GP events may catalyze shifts** in behaviors & policies that are the true **causal forces**
- **To robustly tie** GPR to financial mkts we need a truly **high-frequency** event-time analysis

Are Geopolitical Risks Financial Market Risks?

Fortunately...

- **Materialized events**–if not fully anticipated–*are* new information and may
  - Alter **expectations** and/or
  - Directly increase **risk and uncertainty**
- **Events** more likely to move **markets** than tensions, escalations, threats (ever present)

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So we *can* ask...

- Are geopolitical events **big market events**, and if so why?
- Is *news* **attention** to GPR reflected in *investor* **perceptions** of risk or altered **expectations**?

Are Geopolitical Risks Financial Market Risks?

- **Here: study high-frequency financial market reactions** to GPR events
- Use **mixed-freq. structural (MxFS)** approach Bianchi, Ludvigson, and Ma (2022) (BLMa)
- Key Idea: use **jumps in dozens of high-frequency, forward-looking** series from financial markets & **dynamic structural model** to estimate *why markets react* to **news**
  - Estimate **high-freq revisions** in **market participant** *nowcasts* of current economic state
  - Filter out **jumps** in nowcasts of **lower frequency** data (e.g., **macro uncertainty**)
  - Reactions to *any type* of news can be **analyzed** (previous work: **Fed announcements, macro data releases, corp earnings**)
- MxFS + structural **asset pricing model** => decompose jumps into component sources:
  1. Revisions in investor **perceptions** of quantity or price of **stock market risk**
  2. Revisions in investor **perceptions** of structural **macro shocks & cash flows** to investors

Main Findings

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3. Most **spikes in financial uncertainty**–even at HF around big GPR events–not driven by **orthogonalized GPR** VAR innovations (first-order effects small)
4. **MxFS + Structural AP model estimates** => big GPR events generate **small moves** in stock market **risk premia**, perceived risk, risk pricing

Main Findings

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- ...but instead b/c investors' subjective **cash flow expectations** *over*react to GPR news

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- **Structural AP model estimates** => investors **inflate** importance of **GPR news** for future cash-flow growth, *amplifying* market volatility

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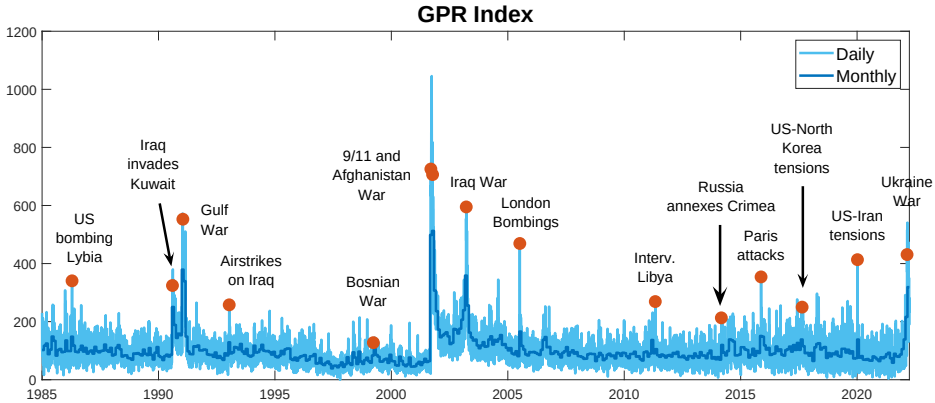
- **Structural AP model estimates** => investors **inflate** importance of **GPR news** for future cash-flow growth, *amplifying* market volatility
  - Reflected in **jumps down** in high-freq *survey* forecasts of S&P 500 earnings growth
  - Estimates of behavioral asset pricing model Bianchi, Ludvigson, and Ma (2024) (BLMb)

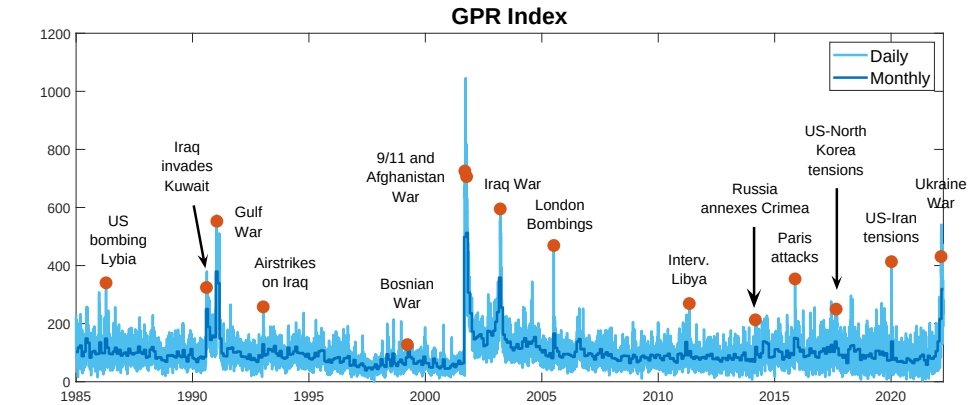
The Geopolitical Risk (GPR) Index



GPR index of CI. This figure plots the monthly and daily geopolitical risk (GPR) indices from Caldara and Iacoviello (2022). The red dots show spikes in the daily index on selected days with big GPR evnts. The sample period spans 1985:01-2022:03.

The Geopolitical Risk (GPR) Index

- GPR index can spike w/o event b/c news coverage doesn't always align with event time



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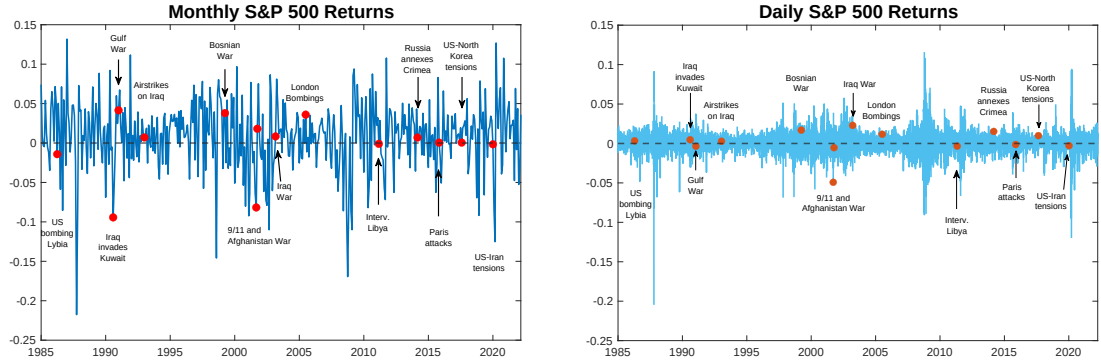
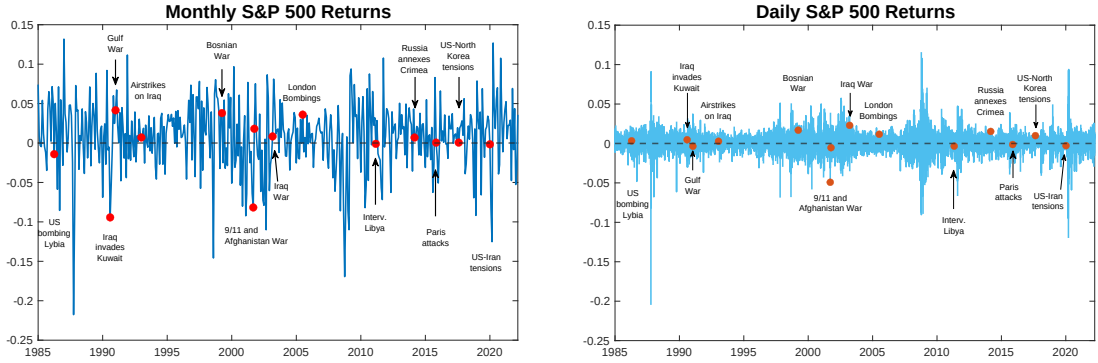
S&P 500 Returns



Stock market returns and GPR events. Monthly and daily S&P 500 returns (excluding dividends). The red dots in the left (right) panel show stock market returns on the months (days) of 15 key geopolitical events from Figure 2 of Caldara and Iacoviello (2022). The sample is 1985:01-2022:03.

S&P 500 Returns

- Most down-jumps in market are not GPR events
- Most GPR events are not associated with downward-jumps in market



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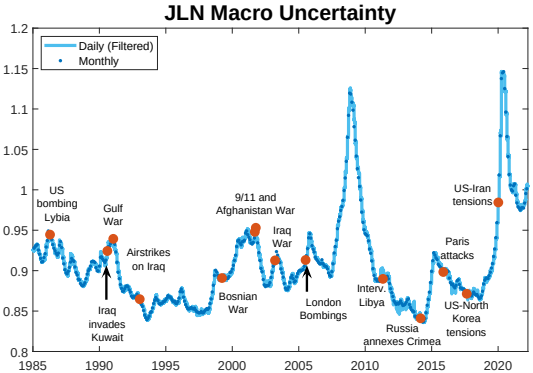
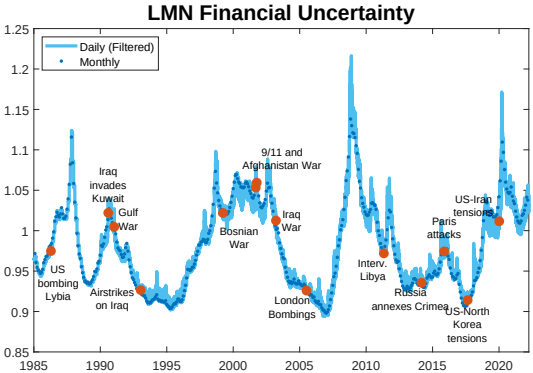
Daily Nowcasts of Macro and Financial Uncertainty

- Natural to ask how measures of uncertainty react to GPR events

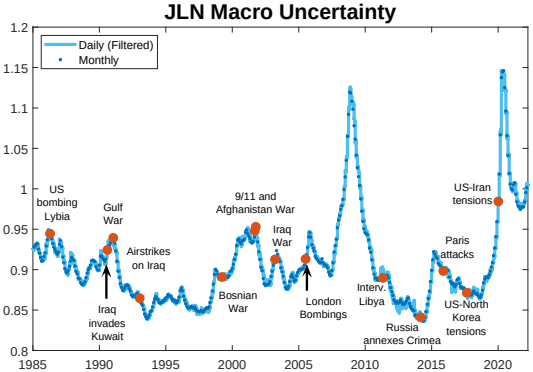


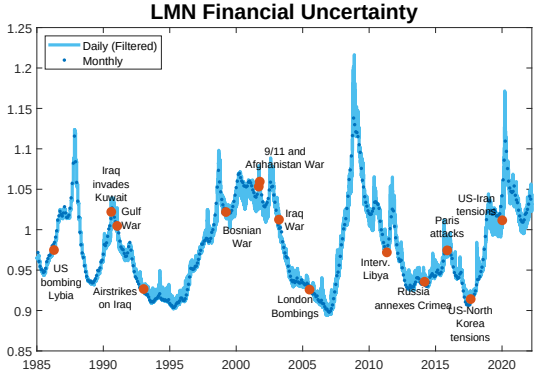


Macro and financial uncertainty over time. The dark blue dots reports the monthly series from Jurado, Ludvigson, and Ng (2015) and Ludvigson, Ma, and Ng (2021). The solid light blue line plots our filtered daily nowcasts from the mixed frequency structural approach applied to the VAR model described below. The sample period is 1985:01 - 2022:03.

Daily Nowcasts of Macro and Financial Uncertainty

- MxFS approach to impute daily market participant **nowcasts** of U_m index of Jurado, Ludvigson, and Ng (2015) (JLN) and U_f index Ludvigson, Ma, and Ng (2021) (LMN)





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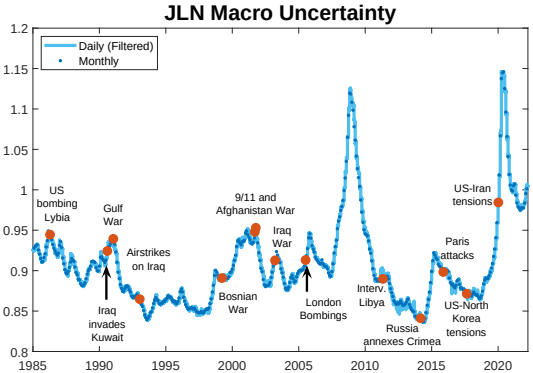
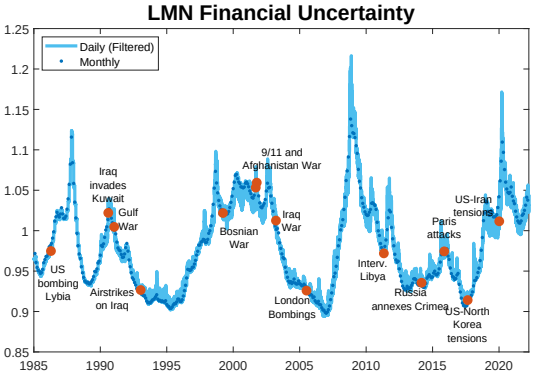
Daily Nowcasts of Macro and Financial Uncertainty

- Daily $\neq$ step function $\Rightarrow$ investors continuously update perceptions of uncertainty





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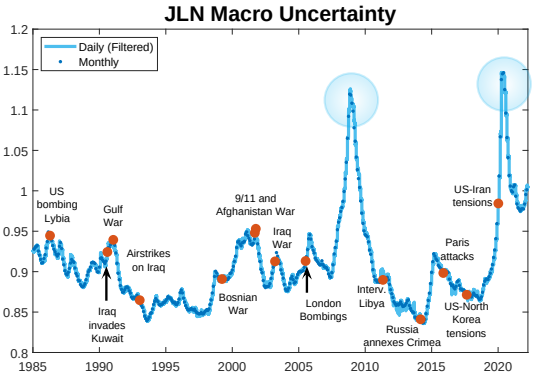
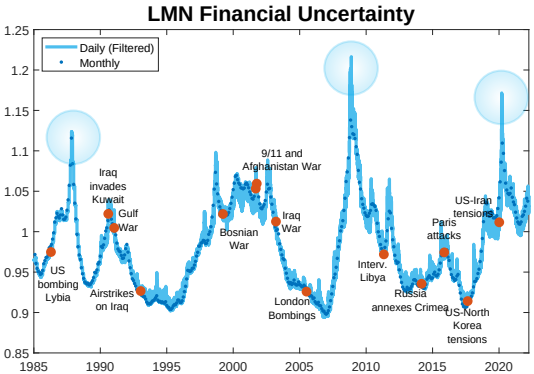
Daily Nowcasts of Macro and Financial Uncertainty

- GPR events align w/ some local peaks, but biggest spikes in U_m and U_f not GPR events





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Searching for Risk-Premia: Does GPR Index Predict Stock Returns?

$$rx_{t+h} = \alpha + \beta_{gpr} GPR_t + \epsilon_{t+h}$$

Horizon h (months)	$h=1$	$h=3$	$h=12$	$h=24$	$h=36$	$h=60$
β_J	0.218	0.024	−0.131	0.198	0.055	0.159
t-stat	(1.124)	(0.128)	(−0.769)	(1.372)	(0.498)	(1.053)
Adj. R^2	0.002	0.000	0.001	0.002	0.000	0.001
N	446	444	435	423	411	387

Predicting returns with the GPR index. Table reports results of monthly regressions of the h-month ahead log excess return, rx_{t+h}, on the level of the (standardized) GPR index in month t ("GPR_t"). The excess return rx_{t+h} is measured as the log difference in S&P 500 minus the 1-month Treasury bill rate. Newey-West corrected t-statistics with 4 lags are reported in parentheses: * sig. at 10%. ** sig. at 5%. *** sig. at 1%. The sample for the regression spans 1985:01-2022:03.

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Searching for Risk-Premia: Does GPR Index Predict Stock Returns?

- **Increases in GPR index** not associated with **higher** *future* excess returns

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Do (Big) Spikes in the Daily GPR Index Predict Stock Returns?

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β_J	0.000	−0.000	0.000	0.001	0.001	0.000
t-stat	(0.291)	(−0.161)	(0.043)	(1.641)	(1.365)	(1.012)
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Do (Big) Spikes in the Daily GPR Index Predict Stock Returns?

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Do Market Moves on Big GPR Index Days Predict Stock Returns?

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Horizon h (months)	$h=1$	$h=3$	$h=12$	$h=24$	$h=36$	$h=60$
(a) All events						
β_J	0.131	0.149	−0.025	0.231*	−0.023	−0.007
t-stat	(0.959)	(1.278)	(−0.208)	(1.755)	(−0.246)	(−0.055)
(b) Bad market news						
β_J	−0.215	0.091	−0.050	0.149	−0.126	−0.100
t-stat	(−1.313)	(0.516)	(−0.341)	(1.183)	(−1.212)	(−0.708)
(c) Good market news						
β_J	0.443***	0.016	−0.106	0.179	0.128	0.014
t-stat	(3.276)	(0.163)	(−0.854)	(1.048)	(1.028)	(0.121)

Predicting returns with market jumps. Table reports results of monthly regressions of the h-month ahead log excess return, rx_{t+h}, on the sum of high-frequency (daily) changes in the S&P 500 around "Big GPR Index Days"in month t ("$MktJumps_t$"). A Big GPR Index Day is defined as an upward jump in the daily GPR index at or above the 95th percentile of all daily jumps in the sample, amounting to 680 events out of 13,603 days in the sample period. The results for the subset of events in which $MktJumps_t < 0$ and $MktJumps_t > 0$ are reported under the panel labeled "Bad market news" and "Good market news," respectively. Newey-West corrected t-statistics with 4 lags are reported in parentheses: * sig. at 10%. ** sig. at 5%. *** sig. at 1%. The sample is 1985:01-2022:03.

Do Market Moves on Big GPR Index Days Predict Stock Returns?

- If ↗ in GPR ↗ **risk premia** then mkt **declines** on big GPR days should predict ↗ **returns**

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Horizon h (months)	$h=1$	$h=3$	$h=12$	$h=24$	$h=36$	$h=60$
(a) All events						
β_J	0.131	0.149	−0.025	0.231*	−0.023	−0.007
t-stat	(0.959)	(1.278)	(−0.208)	(1.755)	(−0.246)	(−0.055)
(b) Bad market news						
β_J	−0.215	0.091	−0.050	0.149	−0.126	−0.100
t-stat	(−1.313)	(0.516)	(−0.341)	(1.183)	(−1.212)	(−0.708)
(c) Good market news						
β_J	0.443***	0.016	−0.106	0.179	0.128	0.014
t-stat	(3.276)	(0.163)	(−0.854)	(1.048)	(1.028)	(0.121)

Predicting returns with market jumps. Table reports results of monthly regressions of the h-month ahead log excess return, rx_{t+h}, on the sum of high-frequency (daily) changes in the S&P 500 around "Big GPR Index Days"in month t ("$MktJumps_t$"). A Big GPR Index Day is defined as an upward jump in the daily GPR index at or above the 95th percentile of all daily jumps in the sample, amounting to 680 events out of 13,603 days in the sample period. The results for the subset of events in which $MktJumps_t < 0$ and $MktJumps_t > 0$ are reported under the panel labeled "Bad market news" and "Good market news," respectively. Newey-West corrected t-statistics with 4 lags are reported in parentheses: * sig. at 10%. ** sig. at 5%. *** sig. at 1%. The sample is 1985:01-2022:03.

Do Market Moves on Big GPR Index Days Predict Stock Returns?

- **Big GPR index spikes** not associated with market declines that **predict** *future* returns

$$rx_{t+h} = \alpha + \beta_{Jm} MktJumps_t + \beta_r rx_t + \epsilon_{t+h}$$

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MxFS Approach: Expansive Datasets & Home in on GPR Events

Mixed-freq structural (MxFS) approach to study *why* markets react to news

- Low-frequency Dynamics:
  - **From e.g., VAR, DSGE, other structural model** are **disciplined** by large number of *forward-looking* series $=>$ valuable additional *signals*
  - Estimates of **dynamic relations** must be consistent with *additional* information (e.g., surveys, futures mkts, spot mkts, etc.) on market participants' **expectations**

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- High-frequency Dynamics:
  - Informed by *jumps* dozens high-freq, financial market series in **tight windows** around news
  - Jumps mapped onto **dynamic model**, providing estimates of *why* **markets react** to news
  - Filter out high-freq jumps in *lower frequency* data (e.g., **macro uncertainty**) and/or latent states (e.g., **subj risk premia**)
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- Upshot: MxFS **parsimoniously** uses far more information than VAR dynamics alone

Tight Windows around Key Geopolitical Events: 2000-2020

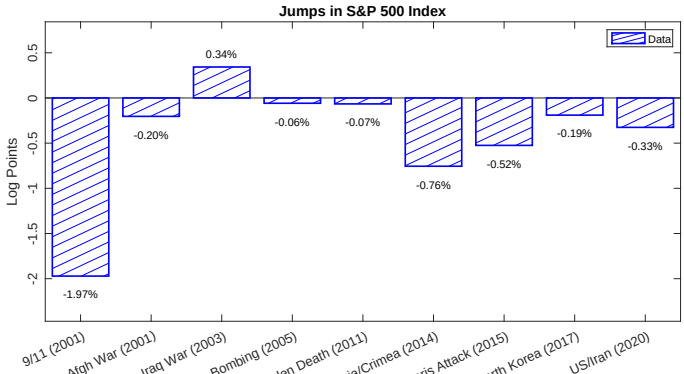
- All "key" *materialized* geopolitical events in CI significant enough to appear as **spikes in monthly** GPR index after 2000 (when high-freq S&P 500 (E-mini) futures available)
- **One hour windows** where possible (exceptions: weekend & early closures in which case use nearest close-to-open mkt values around news)

Event Description	Event Date	News Released	Window Start	Window End	Window Explanation
9/11 Terrorist attacks	Tuesday, Sep 11, 2001	8:46am	8:36am	9:15am	Emini futures stopped trading at 9:15am EST.
US invades Afghanistan	Sunday, Oct 7, 2001	1:00pm	Oct 5, 5:00pm	Oct 7, 6:00pm	Emini does not trade weekends, i.e., from 5pm on Friday to 6pm on Sunday.
Beginning of the Iraq War	Wednesday, Mar 19, 2003	10:14pm	10:04pm	11:04pm	
London bombings 7/7	Thursday, Jul 7, 2005	3:50am	3:40am	4:40am	
US announces death of Osama Bin Laden	Sunday, May 1, 2011	11:35pm	11:25pm	May 2, 12:25am	
Russia invades Crimea	Saturday, Mar 1, 2014	10:27am	Feb 28, 5:00pm	Mar 2, 6:00pm	Emini does not trade weekends, i.e., from 5pm on Friday to 6pm on Sunday.
Paris terrorist attacks	Friday, Nov 13, 2015	4:11pm	4:01pm	5:00pm	Emini closes after 5pm on Fridays.
North Korea tensions	Friday, Aug 18, 2017	1:17pm	1:07pm	2:07pm	
US/Iran tensions escalate	Tuesday, Jan 7, 2020	5:30pm	5:20pm	6:20pm	

Timing key GPR events. Windows around events used to measure changes in S&P 500, E-mini, fed funds, and euro dollar futures data. News timing from Factiva searches. Where possible, windows span 10 minutes pre-news release to 50 minutes post-news. Deviations due to stock market closures on weekends and during crises, in which case we use close-to-open market values around the event. All times are ET.

Stock Market Jumps around Key GPR Events

- Biggest jumps down around 9/11 (2001), Russian/Crimea (2014), US/Iran (2020)



Stock market jumps and GPR news. See previous table. This figure plots the jump in the S&P 500 index from tick-level data in 1-hour windows (as possible) around 9 key GPR events. For trades outside the regular market trading hours, we use E-mini S&P 500 futures. Deviations due to market closures on weekends and crises.

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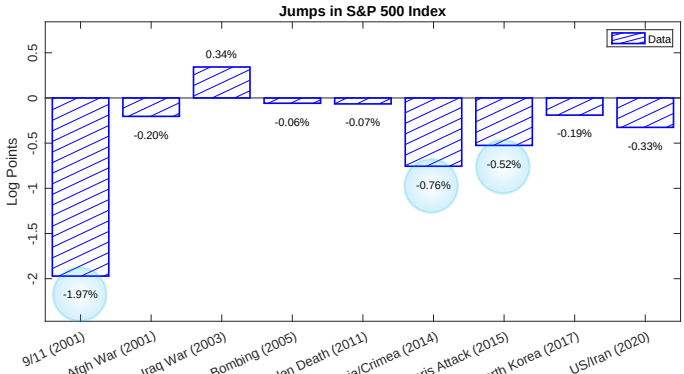

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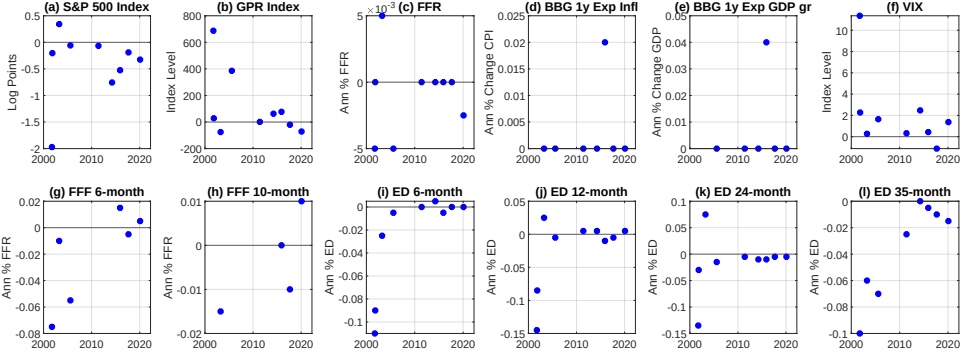
Jumps in High-Frequency Data around Key GPR Events

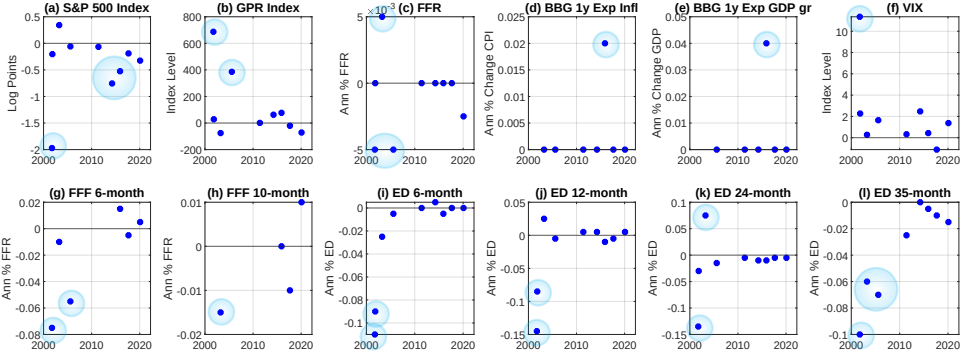
- S&P 500, FFF, ED are minutely & show jumps around one hour windows. Other variables are available daily & show changes from day before to day after.



Jumps in high-frequency data Figure plots changes in high-freq data around 9 GPR events from 2000-2020. For high-frequency jumps in FFR, we use current month FFF data when available and daily jumps in effective FFR otherwise. For tick-level data in panel (a), (c), and (h)-(i), this corresponds to a change measured from 10 minutes before to 50 minutes after the news is first released, unless markets are closed, in which case we use the last available trade before window start and first available trade after window end. For daily data in panels (b), (d)-(f), changes from one day before to one day after the event are plotted.

Jumps in High-Frequency Data around Key GPR Events

- Big **jumps in fw-looking data** => series highly informative on *why* markets react



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Dynamic Model: VAR

Dynamic model for S_t is monthly VAR(1).

MxFS approach: full empirical model in **state space** form

$$S_t = C + TS_{t-1} + R\epsilon_t, \quad \epsilon \sim N(0, I)$$
$$X_t = D + ZS_t \quad + Uv_t, \quad v_t \sim N(0, I)$$

$$S_t = \begin{bmatrix} \text{GPR}_t \\ \Delta \ln(\text{GDP}_t) \\ \text{Inflation}_t \\ \text{Federal Funds Rate}_t \\ \text{Uncertainty}_t \\ \ln(\text{S\&P 500 Return}_t) \end{bmatrix}$$

X_t includes **25 series**; D, Z map X_t onto VAR dynamics, U_t diagonal matrix w/ SD of OBS errors. Residuals ϵ_t orthogonalized w/ **Cholesky** decomp

- **Order of VAR**: follow CI in putting GPR index first, Bloom (2009) in ordering of others
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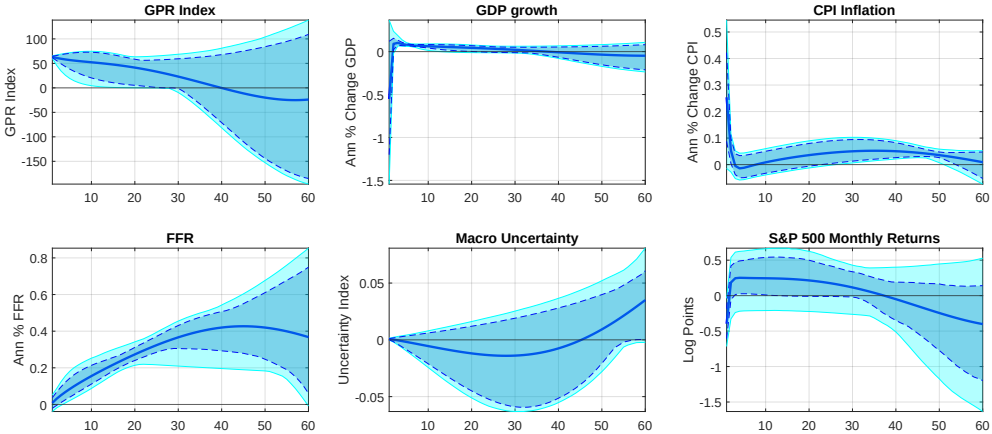
With all data available, X_t contains:

- **Monthy/quarterly** data: (macro or financial) uncertainty, $\Delta \ln(GDP)$, π, *surveys*: SPF, BC, LIV, BBG π forecasts & SPF, LIV GDP growth forecasts
- **High-freq**: S&P 500, FFR, FF, ED futures, & (daily:) VIX, GPR plus *surveys*: BBG π & *GDP* forecasts

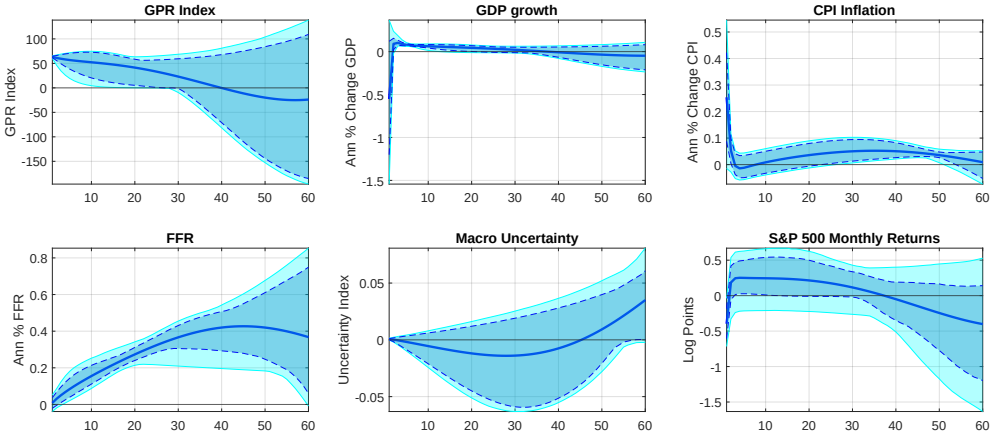
Impulse Responses: VAR with Macro Uncertainty



Macro Uncertainty VAR. The figure plots the impulse response of the state variables to a one standard deviation increase in the GPR index for 60 periods (months) ahead. The VAR uses macro uncertainty from Jurado, Ludvigson, and Ng (2015) as the uncertainty measure. The thick blue lines indicates the mean response from MCMC simulation of parameters. 90% credible sets are shaded by light blue and 68% credible sets are shaded by dark blue.

Impulse Responses: VAR with Macro Uncertainty

- GPR shocks mostly affect FFR but **not** stock market, U_m, GDP growth



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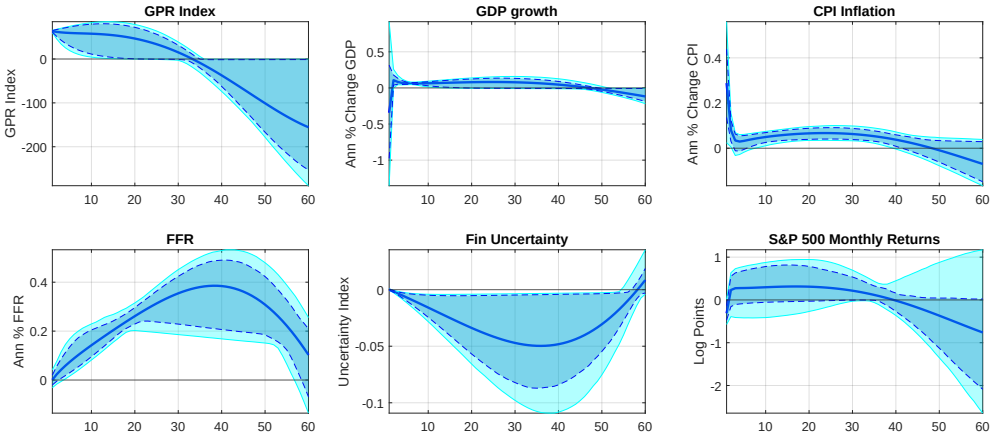
Impulse Responses: VAR with Financial Uncertainty

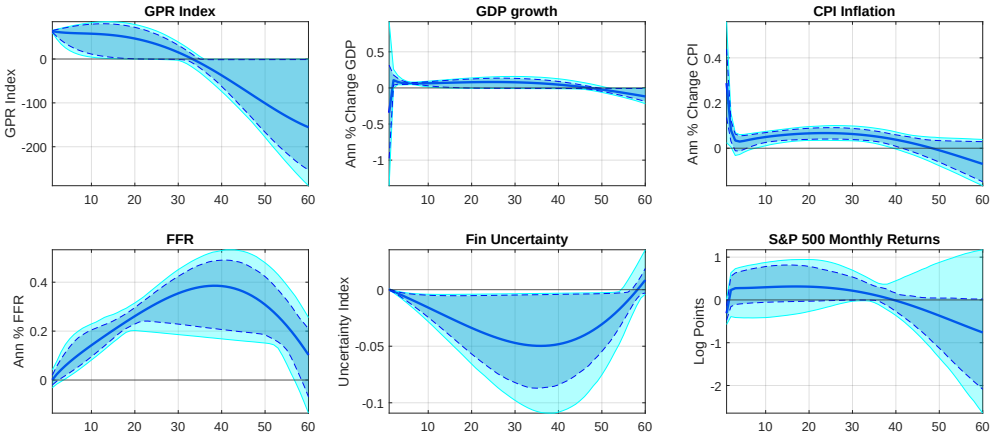
- Again, no stock market affects of GPR shocks...



Financial Uncertainty VAR. The figure plots the impulse response of the state variables to a one standard deviation increase in the GPR index for 60 periods (months) ahead. The model here uses financial uncertainty from Ludvigson, Ma, and Ng (2021) as the uncertainty measure. The thick blue line indicates the mean response from MCMC simulation of parameters. 90% credible sets are shaded by light blue and 68% credible sets are shaded by dark blue.

Impulse Responses: VAR with Financial Uncertainty

- ...but IRFs show effects of **generic** Δ in GPR **index**. What about around **key events?**



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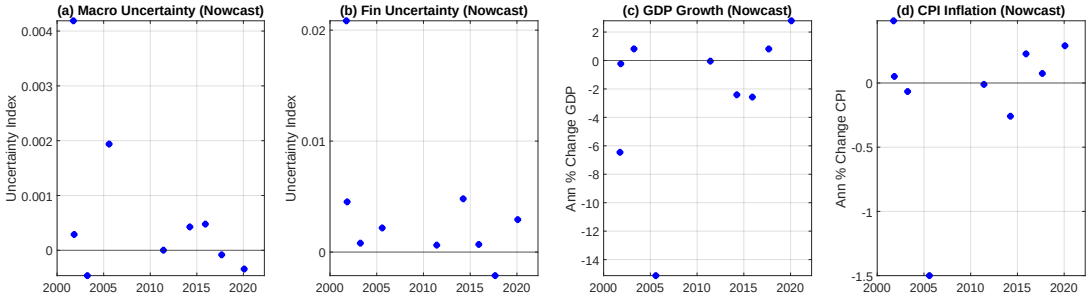
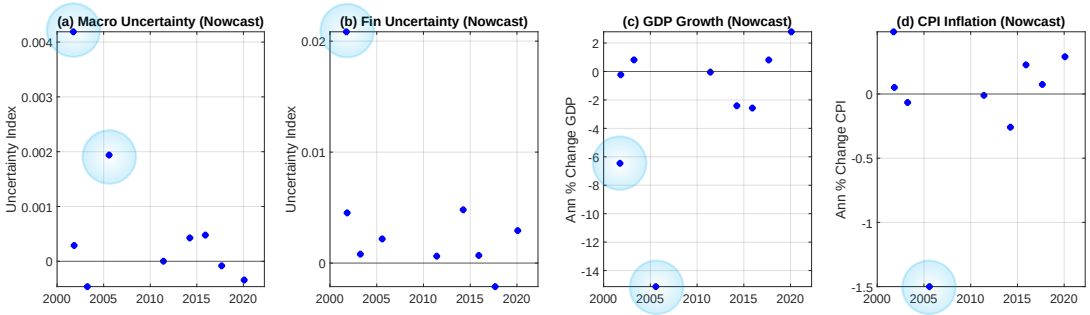
Jumps in Estimated VAR Nowcasts around Key GPR Events



Revisions in nowcasts. Figure plots revisions in the VAR models' filtered series over tight windows around 9 GPR events from 2000-2020. These revisions can be interpreted as jumps in investor beliefs about current economic state (nowcasts). For each event specified in the panel title, the high-frequency window runs from 10 minutes before the event start time to 50 minutes after, unless constrained by data availability. The VARs use either macro uncertainty from Jurado, Ludvigson, and Ng (2015) or financial uncertainty from Ludvigson, Ma, and Ng (2021).

Jumps in Estimated VAR Nowcasts around Key GPR Events

- **Idea of MxFS**: Dozens high-freq, FwL data capture **jumps** in mkt participant *nowcasts*



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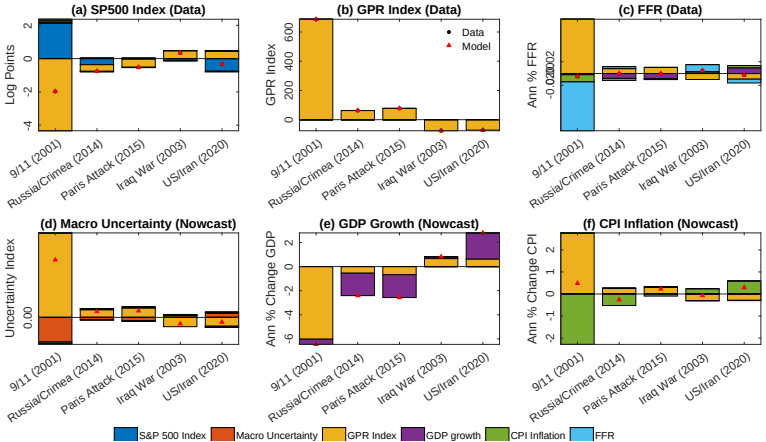
Reactions to GPR Events: VAR with Macro Uncertainty

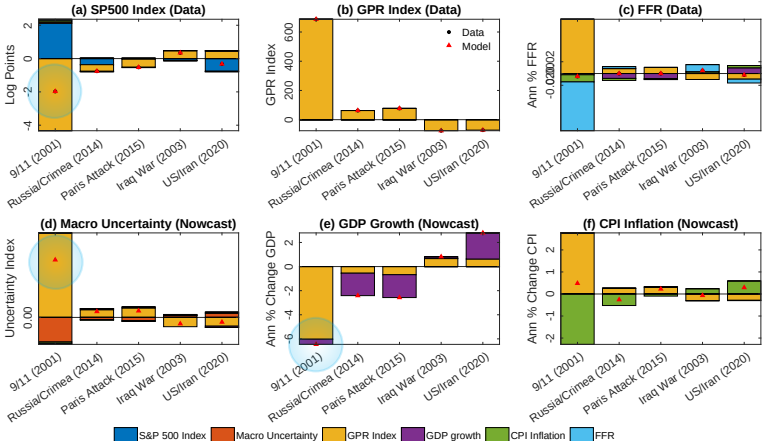
- **Decompositions** tell *why* (through lens of model) HF data & filtered states jump



Macro uncertainty VAR. Decomposing jumps in data and filtered states (nowcasts) pre- and post-large GPR events into components attributable to the VAR innovations. For the stock market the jump corresponds to the jump in the data. For trades outside the regular trading hours, we use E-mini S&P 500 futures. For each event specified in the panel title, the high-frequency window runs from 10 minutes before the event start time to 50 minutes after, unless constrained by data availability. The figure reports shock decomposition for the 5 GPR events associated with the largest absolute change in stock market.

Reactions to GPR Events: VAR with Macro Uncertainty

- **Biggest event is 9/11**: GPR shock drives market down, U_m up, GDP growth down



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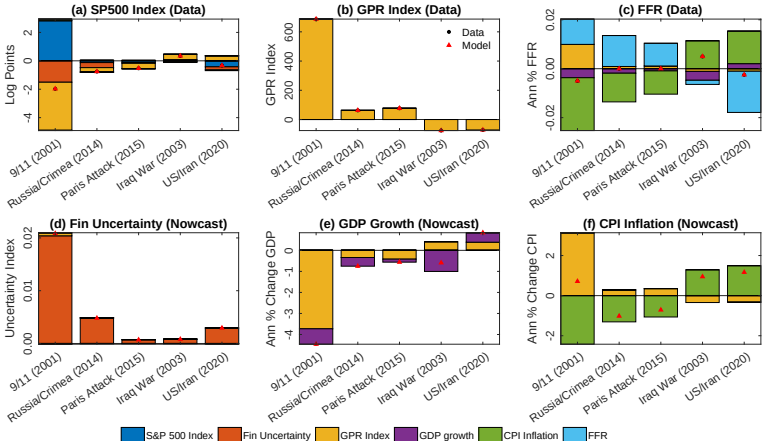

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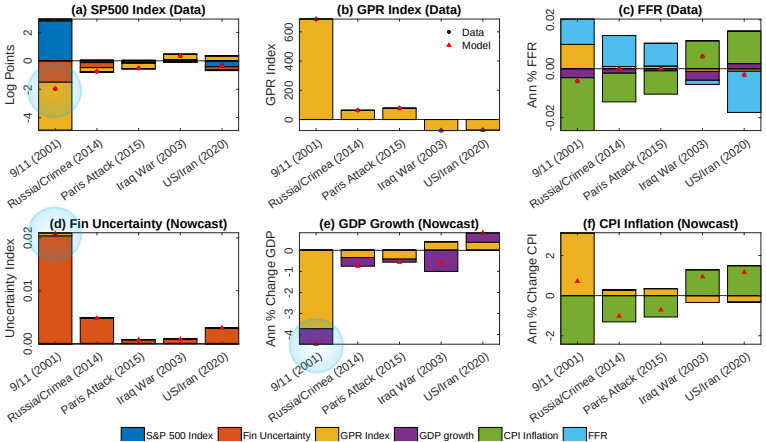

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Taking Stock: What Have We learned?

Summary of results so far:

- Some events *are* associated with stock market jumps. **But why?**
- Evidently not b/c GPR drives up financial uncertainty or return premia
- Issue: VAR effects (even orthogonalized) depend on ordering and essentially tell us about **correlations**–not a precise **conceptual framework**
- Silent on cause vs effect & on **deeper interpretation** of what GPR represents
- Arguably, GPR is not a distinctive primitive to which economy responds, but instead represents a **confluence of forces** set in motion by **expectation-altering news**

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Motivates Analyzing GPR News Through Lens of Structural Asset Pricing Model

- Interpret GPR as **a type** of expectation-altering **news** that could (potentially) move mkt
- Use MxFS approach integrate high-frequency event study *into* structural model
- Address question: through lens of model, why do markets react to **GPR news?**

Structural Asset Pricing Model with Behavioral Elements (BLMb)

Behavioral Elements: deviations from RE by magnitudes freely estimated

- Distorted perceptions about LOM driving macro fundamentals
- Nests belief-models with **overreaction** (DE), **underreaction** (IA), or **Rational** (RE)

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Macro dynamic system with **8 primitive shocks** ε_t^M and **stochastic volatilities**

- System: 4 variables w/ 2 corr "trend & cycle" components with separate **shocks**:
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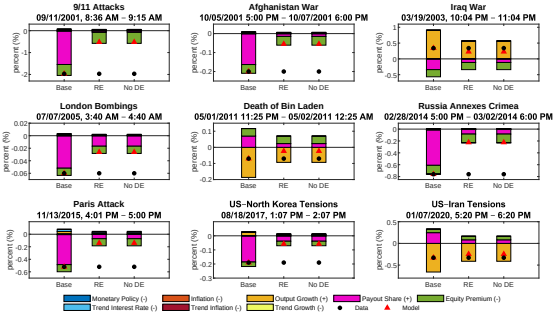
Asset Pricing Dynamics with **2 sources** variation in **return premia**

- Δ's in *perceived quantity* risk from perceived vols & in *price* of risk from lp_t (e.g., sentiment, impl RA, flights-to-quality...)

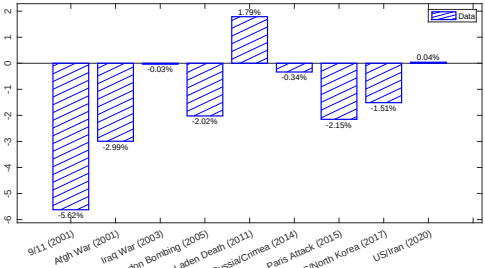
$$\underbrace{\widetilde{\mathbb{E}}_t\left[r_{t+1}^D\right] - \left(i_t - \widetilde{\mathbb{E}}_t\left[\pi_{t+1}\right]\right)}_{\text{subj. equity premium}} = \underbrace{\begin{bmatrix} -5\widetilde{\mathbb{V}}_t\left[r_{t+1}^D\right] - \widetilde{\mathbb{COV}}_t\left[m_{t+1}, r_{t+1}^D\right] \\ +.5\widetilde{\mathbb{V}}_t\left[\pi_{t+1}\right] - \widetilde{\mathbb{COV}}_t\left[m_{t+1}, \pi_{t+1}\right] \end{bmatrix}}_{\text{subj. risk premium}} + \underbrace{lp_t}_{\text{liquidity Premium}}$$

Reactions to GPR Events: Structural Asset Pricing Model

A. Decomposing Jumps in S&P 500 Index



B. Jumps in BBG S&P 500 Earnings Nowcasts



The left panel decomposes jumps in the S&P 500 pre- and post-large GPR events into components attributable to revisions in perceived macro shocks and the subjective equity premium from the structural model in Bianchi, Ludvigson, and Ma (2024). The right panel plots the change in the S&P 500 Earnings nowcasts from Bloomberg pre- and post- GPR events. For trades outside the regular trading hours, we use E-mini S&P 500 futures. For each event specified in the panel title, we use data from 10 minutes before the event start time to one hour after, unless constrained by data availability. Source for model: Bianchi, Ludvigson, and Ma (2024).

Reactions to GPR Events: Structural Asset Pricing Model

- Big mkt ↘ *not* due to **return premia** but to ↘ revision in expected **cash-flow growth**

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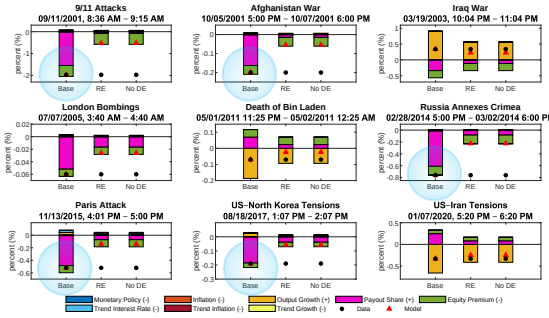
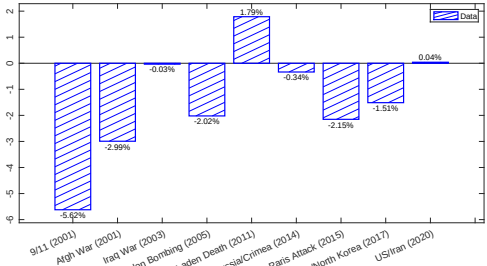


B. Jumps in BBG S&P 500 Earnings Nowcasts



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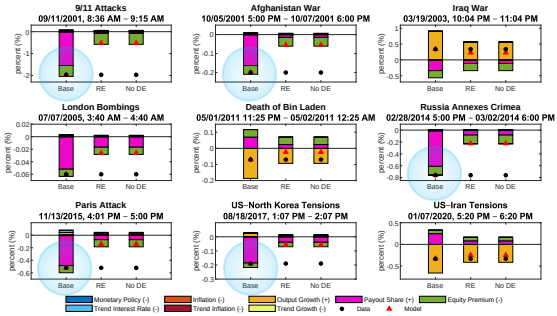
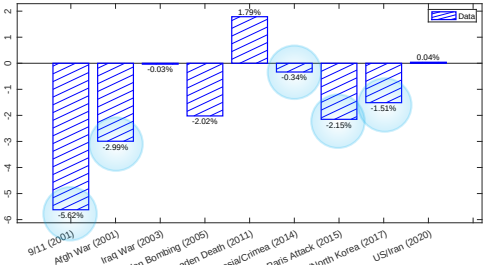
Reactions to GPR Events: Structural Asset Pricing Model

- Mirrored in jumps ↘ in BBG quarterly earnings nowcasts around events

A. Decomposing Jumps in S&P 500 Index



B. Jumps in BBG S&P 500 Earnings Nowcasts



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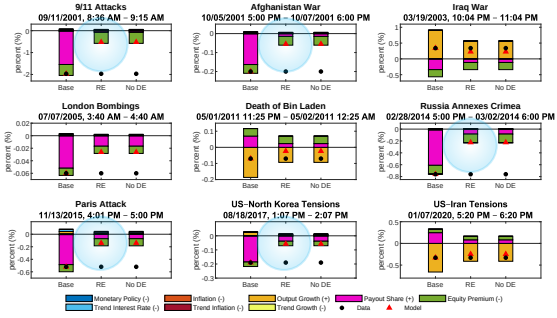
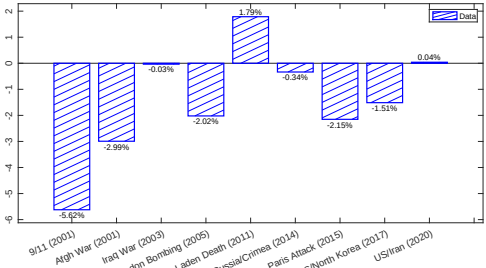
Reactions to GPR Events: Structural Asset Pricing Model

- Big *over*reactions: RE ↘ much smaller (**over-pessimism**) driven by DE

A. Decomposing Jumps in S&P 500 Index



B. Jumps in BBG S&P 500 Earnings Nowcasts



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Conclusion

- **We ask:** **Is geopolitical risk** relevant for **financial markets?**
- **We argue:** robustly tieing GPR to financial markets requires a **high-frequency approach** that *isolates* geopolitical events & distinguishes from other news
- **We study:** how GPR might affect *expectations and perceived risks* using:
  1. **An empirical strategy** that accommodate lots of **forward-looking information** at mixed-sampling intervals
  2. **A conceptual framework** needed to gauge the role of **beliefs** (possibly distorted) and **perceived risks** in market reactions to geopolitical events
- Accomplished by employing the MxFS approach (BLMa) & estimated AP model (BLMb)

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- Accomplished by employing the MxFS approach (BLMa) & estimated AP model (BLMb)
- **We find:**
  1. **Generic movements** in GPR index not associated big changes in U.S. stock market
  2. **Little evidence** stock market **risk premia, perceived risk, risk pricing**, vary due to GP events
  3. **Still, a handful** of GP events *are* associated w/ **jumps** in market but *not* b/c **risk premia vary**
  4. **Instead**, when there *are* jumps it's b/c investors' subj **cash flow expectations** *overreact* to news

APPENDIX

High-Frequency Stock Market Reactions GPR Events: Data vs RE

Event	Actual (%)	RE(%)
9/11 Attacks	-1.97	-0.52
Afghanistan War	-0.20	-0.05
Iraq War	0.34	0.23
London Bombings	-0.06	-0.03
Death of Bin Laden	-0.07	-0.02
Russia Annexes Crimea	-0.76	-0.22
Paris Attack	-0.52	-0.14
US-North Korea Tensions	-0.19	-0.06
US-Iran Tensions	-0.33	-0.25

This table reports the change in the S&P 500 index pre- and post-large GPR events, compared to a rational expectations benchmark using the structural model in Bianchi, Ludvigson, and Ma (2024). For trades outside the regular trading windows, we use E-mini S&P 500 futures. For each event specified in the panel title, we use data from 10 minutes before the event start time to one hour after, unless constrained by data availability. Source for model: Bianchi, Ludvigson, and Ma (2024).

References I