High-Frequency Cross-Sectional Identification of Military News Shocks

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Outline

Introduction

HFXS Framework & Identification

Empirical Results

Application: US GDP XS-Multipliers

Conclusion

Motivation

- Economists are interested in the effects of defense spending because it provides:
  - **Exogenous variation** in government spending (causal inference)
  - Multiplier estimates of **military build-ups** (policy relevance)

- Identification challenges:
  - Effects of government spending are anticipated (Ramey, 2011)
  - Measuring expectations is tricky

→ **Research Question:**

"How does the economy respond to ***anticipated*** *changes in defense spending?"*
&
"How can we effectively measure ***expectations*** *about future defense spending?*

Literature Review

- Macro shocks need to be unanticipated (Ramey, 2016)
  - **Fiscal foresight**
    Mertens and Ravn (2010) (gov. spending), Leeper et al. (2013) (taxes)
  - **Measurement delays** (Briganti et al., 2025)
  - → Non-invertibility of fiscal shocks

→ **Unanticipated measures** of government spending shocks:

- **VAR Restrictions**: Blanchard and Perotti (2002) (short-run restrictions), Ben Zeev and Pappa (2017) (medium run restrictions (Barsky and Sims, 2011)), Ascari et al. (2023) (sign restrictions (Mountford and Uhlig, 2009))
- **Narrative Instruments**:
  Ramey and Shapiro (1998) (war dates), Ramey (2011)+Ramey and Zubairy (2018) (def. news)
- **Bartik Instruments**: Nakamura and Steinsson (2014), Dupor and Guerrero (2017), Demyanyk et al. (2019), Auerbach et al. (2020), Muratori et al. (2023) , Barattieri et al. (2023), Auerbach et al. (2024).
- **Stock-Price-Based Instruments**:
  Fisher and Peters (2010), McClure and Yding (2024)(narrative+high frequency).
- **High Frequency Instruments**: Bandeira et al. (2025) (Brazil Deficit), Wiegand (2025)+ Gomez-Cram et al. (2025)+Hazell and Hobler (2025)+Bi et al. (2025)(US Deficits)

Contribution: HFXS Identification

- We introduce a novel method to quantify expectations of future military spending
  i. Identify HF-fiscal events using narrative analysis augmented with LLM searches
  ii. Leverage stock price XS-variation to quantify expected shifts in defense expenditure
- Benefits:
  i. Model consistent methodology grounded in asset pricing theory
  ii. Self-validating: it *estimates* and allows statistical validation of each event (*testing*)
  iii. Generalizable to contexts where units are heterogeneously impacted by aggregate shocks
  iv. Parsimony and objectivity (i.e., minimizes subjectivity in narrative approaches)
- Contributions:
  i. Novel LLM-augmented narrative analysis: key fiscal events (2001-2023)
  ii. Novel military news shocks series (2001-2023)
  iii. Novel XS-multiplier estimates (MSA / 2001-2023)

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A Simple Model of Stock Prices

- Profits $D_{i,t}$ of firm i at time t

$$D_{i,t} := (1-\tau_t)\cdot \underbrace{(V_{i,t}+G_{i,t})}_{\text{Total Sales}}\cdot\left(1-\frac{1}{\mu_i}\right)$$

  - $V_{i,t}$ is private sales
  - $G_{i,t}$ is government sales
  - μ_i is the markup and τ_t is a corporate tax

- Gordon (1959):

$$P_{i,t} := \sum_{h=0}^{\infty} \frac{D^e_{i,t+h}}{\prod_{\tau=0}^{h}(1+i^e_{t,t+\tau})}$$

  - $P_{i,t}$ is the stock price of firm i
  - $i^e_{t,t+\tau}$ is the expected $(t+\tau)$-period ahead interest rate at time t

Government Sales: Linked to Stock Prices

- Under (i)-(ii):
    1. Expected profits are proxied by current profits
    2. Expectations hypothesis of the term structure holds

$$P_{i,t} = \frac{D_{i,t}}{1 - \frac{1}{1+i_t}} = \frac{1+i_t}{i_t} \cdot \underbrace{(1-\tau_t) \cdot (V_{i,t} + G_{i,t}) \cdot \left(1 - \frac{1}{\mu_i}\right)}_{D_{i,t}} \tag{1}$$

$\longrightarrow$ The stock prices are proportional to government sales

Stock Returns Are Proportional to Government Sales

Let us focus on cross-section (XS) of contractors i

- Denote *Reliance on DoD* by $\lambda_i := \frac{G_i}{G_i+V_i}$; define $G_i := \theta_i \cdot G$
- Log-Differentiate (1) around a **HF fiscal event**:

$$\underbrace{d\log P_i}_{\text{Stock Return}} = \alpha + \underbrace{\lambda_i}_{\text{Reliance}} \cdot \left(\underbrace{d\log G^e}_{\text{Shock}} + d\log\theta_i^e - d\log V_i^e \right) + \varepsilon_i \qquad (2)$$

  - α: time FEs (e.g., $\mathbb{E}$ change in corporate taxes);
  - ε_i: firm-specific FEs (e.g., $\mathbb{E}$ change in markups)

Extract News Shocks from Stock Returns

HFXS Identification: Theorem

Generalization

Under weak Assumptions, regressing stock returns ($d\log P_i$) on reliance on DoD contracts (λ_i):

$$d\log P_i = \alpha + \gamma \cdot \lambda_i + e_i \tag{3}$$

yields

$$\hat{\gamma}_{\text{OLS}} \xrightarrow{p} d\log G^e$$

That is, $\hat{\gamma}_{\text{OLS}}$ consistently estimates expected changes in defense spending ($d\log G^e$)

"If Lockheed's reliance on DoD (λ_i) is 71% and Boeing's is 30%, a positive shock will affect Lockheed's price more, mirroring its larger profit potential."

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Events that Shifted US Expected Military Spending (2000-2023)

Date	*Sign*	*Description of the Event*
11 September 2001	+	9/11 terrorist attacks + ensuing invasion of Afghanistan in October 2001
20 March 2003	+	U.S.-led invasion of Iraq opens a second major war
10 January 2007	+	President Bush's Iraq "Surge" address
4 November 2008	−	Barack Obama elected U.S. president after campaigning to end the Iraq War
2 August 2011	−	Budget Control Act of 2011 signed amid debt-ceiling crisis
1 March 2013	−	U.S. Government Sequestration takes effect after Congress fails to agree on deficit reductions
18 March 2014	+	Russia's illegal annexation of Crimea
22 September 2014	+	Extremist group ISIS seizes large parts of Iraq & Syria
8 November 2016	+	Trump wins 2016 U.S. Elections campaigning on military build-up
9 February 2018	+	Bipartisan Budget Act of 2018 lifts strict BCA spending caps for FY 2018–19
2 August 2019	+	Bipartisan Budget Act of 2019 raises defense spending caps + ends sequestration-era limits
24 February 2022	+	Russia invades Ukraine

Prompt: Narrow Context Without Example   Prompt: Narrow Context Without Example

Defense Contractors Data

- Annual official Top100 Report (available from 1958)

→ 430 Top100 Contractors from FY2001

- **Three conditions**:

  I. **Publicly Traded** (NYSE or NASDAQ)
  → 57 contractors

  II. **Salience**: investors associate contractors to "defense"
  → Appear at least four times in Top100 report (e.g., rules out **Moderna**)

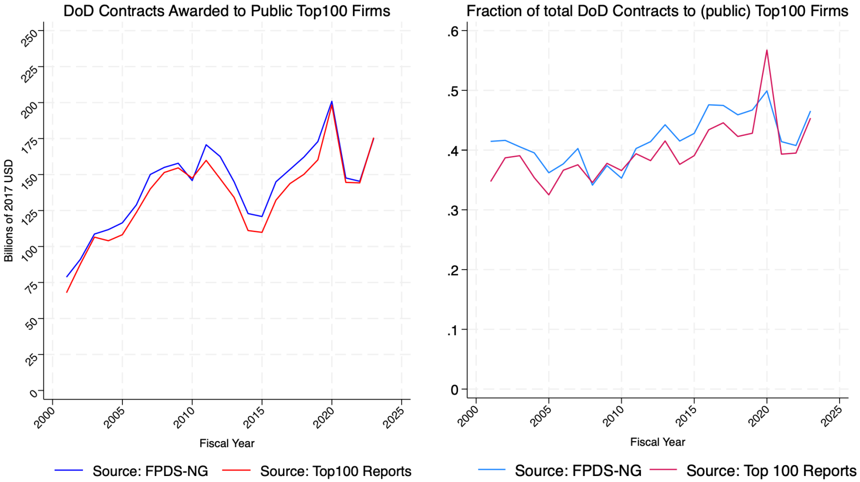
  III. **Relevance**: stock price non-negligibly affected by gov. contracts
  → Median reliance $\geq$ 1% (e.g., rules out **BP**):

$$\text{Median}\left(\lambda_{i,t}\right) \geq 1\%, \quad \lambda_{i,t} := \frac{\text{DoD Contracts}_{i,t}}{\text{Tot. Sales}_{i,t}}$$

→ 33 Contractors meet conditions I-III

  – Median reliance is 20%. Interquartile range is [3.7%,39.9%] Descriptive Stats

33 companies = 40% total DoD Procurement spending!



Model-Implied XS-Regression

- We have:
  - Set of Narrative Dates $\mathcal{T}$
  - Set of 33 **publicly traded**, **salient** and **relevant** defense contractors

→ Implement HFXS Regressions

- For each date $\tau \in \mathcal{T}$ estimate empirical analog of Equation (3):

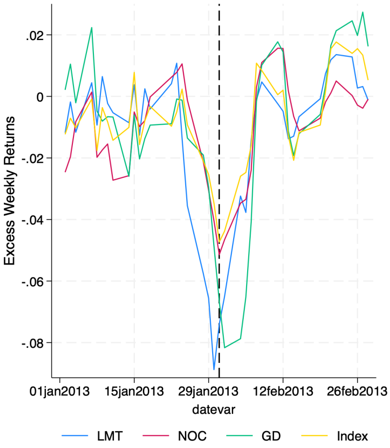
$$\underbrace{v_{i|t=\tau}}_{\approx d\log P_{i,t}} = \alpha + \gamma_{t=\tau} \cdot \underbrace{\lambda_{i|t=\tau}}_{\text{Reliance}} + \epsilon_i \quad \forall \tau \in \mathcal{T},\ \forall i \in \mathcal{I}_\tau, \tag{4}$$

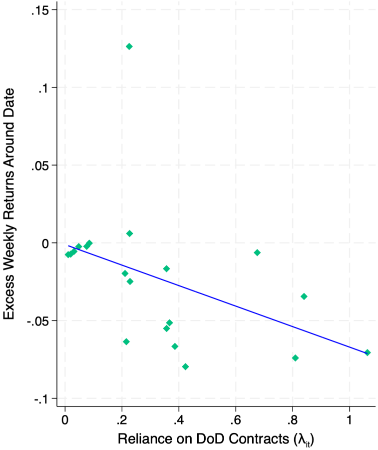
  - $v_{i|t=\tau}$: weekly excess returns
    - Constructed using Fama-French 3 factors model
    - Frequency: five trading days
  - $\lambda_{i|t=\tau}$: reliance on DoD purchases in the quarter of the event

- We have:
  - Set of Narrative Dates $\mathcal{T}$
  - Set of 33 **publicly traded**, **salient** and **relevant** defense contractors

→ Implement HFXS Regressions

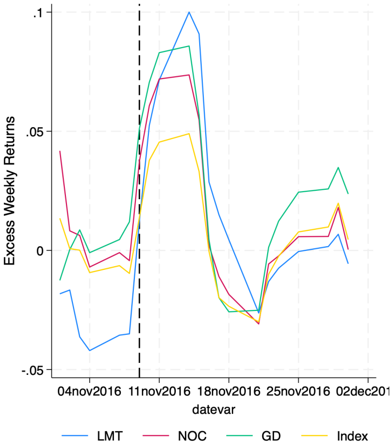
Example 1: Budget Sequestrations (2013Q1)

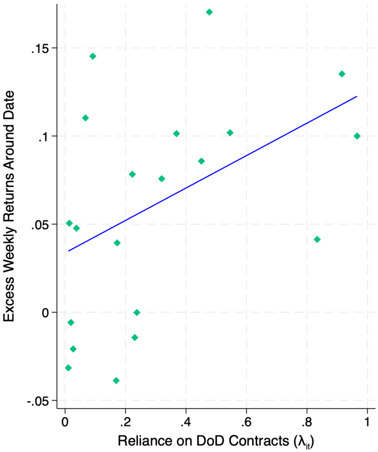




$\rightarrow$ **Estimated Slope** ($\hat{\gamma}$): -0.066 (0.015)

Example 2: Trump Election (2016Q4)





→ **Estimated Slope** ($\hat{\gamma}$): +0.092 (0.024)

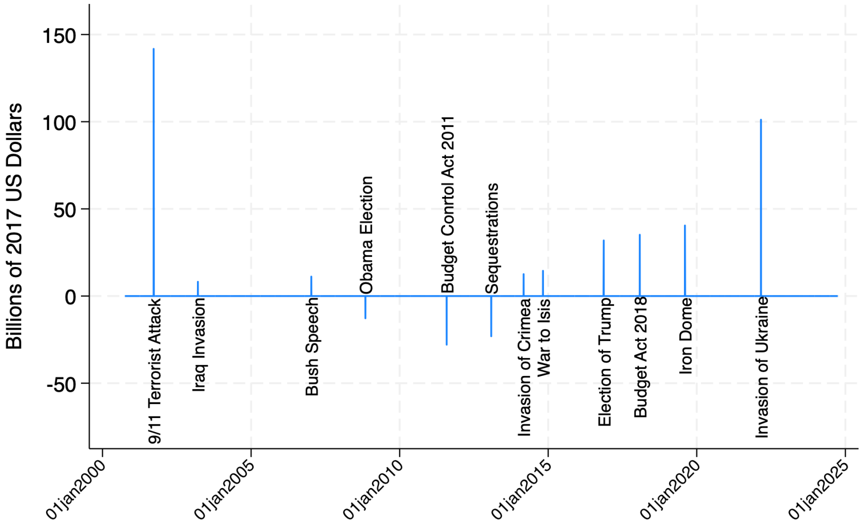
Estimates of HFXS Military News Shocks

Event	Shock Trading Date	Expected Sign	$\mathbf{d}\log\mathbf{G_t}$ $(\gamma_{t=\tau})$	pvalue	N	Defense Index
9/11 Terrorist Attack	*September 21, 2001*	+	0.629 (0.133)	0.000	14	+5.2%
Invasion of Iraq	*March 19, 2003*	+	0.029 (0.035)	0.406	20	+ 6.4%
Bush Speech on Iraq	*January 11, 2007*	+	0.028 (0.017)	0.117	20	+3.1%
Obama Election	*November 6, 2008*	-	-0.031 (0.030)	0.327	18	-2.3%
Budget Control Act 2011	*August 2, 2011*	-	-0.065 (0.019)	0.002	23	-3.1%
Sequestrations	*January 31, 2013*	-	-0.066 (0.015)	0.000	21	-4.7%
Russia's Invasion of Crimea	*March 5, 2014*	+	0.038 (0.021)	0.086	21	+1.5%
War to Isis	*29 October 2014*	+	0.047 (0.024)	0.065	23	+3.3%
Trump Election	*November 14 2016*	+	0.092 (0.043)	0.042	23	+4.9%
Bipartisan Budget Act 2018	*January 31 2018*	+	0.091 (0.038)	0.024	23	+5.8%
Bipartisan Budget Act 2019 + Iron Dome	*9 August, 2019*	+	0.101 (0.028)	0.002	23	+3.7%
Invasion of Ukraine	*March 1, 2022*	+	0.273 (0.041)	0.000	23	+10.4%

Notes: Robust standard errors in parentheses. Last column (Defense Index), refers to the excess weekly returns of the Defense Index. Interquartile range of excess weekly returns of Defense Index is [-1.0%,+1.0%], 10th and 90th percentiles are -2.2% amd +2.1%.

HFXS Military News Shock Series

RZ18 Comparison



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Military News Shocks are (Regionally) Salient!

Pasadena Star-News

News | Local News | Sports | Things to Do | Obituaries | Opinion | The T.E.A.

TRENDING: Stolen bulldog reunited with family | Man accused in kidnapping | Nephew-killer sentenced | Big Bear Lake before/after | Michelin's 'new discoveries'

LOCAL NEWS

Good news about a Trump economy? California's defense industry could benefit

Southern California is expected to benefit from a boost in defense spending under the Trump administration. Monrovia-based AeroVironment Inc. makes a variety of unmanned drones that are used by the U.S. military. One of the company's drones is shown here as a worker prepares to test it in Simi Valley. (Andy Holzman/Los Angeles Daily News)

MOST POPULAR

1. Retired news anchor Chuck Henry's Pasadena home finds a buyer, fast
2. California adopts one of nation's highest fixed-utility fees
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6. Kaiser Permanente's inaugural Pasadena medical school cohort set to graduate
7. Here are the ultraprocessed foods you most need to avoid, according to a 30-year study
8. Art Del Rey, an Arcadia pioneer in Spanish language barbershop quartet singing, has died
9. USC faculty censures university president, provost over Gaza protest response
10. USC graduates relieved by smooth sailing on Day One of 100-plus ceremonies

Los Angeles Times

BUSINESS

Southern California aerospace and defense contractors expecting boost from Trump budget

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Full Text | Newspaper

THE NATION; Local defense firms expect boost; Trump's budget bodes well for California's aerospace and milit
contractors.

Hennigan, W J. Los Angeles Times; Los Angeles, Calif.. 23 Mar 2017: A.6.

Preview publication details

Los Angel

Full text

Details

Full Text

Southern California's defense industry, long the epicenter for high-flying aerospace technology and advanced weapons for the military, could get a ma

LOS ANGELES

Trump Policies Could Be More Benefit Than Burden For California

KCAL NEWS

December 6, 2016 / 9:29 AM PST / KCAL News

LOS ANGELES (CBSLA.com) – The presidential election has thrown California's economic future into turmoil, but maybe for the better, according to the UCLA Anderson Forecast released Tuesday.

Regional Economic Effects

$$\frac{Y_{\ell,t+h} - Y_{\ell,t-1}}{Y_{\ell,t-1}} = \underbrace{\beta_h}_{\text{XS-Multiplier}} \cdot \frac{G_{\ell,t+h} - G_{\ell,t-1}}{Y_{\ell,t-1}} + \alpha_\ell^h + \lambda_t^h + \varepsilon_{\ell,t+h}$$

- $Y_{\ell,t}$ real GDP, $G_{\ell,t}$ real DoD Contracts, α_ℓ^h & λ_t^h location & time FE; (N = 377; T = 24)

! **Endogeneity** of $G_{\ell,t}$: Reverse Causality (Mintz, 1992), Anticipation (Auerbach et al., 2020)

→ shift-share (**Bartik**) instrument:

$$Z_{\ell,t+h}^{\text{Bartik}} = \frac{s_\ell \left(G_{t+h} - G_{t-1}\right)}{Y_{\ell,t-1}}$$

- s_ℓ (Share): DoD contracts share MSA ℓ
- G_t (Shift): National DoD contracts

→ We replace the Shift:

$$Z_{\ell,t+h}^{\text{HFXS}} = \frac{s_\ell \, \mathbb{E}_t(G_{t+1})}{Y_{\ell,t-1}}$$

- $\mathbb{E}_t(G_{t+1})$: HFXS Military News Shocks

2-year XS Multiplier of ≈ 1

Horizon	**IV: HFXS Military News Shocks**		
	Coefficient	*pvalue*	*Effective F*
Impact	2.647 (2.307)	0.252	1.462
Year 1	1.352 (0.369)	0.000	14.939
Year 2	0.953 (0.271)	0.000	30.558
Year 3	0.614 (0.338)	0.070	6.257

Notes: 377 MSAs, 2001-23. GDP price deflator from BEA, base year 2017. Robust SE in parentheses, clustered at MSA level. Montiel Olea and Pflueger (2013) F calculated with `weakivtest`.

→ Military news shocks **have real economic effects**

Horizon	**IV: HFXS Military News Shocks**			**IV: Standard Bartik**		
	Coefficient	*pvalue*	*Effective F*	*Coefficient*	*pvalue*	*Effective F*
Impact	2.647 (2.307)	0.252	1.462	0.095 (0.044)	0.030	17.088

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Conclusion

- **New model-consistent methodology** to identify military news shocks
  - Estimate & Test shocks from the data!
    - A. Identify narrative events
    - B. Run model-implied HFXS-regressions around events
  - $\rightarrow$ **Self-validating** (sign & significance)
  - **Generalizable** to contexts of aggregate shock/heterogeneous exposure
- Application: US Military Spending post-2000:
  - Document **novel series** of key US military events
  - Construct **new** (HFXS) defense news shocks
  - $\rightarrow$ Defense news shocks have significant effects on regional GDP (2-year XS-$\mathcal{M} \approx 1$)

Thank You!

Outline

Appendix

Example of Prompt with Non-Controversial Events Back

"Compile a list of dates or events—from 2000 onward—that signal a potential shift in the expected path of US military procurement spending. Include both positive and negative shocks. Examples: (a) September 11, 2001 terrorist attacks: widely seen as a precursor to higher defense spending; (b) Failure in February/March 2013 of President Obama and Congress to reach a budget agreement: triggered automatic cuts (sequestration) and reduced defense spending; (c) Unexpected election victory of Donald Trump, November 2016: he campaigned on increasing military outlays. Use a similar standard to identify and briefly justify each additional event you list."

- 9/11: defense news shock according to Ramey and Zubairy (2018).
- Budget Sequestrations: exogenous fiscal consolidation by Alesina et al. (2014).
- Trump's 2016 election: marginal win + campaign on "*peace through strength*"

Prompt for Narrower Periods without Examples

Back

- Context: Iraq & Afghanistan wars followed from 9/11 and prompted increased spending
- Then, we ask:

  "*List the defining moments/events of the war in Iraq and Afghanistan that (a) had large media coverage in the US around the years 2004-2008 and (b) which also gave the impression of an expected increase in military spending in the US.*"

Assumptions for Identification Back

- **Assumption 1.** $\lambda_i \perp d\log V_i^e$
- **Assumption 2.** $\mathbb{E}[d\log V_i^e] = 0$
  Private sales may move in both directions:
  - Lee (2024): new contracts crowd-in private sales via learning-by-doing.
  - Ilzetzki (2023): capacity constraints during WWII may have limited the ability of contractors to expand private
  - di Giovanni et al. (2023): crowding-out on impact, and crowding-in after one year after winning a contract.
- **Assumption 3.** $\lambda_i \perp d\log \pi_i^e := \frac{d\log \mu_i^e}{\mu_i - 1}$
  If investors form expectations about future contractors' profitability, those expectations must be independent of reliance
- **Assumption 4.** $\lambda_i \perp d\log \theta_i^e$
- **Assumption 5.** $\mathbb{E}[d\log \theta_i^e] = 0$
  If investors form expectations about future contractors' profitability, those expectations must be independent of reliance and average out to zero

Framework Generalizable to Broader Macro Contexts

Back

- It is possible to show that:

$$d\log P_{i,t} = \underbrace{\underbrace{\lambda_{i,t}}_{(i)} \cdot \underbrace{\xi_i}_{(ii)}}_{\text{Heterogeneous Exposure}} \cdot \underbrace{d\varepsilon_t}_{(iii)-\text{Shock}}$$

I. $\lambda_{i,t}$: fraction of sales exposed to the news shock

II. ξ_i: elasticity of sales with respect to the shock

III. $d\varepsilon_t$: shock you want to identify

Proposition: Generalization

Let units experience a common shock ε_t with heterogeneous loadings captured by observable (or parametrizable) terms $(\lambda_{i,t}, \xi_i)$. Then, estimating the cross-sectional regression around the event yields an estimate of the shock magnitude.

Largest firms in the sample

Back

- Median reliance is 20%. Interquartile range is [3.7%,39.9%].
- Top 3 firms by (median) reliance:
  - **VSE Corp** (86%) (Aviation Services)
  - **L3 Harris Technologies** (82%) (Avionics)
  - **Huntington Ingalls Industries** (73%) (Ship building)
- Top 3 firms by fraction of DoD Contracts (FY23):
  - **Lockheed Martin** (14.7%) (Aerospace)
  - **Raytheon (RTX)** (6.5%) (Weapons and Electronics)
  - **General Dynamics** (5.0%) (Aerospace, Submarines, Vehicles)
- Data cross-validation:
  - We match these companies with universe of micro-contracts from FPDS
  - We compare FPDS data with Top100 Report data

  → **The two data sources match!**

Construction of Excess Returns Back

- Need to "*clean*" the returns $\rightarrow$ extract *excess returns*

- Fama and French (1993) three factor model:

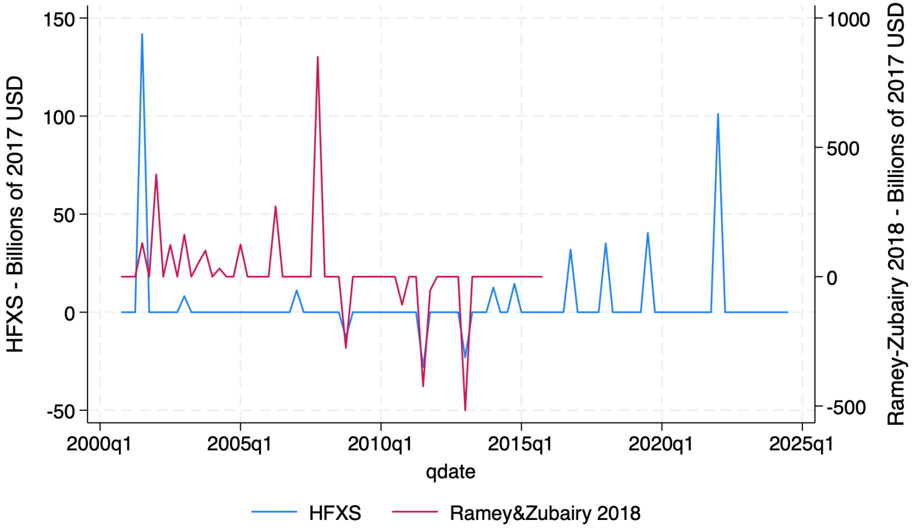
$$r_{i,t} = \alpha_i + \beta_i^1 \cdot \mathrm{MKT}_t + \beta_i^2 \cdot \mathrm{SML}_t + \beta_i^3 \cdot \mathrm{HML}_t + v_{i,t} \quad \forall i \in \mathcal{I}$$

  - $r_{i,t}$: contractors' weekly returns (WRDS)
  - Three factors: MKT (market), SML (size) and HML (value)

$\rightarrow$ $v_{i,t}$: OLS residuals˜ weekly excess returns

HFXS and RZ18 shocks are similar but not identical

Back



Robustness: Exclusion of 9/11 Back

Robustness - Sample: 2002-2023 (Without 9/11) - 377 MSAs								
Horizon	*IV: HFXC Military News Shocks*			*IV: Standard Bartik*			*OLS*	
	Coefficient	*pvalue*	*Effective F*	*Coefficient*	*pvalue*	*Effective F*	*Coefficient*	*pvalue*
Impact	-0.112	0.594	9.428	0.124	0.008	17.575	0.009	0.622
	(0.209)			(0.047)			(0.018)	
Year 1	0.609	0.044	17.868	0.494	0.000	100.184	0.052	0.042
	(0.301)			(0.120)			(0.025)	
Year 2	0.571	0.033	12.293	0.437	0.002	42.991	0.078	0.090
	(0.268)			(0.142)			(0.046)	
Year 3	0.620	0.147	6.656	0.638	0.019	10.163	0.123	0.074
	(0.427)			(0.271)			(0.069)	

Notes: 377 MSAs, 2001-23. GDP price deflator from BEA, base year 2017. Robust standard errors in parentheses, clustered at MSA level. Montiel Olea and Pflueger (2013) effective F is calculated with `weakivtest`, coincides with Kleibergen and Paap (2006) statistic for single instrument