High-Frequency Cross-Sectional Identification of Military News Shocks

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Outline

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

Outline

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.*"

Outline

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

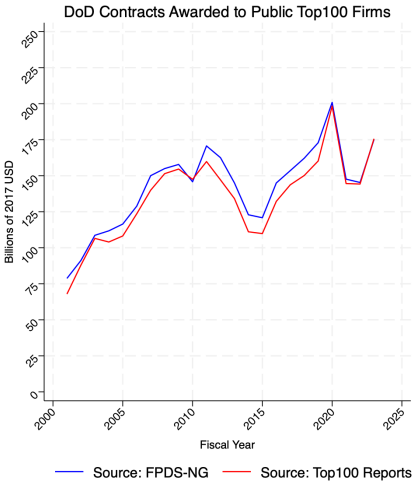
II. **Salience**: investors associate contractors to "defense"
→ Appear at least four times in Top100 report (e.g., rules out **Moderna**)

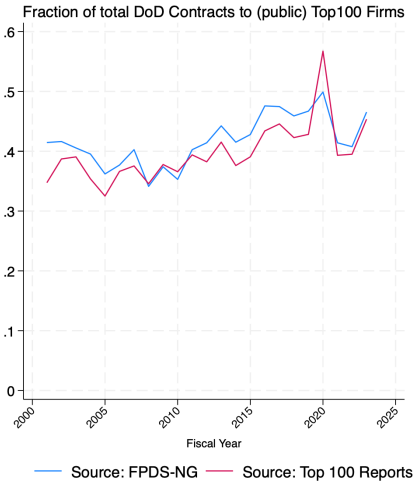
III. **Relevance**: stock price non-negligibly affected by gov. contracts
→ Median reliance $\geq 1\%$ (e.g., rules out **BP**):

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

→ 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):

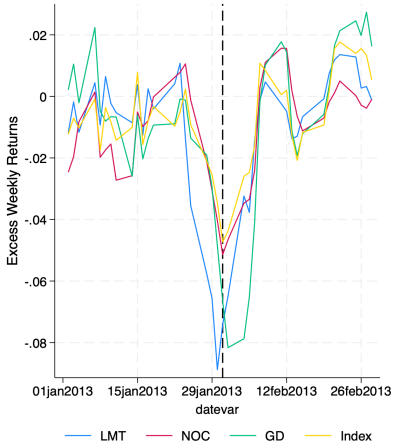
$$\underbrace{v_{i|t=\tau}}_{\approx d \log P_{i,t}} = \alpha + \gamma_{t=\tau} \cdot \underbrace{\lambda_{i|t=\tau}}_{\text{Reliance}} + \epsilon_i \quad \forall \tau \in \mathcal{T},\ \forall i \in \mathcal{I}_\tau, \tag{4}$$

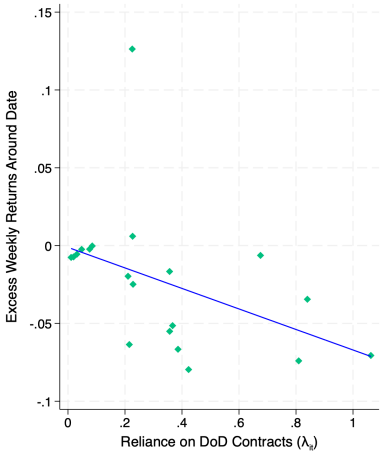
  - $v_{i|t=\tau}$: weekly excess returns
    - Constructed using Fama-French 3 factors model
    - Frequency: five trading days
  - $\lambda_{i|t=\tau}$: reliance on DoD purchases in the quarter of the event

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

→ Implement HFXS Regressions

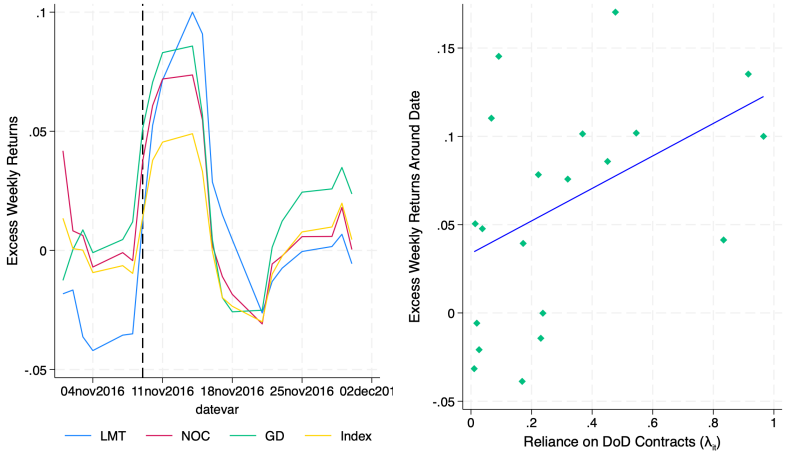
Example 1: Budget Sequestrations (2013Q1)





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

Example 2: Trump Election (2016Q4)



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

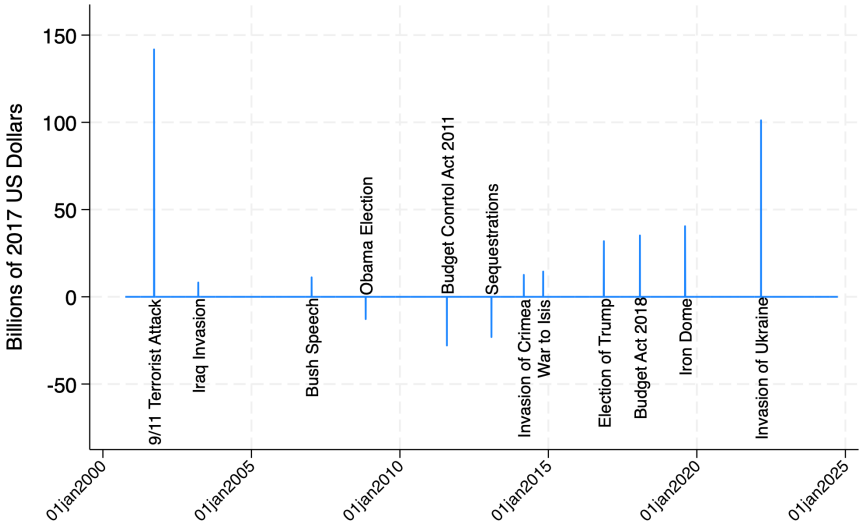
Estimates of HFXS Military News Shocks

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

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%.

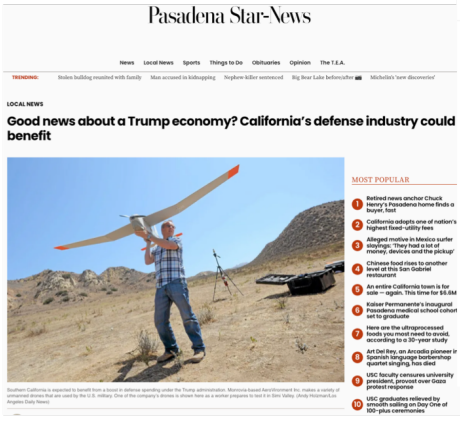
HFXS Military News Shock Series

RZ18 Comparison



Outline

Military News Shocks are (Regionally) Salient!


Pasadena Star-News

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LOCAL NEWS

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

MOST POPULAR

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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)

Los Angeles Times

BUSINESS

Southern California aerospace and defense contractors expecting boost from Trump budget

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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

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

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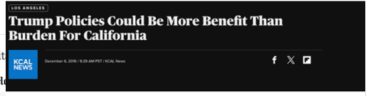

LOS ANGELES

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**			**IV: Standard Bartik**		
	Coefficient	*pvalue*	*Effective F*	*Coefficient*	*pvalue*	*Effective F*
Impact	2.647	0.252	1.462	0.095	0.030	17.088
	(2.307)			(0.044)		
Year 1	1.352	0.000	14.939	0.539	0.000	95.193
	(0.369)			(0.125)		
Year 2	0.953	0.000	30.558	0.484	0.001	46.408
	(0.271)			(0.148)		
Year 3	0.614	0.070	6.257	0.639	0.013	15.239
	(0.338)			(0.256)		

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) effective F is calculated with `weakivtest`.

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

→ Produce **higher XS-multipliers** than standard Bartik

Robustness: exclusion of 9/11

Outline

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
  - → **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
  - → Defense news shocks have significant effects on regional GDP (2-year XS-$\mathcal{M}$ ≈ 1)

Thank You!

Outline

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 → extract *excess returns*

- Fama and French (1993) three factor model:

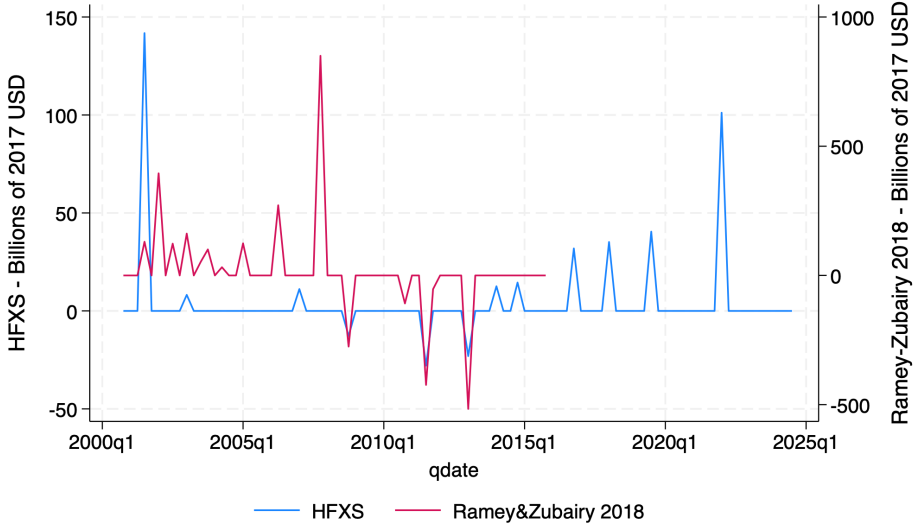
$$r_{i,t} = \alpha_i + \beta_i^1 \cdot \text{MKT}_t + \beta_i^2 \cdot \text{SML}_t + \beta_i^3 \cdot \text{HML}_t + v_{i,t} \quad \forall i \in \mathcal{I}$$

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

→ $v_{i,t}$: OLS residuals$\tilde{}$ 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