The Macroeconomic Effects of Defence Expenditure: Evidence from Spain

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Defence Expenditure in Spain

Introduction

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- **Research question**: What are the macroeconomic effects of defence spending?.
- Important **differences** to *normal* fiscal policy:
  1. Particular statistical treatment.
  2. Major empirical challenge: **anticipation** and **long implementation** lags.
- How to **empirically estimate** effects of fiscal policy in this context?.

This paper

- Exploits evidence from the **universe of contracts** from the Ministry of Defence in Spain.
  - Military contracts overcome some of the existing empirical challenges: dynamics.
  - Highlight role of investment *vs.* consumption.
- **Long implementation lags**: focuses on medium-term effects.

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  - Highlight role of investment *vs.* consumption.
- **Long implementation lags**: focuses on medium-term effects.
- Preview of **results**:
  - Anticipation: output effects precede government spending.
  - Output effect **takes time** to materialise, becomes **relatively large** but it is **transitory**.
  - Multiplier close to 0.2-0.5 in the short-run, raises to 1.0-1.3 after 5 years.
- Economic transmission mechanism: How should we think about defence expenditure in a **General Equilibrium** model?

Related literature

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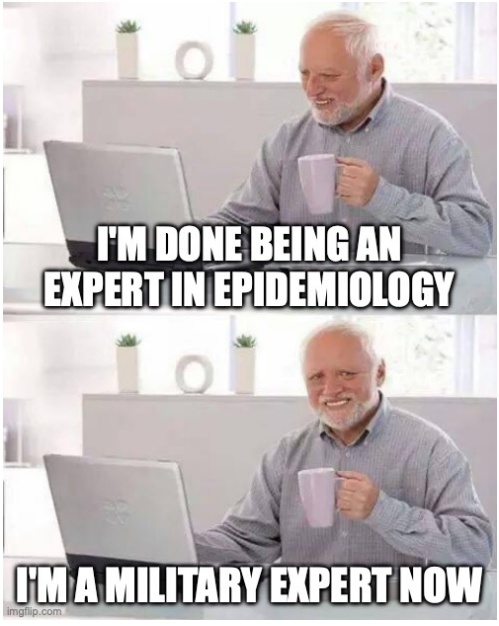
  - More recently: Ilzetzki (2025), Antonova et al. (2025), Briganti and Sellemi (2023), Brunet (2023).
- Lags on **implementation** of fiscal policy: Kydland and Prescott (1982), Ramey (2021).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EXPERT IN EPIDEMIOLOGY
I'M A MILITARY EXPERT NOW
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The life cycle of major military purchases

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1. Government agreement and **budgetary appropriations**.

La Moncloa

Madrid, 20 de febrero de 2004

El Consejo de Ministros ha autorizado la financiación de los créditos plurianuales para la adquisición de cuatro submarinos S-80 y el buque de proyección estratégica LLx, de acuerdo a lo establecido en la Ley General Presupuestaria. El pasado 5 de septiembre el Consejo de Ministros autorizó al Ministro de Defensa a iniciar las actuaciones necesarias para las citadas adquisiciones.

El coste del Buque de Proyección LLx es de 360 millones. La construcción está previsto que finalice en 2008 y se entregue el buque a la Armada. Este programa supone para IZAR unos 3,13 millones de horas de trabajo directo y otros cinco millones de horas en trabajo inducido, lo que equivale al empleo de unas 1.645 personas durante cinco años.

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Este programa supone, igualmente para IZAR, unos ocho millones de horas de trabajo directo y, al menos, otros ocho millones de horas en la industria auxiliar. El astillero invertirá 1.250.000 horas/hombre de ingeniería y se propiciará la creación de 2.814 empleos durante diez años. Por otra parte, el programa asegurará el sostenimiento de este tipo de buques en España.

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5. Formal **delivery** and becoming operational.

Examples of major military contracts in Spain

Contract	Size (% GDP)	Contract Signed	First Production	First Unit Ready	First Delivery
4 F-100 frigates	0.32%	1997	1999	2000	2002
219 Leopard 2E tanks	0.34%	1998	2003	2004	2004
4 S-80 submarines	0.20%	2004	2006	2021	2023
45 NH90 helicopters	0.13%	2006	2010	2011	2014
5 F-110 frigates	0.34%	2019	2022	2025	2028
348 VCR 8x8	0.15%	2020	2022	2022	2025

- **Time-to-spend** and **time-to-build** (and **time-to-register!**): gap until start of production, production (and redesign) process, delivery gap.

Statistical recording of military equipm.: ESA 101

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Military equipment as investment (ESA 2010, p. 443)

"Military weapon systems, comprising vehicles and other equipment such as warships, submarines, military aircrafts, tanks, missile carriers and launchers etc. are used continuously in the production of defence services. They are fixed assets, like those used continuously for more than one year in civilian production. Their acquisition is **recorded as gross fixed capital formation**, *i.e. as capital expenditure [...]"*

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Time of recording (ESA 2010, p. 443)

"The time of recording of asset acquisition is the time of the transfer of the ownership of the asset. In case of long-term contracts involving complex systems, the **time of recording of the transfer of assets should be upon actual delivery** *of the assets, not the time of cash payments."*

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- Variation in **National Accounts expenditure**: $G_t^{NA} = G_t^{NA,empl} + \sum_{j=0}^{J} s_{t-j}$
  - A convolution of *current* spending and previous contracts s_t.
  - Helpful for identifying effects of very contemporaneous items (e.g. compensation employees, consumption services).
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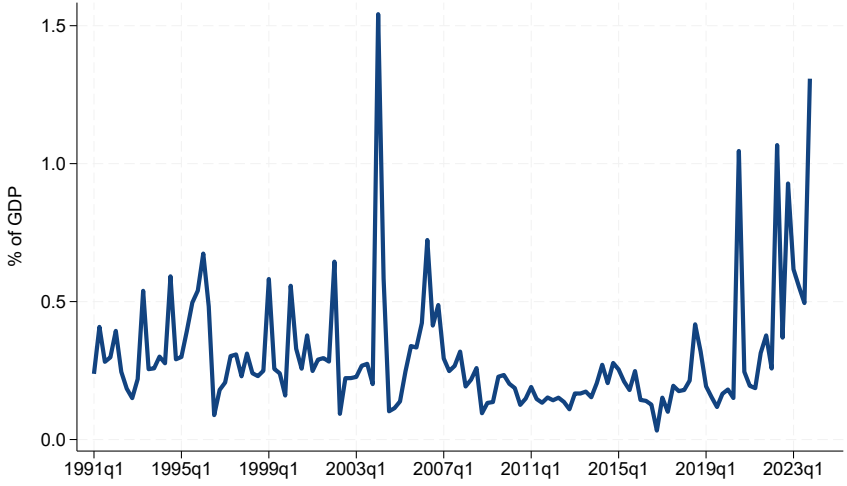
- Signing of **defence contracts** s_t as change in agents information set? (*fiscal news*):
  - More suitable for large military programs.
  - Military strategy less likely to suffer from countercyclical considerations.

A new account of defence contracts in Spain

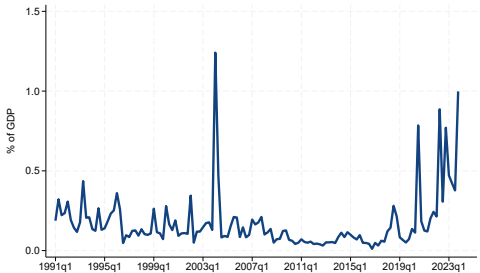
- Digitalisation of total **defence contracts on a monthly frequency from 1991-2023**, from Military Statistical Yearbook. Go to data
- Individual identification of **consumption- and investment-related** contracts using i) description of contracts and ii) official documents. Go to data
- Contracts have **multi-annual** nature: $Corr\left(s_t, G^{NA}_{t+h}\right) > 0$, for $h > 0$. Correlation

All defence contracts



Consumption and investment defence contracts

(a) Investment-related Contracts



(b) Consumption-related Contracts

Empirical specification

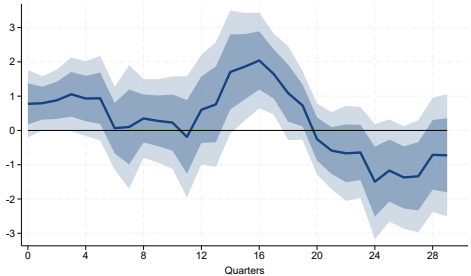
- Estimate **series of LPs**:

$$z_{t+h} = \beta_h s_t + \Theta_h' w_t + \xi_{t+h}$$

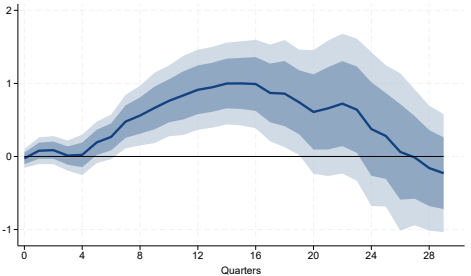
- z_{t+h} is output (Y_t) or government spending G_t (scaled over trend GDP).
- w_t: 8 lags of Y_t, G_t and s_t (and constant and linear trend).
- **Identification assumption**: defence contracts in quarter t not affected by *current* economic conditions.
- Initially consider all contracts s_t, but our main focus is investment-related contracts.

Dynamic responses to defence contracts

(a) Output



(b) Government Spending



Fiscal multipliers for defence expenditure

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  - Estimated from (s_t as instrument from $\sum_{j=0}^{h} G_{t+j}$) :

$$\sum_{j=0}^{h} Y_{t+j} = \Theta_h' w_t + \mathcal{M}(h)^C \sum_{j=0}^{h} G_{t+j} + \psi_{t+h}$$

  - Is it adequate under long $time - to - registry$ spells?
  - Useful for medium-run, but not well defined in the short-run.

Fiscal multipliers for defence expenditure

- An alternative, **total spending multiplier**:

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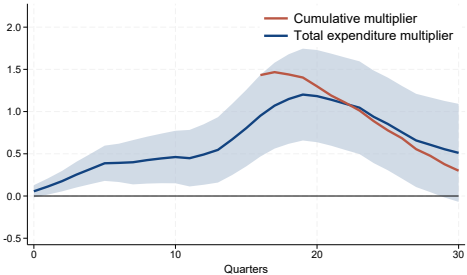
  - Independent of timing of registry.
  - But inference becomes more challenging.

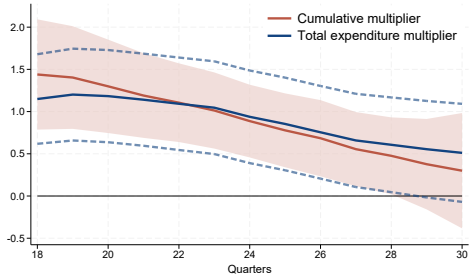
- Note $\mathcal{M}(h)^C = \mathcal{M}(h)^T$ for $h = H$

Multipliers

(a) Overall multipliers

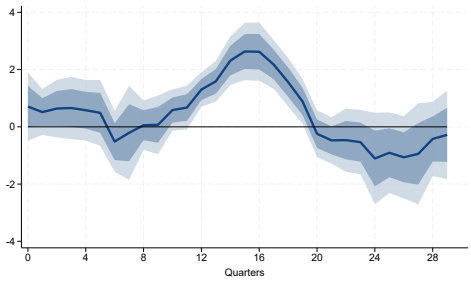


(b) Medium-run multipliers



Dynamic responses to investment-related contracts

(a) Investment shock: Output



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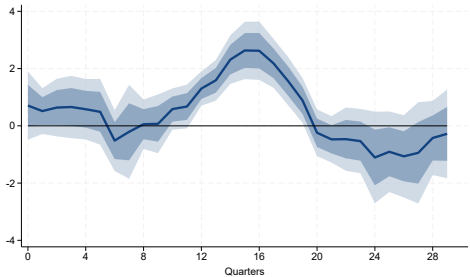
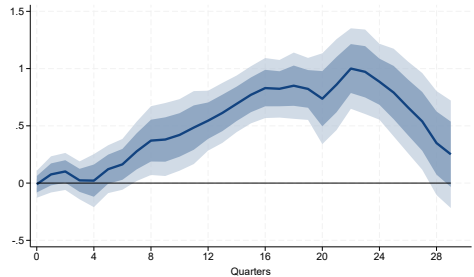


(b) Investment shock: Gov. Spending



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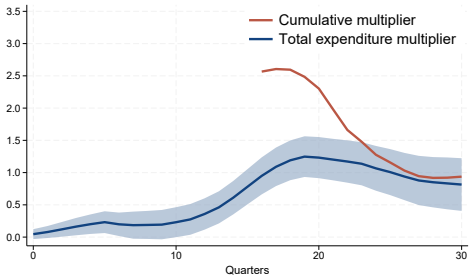

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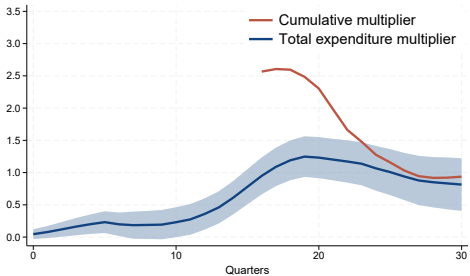
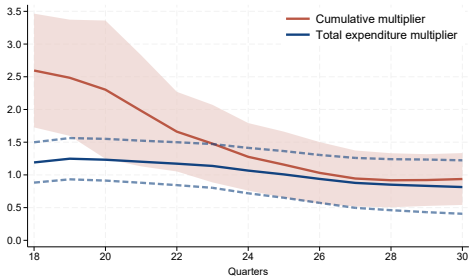


(b) Medium-run investment multipliers



Further results and robustness

- **Consumption**-related contracts IRFs consumption
- **Transmission mechanism** IRFs macro
- Effect on **prices** IRFs prices
- Results at **EU-level** EU results
- **Robustness** (specification, sample, major contracts, ...) Go to robustness

Defence investment in a GE model

- (Tangible) **defence investment**, I_t^G:

$$\begin{aligned} Y_t &= A_t \left[\left(K_{t-1}^G \right)^{\eta} K_t^{\alpha} N_t^{(1-\alpha)} \right] \\ K_t^G &= (1 - \delta^G) K_{t-1}^G + I_t^G \end{aligned}$$

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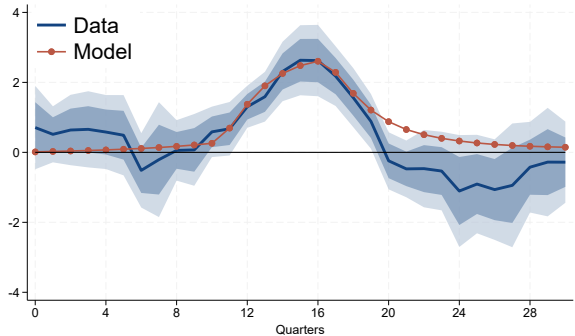
  - An **example**: production of major military equipment where investment and skilled labour positively spill over total production (large η) but with a link that separates quickly (large δ^G),
- Need to account for **time-lags** in spending, building and statistical recording.
- Question: what values of η and δ^G to **reconcile model and empirical responses**?

IRF matching: output response



- $\eta = 0.054$ and $\delta^G = 0.75$ and time-frictions $\Rightarrow$ replicates reasonably well empirical response of output.
- Alternatives (*standard* deprc., defence invest. as public consumption) behave poorly.

Conclusions

- Defence expenditure has stark **differences** with *average* fiscal stimulus.
- **Output effects** are transitory, relatively large, and precede government spending response.
- Introducing (tangible) military investment in **DSGE model** might require non-standard calibrations.
- All in all: effects of major military rearmament are likely to **materialise in the medium-run**.

THANK YOU!

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MINISTERIO DE DEFENSA
SECRETARIA GENERAL TECNICA

ANUARIO ESTADISTICO MILITAR

Núm. 34

Año 1991

3.2. Importe total contratado

3.2.5. Distribución por adjudicaciones mensuales (en millones de pesetas)

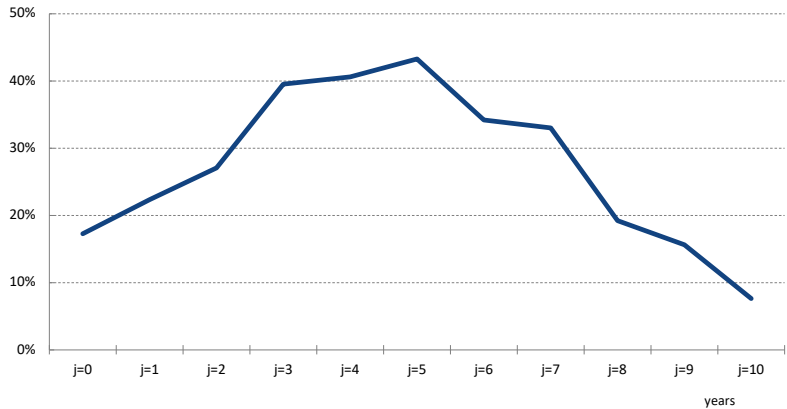
MES	Nº DE CONTRATOS	%	% ACUMULADO	IMPORTE	%	% ACUMULADO
TOTAL	**14.012**	**100,00**	**100,00**	**178.187**	**100,00**	**100,00**
Enero	318	2,27	2,27	1.149	0,64	0,64
Febrero	522	3,73	6,00	2.350	1,32	1,96
Marzo	872	6,22	12,22	3.573	2,00	3,96
Abril	1.914	13,66	25,88	14.719	8,26	12,22
Mayo	1.601	11,43	37,31	16.238	9,11	21,33
Junio	1.759	12,55	49,86	12.724	7,14	28,47
Julio	1.781	12,71	62,57	11.666	6,55	35,02
Agosto	865	6,17	68,74	7.317	4,11	39,13
Septiembre	1.246	8,89	77,63	8.786	4,92	44,05
Octubre	1.125	8,03	85,66	8.188	4,60	48,65
Noviembre	1.033	7,37	93,03	5.716	3,21	51,86
Diciembre	976	6,97	100,00	85.780	48,14	100,00

Back

5.8. Importe total contratado distribuido por clase de material. Pesetas.

CLASE DE MATERIAL	ÓRGANO CENTRAL		EJÉRCITO DE TIERRA		ARMADA		EJÉRCITO DEL AIRE		TOTALES	
	Nº Contratos	Importe	Nº Contratos	Importe	Nº Contratos	Importe	Nº Contratos	Importe	Nº Contratos	Importe
TOTAL	**3.011**	**24.913.086.136**	**15.578**	**83.792.321.142**	**1.560**	**84.524.001.432**	**1.376**	**40.928.711.547**	**21.525**	**234.158.120.257**
Aire acondicionado	20	12.209.770	41	48.263.457	0	0	0	0	61	60.463.227
Alimentación	22	8.535.874	1.694	15.690.383.640	228	2.924.443.704	301	1.886.224.003	2.245	20.509.587.221
Alimentación ganadera	0	0	111	209.571.124	1	4.186.900	2	21.199.688	114	234.957.712
Animales vivos	1	2.600.000	9	29.309.520	0	0	0	0	10	31.909.520
Armamento diverso	0	0	5	128.503.784	8	1.071.290.961	4	4.218.364.848	17	5.418.159.593
Artículos de limpieza	10	22.401.915	290	516.645.121	20	204.561.042	24	172.617.717	344	916.225.795
Asistencia técnica	327	4.962.837.592	496	1.322.810.837	44	2.333.552.174	50	2.402.153.548	917	11.051.154.151
Bombas (Compr. Mot.)	16	15.834.635	47	378.292.725	22	412.302.509	7	184.538.300	92	990.968.169
Buques	0	0	1	800.000.000	5	1.234.126.499	0	0	6	2.034.126.499
Calefac. sanea. y font	18	13.629.723	72	165.865.148	6	24.003.369	3	24.620.462	99	228.118.702
Combust. y carbur	96	167.756.725	206	1.503.048.808	23	5.215.888.998	23	2.303.521.575	348	9.210.216.106
Comunicaciones	127	11.907.131.872	73	580.569.512	19	2.616.147.519	10	894.866.986	229	15.999.715.889
Construcción	45	191.667.923	604	5.332.825.248	19	1.109.021.634	51	638.506.581	719	7.272.021.386
Emb. Menores	0	0	2	5.073.605	4	158.766.000	0	0	6	163.839.605
Equ.agrícolas y jardiner	1	1.861.800	10	2.073.247	0	0	2	7.025.000	13	10.960.047
Equipos de cocina	36	20.348.235	89	366.139.994	17	62.319.637	12	38.227.813	156	487.035.679
Gastos protocolarios	52	87.375.735	300	203.609.778	0	0	0	0	352	290.985.513
Gastos traslados, etc	20	15.990.421	196	1.563.908.936	1	60.000.000	2	20.000.000	219	1.659.899.357
Helicópteros	0	0	0	0	1	34.096.291.315	0	0	1	34.096.291.315
Informática	324	1.921.478.665	266	789.418.004	24	1.360.261.169	109	1.940.891.045	723	6.032.048.883
Infraestructura	123	1.004.795.221	1.068	3.993.214.434	42	760.326.820	71	1.064.589.753	1.304	6.799.666.228
Instru. medida y preci	88	264.166.921	67	279.591.416	14	218.501.146	13	176.576.081	182	938.835.564
Limpieza y jardines	64	668.431.551	255	881.437.290	51	276.158.781	44	720.178.813	414	2.546.206.435
Maderas	5	1.696.481	43	72.417.522	4	13.010.000	4	9.357.230	56	96.481.233
Mantenimiento	370	782.832.474	2.151	10.349.356.274	504	13.727.501.082	104	5.494.753.155	3.129	30.354.442.985
Maquinaria, herr. etc	110	126.728.923	126	407.328.014	9	15.612.521	19	140.501.511	264	683.070.969
Máquinas de oficina	54	60.386.651	63	288.415.597	6	10.450.950	2	10.540.883	125	369.794.081
Máquinas transporte	4	377.180	22	116.797.029	8	175.311.674	6	30.718.562	40	323.204.445
Material incendios	13	5.540.390	71	252.634.351	1	699.560.026	4	124.677.000	89	1.082.401.767
Material oficina	121	124.752.306	1.307	1.757.862.730	20	104.737.904	27	75.152.510	1.475	2.062.505.452
Material ferretería	41	36.859.141	330	342.809.134	38	215.471.619	17	46.436.880	426	643.575.974
M. eléctrico y electrón	42	78.985.708	176	349.039.197	38	300.954.252	38	266.589.026	294	995.568.185
Material sanitario	1	242.173	370	945.167.168	18	92.163.629	15	183.324.390	404	1.220.897.360
Material de campaña	0	0	31	394.760.274	5	88.930.836	2	8.778.026	38	492.469.136
Metales	12	17.744.990	34	317.795.566	5	29.487.190	2	38.348.790	57	147.366.536
Mobiliario diverso	319	249.876.652	646	765.205.966	19	108.843.971	44	73.389.923	1.028	1.197.316.512
Motores	30	5.557.616	15	5.322.513.260	9	249.325.608	3	321.419.010	57	5.898.815.494
Munición	2	37.968.162	31	2.497.370.879	28	2.251.508.628	7	373.450.634	68	5.160.498.303
Paracaidas y M. Buceo	0	0	16	120.810.627	5	10.688.625	9	189.346.635	30	320.845.887
Pinturas, pastas, etc	14	11.601.624	80	187.342.220	9	24.191.723	7	29.652.832	110	252.791.399
Productos mercería	9	4.541.595	65	353.178.303	7	58.273.552	0	0	81	415.993.450
Productos químicos	11	13.883.925	54	258.161.348	13	63.974.100	11	406.997.048	89	743.016.421
Publicaciones	208	419.969.524	309	244.006.090	2	3.642.114	7	94.884.128	526	762.501.856
Radares, simul. etc	11	87.878.467	4	123.176.823	13	425.963.613	17	1.833.393.537	45	2.470.414.440
Repuestos	68	174.418.623	2.062	13.524.146.899	179	5.089.849.232	170	11.554.416.181	2.499	30.352.834.935
Ropa	59	63.019.042	322	2.530.231.029	43	1.556.923.082	69	2.533.775.674	493	6.703.948.827
Sanidad	29	12.384.419	1.202	4.287.977.549	5	23.942.646	53	178.067.723	1.289	4.502.372.337
Seguridad	53	347.078.552	84	392.485.792	14	134.629.705	6	57.714.409	157	931.908.458
Seguros	5	774.662.640	7	1.124.749.235	3	12.950.413	1	13.746.217	16	1.926.108.505
Vehículos	27	214.559.953	30	1.462.425.356	3	103.110.000	3	84.721.208	63	1.884.816.517

Correlation of contracts and NA data: $Corr\left(s_t, G_{t+h}^{NA}\right)$



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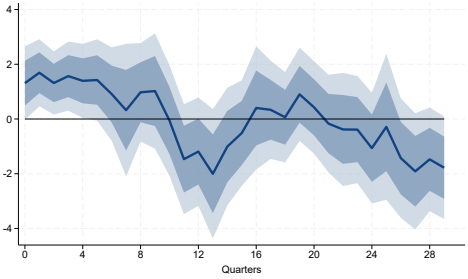
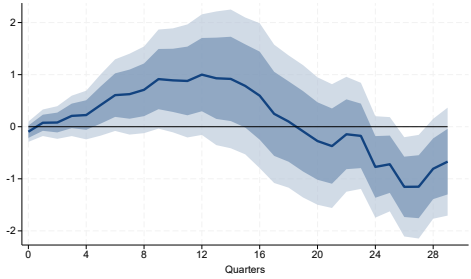
Main results: consumption-related contracts

(a) Consumption shock: Output



(b) Consumption shock: Gov. Spending



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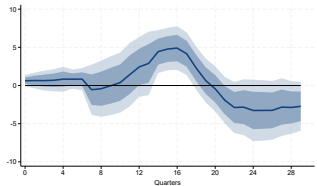
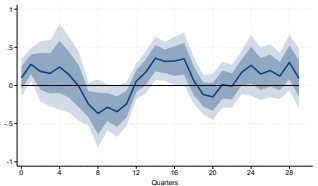
Dynamic responses of macro aggregates

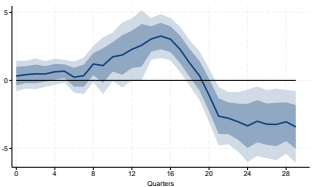
(a) Employment



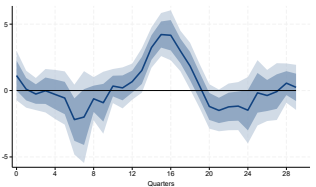
(b) Inventories



(c) Investment



(d) Private Consumption



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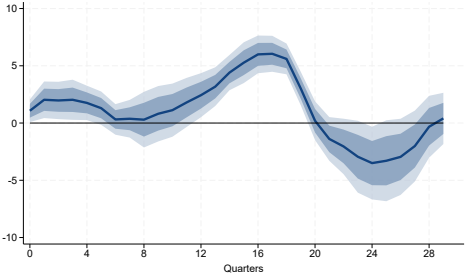
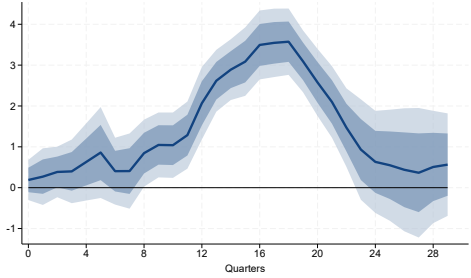
Dynamic responses: prices

(a) Manufacturing: total



(b) Manufactuing: equipment



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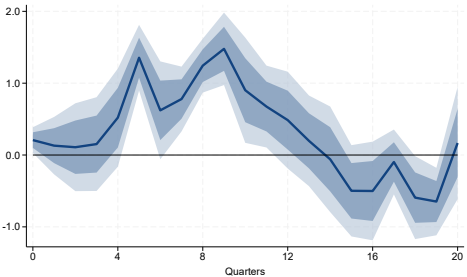
An alternative measure based on EU contracts

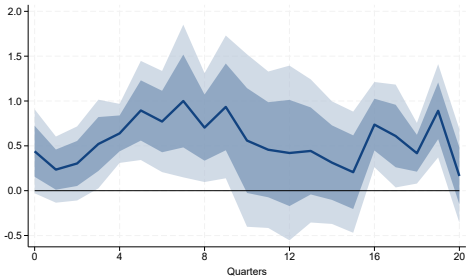
- Can we generalise the results to other **European countries**?
- Use tender-level**TED** database.
- Important **data limitations**: missing major contracts, short sample, strong country heterogeneity...
- But can be used to gather insights about **domestic vs foreign** contracts.

Dynamic responses: EU defence contracts

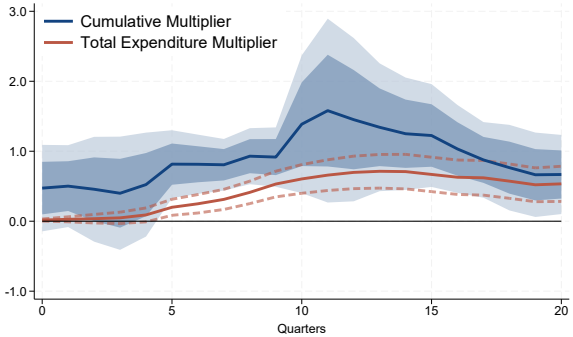
(a) Output



(b) Government Spending

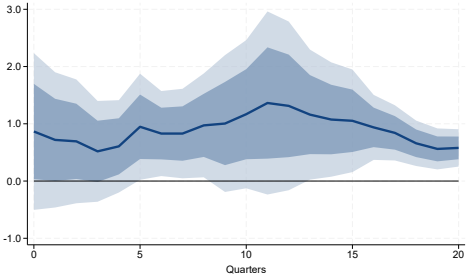


Multipliers: EU defence contracts

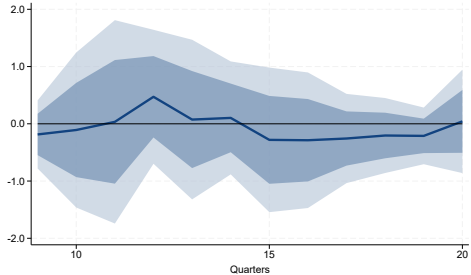


Multipliers: EU defence contracts

(a) National



(b) Foreign



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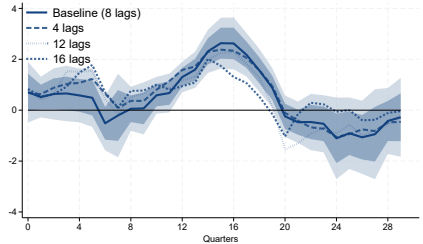
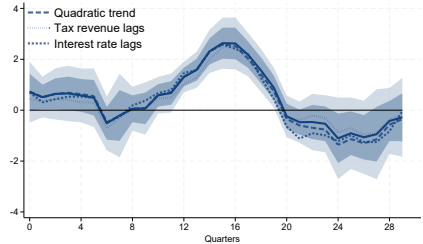
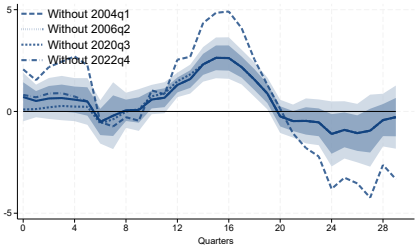
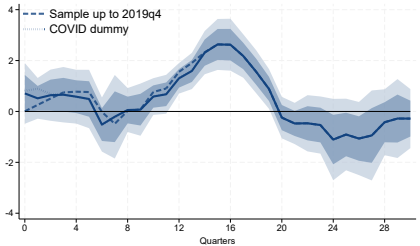
Robustness









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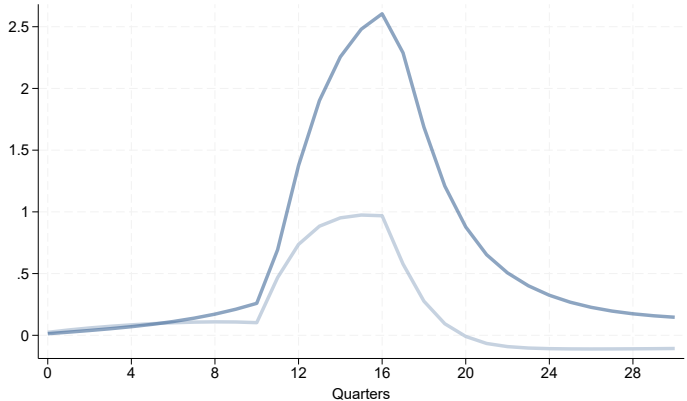
The Role of the Public Capital Externality

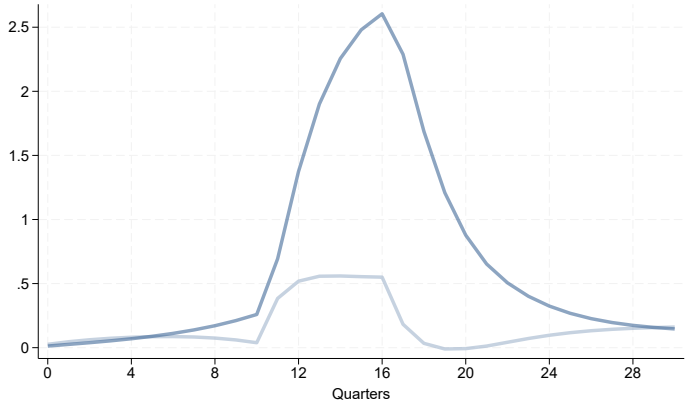
Figure: Defense procurement shock to GDP.



- dark blue: $\eta = 0.054$ (Benchmark)
- light blue: $\eta = 0.015$

The Role of the Public Capital Depreciation

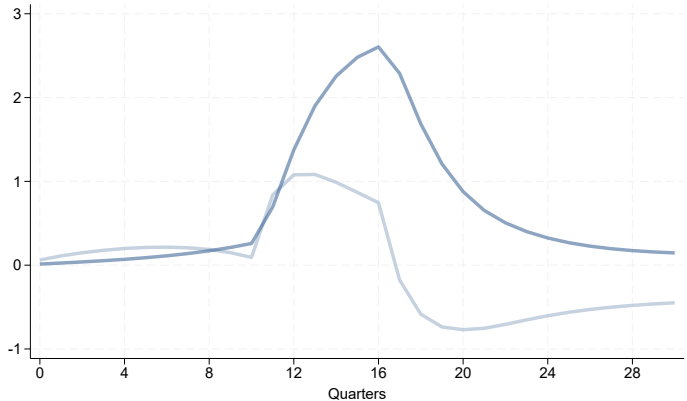
Figure: Defense procurement shock to GDP.



- dark blue: $\eta = 0.75$ (Benchmark)
- light blue: $\eta = 0.025$

Public Investment Vs. Public Consumption

Figure: Defense procurement shock to GDP.



- dark blue: positive externality to private production
- light blue: without positive externality to private production