The Military Multiplier

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Motivation

- **Defense budgets are surging:** US FY-2024 \$886 bn (+3 % y/y), NATO members +8 % in 2023, Japan +26%–largest build-ups since the Cold War.
- How effective are these outlays in terms of *actual militarization*?
- Every extra defense dollar has two immediate effects:
  1. Increase in military equipment produced (intended outcome)
  2. **Military-goods prices rise** (undesired outcome)

This Paper

Research question

- What determines the effectiveness of military spending?

What we do

- Introduce **Military Multiplier** (*MM*): measure of the effectiveness of military spending
- Empirically estimate the *MM* in the US
- Build a multisectoral RBC model with costly capital reallocation to study the determinants of the *MM*

Main results

- *MM* was much larger during the Cold War than post-Cold War: 0.9 vs 0.4
- De-industrialization of the US economy explains this pattern

Related Literature

- **Military buildups & costly reallocation** Ramey and Shapiro (1998); Ramey (2011); survey in Ilzetzki (2025).
- **Fiscal policy in multi-sector / network models** Bouakez et al. (2023); Bouakez et al. (2022); Acemoglu et al. (2016); Devereux et al. (2023); Flynn et al. (2022); Ramey (2019).
- **Sectoral shock propagation and production–investment networks** Long and Plosser (1983); Horvath (2000); Foerster et al. (2011); Atalay (2017); Acemoglu et al. (2012); Baqaee and Farhi (2019); Vom Lehn and Winberry (2022).
- **Capital reallocation frictions** Eisfeldt and Rampini (2006); Eisfeldt and Rampini (2007); Cooper and Schott (2013); Rampini (2019); Wang (2021); Lanteri and Rampini (2023).

Military Multiplier

- X_t dollars of military spending buys G_t of equipment at price P_t: $X_t = P_t \cdot G_t$
- Consider $\%\Delta X$ to be an increase in military spending. Then

$$\%\Delta X = \underbrace{\%\Delta G}_{\text{Equipment}} + \underbrace{\%\Delta P}_{\text{Price}}$$

Definition (Military multiplier). MM is defined as

$$MM = \frac{\%\Delta G}{\%\Delta X} = 1 - \frac{\%\Delta P}{\%\Delta X} \tag{1}$$

Remark 1: Contrast with standard fiscal multiplier: $M = \frac{\Delta Y_t}{\Delta X_t}$, where ΔY_t - change in GDP
Remark 2: Cumulative MM over h periods $MM(h) = \frac{\sum_h \%\Delta G_t}{\sum_h \%\Delta X_t}$

Partial-Equilibrium Mechanics

- **Military-goods market**

$$\underbrace{y_{g,t}}_{\text{qty}} = -\,\epsilon^{d}\, p_t + g_t \quad \text{(demand)}, \qquad y_{g,t} = \epsilon^{s}\, p_t \quad \text{(supply)}.$$

- Military multiplier: Higher elasticities on **either** side $\Rightarrow$ smaller price rise $\Rightarrow$ larger MM.

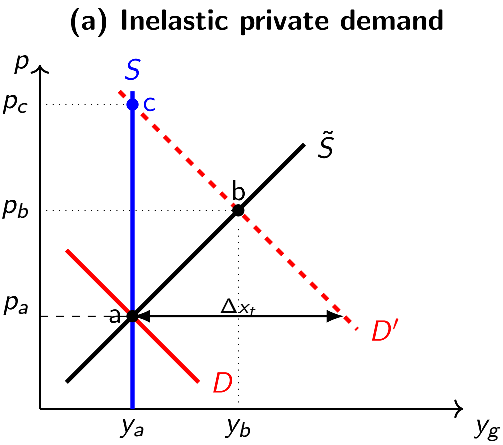
$$\boxed{MM \;=\; 1 - \frac{\Delta p_t}{\Delta x_t} \;=\; \left[1 + \tfrac{1}{\epsilon^{d} + \epsilon^{s}}\right]^{-1}}$$

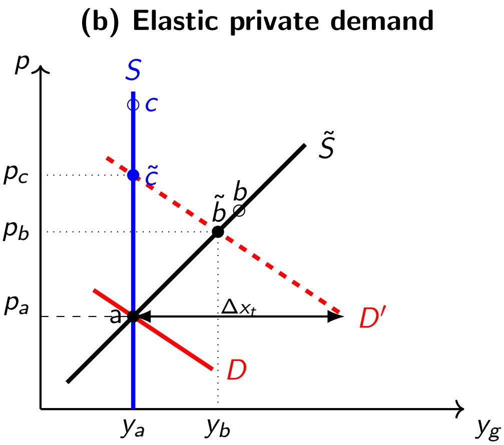
- Policy sets the budget increment $x_t \equiv p_t + g_t$ (measured in the numéraire). Substituting $g_t = x_t - p_t$ gives the **transformed demand curve**

$$y_{g,t} = -(1 + \epsilon^{d})\, p_t + x_t,$$

slope $-\,(1 + \epsilon^{d})$ and horizontal shift Δx_t

Supply–Demand Illustration





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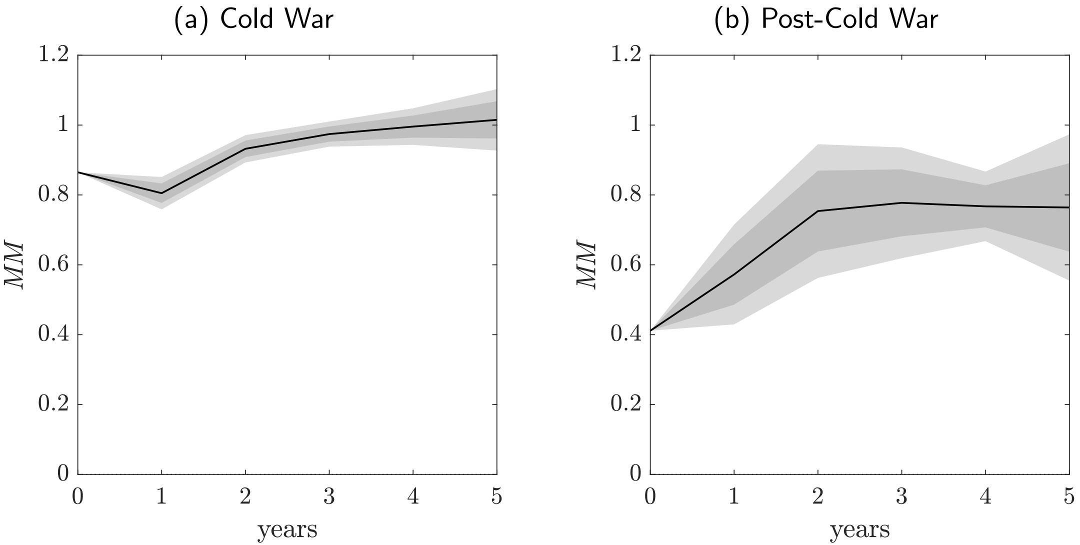
Empirical Strategy: Price Response to Defence Shocks

- **Objective** – identify the relative-price response that pins down the MM.
- **Shock series** – defence-spending "news" shocks from Ramey (2016).
- **Estimation** – local projections Jordà (2005) of $\Delta\text{PPI}_{\text{mfg}}$ on the shock $\rightarrow \widehat{MM}$.
- **Sub-samples**
  - Cold War: 1947 Q1–1990 Q4
  - Post-Cold War: 1991 Q1–2018 Q4
- **Price measure** – Manufacturing PPI defence-goods price (manufacturing absorbs the bulk of DoD procurement).

Estimated cumulative Military Multiplier ▸ Prices



Model: What Pins Down the Military Multiplier?

Framework

- Multi-sector RBC core with *input–output* linkages
- *Investment network*: sector-specific capital goods (à la Vom Lehn and Winberry, 2022)

Key frictions

- **Costly capital reallocation**
- One-year *time-to-build* for new capital

Elasticities emerging from this structure $\Rightarrow$ Military Multiplier

Model - Household

Representative household maximizes its expected lifetime utility:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[log(C_t) - \frac{L_t^{1+\gamma}}{1+\gamma} \right]$$

subject to the budget constraint $C_t + Q_{t,t+1} B_{t+1} = B_t + W_t L_t + T_t$

Consumption index C_t consists of a bundle of N sector-specific consumption goods:
$C_t = \bar{b} \prod_{i=1}^{N} C_{t,i}^{b_i}$ where $C_{t,i}$ is consumption of sector i good

Total hours worked consists of labor supplied to each of N sectors, that is

$$L_t = \sum_{i=1}^{N} L_{t,i} \quad \text{(Labor aggregation)} \tag{2}$$

where $L_{t,i}$ labor supplied to sector i

Model - Output and investment good production

Sector i produces output $Y_{t,i}$ according to sector-specific CRS production technology

$$Y_{t,i} = F_i(A_{t,i}, \hat{K}_{t,i}, L_{t,i}, ..X_{t,ij}, ...)$$

where $\hat{K}_{t,i}$ is capital input, $L_{t,i}$ - labor input, $X_{t,ij}$ - sector j output used as intermediate input in sector i, $A_{t,i}$ - sector-specific productivity.

Investment in each sector is produces according to sector-specific CRS technology, which combines sector-specific goods. Investment in sector i is given by

$$I_{t,i} = \bar{\lambda} \prod_{j=1}^{N} I_{t,ij}^{\lambda_{ij}}$$

where $I_{t,ij}$ is sector j output used to produce investment in sector i.

Model - Capital accumulation and reallocation

Capital accumulating firms maximize the expected stream of profits:

$$E_0 \sum_{t=0}^{\infty} Q_{0,t} \left[r_{t,i} \hat{K}_{t,i} - P^I_{t,i} I_{t,i} - \sum_{j=1}^{N} P^o_{t,ij} R_{t,ij} \right]$$

where $R_{t,ij}$ capital reallocated from sector j to sector i and $P^o_{t,ij}$ price of this reallocated capital; $Q_{0,t}$ is a t-period stochastic discount factor.

Capital dynamics is

$$\hat{K}_{t,i} = K_{t-1,i} + R_{t,i} - \underbrace{\frac{1}{2} \sum_{j=1}^{N} \phi_{ij} R^2_{t,ij}}_{\text{realloc. cost}} \quad \text{(Sector } i \text{ available capital)} \tag{3}$$

$$K_{t,i} = (1-\delta)\hat{K}_{t,i} + I_{t,i} \quad \text{(Sector } i \text{ capital accumulation)} \tag{4}$$

Model - Reallocation and prices

Can derive the **sector-pair-specific reallocation flows** as function of **sectoral prices**

$$R_{t,ij} = \frac{1}{\phi_{ij}} \cdot \frac{P^o_{t,i} - P^o_{t,j}}{P^o_{t,i} + P^o_{t,j}}$$

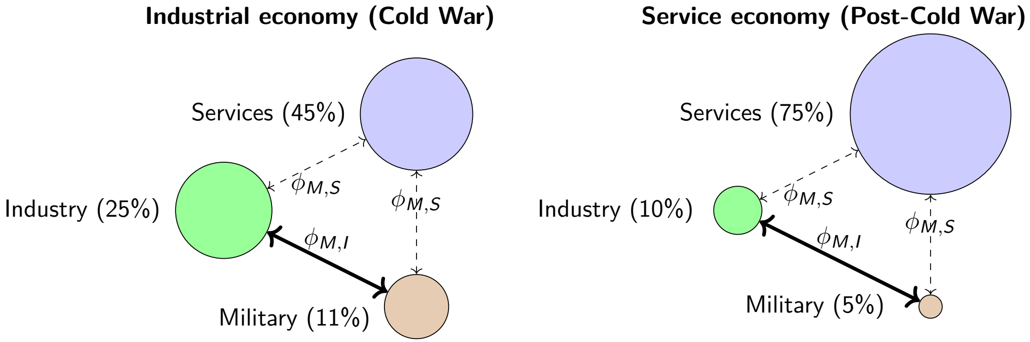
where existing capital price $P^o_{t,i} = r_{t,i} + (1-\delta)P^I_{t,i}$ with $r_{t,i}$ capital return and $P^I_{t,i}$ investment good price; ϕ_{ij} reallocation cost

Model - Market clearing

The resource constraint on output in sector i implies that

$$Y_{t,i} = C_{t,i} + \sum_{j=1}^{N} X_{t,ji} + \sum_{j=1}^{N} I_{t,ji} + G_{t,i} \quad \text{(Sector } i \text{ resource constraint)} \tag{5}$$

3-sector application: US in Cold War vs post-Cold War



Notes: US Military-Industrial complex size and capital reallocation potential over time

Calibration - Reallocation cost

Model calibration: Empirical targets and parameter values

Panel A: Impact MM Response to a Military Shock

Period	Empirical (%)	Model (%)
Cold War	0.86	0.86
Post Cold War	0.41	0.41

Panel B: Capital Reallocation Cost Parameters

Sector Pairs	Reallocation Cost Parameter ϕ_{ij}
Industry to Military	0.036
Services to Military	26.94

Calibration - Sectors

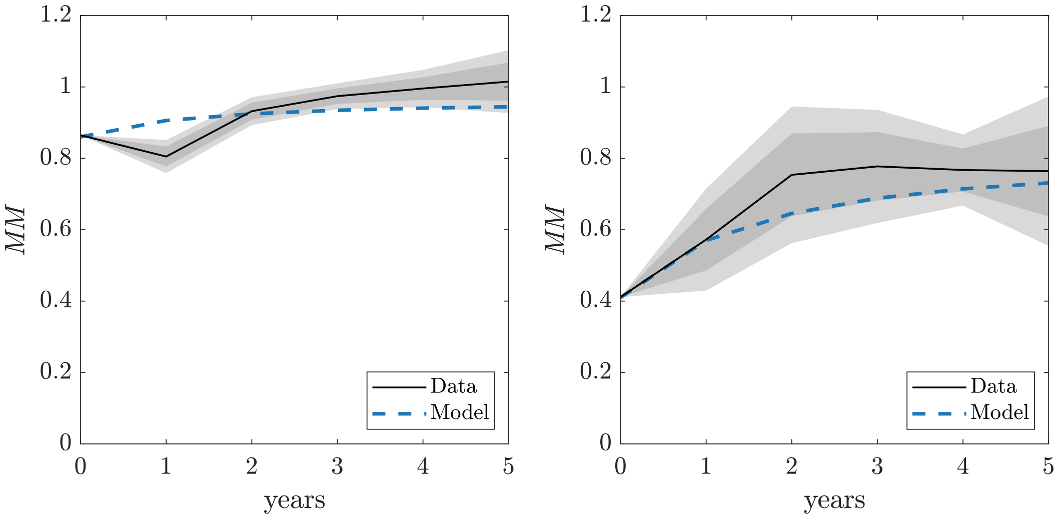
- Yearly frequency
- Leontief production function as baseline
- Sectoral sizes: Industry/Services/Military sector sizes during/post Cold War
- Sectoral links
  - IO network: none
  - Investment network: Industry and Services use own output for investment, Military uses Industry output

Calibration - Other parameters

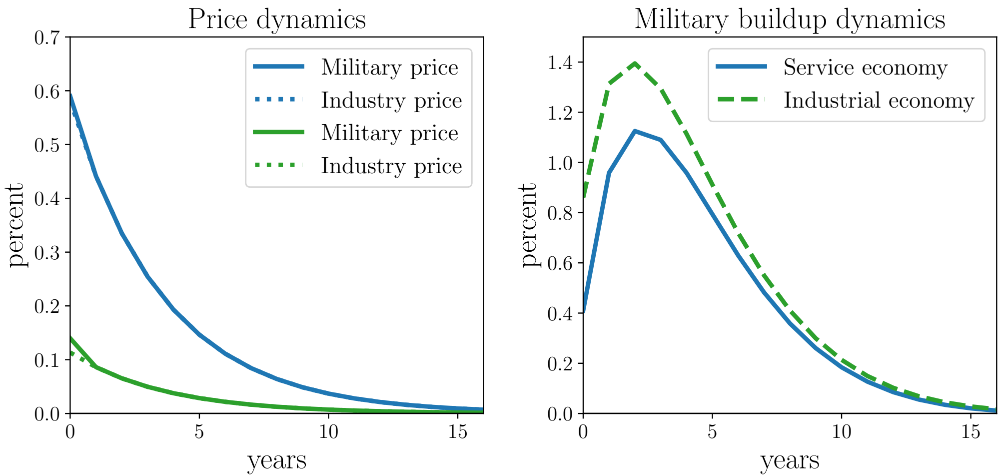
Table: Model parameters

Parameter Description	Symbol	Value
Depreciation rate	δ	10%
Discount rate	β	0.96
Frisch labor supply elasticity	γ	1
Share of primary factors in production	θ_i	1
Capital share in primary factors	α_i	0.3
Persistence of military spending, AR(2)	ρ_g^1, ρ_g^2	1.4, -0.6

1% Military buildup shock: MM



Military prices and equipment produced

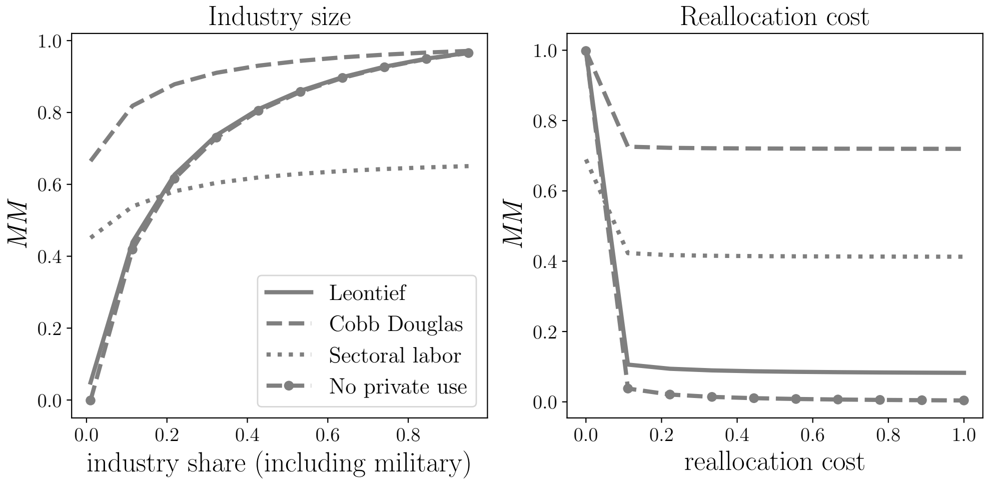


Takeaway: MM fit

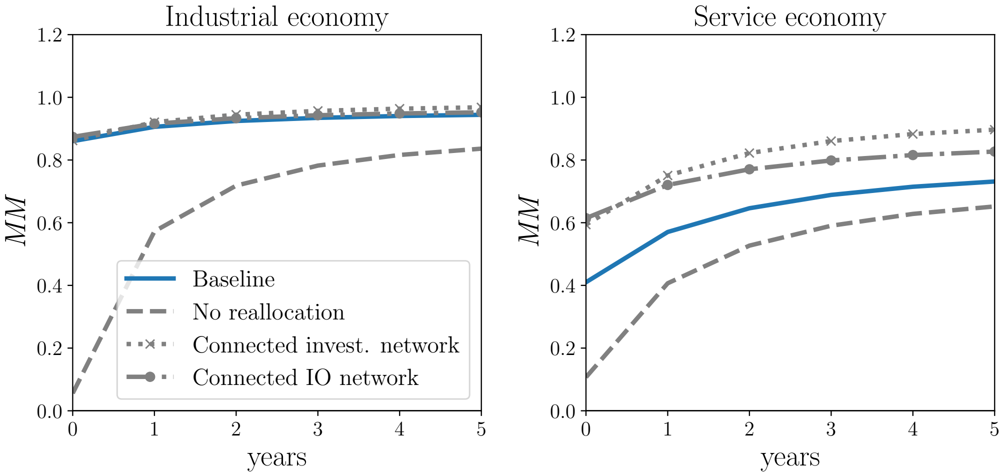
- Model calibrated to an **Industrial** economy matches the Cold-War path: impact MM ≈ 0.86, peaking near 1.0.
- **Services** calibration reproduces the Post-Cold-War fall: impact MM ≈ 0.41, peaking at 0.76.
- Sectoral composition alone explains the 50% drop in capability per dollar.

- Military- and Industry-good prices jump on impact and stay high; the surge is **twice as large** in the Services economy.
- Actual equipment output rises far more in the Industrial economy—price pressure absorbs scarce capacity in Services.

MM determinants: industry share, realloc. cost



MM determinants: investment and IO networks

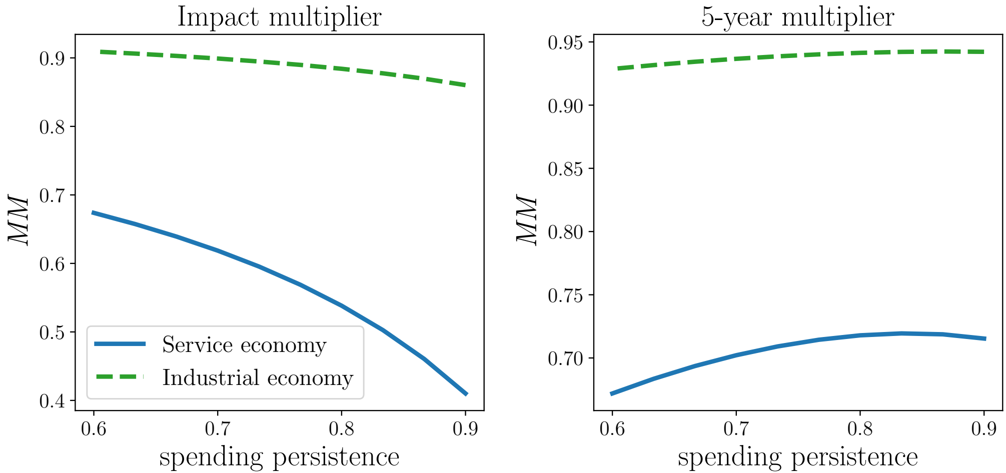


Takeaway: Reallocation & networks

- Across production technologies, the impact MM **rises with the Industry share** in GDP.
- Higher cross-sector capital–adjustment costs depress the MM; with no private demand, it can approach zero.

- **Shutting off capital reallocation** drives the impact MM almost to zero—capacity cannot expand on impact.
- Allowing Military/Industry goods to enter broader investment or intermediate networks lifts the MM, especially in a Services economy.

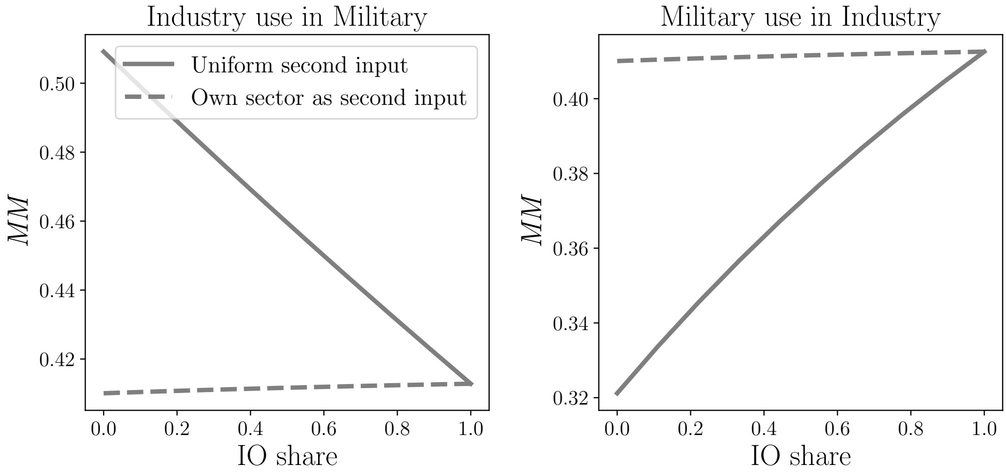
MM determinants: spending persistence



Takeaway: Persistence

- More persistent spending lowers the **impact** MM but raises the **five-year cumulative** MM.
- Reason: higher expected demand boosts prices first; investment catches up later.

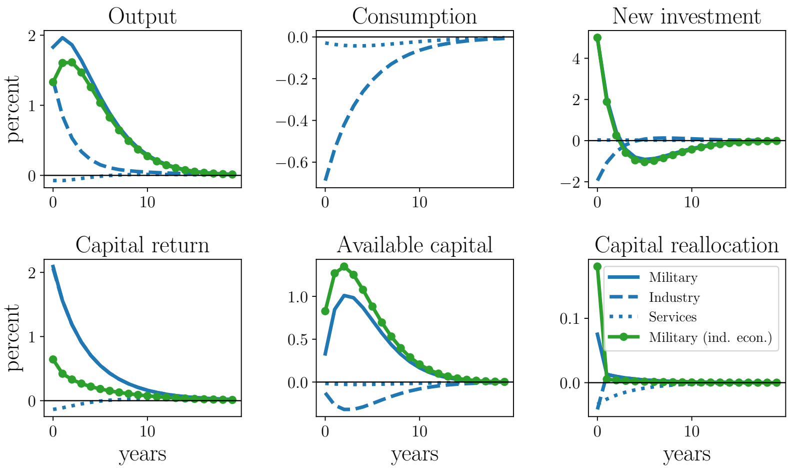
MM determinants: dual use



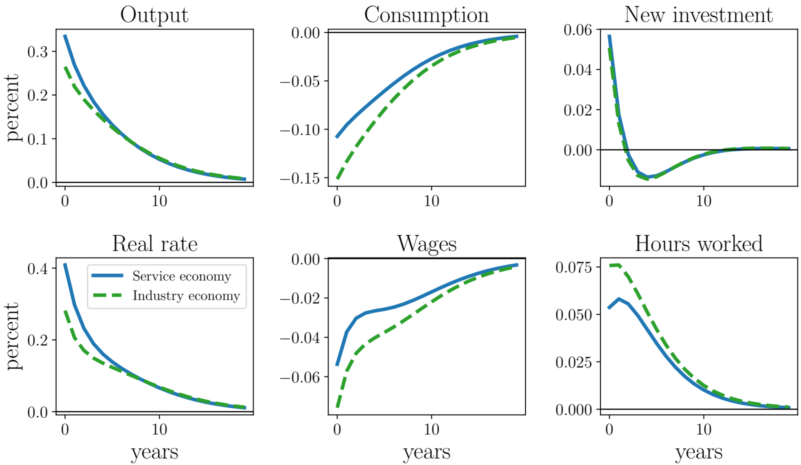
Takeaway: Dual-use linkages

- Letting civilian Industry require Military goods (and vice-versa) expands the effective military-industrial base.
- Dual-use linkages raise the MM, with a larger effect in a Services-heavy economy.

Sectoral IRFs



Aggregate IRFs



Takeaway: Aggregate effects

- Military and Industry outputs rise; Services contracts.
- Capital reallocation flows mainly **from Industry to Military**.
- Reallocation is larger and price pressure smaller in the Industrial economy.

- Military spending is expansionary for GDP but crowds out private consumption; total hours worked rise.
- Fiscal multiplier < 1 in both economies, yet capability (MM) differs sharply—**budget $\neq$ capability**.

Conclusions

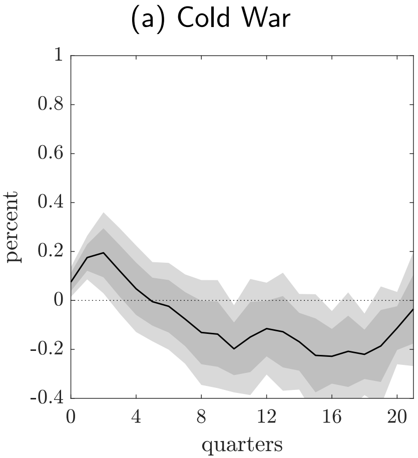
- **Military Multiplier.** Quantifies how many units of defense capability each extra dollar actually buys.
- **Evidence.** $MM \approx 0.9$ during the Cold War, ≈ 0.4 since 1991— half the hardware per dollar once the industrial base shrank.
- **Mechanism.** A large industrial sector and low capital-reallocation costs keep defense-good prices from spiking.
- **Implication.** Fiscal budget $\neq$ military capability.

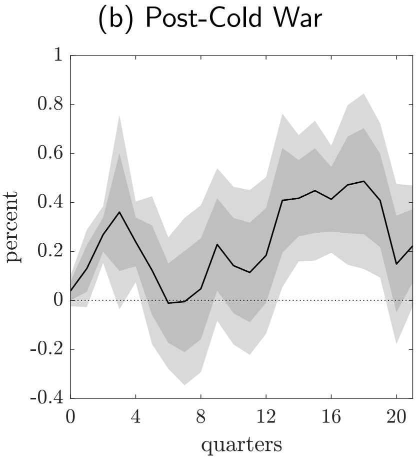
Outlook

- **Capital-reallocation network.** Estimate ϕ_{ij} across a finer 2-digit industry matrix to capture bottlenecks more precisely.
- **Cross-country MMs.** Map sectoral composition for NATO, EU, East Asia; benchmark each country's "dollar-to-hardware" efficiency.
- **Policy simulations.**
  - Coordinated defense procurement within the EU.
  - Industrial-policy instruments that lower ϕ_{ij}.
- **Technology shift.** How to drones/cyber affect production technologies and alter the MM over time.

Appendix

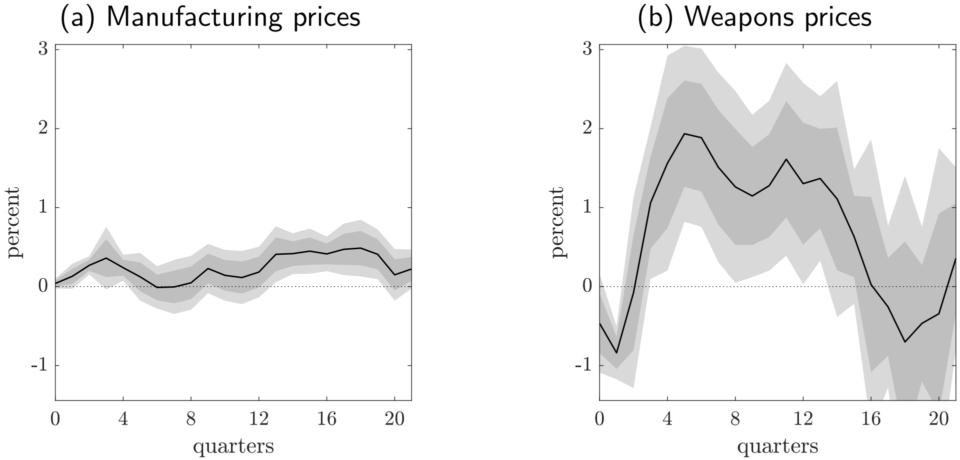
Real manufacturing PPI response to military shock





Go back

Real weapon price response to military shock



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