The Price of War

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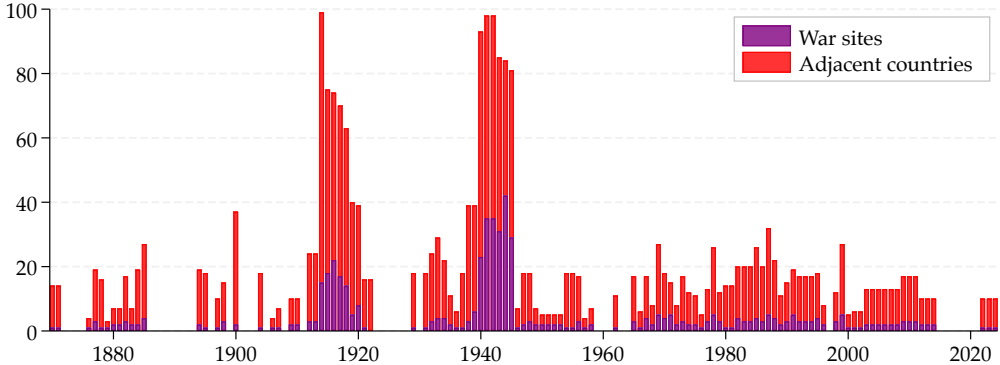
Countries exposed to interstate wars 1870–2023

Unconditional prob. war site: 2.4% v 11.5% for war next door

Figure: War sites and their geographical neighbors



The questions

What is the macroeconomic impact of war?

- Death and destruction of the war site contractionary: many economic disasters associated with wars on country's own soil (Barro 2006)
- Military buildups expansionary (Ramey Shapiro 1998, Ilzetzki 2024)
- No systematic study

What about third countries? Do they pay a price for the war as well?

- Potentially strong economic spillovers from war site to third countries, depending on geographic distance
- Nearby countries pay substantial price of war, even if not party to war

Empirical analysis

New data for all interstate wars since 1870

- Geolocate war sites and identify *casus belli* narratively
- Estimate macroeconomic effect of war conditional on distance from war site

Dynamic effects of war

- War sites: GDP falls up to 20% (∅16%), inflation spikes to 10ppt (∅4.5ppt)
- Spillovers on third countries depend on size of war site, here: 5% of world GDP
  - Nearby: GDP falls up to 5% (∅3.5%), inflation spikes to 7ppt (∅2.5ppt)
  - Distant: GDP falls up to 2% (∅1%), inflation rises up to 2ppt (∅1ppt)
- GDP contraction highly persistent (15 years), inflation spike less so (5-6 years)

Structural interpretation / transmission channels

Multi-country model of world economy

- Trade integration—distance—differs across countries
- Devise war scenario: capital destruction, TFP decline, military spending and seignorage

Calibrated model can account for evidence

- Offers account of transmission channels where data coverage is limited
- Endogenous supply-side contraction as intermediate-goods trade falters
- Spillovers primarily depend on pre-war trade integration (i.e. distance)

Related literature: economic impact of war . . .

on parties to the war

- Case studies: Oliver 1941, Harrison 1998, Davis Weinstein 2002, Tooze 2006
- Growth effect somewhat elusive: Rasler Thompson 1985, Barro Lee 1994, Caplan 2002, Acemoglu et al 2005, Thies and Baum 2020
- Stronger for civil wars: Abadie Gardeazabal 2003, Novta and Pugacheva 2021, Chupilkin Kóczán 2022
- Modelling war/military buildups: Ramey Shapiro 1998, Auray Eyquem 2019

on third countries/spillovers

- Trade/networks: Martin et al 2008, 2012, Glick Taylor 2010, Couttenier et al 2022, Korovkin Makarin 2023
- From civil wars, with focus on geography: Murdoch Sandler 2002, 2004, Qureshi 2013, Verdickt 2020, Mueller et al 2022

Data and basic facts

Annual observations: 1870–2023

Outcome variables: output and inflation for up to 60 countries

- Macroeconomic History Base (Jorda Schularick Taylor), extended in Funke Schularick Trebesch (2023)

Bilateral distance from war site measured in kilometers

- Distance of two most populated cities across countries (Mayer Zignago 2011)

Analysis centered around war sites

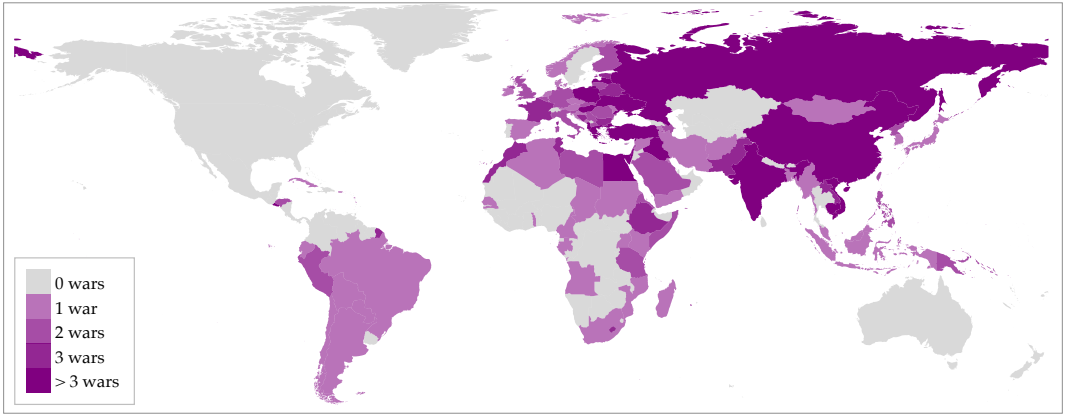
- *Correlates of War project* (Sarkees Wayman, 2010): all interstate wars ($> 1\,000$ battle deaths) between 1816 and 2007 & updated: 75 wars
- Geolocate war sites: digitize disaggregated battle-level data based on Clodfelter (2017) and various other sources

War sites

- Geolocate 1625 battles: collect number of deaths, missing, wounded (causalities)
- Aggregate back to country level **using today's borders**
- Cross-check via GPT-4 yields another 5 war sites
- Exclude battles taking place far from core territory (e.g., Aleutian Islands in WW2)

Casualties		Length		Wars	Macro time-series for...		
Min	Mean	Mean	Median	Total	Sites	Belligerents	Third
2	220,113	2.5	2	224	85	129	2,525

All war sites 1870–2023



Are wars exogenous to the business cycle?

Common assumption in fiscal policy literature

- Military spending (news) good instrument (e.g., Ramey Shapiro 1998, Barro Redlick, 2011; Ramey Zubairy, 2018; Miyamoto et al 2019)

Some evidence that US Presidents more likely go to wars

- In times of economic stress (Ostrom Job 1986)
- During recession & if president up for reelection (Hess Orphanides 1995)

Verify using a narrative approach a la Romer Romer (2010)

- Classify *casus belli* for all wars in our sample
- Initial classification according to the warfare encyclopedia by Clodfelter (2017)
- Cross-checks based on more than 80 different (historical) sources

Why countries go to war: 8 non-exclusive categories

	Notion	# Wars
Nationalism	Creation of own sovereign state, wars for independence, imperialism	46
Power Transition or Security Dillemma	Rising power challenges a dominant one, arms races, security dilemma	33
Religion or Ideology	Deep-rooted disagreements over religious beliefs or ideologies (e.g., communism)	23
Border Clashes	Unclear borders or intensifying border clashes	15
Economic, Long-Run	Control over trade routes, markets, or valuable resources; economic rivalry and protectionism	10
Domestic Politics	Leaders may use foreign war to distract from domestic issues or to rally their population around a common cause	8
Revenge/Retribution	Wars can be initiated in response to perceived wrongs or to regain lost honor, even if there's no tangible gain to be had	3
Economic, Short-Run	Economy in severe recession (e.g., unemployment is high)	2

Empirical framework and results

Empirical framework

Variables capture start of the war: country i is ...

- $Site_{i,t} = 1$ if war starts on soil of country i in year t
- $Third_{i,t} = \sum_{j \in T_{i,t}} \varepsilon_{j,t}$ if war starts elsewhere (and i is not belligerent in same war)

Where $\varepsilon_{i,t}$ indicates economic size of war sites

$$\varepsilon_{i,t} \equiv GDP_{i,t-1} / GDP_{world,t-1}$$

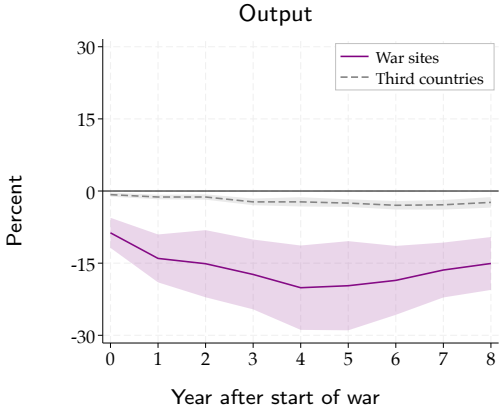
Estimate dynamic effect of war in sites and third countries

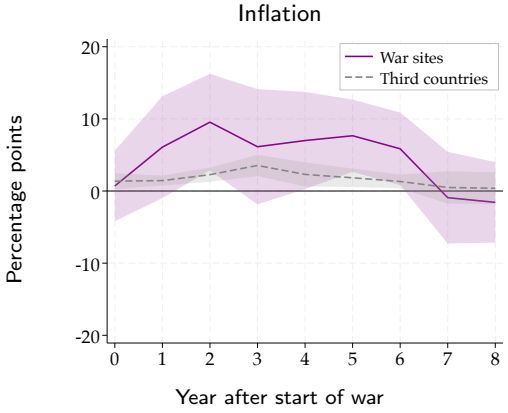
$$x_{i,t+h} - x_{i,t-1} = \alpha_{i,h} + \gamma_h Site_{i,t} + \psi_h Third_{i,t} + \zeta_h Controls_{i,t} + u_{i,t+h}$$

- $x_{i,t+h}$: output or inflation (baseline)
- Controls: 4 lags of dependent variable and regressors

Strong adverse effect on war site, small spillovers **on average**

War site accounts for 5% of world GDP





Zooming in: condition spillovers on **distance** from sites

Smooth transition model

$$x_{i,t+h} - x_{i,t-1} = \cdots + \psi_{n,h}\left[1 - F(i,t)\right] Third_{i,t} + \psi_{d,h} F(i,t)\, Third_{i,t} + \ldots$$

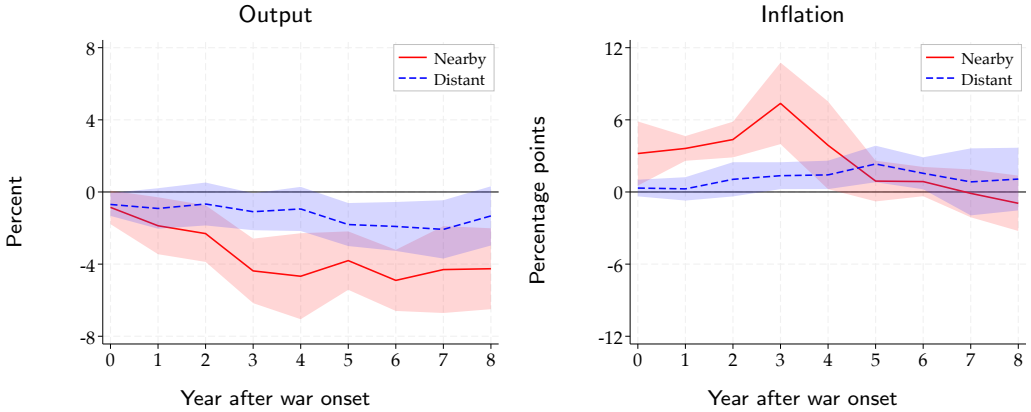
- Limiting cases: $\psi_{n,h}$ (nearby) v $\psi_{d,h}$ (distant)
- Spillovers depend on shock-weighted normalized distance

$$F(i,t) = \sum_{j \in T_{i,t}} \frac{\varepsilon_{j,t}}{\sum_{k \in T_{i,t}} \varepsilon_{k,t}} \left[\frac{\ln(1 + d_{i,j})}{\ln(1 + d^{\max})} \right],$$

where $d_{i,j}$ denotes geographic distance between countries i and j, and d^{max} maximum distance between any two countries

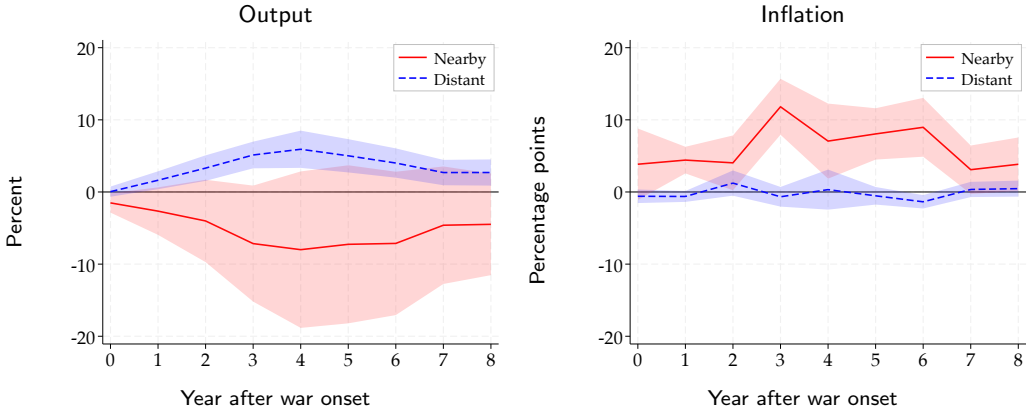
Strong adverse spillovers on **third countries** if close to war site

War site accounts for 5% of world GDP



Spillovers to **belligerents**

War site accounts for 5% of world GDP



Robustness and further evidence

Main results robust across a number of alternative specifications details

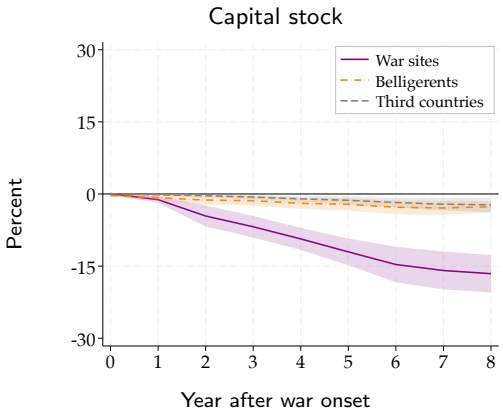
- Longer horizons
- Drop US from sample
- Restrict to shorter and longer wars
- Alternative timing of war shocks
- Control for military strength

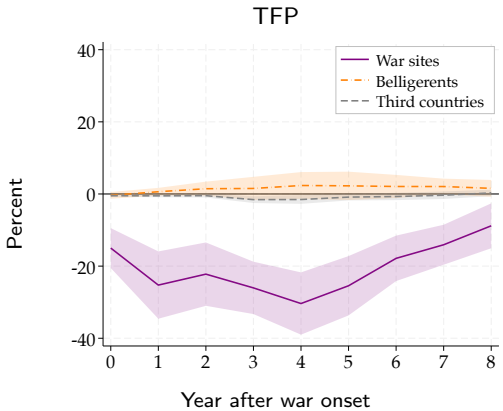
Further evidence details

- Condition on trade integration
- Incorporate severity of wars
- Trade responses

Evidence on underlying causes

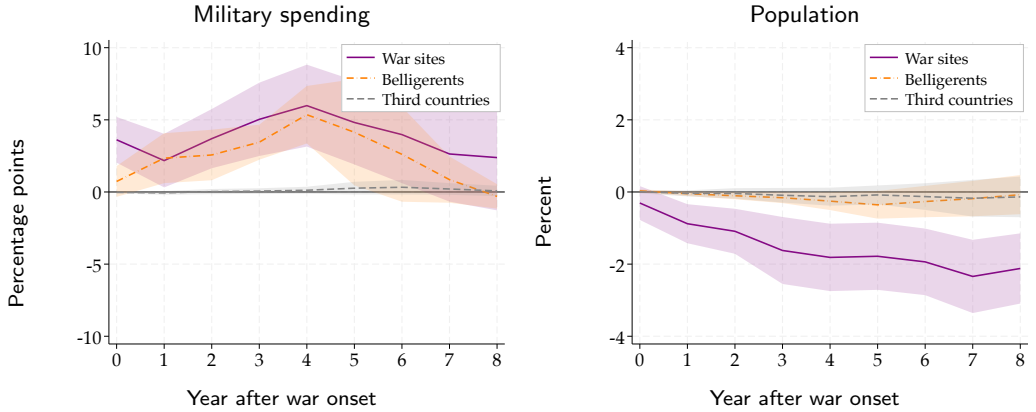
Source: Long-Term Productivity Database (Bergeaud et al 2016); restricted sample





Evidence on underlying causes cont'd

Source: Correlates of War / Maddison project; restricted sample



Structural interpretation

Structural interpretation

Multi-country model (Gopinath et al 2020, Eichenbaum et al 2021)

- Site, Nearby, Distant, each 5% of world output; and Rest of the World
- Site and Nearby fully integrated; little trade with Distant
- Intermediate inputs in production
- Incomplete financial markets; labor and capital immobile across countries
- Monopolistic competition & stickiness in labor and goods market
- Monetary policy determined by money growth rules

War as AR(2) shock with 4 dimensions

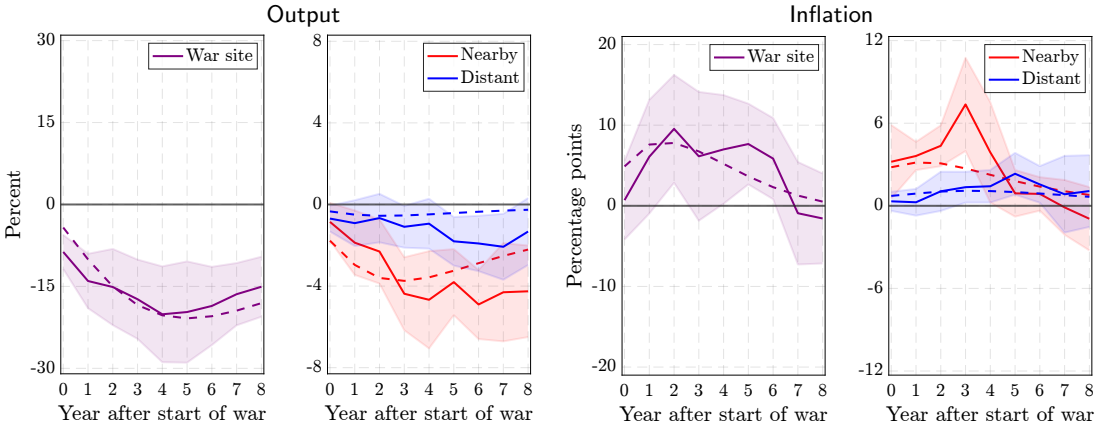
(i) Destroys capital stock in **Site (only)**, as in rare disasters (Gourio 2012)

(ii) Reduces TFP in **Site (only)**, as in rare disasters (Gourio 2012)

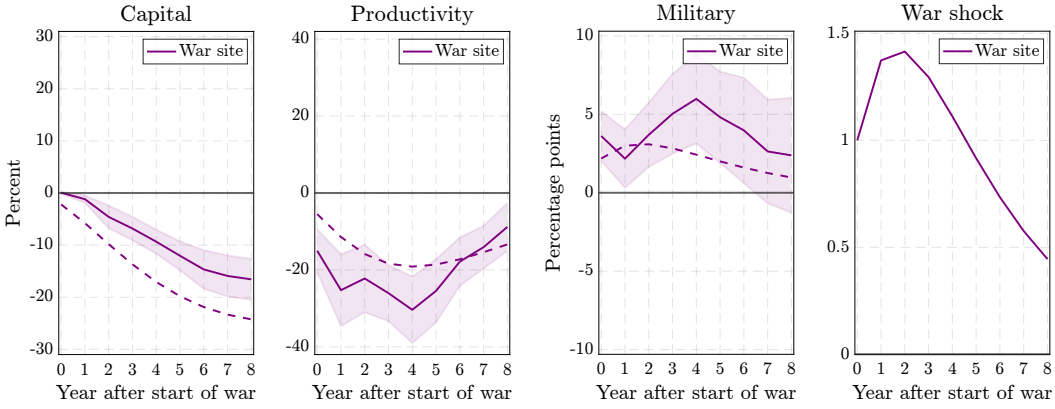
(iii) Raises military spending in **Site (only)**

(iv) Monetary policy accommodates **globally**, but to different degrees

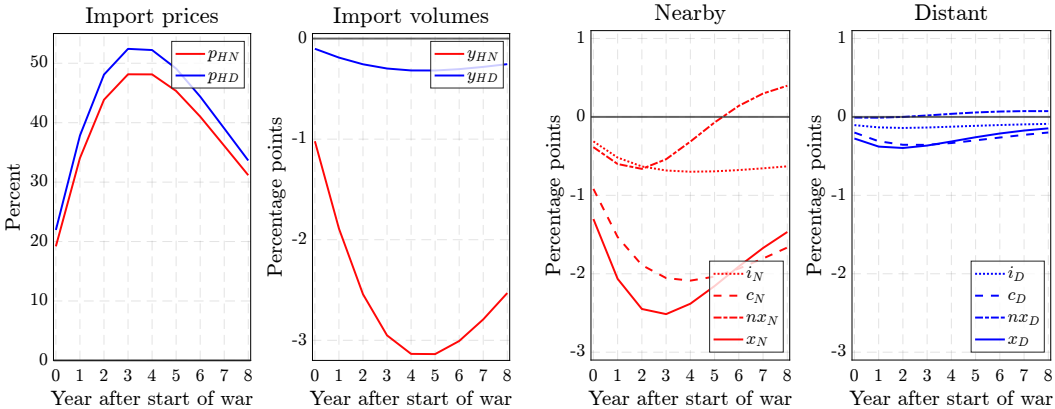
Macroeconomic impact of war in Site, Nearby, and Distant



Implications of calibrated model—External validation

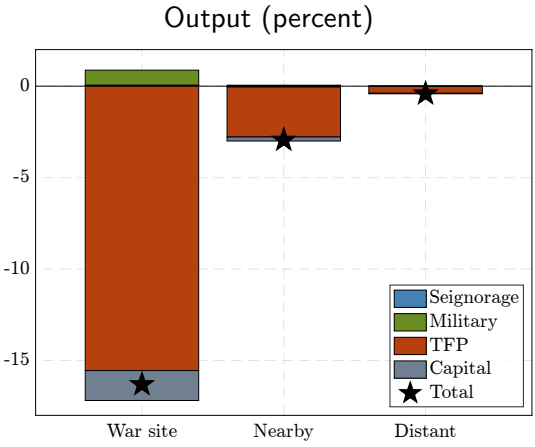


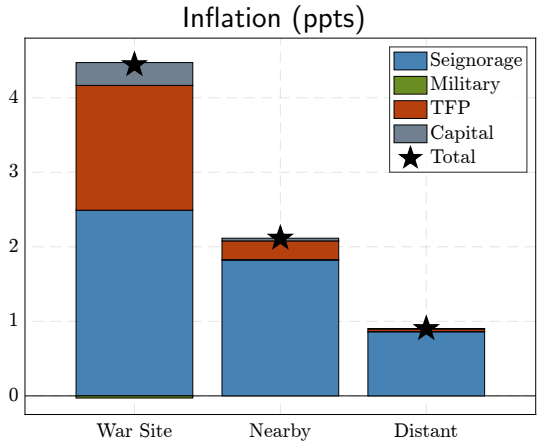
Inspecting the mechanism: Supply side spillovers



Decomposing the macroeconomic impact of war

Average annual effect (year 0 to 8) on . . .





Conclusion

Macroeconomic impact of war

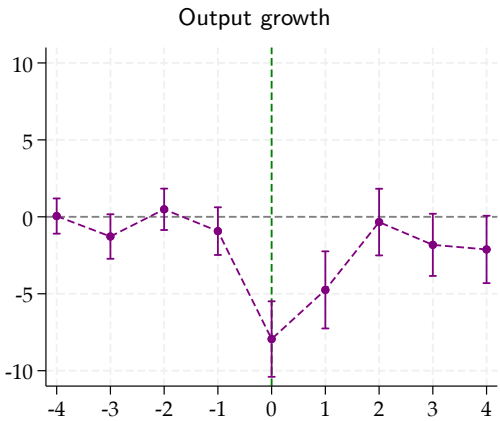
- Large adverse effects in war site
- Yet nearby countries pay substantial price too, even if not party to war

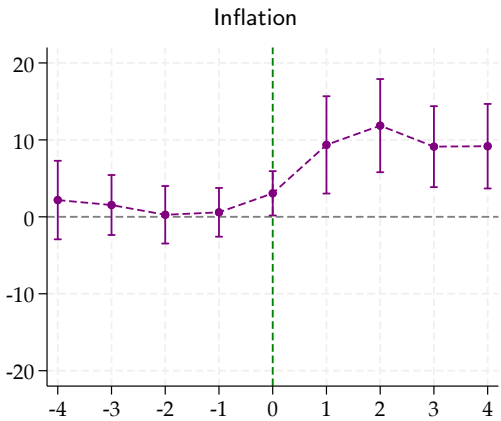
Mechanism / policy

- adverse supply shock dominates in war site and Nearby as trade falters: effect declines with distance
- for belligerents: might be (partly) offset by increased military spending
- Monetary policy (in Nearby): difficult trade-off for stabilization policy

Appendix

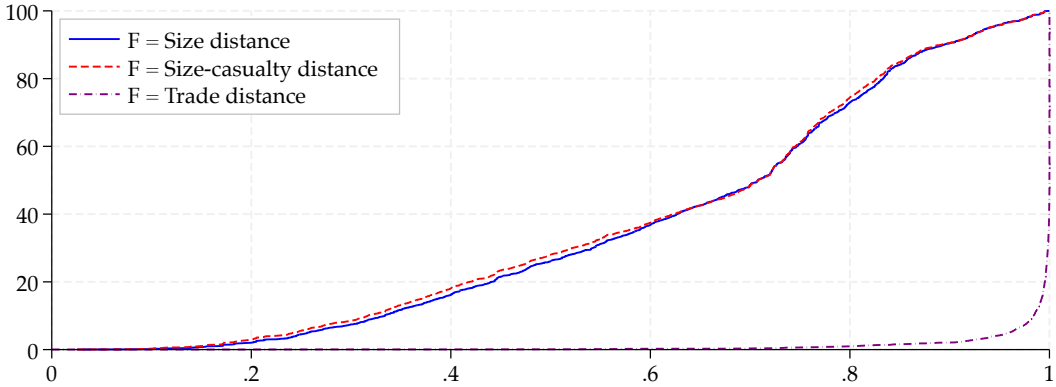
Growth and inflation around start of war





Distance of war sites almost uniformly distributed in sample

Cumulative distribution function of



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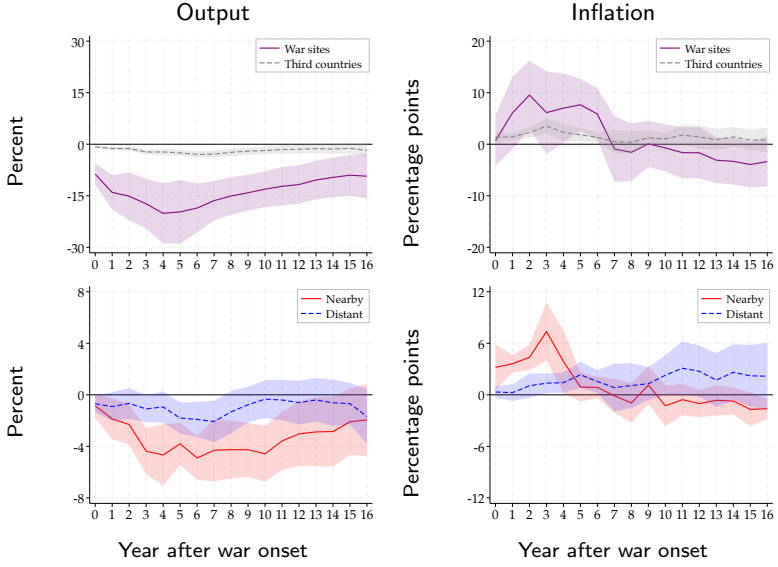
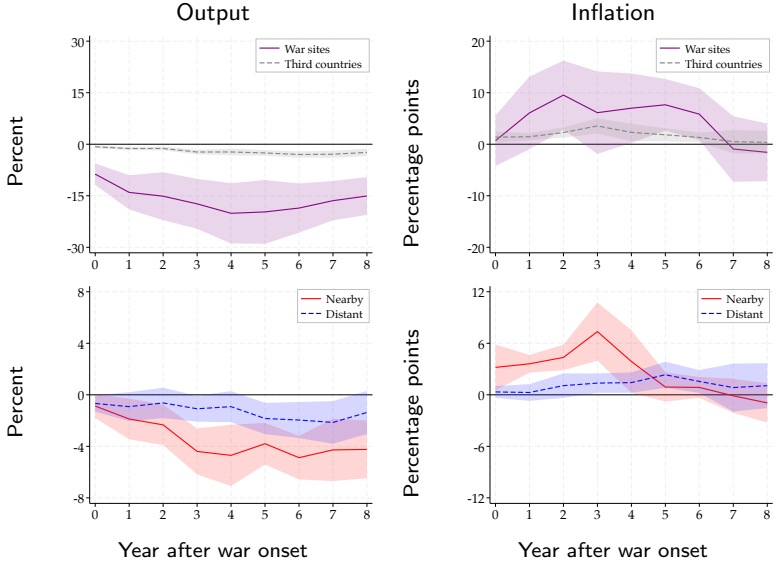
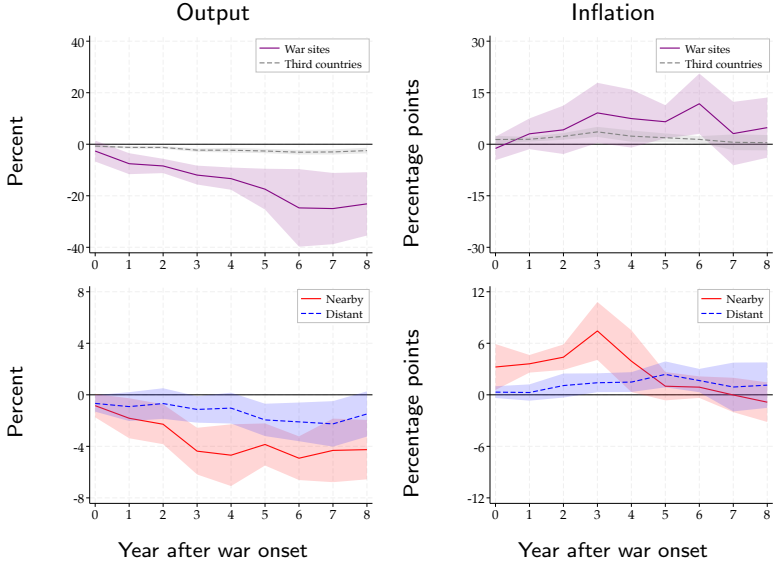
Longer horizons: effects very persistent



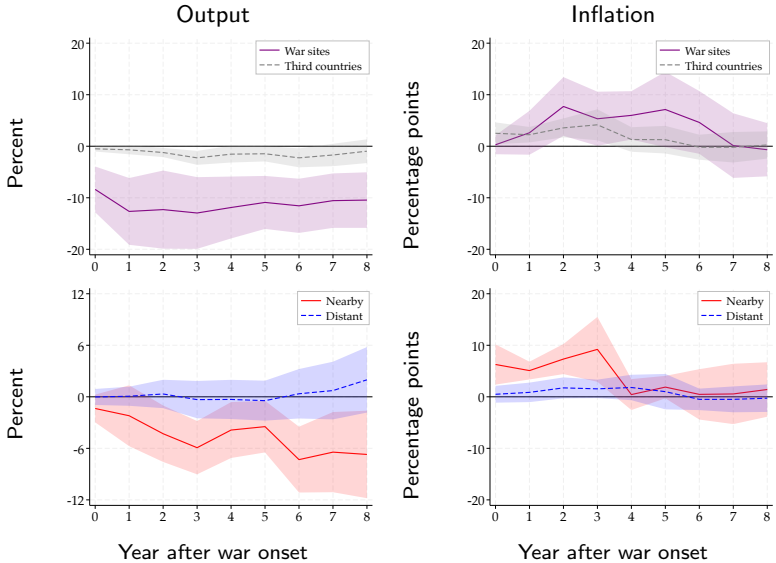
Sample w/o US


Output
Inflation
Back
War sites
Third countries
Nearby
Distant
Percent
Percentage points
Year after war onset

Alternative start years



Short wars (duration ≤ 2 years)



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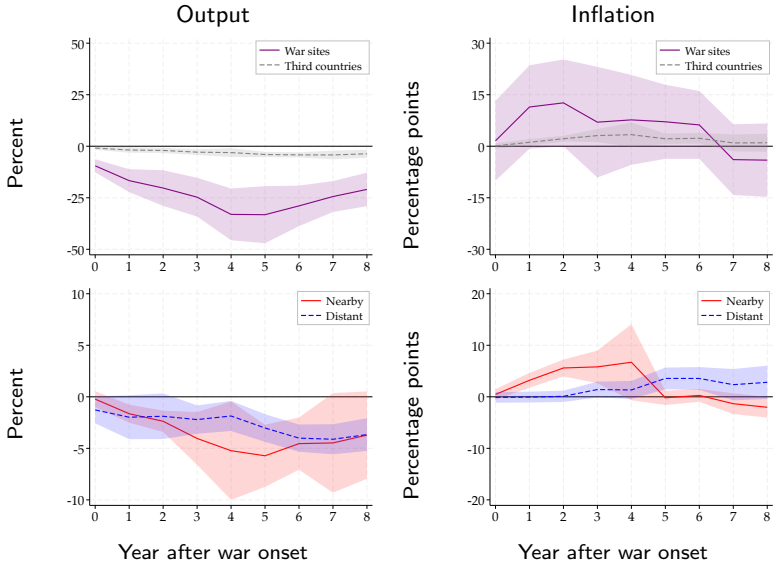
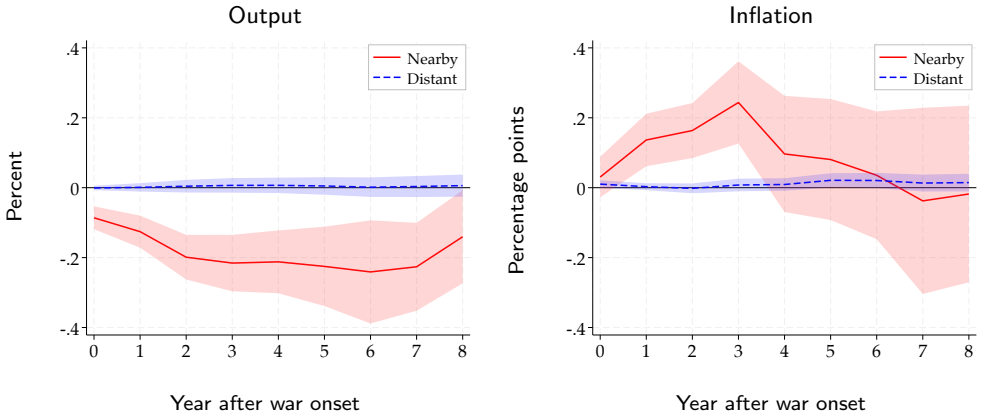
Long wars (duration $>$ 2 years)



Spillovers from foreign war depend on import share

Point estimates and 90% confidence bounds based on Driscoll-Kraay SE



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Model outline

Household objective in country j

$$E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{1}{1-\sigma^C} \left(C_{j,t}(h) - \phi^C c_{j,t-1} \right) - \frac{\chi^L}{1+\sigma^L} (L^s_{j,t}(h))^{1+\sigma^L} \right\}$$

Owns internationally immobile capital stock, $k_{j,t}$, which evolves according to:

$$k_{j,t} = \left((1-\delta^K) k_{j,t-1} + \Phi^K \left(\frac{i_{j,t}}{k_{j,t-1}} \right) k_{j,t-1} \right) e^{-\Delta^K_j \omega_t}$$

War shock follows AR(2) process:

$$\omega_t = \rho^\omega_1 \omega_{t-1} + \rho^\omega_2 \omega_{t-2} + \eta_t$$

Budget constraint of county j in real per-capita terms:

$$c_{j,t} + i_{j,t} + \mathcal{E}^r_{Rj,t} b_{Rj,t} + \frac{\phi^B}{2}\left(\mathcal{E}^r_{Rj,t} b_{Rj,t}\right)^2 + \tau_{j,t} = \frac{1}{n_j}\int_{\mathcal{N}_j} \frac{W_{j,t}(h) L^s_{j,t}(h)}{P_{j,t}} dh + r^K_{j,t} k_{j,t-1} + \mathcal{E}^r_{Rj,t} \frac{R_{R,t-1}}{\Pi_{R,t}} b_{Rj,t-1} + \sum_i div_{ji,t}$$

Final good is CES aggregate of wholesale goods from country i

$$y_{j,t} = \left(\gamma_{jj}^{\frac{1}{\sigma}} y_{jj,t}^{\frac{\sigma-1}{\sigma}} + \sum_{i \neq j} \gamma_{ij}^{\frac{1}{\sigma}} \left[\varphi_{ij,t} y_{ij,t}\right]^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}$$

with $\gamma_{jj} = 1 - \sum_{i \neq j} \gamma_{ij}$. σ is trade-price elasticity and $\varphi_{ij,t}$ import-adjustment costs. Import shares reflect size and home bias

$$\gamma_{ij} = \Omega_{ij}\ n_i, \text{ where in calibration } \Omega_{HN} = \Omega_{NH} = 1$$

Producers operate under monopolistic competition with Calvo price setting constraint assuming producer currency pricing (PCP)

Production function:

$$A_{j,t}(X^d_{j,t}(m))^{\alpha^X}\left(K^d_{j,t}(m)^{\alpha^K}L^d_{j,t}(m)^{1-\alpha^K}\right)^{1-\alpha^X} = \sum_i Y^d_{ji,t}(m).$$

where $x_{j,t} = \frac{1}{n_j}\int_{\mathcal{N}_j} X^d_{j,t}(m)dm$ are intermediate inputs in production (sourced from final goods)

Productivity subject to war shock:

$$\log(A_{j,t}/A_j) = \rho^A \log(A_{j,t}/A_j) - \Delta^A_j \omega_t$$

Market clearing for final goods

$$y_{j,t} = c_{j,t} + i_{j,t} + x_{j,t} + \frac{P_{jj,t}}{P_{j,t}} g_{j,t} + \frac{\phi_b}{2} \left(\mathcal{E}^r_{Rj,t} b_{Rj,t} \right)^2$$

where $g_{j,t}$ is per-capita government spending (funded through lump-sum taxes) and impacted by war shock

$$\frac{g_{j,t}}{gdp_j} = \left(\frac{g_j}{gdp_j} \right) + \Delta^G_j \ \omega_t$$

Monetary policy

$$\left(\frac{M_{j,t}}{M_{j,t-1}} \right) = (1 - \rho^M_j)\Pi_j + \rho^M_j \left(\frac{M_{j,t-1}}{M_{j,t-2}} \right) + \Delta^M_j \ \omega_t$$

Real GDP defined as value added: $gdp_{j,t} = y_{j,t} - x_{j,t}$

Calibration