The Price of War

Jonathan Federle, André Meier, Gernot J. Müller,
Willi Mutschler, and Moritz Schularick

June 2024

# The issue

What is the macroeconomic impact of war?

- Wars cause death and destruction, but also impact war-site economy adversely
- Many large economic disasters associated with wars on country's own soil (Barro 2006)

Other countries pay price for war, too

- Adverse economic impact of war spills overs from war site
- Exposure of other countries depends on their distance from war site
- Nearby countries pay substantial price of war, even if not party to war

Taking the perspective of adjacent countries: war not so rare event

Interstate wars 1870–2022: unconditional prob. 1.3% for domestic v 8.5% for foreign war in adjacent country
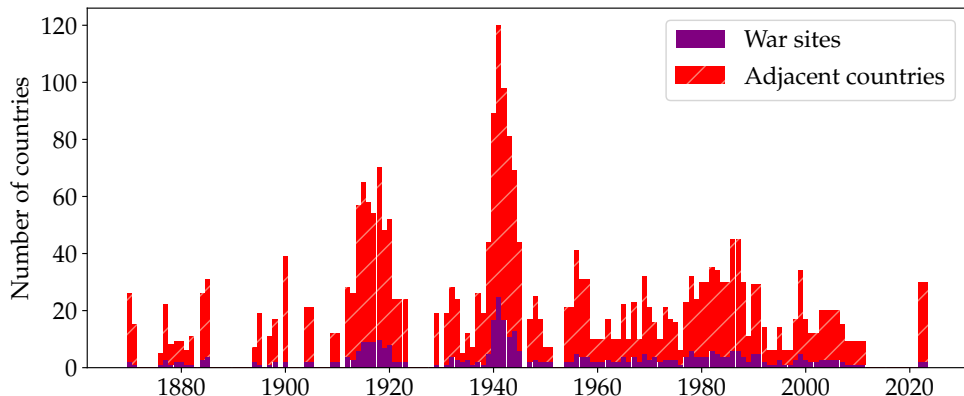
Data and Results

Data of all interstate wars since 1870 and macro data for up to 60 countries

- Identify and geolocate war sites of interstate wars
- Provide narrative account of causus belli
- Establish macroeconomic effect of war in war site and beyond

Data and Results

Data of all interstate wars since 1870 and macro data for up to 60 countries

- Identify and geolocate war sites of interstate wars
- Provide narrative account of causus belli
- Establish macroeconomic effect of war in war site and beyond

Average effect of large wars (casualties $> 10k$)

- Home: GDP falls by 30%, inflation rises by 15ppts per year
- Foreign, if nearby: GDP falls by about 10%, inflation rises by 5ppts
- Foreign, if distant: GDP can increase, inflation flat
- Spillovers similar for belligerents and non-belligerents

Structural interpretation

New Keynesian multi-country model

- Home, Nearby, Distant, and Rest of the World
- Home (war site) highly integrated with Nearby, much less with Distant
- War impacts Home: destroys capital stock & lowers productivity
- Government spending increases globally

Calibrated model can account for evidence

- Adverse supply shock in Home spills over to Nearby through trade
- Endogenous supply-side contraction in Nearby
- Small positive output spillovers in Distant due to increased government spending and redirection of trade flows

Related literature

Economic impact of war

- Case studies: Harrison 1998, Davis Weinstein 2002, Tooze 2006
- Growth: Barro Lee 1994, Caplan 2002, Acemoglu et al 2005, Auray Eqquem 2019, Chupilkin Koczan 2022
- Increased military spending: Barro 1987, Braun McGrattan 1993, Ilzetzki 2002

Trade and war

- Spillovers: Murdoch Sandler 2002,2004, Glick Taylor 2010, Qureshi 2013, Verdickt 2020, Mueller et al 2022, Couttenier et al 2022, Korovkin Makarin 2023
- Trade/alliances: Martin et al 2008,2012, Konrad Morath 2023

Market response to conflict and policy uncertainty

- Leigh et al. 2003, Guidolin La Ferrara 2007, Zussman Nielsen 2008, Caldara Iacoviello 2022; Baker et al 2016; Born et al 2019, Federle et al 2023

Data and basic facts

Annual data 1870–2022

Outcome variables: output and (CPI) inflation for up to 60 countries

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

Annual data 1870–2022

Outcome variables: output and (CPI) inflation for up to 60 countries

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

Bilateral distance from war site measured in kilometers

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

Annual data 1870–2022

Outcome variables: output and (CPI) inflation for up to 60 countries
- Sources: Macroeconomic History Base (Jorda Schularick Taylor), extended in Funke Schularick Trebesch (2023)

Bilateral distance from war site measured in kilometers
- Distance between the 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; and countries involved
- Including war in Ukraine: 75 wars in our sample period
- Need to locate action/destruction: disaggregate wars to battle level, digitizing data in Clodfelter (2017)

Example battle-level coding: Six Day War 1967

Location of battles: Golan Heights, Jerusalem and West Bank, and Sinai
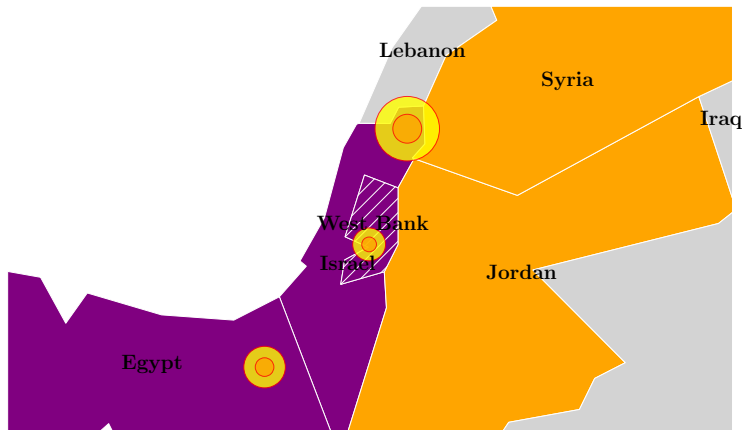
War sites

- Geolocate 525 battles, more or less granular (e.g. eastern front in WW2)
- Collect number of deaths, missing, wounded (causalities) for each battle
- Aggregate back to country level **using today's borders**
- Cross-check via GPT-4 yields another 18 war sites
- **Large** war sites: casualties $> 10k$

War sites

- Geolocate 525 battles, more or less granular (e.g. eastern front in WW2)
- Collect number of deaths, missing, wounded (causalities) for each battle
- Aggregate back to country level **using today's borders**
- Cross-check via GPT-4 yields another 18 war sites
- **Large** war sites: casualties $> 10k$

	Causalities		Length		Wars	Time series for...	
Severity	Minimum	Mean	Mean	Median	Total	Home	Foreign
All sites	46	191,724	2.6	2.0	176	66	2,786
Large sites	10,000	347,803	3.3	2.0	96	38	1,798
Major sites	105,525	702,779	4.4	4.0	46	21	1,026

War sites 1870–2022
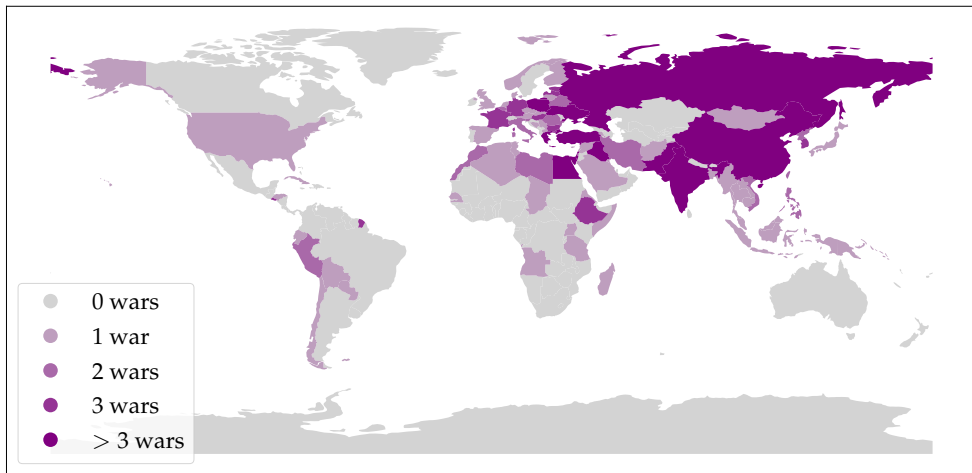
Are wars exogenous to the business cycle?

Common assumption in fiscal policy literature

- Military spending (news) good instrument (e.g., Barro and Redlick, 2011; Ramey Zubairy, 2018; Miyamoto, Nguyen and Sheremirov, 2019)

Are wars exogenous to the business cycle?

Common assumption in fiscal policy literature

- Military spending (news) good instrument (e.g., Barro and Redlick, 2011; Ramey Zubairy, 2018; Miyamoto, Nguyen and Sheremirov, 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 (Hees Orphanides 1995)

Are wars exogenous to the business cycle?

Common assumption in fiscal policy literature

- Military spending (news) good instrument (e.g., Barro and Redlick, 2011; Ramey Zubairy, 2018; Miyamoto, Nguyen and Sheremirov, 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 (Hees 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

No anticipation effects

Growth shortfall and excess inflation in war sites
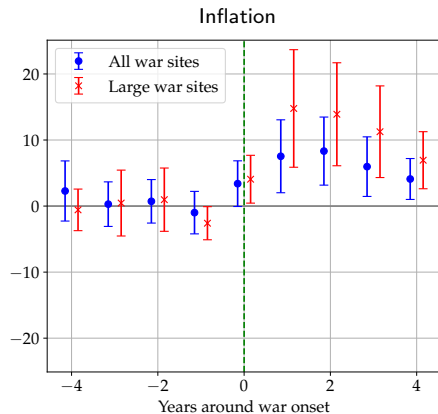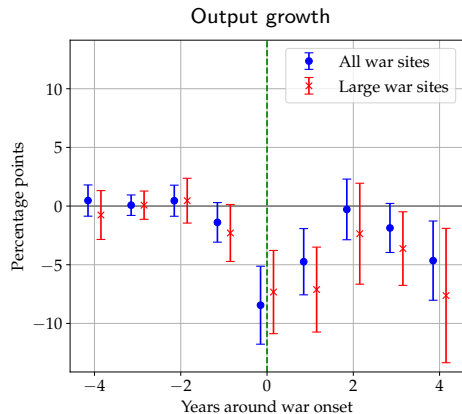
Empirical framework and results

Empirical framework

Narrative identification scheme: consider only wars exogenous to business cycle

Set dummy as large war starts (zero afterwards)

- $Home_{i,t} = 1$ if war starts on soil of country
- $Foreign_{i,t} = 1$ if country $j \neq i$ becomes war site; except if i becomes war site of same war

Empirical framework

Narrative identification scheme: consider only wars exogenous to business cycle

Set dummy as large war starts (zero afterwards)

- $Home_{i,t} = 1$ if war starts on soil of country
- $Foreign_{i,t} = 1$ if country $j \neq i$ becomes war site; except if i becomes war site of same war

Estimate dynamic effect of war in Home and Foreign

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

- $x_{i,t+h}$: output or inflation (about 9,000 obs each)
- Capture average effect in/spillover from large war site (6% of world GDP)

Strong adverse effect on war site, no spillovers **on average**

Linear model, point estimates and 90% confidence bounds based on Driscoll-Kraay SE
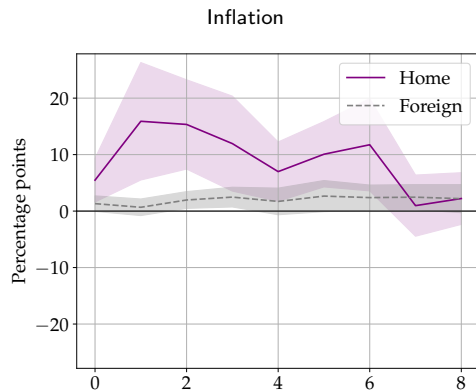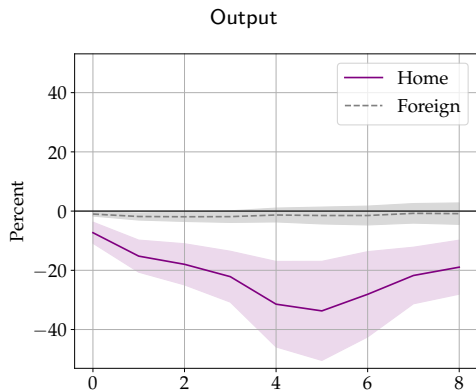
Zooming in: condition spillovers on **<u>distance</u>** from war site

Smooth transition model

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

Zooming in: condition spillovers on **__distance__** from war site

Smooth transition model

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

Allow spillovers on $Foreign_{i,t}$ to differ in distance from war site

$$0 \leq F(i,t) = \frac{\ln(1 + d_{i,t})}{\ln(1 + d^{max})} \leq 1,$$

where $d_{i,t}$ is closest war site and d^{max} maximum distance between any two countries

- Weights about uniformly distributed (show distribution)
- Effect for limiting cases: $\psi_{n,h}$ ($F = 0$, nearby) v $\psi_{d,h}$ ($F = 1$, distant)

Strong adverse spillovers on Foreign if close to war site

Point estimates and 90% confidence bounds based on Driscoll-Kraay SE
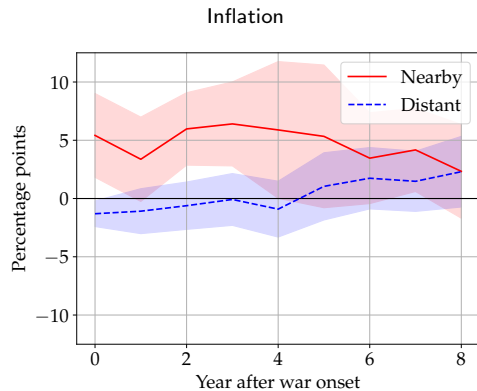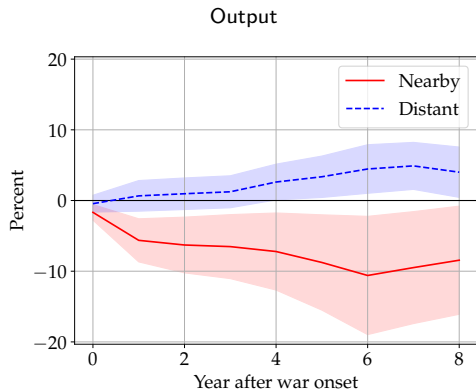
Wars can be big or small . . .

Replace war-site dummy with quantitative measure of war size

Compute share of foreign war sites in world GDP in year prior to war

$$Foreign_{i,t} = \sum_{j \in J_{i,t}} \frac{GDP_{j,t-1}}{GDP_{world,t-1}},$$

where $J_{i,t}$ set of all countries that become war sites of foreign war in year t

Wars can be big or small . . .

Replace war-site dummy with quantitative measure of war size

Compute share of foreign war sites in world GDP in year prior to war

$$Foreign_{i,t} = \sum_{j \in J_{i,t}} \frac{GDP_{j,t-1}}{GDP_{world,t-1}},$$

where $J_{i,t}$ set of all countries that become war sites of foreign war in year t

Measure GDP-weighted average distance from war-site economies

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

Memo: 35 domestic wars, 961 foreign wars

Spillovers Foreign war: accounting for size of war site

War site normalized to 1% of world GDP
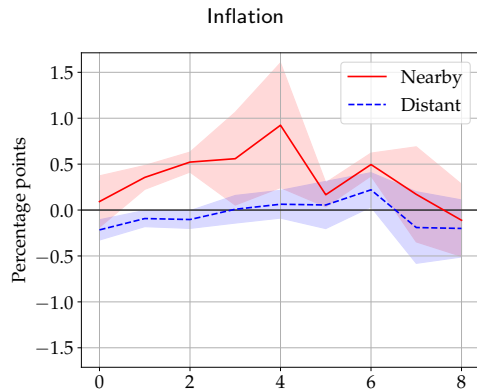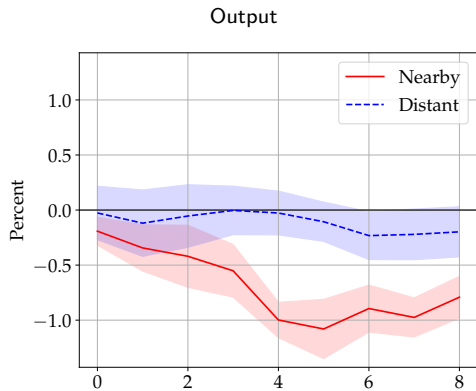
Is distance just gravity?

Measure exposure with importshare rather than distance

Keep baseline: $Foreign_{i,t}$ as dummy variable

Measure distance by accounting for aggregate import share from all war-site economies

$$F(i,t) = 1 - \sum_{j \in J_t} \frac{imports_{j \to i, t-1}}{imports_{i, t-1}}$$

- $F(i,t) = 1$ amounts to maximum "distance," just like in baseline

Memo: 58 domestic wars, 848 foreign wars

Spillovers from foreign war depend on import share

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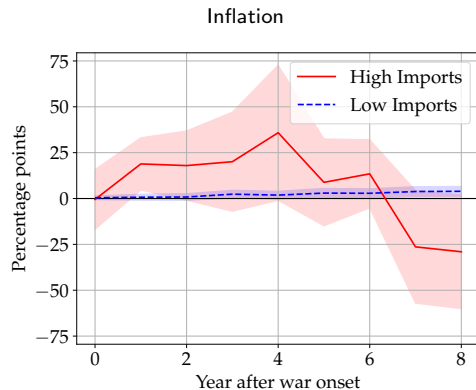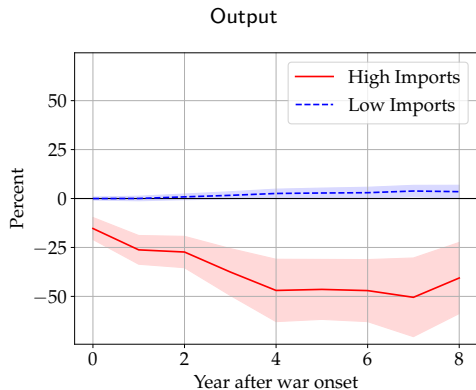
Robustness and further evidence

Main results robust across a number of alternative specifications (details)

- Longer horizons
- Drop world wars from sample
- Look at all 158 war sites
- Drop belligerents that are not war site

Further specifications/evidence (details)

- Condition on severity of war in terms of casualties rather than distance
- Employment in the military, population response, unemployment

Structural interpretation

Structural interpretation

New Keynesian multi-country model (Gopinath et al 2020, Eichenbaum et al 2021)

- Home, Nearby, Distant, each 6% of world output; and Rest of the World
- Home and Nearby highly integrated: no home bias; very little trade with Distant, RoW trade given by relative sizes
- Incomplete financial markets; labor and capital immobile across countries
- Monopolistic competition & stickiness in labor and goods market
- Monetary policy determined by standard Taylor rules

Structural interpretation

New Keynesian multi-country model (Gopinath et al 2020, Eichenbaum et al 2021)

- Home, Nearby, Distant, each 6% of world output; and Rest of the World
- Home and Nearby highly integrated: no home bias; very little trade with Distant, RoW trade given by relative sizes
- Incomplete financial markets; labor and capital immobile across countries
- Monopolistic competition & stickiness in labor and goods market
- Monetary policy determined by standard Taylor rules

War as AR(2) shock with 3 dimensions

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

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

(iii) Raises military spending globally

Macroeconomic impact of war in Home, Nearby, and Distant

Output

Inflation
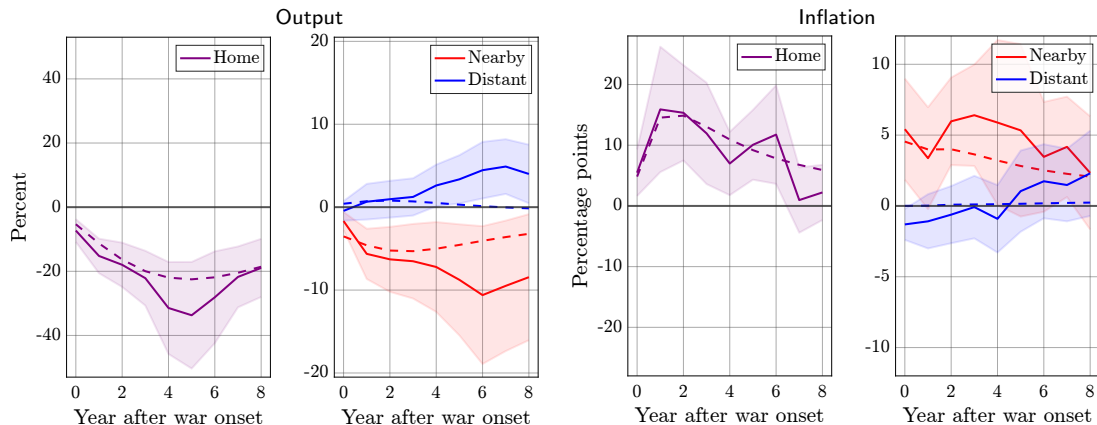
Implications of estimated model—External validation
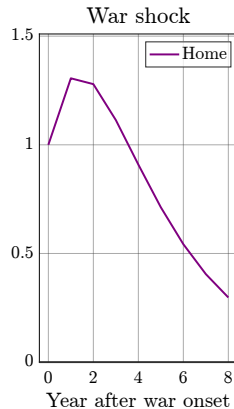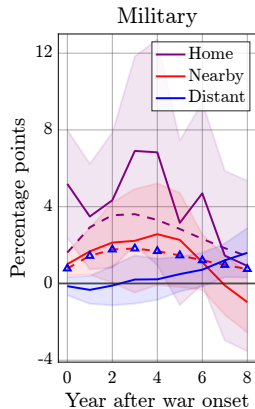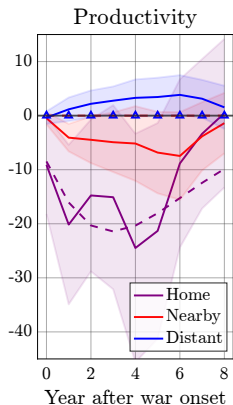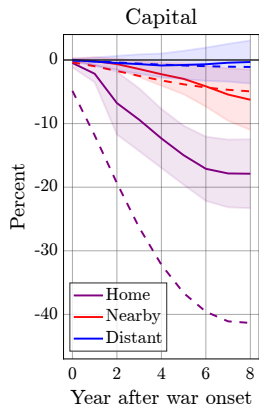
Inspecting the mechanism: Supply side spillovers to Nearby
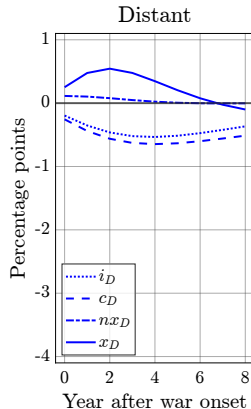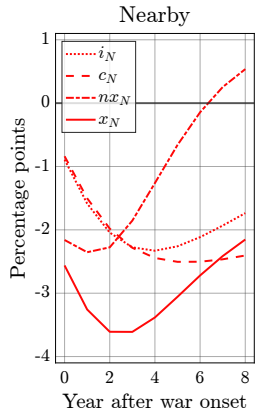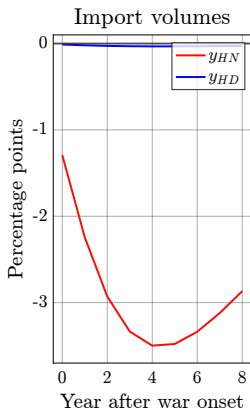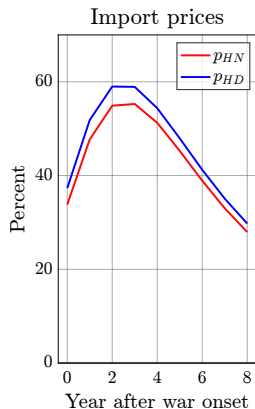
Decomposing the macroeconomic impact of war

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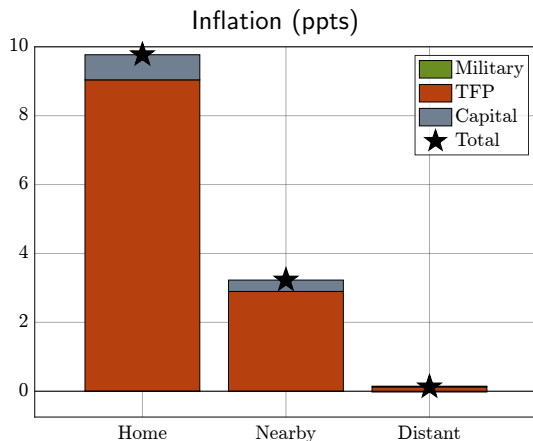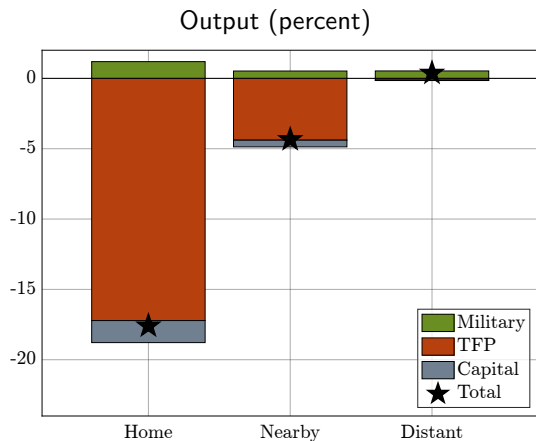
Conclusion

Mapping macroeconomic impact of war

- Large adverse effects in war **site**
- Spillovers large for nearby countries, smaller (or positive) for distant countries

Conclusion

Mapping macroeconomic impact of war

- Large adverse effects in war **site**
- Spillovers large for nearby countries, smaller (or positive) for distant countries

Mechanism / policy

- Adverse **supply shocks dominate in vicinity** of war site:
  decline with distance, (partly) offset by increased demand
- Being close to war site gives rise to trade off for monetary policy:
  fallout of war cannot be fully contained

Appendix

Robustness

Distance of war sites almost uniformly distributed in sample

Cumulative distribution function of
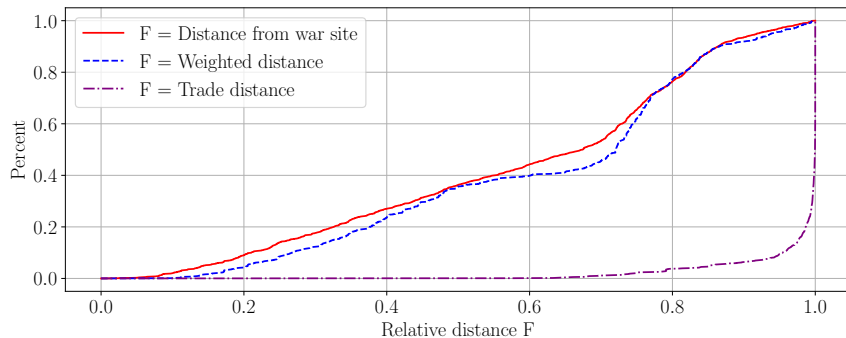
Back

Longer horizons: effects very persistent
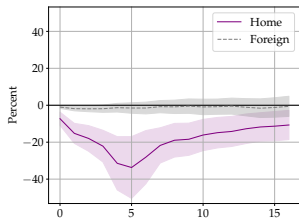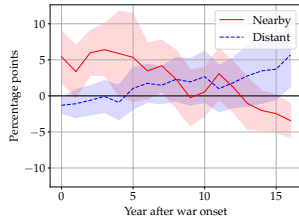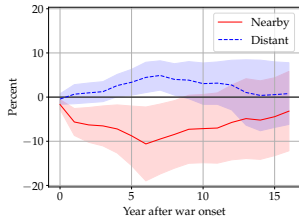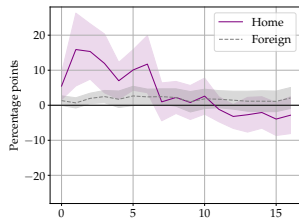
Large wars w/o world wars
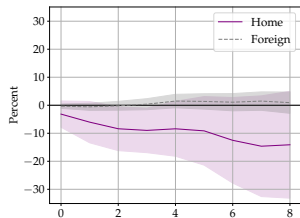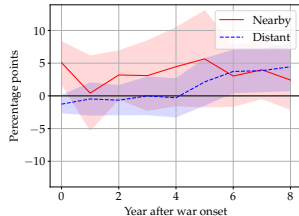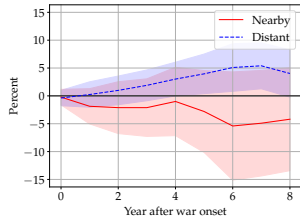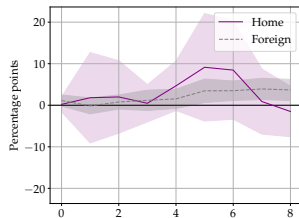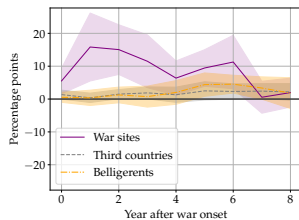
Output

Inflation

All war sites (158)
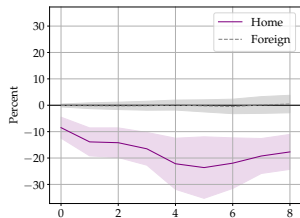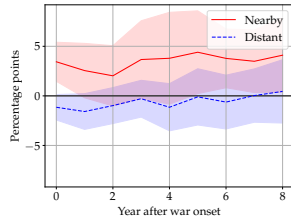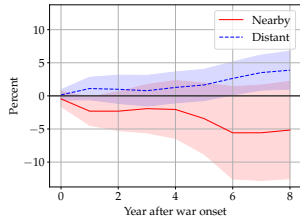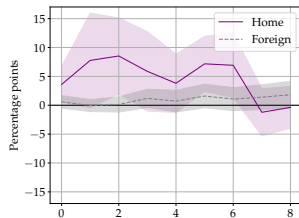
Output

Inflation

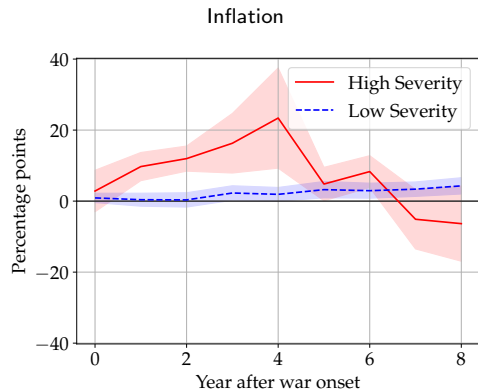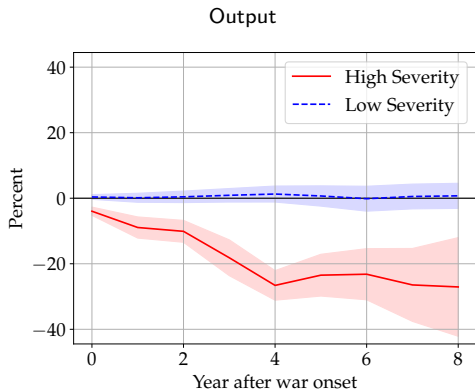# Third countries w/o belligerents
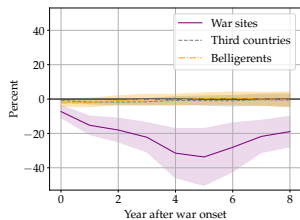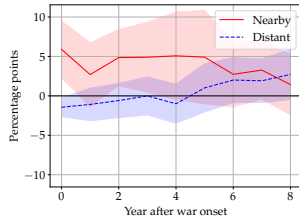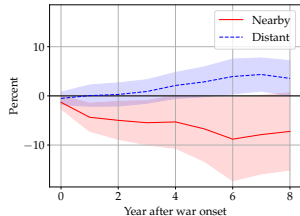
Condition spillovers on severity of war

Focus on *all* nearby wars

- War sites located within 1,000 kilometers
- Redefine dummy, $Foreign_{i,t}$, to take on the value of 1 in this case only

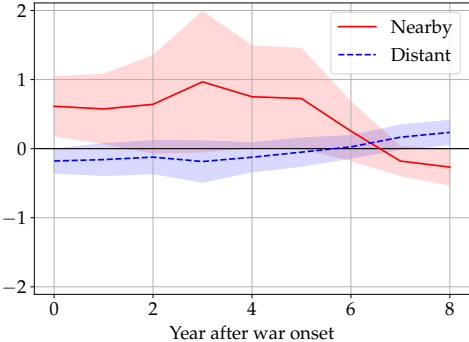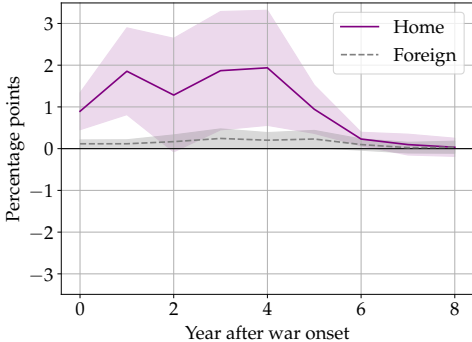Modify indicator function in the following way

$$F(i, t) = \frac{casualties_{i,t}}{\max casualties_{i,t}}$$
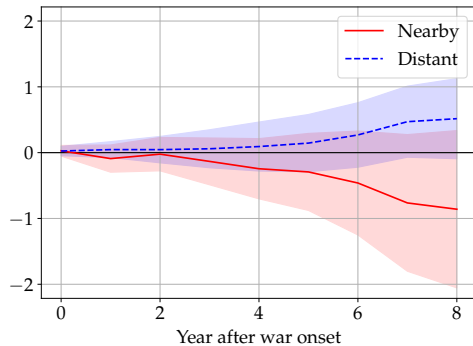
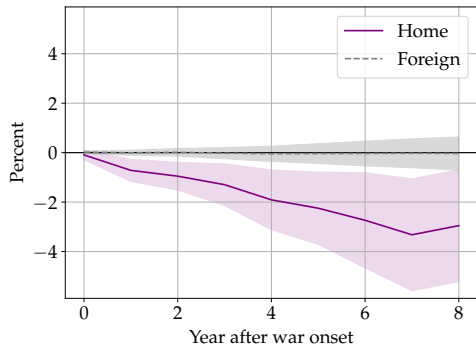# Spillovers from nearby war by severity

Output

Inflation

Further evidence 1: employment in military sector

Further evidence 2: Population response

Further evidence 3: unemployment drops in war site