The Price of War

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Abstract

In an integrated global economy, the economic fallout of war is not confined to the country where the conflict is fought but spills over to other countries. We study the economic effects of large interstate wars using a new data set spanning 150 years of data for more than 60 countries. War on a country's territory typically leads to an output decline of 30 percent and a 15 percentage point increase in inflation. We find large negative effects also for countries that are geographically close to the war site, irrespective of their participation in the war. Output in neighboring countries falls by more than 10 percent over 5 years, and inflation rises by 5 percentage points on average. Negative spillovers decline with geographic distance and increase in the degree of trade integration with the war site. For very distant countries, output spillovers can turn positive so that wars create winners and losers in the international economy. We rationalize these findings in an international business cycle model, calibrated to capture key features of the data. As the war destroys capital in the war site and productivity falls, trade with nearby economies decreases, generating an endogenous supply-side contraction abroad.

Keywords: Interstate Wars, Business Cycles, Spillovers, Distance, Supply Shocks, International Transmission

JEL Classification: F40, F50, E50

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*We wish to dedicate this paper to Philippe Martin who discussed it at the Kiel-CEPR Geoeconomics Conference in Berlin before his untimely death in December 2023. Federle: Kiel Institute (email: jonathan.federle@ifw-kiel.de); Meier: Tudor Capital Europe LLP (email: Andre.Meier@alumni.eui.eu); Müller: Department of Economics, University of Tübingen, CEPR and CESifo (email: gernot.mueller@uni-tuebingen.de). Mutschler: Department of Economics, University of Tübingen (email: willi@mutschler.eu). Schularick: Kiel Institute, Sciences Po, and CEPR (email: moritz.schularick@sciencespo.fr). The views expressed in this paper are those of the authors and do not necessarily reflect the views of the institutions they are affiliated with. We thank our discussants Alessandra Bonfiglioli, Luca Dedola, Philippe Martin, and Ansgar Rannenberg, as well as Thierry Mayer, Timothy Meyer, and Mathias Thoenig for very helpful comments. Sven Eis, Kevin Klein, and Maximilian Reinhard provided excellent research assistance. The usual disclaimer applies.

"You may not be interested in war, but war is interested in you."

Leon Trotsky

1 Introduction

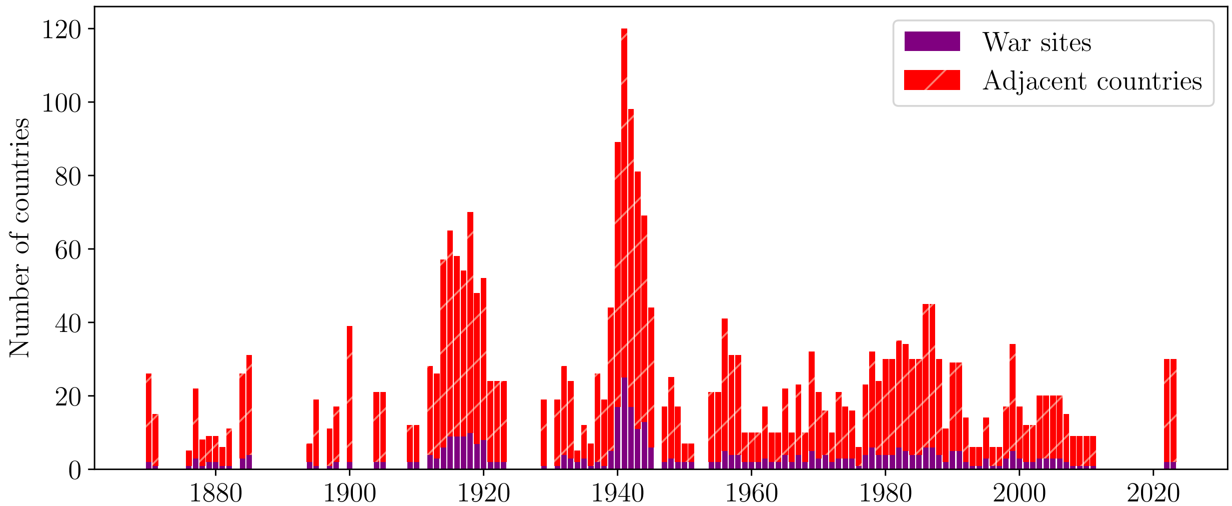
The global political and economic landscape is undergoing profound changes. Geopolitical tensions are rising and rivalries between nations are breaking into the open. The process is fueled by a volatile blend of nationalism and shifts in power dynamics—the two most common reasons for why nations go to war, as we discuss below. Wars cause death and destruction, disrupt trade, and wreak havoc on public finances. They also affect the economy at large, notably output and inflation. Countries that suffer from a war on their own soil often experience economic disasters (Barro, 2006). Yet, wars and the associated rise in military spending can also be expansionary and pull economies out of recessions (Baxter and King, 1993; Braun and McGrattan, 1993; Ilzetzki, 2022).

Who bears the economic price of war? We show that the adverse impact of war, while largest in the war-site economy, spills over to other countries and therefore has an important international dimension. Geography turns out to be a key determinant of these costs. Countries close to the war site experience substantial adverse spillovers. The effects decrease with distance from the war site and increase with trade integration. Although spillovers are somewhat stronger for countries that participate in the war ("belligerents") than for third countries, the overall pattern is similar for both.

While wars on a country's territory are rare events, we show that economies are frequently exposed to the negative spillovers from wars in their neighborhood. Figure 1 illustrates this basic fact. It shows that in a long-run sample starting in 1870, the frequency with which a country is a war site in a given year is very low at 1.4%. In contrast, the frequency with which a country is adjacent to a war site is much higher at 8.2%, and hence about twice as high as the (unconditional) frequency of financial crises (Schularick and Taylor, 2012). Exposure to war occurs almost at business cycle frequency but remains an understudied source of shocks in the international economy.

We perform a comprehensive long-run analysis of the business cycle impact of war, distinguishing the effects on the war-site economy, to which we refer as "Home," and the spillovers on other economies, to which we refer as "Foreign." Among the foreign economies, we distinguish between foreign belligerents and third countries, but the distinction does not turn out to be decisive. To do this, we constructed a new long-run data set based on the *Correlates of War* (COW) project and macroeconomic time-series data as assembled in the *Jorda-Schularick-Taylor Macrohistory Database* (Jordà, Schularick and Taylor, 2017), augmented in Funke, Schularick and Trebesch

Figure 1: War sites and adjacent countries



Notes: Total number of countries is 192, Data source: Correlates of War Project (Stinnett et al., 2002). Classification based on 2016 borders. For details on geolocation of war sites, see Section 2 of the main text.

(2022). We identify 176 war sites in our sample, which spans the years from 1870 to 2022. We define a large war as a war for which the recorded number of casualties exceeds 10k per war site.

Local projections show that war typically reduces output in Home by 30 percent relative to trend over five years. It also raises inflation by 15 percentage points over five years after the start of the war. They are, in the words of Barro (2006), the quintessential economic disasters for the war site. However, the adverse effects are large in nearby economies, too. We establish this result within a smooth-transmission framework that conditions the spillovers of war on geographic distance. We find that war lowers output in Foreign by about 10 percent relative to trend and raises inflation by 5 percentage points if it takes place in a country's immediate neighborhood. The costs of war for foreign countries decline systematically with geographic distance. For very distant countries, war may even raise output somewhat.

Output and inflation are not the only measures for the costs of war and its implications for human welfare. Our analysis does not account for human losses. We also neglect specific economic dimensions, such as the fiscal burden of war. Last, because we lack sufficiently granular data, we cannot say to what extent the composition of GDP changes in wars and how private consumption is affected which is arguably a better measure of economic welfare than GDP. Our focus on GDP and inflation is warranted in order to study the business cycle impact of war, notably in countries that are not parties to the war.

We argue that the empirical patterns that we document support a causal interpretation. We narratively identify, in each individual case and based on a variety of sources, the *casus belli*, or the primary causes and motives behind a given war. The overwhelming majority of wars are linked to nationalist, ideological, or historical causes that are plausibly exogenous to the state of the business cycle.[1] Two exceptions confirm this rule: the Boxer uprising in 1900 and the Italo-Turkish War in 1911. In both cases, the sources available to us suggest that short-term economic conditions were decisive for the start of the war. Hence, we drop these wars from our sample. We also acknowledge that specific economic factors may play a role in the decision to go to war—for instance, disputes over natural resources or wars in the context of colonial expansion, as famously argued by Lenin (1917). Yet even then, these economic motivations appear largely orthogonal to the (short-term) business cycle, considering that they concern medium- to long-run objectives and that the outcome of war is typically uncertain. We see a parallel here with the tax changes for which Romer and Romer (2010) identify "more exogenous reasons."[2]

To provide further structural meaning to our empirical results, we set up a state-of-the-art business cycle model of the global economy, building on earlier work by Gopinath et al. (2020) and Eichenbaum, Johannsen and Rebelo (2021). This setup allows us to study the impact of war in the war site, that is, in "Home". In terms of Foreign, we further distinguish "Nearby" and "Distant." These differ in their distance from Home, as captured by the degree of trade integration in steady state. We also account for their economic weight by appropriately specifying a "Rest of the World." In specifying the war shock, we draw on earlier work on rare disasters (Gourio, 2012). Specifically, we assume that the war shock destroys a part of the capital stock and simultaneously induces a persistent decline of common productivity in the war-site economy (Home)—and only there. At the same time, the war shock triggers an increase in military spending in Home and, albeit to a lesser extent, in the other countries. To pin down parameter values, we match the impulse response functions that capture the effect of war on the war site using a Bayesian approach.[3]

The model provides an account for the dynamics in both Home and Foreign.In the model, spillovers operate through trade and depend on the degree of pre-war trade integration. The war-site economy suffers from a large supply contraction (the capital stock is destroyed and productivity declines) which spills over to Nearby because, as Home goods become scarce and expensive, Nearby reduces imports from Home considerably. The use of intermediate goods, which feature a sizeable import component, cannot be maintained, and as a result, production in Nearby also declines. In addition, the capital stock in the nearby economy declines endogenously. The resulting supply contraction, both in the war-site and the nearby economy, accounts for the surge in inflation.

[1] The U.S. appear like a notable special case in this regard, as there is evidence that U.S. presidents have been more likely to deploy military force in times of "economic misery" (Ostrom and Job, 1986) and during recessions, provided they were up for reelection (Hess and Orphanides, 1995), notably in the post-WW2 period. What is special about the U.S. is that, despite the frequent involvement in wars during this period, the U.S. never itself turned into a war site.

[2] In our empirical specification, we interpret the *start* of the war as an exogenous event while acknowledging that *its duration* will likely depend on its economic impact. We also verify that "war shocks" are largely unanticipated by macroeconomic indicators and trace out their effects over time relative to a non-war baseline trend.

[3] As a technical contribution of this paper, we extend the method-of-moments toolbox in Dynare to now include formal (Frequentist or Bayesian) Impulse Response Matching capabilities as per Christiano, Trabandt and Walentin (2010). This feature is part of the 6.0 release of Dynare (Adjemian et al., 2022).

The adverse supply-side spillovers are weaker in Distant because there is much less trade with Home to begin with. In Distant, the overall effect may thus be dominated by the expansionary effect of increased military expenditure—accounting for the positive spillovers that we find for some of our empirical specifications. There is also a redirection of trade flows that stimulates economic activity in Distant, but this effect is modest. Overall, we find that the model provides a plausible account for the war's impact on the war site and the spillovers to other countries. It not only offers additional insights into the transmission mechanism but also serves as a useful plausibility check for our empirical results, even from a quantitative point of view.

The paper is structured as follows. In the remainder of this section, we discuss the related literature and clarify the contribution of our paper. Section 2 details the construction of our data set, notably the specification of war sites, the classification of the casus belli, and a number of descriptive statistics. Section 3 discusses our empirical strategy and presents the main results. In Section 4, we outline and calibrate our business cycle model, assess its validity externally, and inspect the transmission mechanism. The final section offers a brief conclusion.

Related literature. Our paper relates to several strands of the literature. First, there is work on the economic impact of war on countries that are directly involved. Economic historians, in particular, have studied the economic damage caused by specific wars, as well as the human and economic costs of sustaining the war effort in the belligerent countries (e.g., Harrison, 1998; Davis and Weinstein, 2002; Tooze, 2006). Interestingly, the literature has struggled to document an adverse effect of war on growth (Barro and Lee, 1994; Acemoglu, Johnson and Robinson, 2005).[4] The fact that GDP in the U.S. and U.K. expanded during both world wars has been attributed to the strong increase in military expenditures (Braun and McGrattan, 1993; Ilzetzki, 2022). Caplan (2002) distinguishes the growth effect of domestic and foreign wars, the latter being defined as wars that are fought abroad: domestic wars lower growth, while foreign wars are mildly expansionary. Likewise, Chupilkin and Kóczán (2022) document that wars on a country's territory reduce economic activity. Auray and Eyquem (2019) estimate a DGSE model on time series data for the two World Wars. What sets our paper apart from these papers is our focus on the macroeconomic spillovers of war.

In this regard, a second strand of the literature is relevant. It investigates the adverse impact of war on trade and production networks (Glick and Taylor, 2010; Qureshi, 2013; Couttenier, Monnet and Piemontese, 2022; Korovkin and Makarin, 2023). Our results are consistent with the findings of this literature, although our perspective is broader. Ex ante, we do not constrain spillovers to operate only via trade. Taking a complementary perspective, Martin, Mayer and Thoenig (2012)

[4]There is consensus about the negative growth effects of conflict more generally (see, for instance, Novta and Pugacheva, 2021; de Groot et al., 2022), or for global and very large wars (Rasler and Thompson, 1985; Thies and Baum, 2020). Blomberg and Hess (2012) document that consumption drops strongly in response to small wars, whether initiated at home or abroad.

link the formation of trade agreements to the probability of conflict, while Konrad and Morath (2023) put the notion that the collateral damage of war is largest in frontline states—that is, states most at risk of becoming war sites—at the center of their theory of alliance formation.

Third, the role of geographic distance as a determinant of conflict spillovers has been highlighted in earlier work, though with a distinct focus on civil war and ethnic conflict (Murdoch and Sandler, 2002, 2004; Mueller, Rohner and Schönholzer, 2022). Fourth, the market response to conflict, both expected and actual, has been analyzed in some detail, also with a view to the role of geographic distance (Leigh, Wolfers and Zitzewitz, 2003; Guidolin and La Ferrara, 2007; Zussman, Zussman and Nielsen, 2008; Verdickt, 2020; Caldara and Iacoviello, 2022; Federle et al., 2022). What sets our analysis apart from these latter studies is our interest in the macroeconomic ramifications of actual wars. Last, we build on earlier efforts to model rare disasters (including wars) already referenced above. In this regard, we share the open-economy perspective of Farhi and Gabaix (2016). In contrast to them, we bring to the fore what determines the economic spillovers of wars on countries that are not war sites but potentially exposed via close geographic proximity.

2 Data, identification, and basic facts

In this section, we introduce our data set and definitions. We also narratively classify the wars in our sample according to their *casus belli*. Finally, we present a number of descriptive statistics on how economic performance changes in the context of wars.

2.1 Data

Our sample covers annual observations for the period 1870–2022 for an unbalanced panel of 60 countries. The beginning of the sample period is constrained by the availability of comprehensive time-series data for macroeconomic outcomes. In the final year, the sample includes the start of the war in Ukraine.

To identify wars for our sample, we build on the *Correlates of War* (COW) project (Sarkees and Wayman, 2010). COW provides data on interstate wars for the period from 1816 to 2007. These wars are defined as "sustained combat involving regular armed forces on both sides and at least 1,000 battle-related fatalities among all of the system members involved." For the more recent years within our sample period, we note that there have been no interstate wars that meet this criterion between 2008 and the Russian invasion of Ukraine in 2022. We verify this using the database of the *Uppsala Conflict Data Program* (UCDP), see Gleditsch et al. (2002); Davies, Pettersson and Öberg (2022).[5]

[5]The definition of war according to UCDP is somewhat more restrictive: It classifies as wars all conflicts with at

Our analysis is centered around the notion of "war sites," that is, countries that experience military action on their own soil. In what follows we therefore use "war" narrowly to refer to the military action and the war site. Moreover, our empirical analysis is premised on the hypothesis that war affects countries differently, depending on whether they are an actual war site or not; and, if not, depending on how geographically close they are to the war. We thus classify, in a first step, countries in their relation to the war as either "Home" or "Foreign": Home (Foreign) are countries where (no) war takes place. Note that Foreign includes both belligerent and non-belligerent countries. In the second step, we determine the geographic distance of Foreign from the war.

The COW project does not provide information on where a given war took place. In order to identify war sites, we consult additional sources and determine the geographical location of the military action. Again, we proceed in two steps. First, we disaggregate wars to the battle level based on information in Clodfelter (2017). As a result, we are able to identify 525 different battles for which we code the geolocation.[6] Using the same sources, we obtain—for each battle—estimates for the number of casualties. Casualties include the number of dead, missing, or wounded people as well as prisoners of war captured in the respective battles. The largest battle in our sample is the Battle of Wuhan in China during the Sino-Japanese War, which is associated with more than 2 million casualties. Other well-known battles, such as the Battle of Stalingrad and the Siege of Leningrad, with a total of 500k and 485k casualties, respectively, also rank among the bloodiest in our sample.

Second, we aggregate casualties to the country level, which is the unit of our analysis.[7] For this purpose, we rely on today's borders so that we can study the macroeconomic outcomes associated with a war in either Home or in Foreign in a geographically consistent manner. In aggregating to the country level, we follow the approach of Conte et al. (2022) and code according to the country definitions provided by the CIA World Factbook. To illustrate the issue, consider the Italian-Turkish War in 1911 as an example. It was fought between the Ottoman Empire and Italy but major warfare predominantly took place in modern-day Libya rather than in Turkey or Italy. Since our macroeconomic indicators consistently refer to present-day national borders, we code Libya as the Home economy of the war while Italy and Turkey are Foreign.

We further cross-check our war-site coding by consulting GPT-4. As a large language model, it is trained on huge corpora of texts, including historical accounts of wars. We leverage this fact and systematically consult the GPT-4 API to identify the countries in which major battles took place and compare the outcomes with our own coding.[8] The Pearson correlation with our coding is 0.68

least 1,000 battle-related deaths in a given year, as opposed to deaths over the course of the entire war as in COW. We note, however, that all wars in the COW data set that lasted longer than a year also caused more than 1,000 battle-related deaths per year.

[6] In some instances, the available information is less granular than what we would ideally like to have. For instance, an important battle in WW2 is the "Eastern front".

[7] In case a battle field extends over the territory of several countries we assign the casualties in equal shares to all countries.

[8] For each war, we ask GPT-4 "*Which countries suffered major battles on their own territory during the war "*"*

and highly significant (p-value < 0.001). In total, GPT-4 identifies 73 countries as war sites that we have not previously identified among the 158 countries in our coding. Because large language models tend to hallucinate, we systematically search for corroborating evidence on these countries and are able to find some documentation of actual fighting in 18 of the proposed addtional war sites. We include these countries in our war site coding, see Table A1 for an overview of these countries. For the period 1870–2022 we end up with 176 country-year observations for when a war starts on a country's soil (Home) and 2,786 corresponding observations for Foreign.[9]

We obtain time-series data for output and inflation from the *macrohistory* database, which covers 18 advanced countries starting in 1870 (Jordà, Schularick and Taylor, 2017). This database, in turn, is constructed from a number of sources, including Bolt and van Zanden (2014) and others that typically make adjustments for changing borders so that the data refer to current borders; see, for instance, Maddison (1995). We complement the macrohistory database with time series for additional countries from various sources (Funke, Schularick and Trebesch, 2022; World Bank, 2022) which, in turn, build on Ursùa and Barro (2010) and Bolt et al. (2018). These sources provide us with data for GDP in per capita terms. For our analysis, we compute an aggregate output measure to account for changes in the population during wars. For this purpose, we rely on population data for the territories that define countries today (Bolt and van Zanden, 2014).[10] The same sources provide us with a measure of consumer price inflation that we winsorize at the 99% and 1% levels. We further obtain data on total factor productivity, labor, and capital stock from the Long-Term Productivity Database (Bergeaud, Cette and Lecat, 2016). Military expenditures are provided by the COW project (Singer et al., 1972; Singer, 1988), and data on unemployment are sourced from Gabriel (2023). Lastly, we source bilateral trade data from Barbieri, Keshk and Pollins (2009) and Barbieri and Keshk (2016).

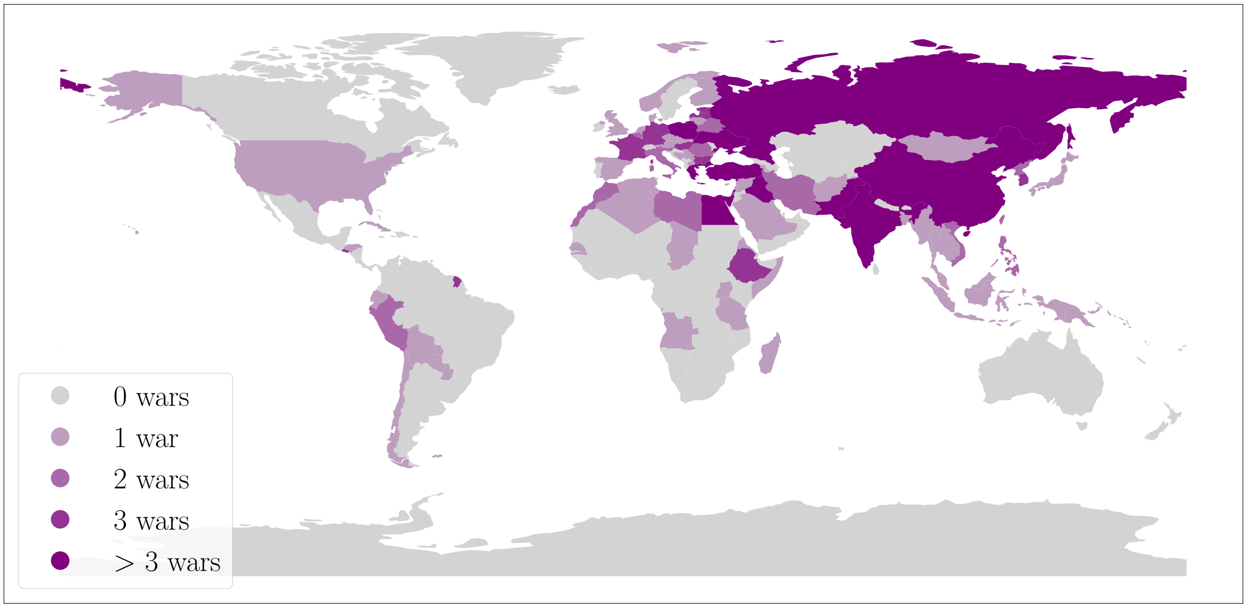
The map in Figure 2 shows the geographical distribution of the war sites in our sample: the darker a country is shaded, the more often it has experienced a war on its own soil. We observe war sites to be distributed across the world, with some clustering in Europe, the Middle East, and Asia. The U.S. also experienced combat on its own soil, but only once: During World War II there were several battles on the Aleutian Islands, a group of islands belonging to Alaska, as well as the Japanese attack on Pearl Harbor. The Aleutian Islands example illustrates that military action will not, in all cases, cause meaningful economic effects. In our baseline, we thus focus on war sites where the fighting was most severe. Specifically, we set the threshold to 10k casualties and refer

*which started in *? Consider modern-day borders. Specifically, even if a state did not exist at the time of the war, refer to it by its current name within today's borders. For example, if there was a war in 1870 within modern-day Libya, please refer to it as having taken place in Libya instead of referring to it as the Ottoman Empire. It is crucial that you only provide the ISO-3 codes of the countries and nothing else, as your response is being parsed as a CSV.*" Parameters of GPT-4 requests were: temperature (0), max_tokens (256), top_p (1), frequency_penalty (0), presence_penalty (0).

[9] In principle, each war in Home should correspond to a war in Foreign for each of the other countries in the sample. However, there are years in which several foreign wars start, which are aggregated into a single war event.

[10] Although Bolt and van Zanden (2014) mostly refer to 1998 boundaries, these have only changed to a small extent since (Schvitz et al., 2022).

Figure 2: War sites



Notes: Figure shows all countries along with the number of wars that took place on their soil for the period 1870–2022.

to the resulting sample as "large war sites" in what follows. The U.S. example does not meet this criterion.

Table 1 provides summary statistics for progressively more severe wars. The top line refers to all 176 wars, with an average duration of war of 2.6 years. The average number of casualties for this sample is 184k. In terms of macroeconomic time series, this full sample includes data for 66 observations for the start of a war in Home and 2,786 observations for Foreign. In the second row we report the figures for large wars (casualties $\geq$ 10k), which we use as our baseline sample and for which we provide details in Table A2 in the appendix.[11] The average number of casualties is as high as 335k in this sample, and the average length of the war extends to over three years. Importantly, this sample still comprises 96 wars, although we note that country-year observations for macro time series are only available for a subset of these, as the rightmost panel of the table reports. The last line of the table reports statistics for the major wars in our sample (casualties $\geq$ 100k), for which we also report results in our robustness analysis.

In our formal analysis below, we relate the spillover effects of war on Foreign to its geographic distance from the war. It is defined as the distance between the most populated cities across these two countries, again in terms of today's borders, see Mayer and Zignago (2011). The greatest distance between two economies in our sample is 19,930 km, which corresponds to the distance

[11] Recall that our casualty measure for war sites is compiled based on specific battles and, therefore, likely understates the actual number of casualties.

Table 1: Categories of war sites

	Casualties		Length		Wars	Macro time-series for...	
Severity	Min.	Mean	Mean	Median	Total	Home	Foreign
All sites	46	184,357	2.6	2.0	176	66	2,786
Large sites	10,000	334,920	3.3	2.0	96	38	1,798
Major sites	105,525	658,323	4.4	4.0	46	21	1,026

Notes: Table shows different war-site samples according to casualty thresholds. Mininum casualties denotes war site with lowest number of casualties in sample. Length denotes duration in years for wars in our sample. Home (Foreign) are observations for when a war starts in the war site (abroad), provided macro time series are available. Large sites restrict sample to those sites with casualties $\geq$ 10k, major sites to those with casualties $\geq$ 100k.

between Bolivia and Taiwan during the 1932 Chaco war. During war times, the mean distance from war, measured in relation to the closest war site, is 6,691 kilometers.

2.2 The casus belli: a narrative classification

In our analysis below, we seek to identify the macroeconomic effect of wars at a business cycle frequency. For this purpose, we assume that wars are largely exogenous to the business cycle. A similar assumption is typically invoked for military spending in the literature on the fiscal transmission mechanism (see, for instance, Barro and Redlick, 2011; Ramey, 2011; Miyamoto, Nguyen and Sheremirov, 2019). It is also consistent with theories in political science which discuss the causes of war in terms of power struggle or power transition (for instance, Organski and Kugler, 1980; Lebow, 2010). The business cycle does not feature in these accounts. However, there is evidence for the U.S., specifically that U.S. presidents have been more likely to deploy military force in times of “economic misery” (Ostrom and Job, 1986) and during recessions provided they were up for reelection (Hess and Orphanides, 1995), notably in the post-WW2 period. For the purposes of our exercise, however, we may disregard this evidence because the U.S. never became a war site during this period. Still, we need to consider the possibility of short-term cyclical considerations driving decisions to go to war and investigate how representative the apparent U.S. evidence may be. To this end, we use narrative records to classify the apparent *casus belli* for the wars in our full sample.

For the classification of wars, we rely on the warfare encyclopedia by Clodfelter (2017) and numerous other sources for cross-checks. A detailed overview of the different sources used for the casus belli identification is provided in Table D1 in the Appendix. Countries go to war for a variety of reasons, and we do not restrict them to be mutually exclusive. As we try to determine the reasons for going to war, our reading of the historical records results in an average of two main reasons per war. These may include, inter alia, nationalism, ideological differences, or power transitions. Table 2 lists the results of our classification based on eight distinct categories. In the right-most column, we report the number of wars which fall into each category.

Table 2: Reasons for going to war

Reason	Explanation	# Wars
Nationalism	Creation of own sovereign state, wars for independence, imperialism	46
Power Transition or Security Dillemma	A rising power challenges a dominant one. Moreover, the arms races leading up to these wars are classic examples of the security dilemma in action, where measures taken by one country to increase its security lead others to feel less secure and to take countermeasures, resulting in increased tensions that can lead to war.	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	States might go to war to gain control over trade routes, markets, or valuable resources; economic rivalry and protectionism	10
Domestic Politics	Leaders may use foreign war to distract from domestic political 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	The economy is in a severe recession (e.g., unemployment is high)	2

Notes: Table shows different reasons for going to war across wars in our full sample. Some wars have multiple causes, which is why sum of war reasons in table exceeds total number of wars in our sample. Reasons were identified using various sources; see Table D1 in the appendix.

Nationalism and power transitions rank among the top reasons for going to war. Importantly, although we find that countries also pursued economic objectives in several wars, these pertain mostly to long-run outcomes, such as gaining control over trade routes or securing natural resources. Such long-run objectives should be largely orthogonal to the business cycle, as has been similarly argued in the influential study on the effects of tax shocks by Romer and Romer (2010). In our sample, we identify only two wars in which short-term economic factors seem to have played a key role. These are the Boxer Rebellion of 1900 and the Italo-Turkish War of 1911. In the first case, religion and nationalism were key aspects, but so were adverse economic conditions. Likewise, in the second case, nationalism or, more specifically, colonialism was key. However, dire economic conditions in Italy, as reflected in mass emigration in the decade prior to the war, were arguably also conducive to the war. Hence, we drop both of these wars from our sample.

2.3 Economic performance of countries around wars

Turning to countries' economic performance in the context of wars, we benchmark growth and inflation during wars against normal times, based on two distinct concepts: the *gap to country norm* and the *gap to global norm*, measured, respectively, as the difference to a country's own average performance over time and to the cross-sectional average during the period under consideration. We do this both for the full sample and for the sample of large wars (casualties exceed 10k). Figure 3 shows the annualized growth rate of output (left panel) and the average inflation rate (right panel) over a period of five years following the start of the war.

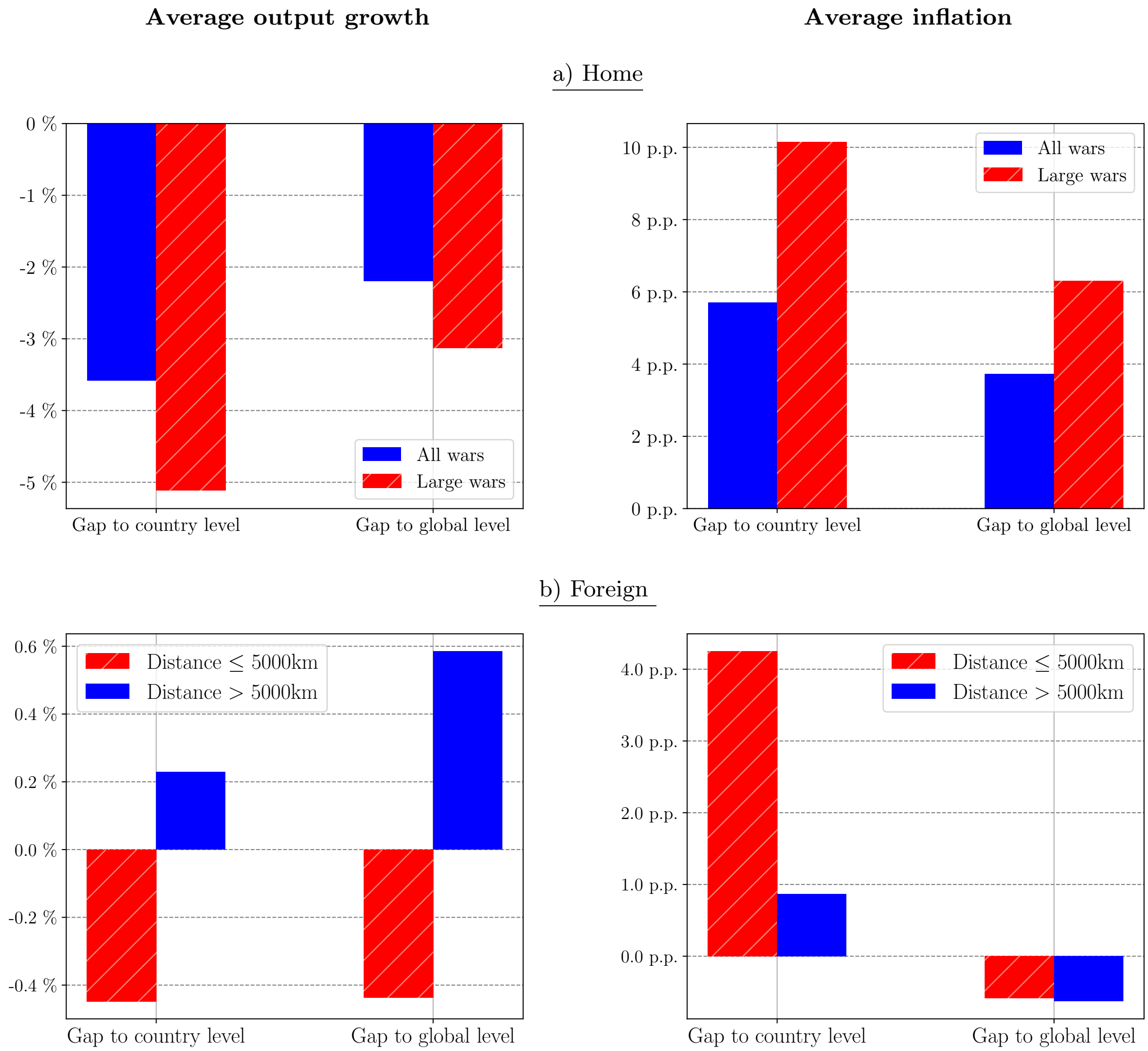
The top panel a) reports the values for Home (the war-site economy). Independently of the specific measure, we find a sizeable shortfall in economic growth. For all wars, average growth is 3.5 percentage points below the total sample average of the country's growth rate and about 2 percentage points below the contemporaneous global average. For large wars, the average annual growth shortfall is even more pronounced, with a 5 percentage-point gap against the country-level benchmark and a 3 percentage-point gap against the global-level benchmark. The difference between the measured gaps at the country and global level is consistent with the notion that the negative economic impact of the war is not confined to the war site.

Turning to the top-right panel of Figure 3, we observe that wars are associated with sustained levels of excess inflation. During wars, Home experiences an annualized excess inflation of about 6 and 10 percentage points, for all and large wars, respectively (gap to country level). Again, the effect is somewhat attenuated, with an annualized excess inflation of between 4 and 6 percentage points, when we benchmark average annual inflation in Home against the global level.

The bottom panel of Figure 3 shows output growth and inflation in Foreign, now limiting ourselves to large wars only. As before, we benchmark growth and inflation against the historical average and the cross section. To address the relevance of geographic distance, we distinguish between countries that are closer to the war site (within about 5,000 kilometers of the war, corresponding to the 25% quantile of bilateral country distances in our sample) and countries that are farther away (the remaining countries). It turns out that this distinction matters: There are large and robust differences in economic performance. Output growth declines in the wake of wars only in countries that are close to the war site, and it increases if the wars are fought far away. Similarly, inflation rises above a country's own average only in countries close to war sites. A similar picture emerges if we consider the full sample of wars, see Figure C1 in the appendix. Note that this pattern is suggestive of the main result that we establish more systematically below: the economic spillovers of war critically depend on geographic distance from the war site.

In the next section, we formally analyze the macroeconomic consequences of war. For this purpose, it is interesting to assess whether economic performance prior to the war suggests the presence of anticipation effects. To assess this possibility, we compute the annual gap vs the country norm for

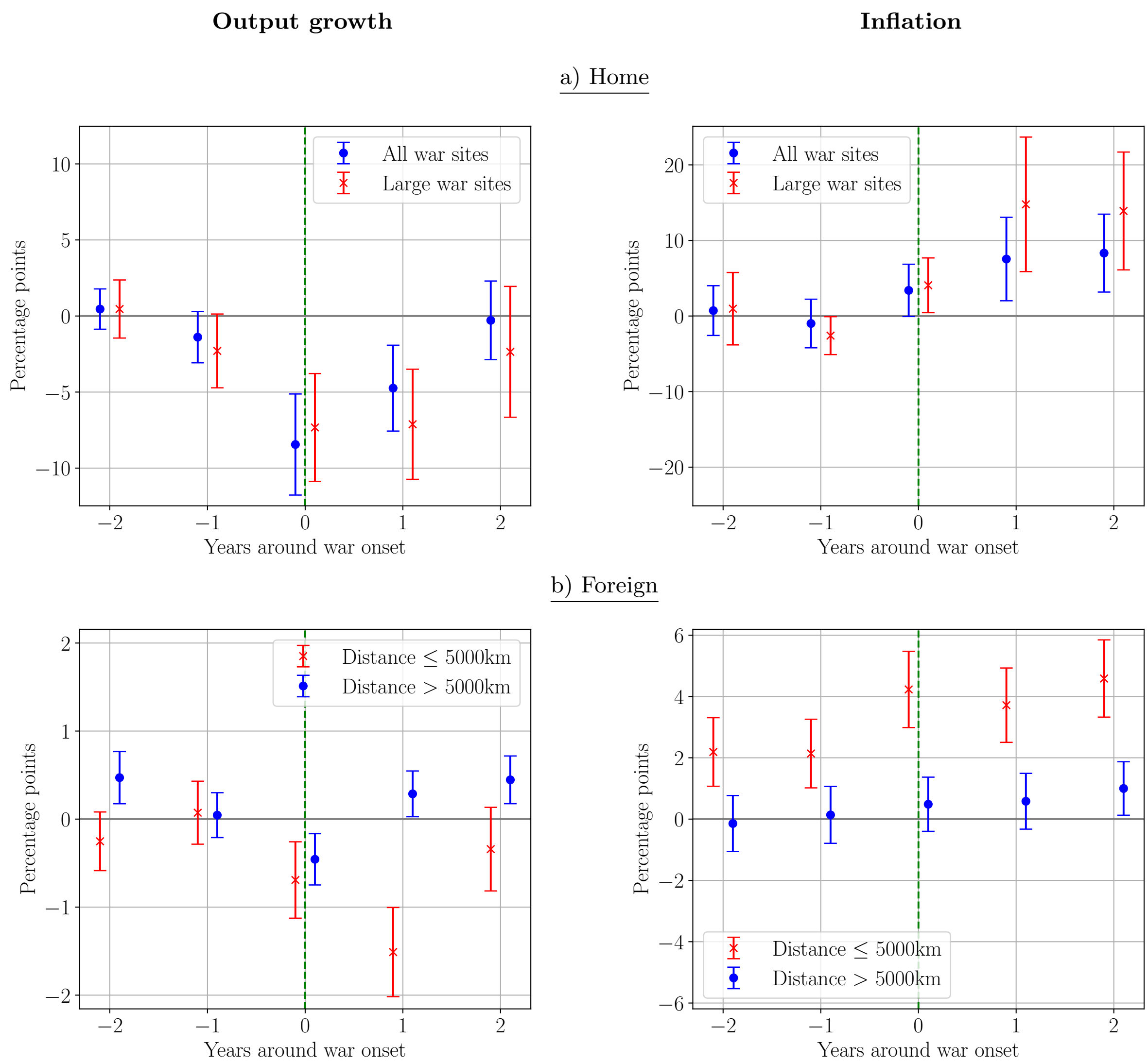
Figure 3: Macroeconomic performance after start of wars



Notes: Output growth and inflation are annualized and measured relative to historical country norm (left bars) and contemporaneous cross-sectional norm (right bars) and expressed as average annual value over 5 years following the start of the war. Top panel shows numbers for war in Home. Bottom panel shows effects on 25% of countries closest to war according to in-sample distances (corresponding to a radius of about 5,000km around war sites) and other countries. Sample: Large wars 1870–2022, unless specified otherwise.

output growth and inflation in a five-year window centered around the start of the war. The results are depicted in Figure 4 with the top panels showing results for Home, both for the full sample (blue) and the sample of large wars (red). Overall, there is not much evidence for anticipation effects. Output growth drops strongly in the year when the war starts and remains low afterward. Excess inflation, in turn, is moderate at the beginning of the war but rises substantially in the first year after the start of the war. The bottom panel of the figure shows the economic performance

Figure 4: Economic performance around start of war



Notes: Output growth and inflation are annualized and measured relative to historical average. Left panel shows annualized output growth measured relative to country norm. Right panel measures inflation relative to country norm. Top panel shows numbers for war in Home. Bottom panel shows effects on 25% of countries closest to war according to in-sample distances (corresponding to a radius of about 5,000km around war sites) and other countries. Sample period: Large wars 1870–2022, unless specified otherwise.

in Foreign, again differentiating between countries closer to the war site (red) and more faraway countries (blue). Here, the picture is somewhat more mixed. Generally, there are no anticipation effects, but inflation is somewhat higher prior to wars in countries closer to the war site.

3 The macroeconomic consequences of war

In this section, we establish and contrast the effects of war in Home and Foreign. We first introduce our empirical framework and then present the results for a number of specifications.

3.1 Empirical framework

We take a business cycle perspective and focus mostly on how war affects output and inflation. In terms of identification, we rely on the notion—established via narrative analysis—that the wars in our sample are largely exogenous to the business cycle, see Section 2.2 above. Importantly, we seek to identify the effect of the *start* of the war and how this effect plays out over time. In this context, we think of the onset of war as a *shock* to the economy. Recall from Section 2.3 that there is indeed little evidence that wars are anticipated via early moves in either growth or inflation. By focusing on the dynamic effects of (or impulse responses to) the initial war shock, we do not rule out possible feedback effects from the macroeconomic consequences of the war to the ability of the warring parties to mobilize the necessary resources to keep the war going. Similarly, we do not rule out that war alters long-term economic prospects. Our identification strategy only requires the start of war to be exogenous to the business cycle of the war-site economy.[12]

Based on these considerations, we estimate a set of local projections to trace out the macroeconomic effects of war over time. Formally, using i to index countries and h the number of years since the start of the war in year t, we let $x_{i,t+h}$ denote the response of a generic outcome variable to the war and estimate the following linear specification:

$$x_{i,t+h} - x_{i,t-1} = \alpha_{i,h} + \gamma_h Home_{i,t} + \psi_h Foreign_{i,t} + \zeta_h Controls_{i,t} + u_{i,t+h} \, . \tag{3.1}$$

Here $\alpha_{i,h}$ captures country fixed effects. $Home_{i,t}$ and $Foreign_{i,t}$ are dummy variables that assume a value of one if the domestic economy or (at least) one foreign economy is turned into a war site in year t, respectively. We assign a value of one in the year in which the war starts and zero later. $Home_{i,t}$ and $Foreign_{i,t}$ are not mutually exclusive because several wars may take place at the same time: A country may become a war site and, at the same time, be exposed to spillovers from another war: Our specification does not rule out this possibility but merely imposes the domestic effects and the spillovers from foreign wars to be additively separable. However, we set $Foreign_{i,t}$ to zero whenever a country is itself a war site in the *same war* at any point in time.[13]

[12] This assumption does not conflict with the evidence put forward by Ostrom and Job (1986) and Hess and Orphanides (1995) for the U.S. since it has never been a war site in the post-WW2 period on which this evidence is based.

[13] In this way we seek to distinguish sharply between the war-site economy and the other countries exposed to a given war. As a practical matter, however, results do not change much if we allow countries to be simultaneously exposed to a domestic war and to the spillovers from other war sites of the same war. Results are available on request.

Specification (3.1) allows us to capture the dynamic effects of a war that starts in period t. The parameters γ_h and ψ_h provide an estimate for the effect in Home and Foreign in year h after the start of the *average* (large) war in our sample. Note also that our specification is agnostic about the duration of the war: It recovers the average effect over time of a war which starts in year t, that is, from year t to year $t+h$. $u_{i,t+h}$ denotes the error term. The set of controls includes four lags of both the dependent variable and the regressors. The dependent variable is specified in differences relative to the pre-war level to account for the possibility that wars have permanent effects on the outcome variables (Stock and Watson, 2018). We also verify that our results are robust if, instead, we exclude this possibility.

While the distinction between Home and Foreign is central to our analysis, so too is the notion that the economic spillovers on Foreign may vary in its distance from the war site. To account for this possibility, we depart from the linear model (3.1) and allow spillovers to differ depending on the distance from the war site in a non-linear way. In what follows we put forward the following smooth-transition model as our "baseline specification:"

$$\begin{aligned} x_{i,t+h} - x_{i,t-1} = \alpha_{i,h} + \gamma_h Home_{i,t} + \psi_{D,h} F(i,t) Foreign_{i,t} + \psi_{N,h} \left[1 - F(i,t)\right] Foreign_{i,t} \\ + \zeta_h Controls_{i,t} + u_{i,t+h} \,. \end{aligned} \tag{3.2}$$

Here the response of the outcome variable may differ at each horizon h across regimes "D" (Distant) and "N" (Nearby), with the ψ-coefficients indexed accordingly. Observations are assigned to these regimes based on the transition function $F(i,t)$. As in Born, Müller and Pfeifer (2020) we use an in-sample criterion to determine this function. Specifically, for each country-year observation, we determine the relative distance to the foreign war site in logs, such that:

$$0 \leq F(i,t) = \frac{\ln(1 + d_{i,t})}{\ln(1 + d^{max})} \leq 1. \tag{3.3}$$

Here $d_{i,t}$ is the distance of the geographically closest war site to country i, measured in thousand kilometers while d^{max} is the maximum distance of a war site from Foreign in our sample.

Wars differ in many dimensions and our baseline specification does not attempt to account for these. Rather, it provides estimates for the effects of the average war in the sample in order to highlight the role of geographic distance for the economic spillovers of war. Still, the economic size of the war site is bound to have a first-order effect on these spillovers, too. If, all else equal, a war site is small, we expect smaller spillovers than in case it is a large economy. Given this argument, we also consider a variation to our baseline specification in which we replace the dummy variable from (3.2) with the economic weight of the war site as a quantitative shock measure. Specifically, we set

$$Foreign_{i,t} = \sum_{j \in J_{i,t}} \frac{GDP_{j,t-1}}{GDP_{world,t-1}}, \tag{3.4}$$

where $J_{i,t}$ is the set of all countries that become war sites of a foreign war in year t.[14] $Foreign_{i,t}$ then captures the aggregate pre-war share in world GDP of the countries that turn into war sites in year t. We adjust our distance measure accordingly and define it as the GDP-weighted average distance from all foreign war-site economies in year t:

$$F(i,t) = \sum_{j \in J_t} \frac{GDP_{j,t-1}}{\sum_{k \in J_t} GDP_{k,t-1}} \left[\frac{\ln(1 + d_{i,j})}{\ln(1 + d^{max})} \right], \tag{3.5}$$

where $d_{i,j}$ is the distance between country i and war site j. Below we refer to this variant of the baseline as the "size specification."

In our analysis, we allow economic spillovers of war to depend on geographic distance. Ultimately, we think of these spillovers as reflecting the extent of economic integration across countries, very much in the spirit of the gravity equation (Head and Mayer, 2014). To assess this hypothesis, we replace, in a second variation of our baseline specification (3.2), the transition function with a measure of economic integration based on the relative importance of trading partners, as measured by imports. Specifically, we replace the transition function (3.3) with a measure of "trade distance":

$$0 \leq F(i,t) = 1 - \sum_{j \in J_t} \frac{imports_{j \to i,t-1}}{imports_{i,t-1}} \leq 1. \tag{3.6}$$

Here $imports_{j \to i,t-1}$ are imports of country i from war site j in the year prior to the war. We scale these with the total imports of country i and sum over all war sites.[15] At its maximum value of 1, $F(i,t)$ indicates that there is virtually no trade with the war site, just like $F(i,t) = 1$ reflects a maximum distance in the baseline.[16]

3.2 Results

We now turn to our main results. They are based on our sample of annual observations for the period 1870–2022. In what follows we consider only large war sites, that is, war sites where casualties exceed 10k; results for alternative specifications are reported in Section 3.3. We estimate the responses of two outcome variables, $x_{i,t}$, in Home and Foreign: the log of real GDP, after the removal of a linear country-specific time trend prior to the estimation, and inflation, measured in terms of consumer price indices. The samples on which the regressions are estimated comprise up to 7,500 country-year observations.

[14] A foreign war, from country i's perspective, is a war in which country i never becomes a war site itself.

[15] Relative importance of trading partners is winsorized at the 99% level to account for varying coverage over time and across country-pairs.

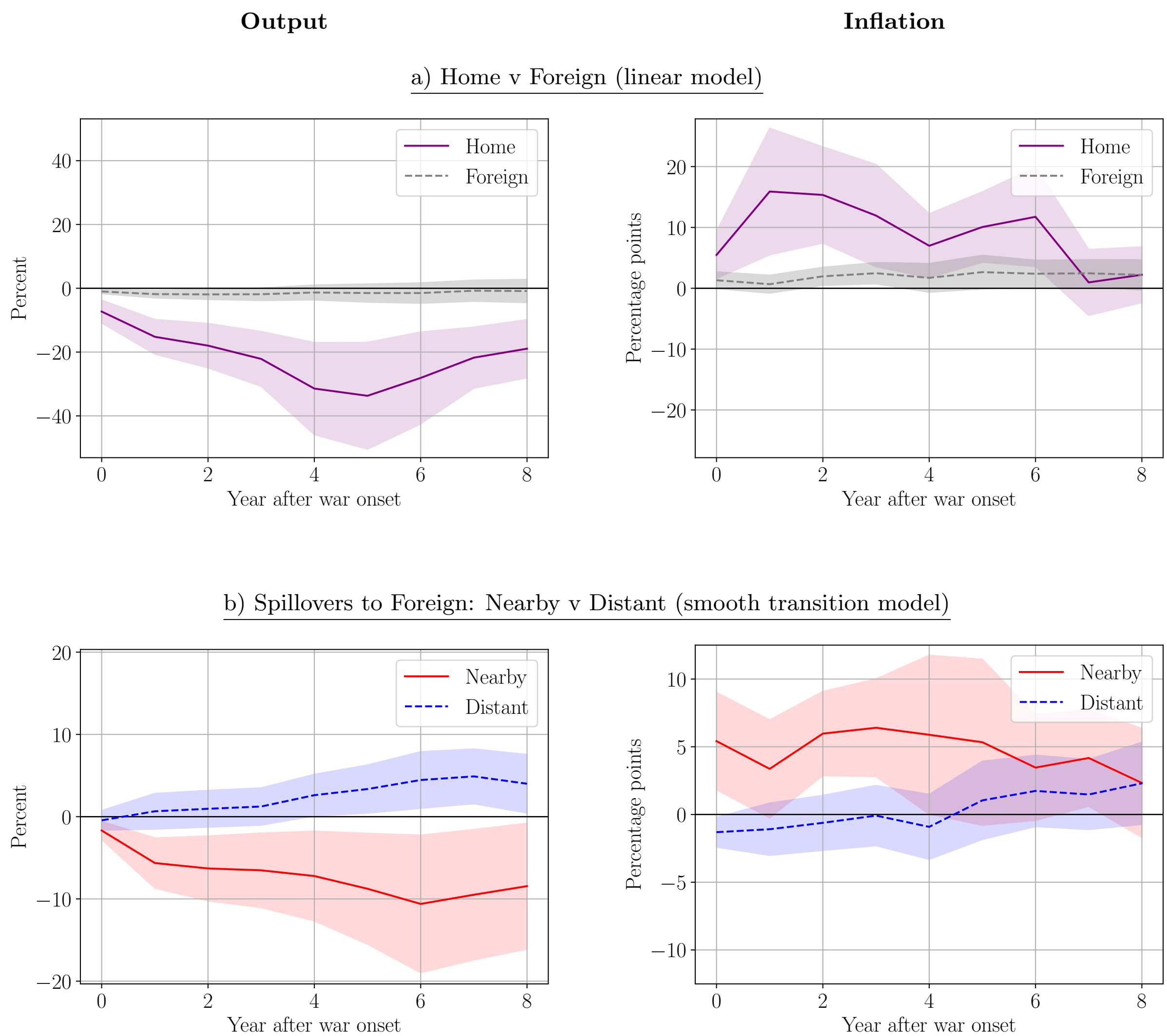
[16] We show the cumulative distribution functions for the three different transition functions in Figure A1 in the appendix. Both the baseline specification and the size specification are approximately uniformly distributed. For the distribution of trade distance, we find that only a few countries exhibit very high trade exposure to the war site.

Figure 5 shows the estimated impulse responses, tracing the macroeconomic consequences of war over time, beginning with the start of the war ($h = 0$). In each panel, the horizontal axis measures time in years. In the left panels, we measure the percentage deviation of (detrended) output from its pre-war level against the vertical axis. In the right panels, we measure the effect of wars on inflation in percentage-point deviations from the pre-war inflation rate norm. In the top panels, we show results for the linear specification (3.1). The solid purple line shows the response for Home, and the dashed black line the estimated spillovers to Foreign. Here, and in what follows, shaded areas indicate 90% confidence intervals, computed using standard errors that are robust with respect to heteroskedasticity as well as serial and cross-sectional correlation (Driscoll and Kraay, 1998).

We observe that the adverse effect in Home is particularly strong and gets stronger over time, reaching a maximum effect some five years after impact. At this point, the war has reduced output in Home by about 30 percent, consistent with the shortfall in growth that we documented for war-site economies in Section 2.3 above. What's more, the subsequent recovery is rather slow. In year $h = 8$, output is still reduced by about 20 percent, and even after 16 years the recovery is incomplete, as Figure C2 in the appendix shows. This is also noteworthy in light of the fact that the mean (median) duration of large wars is 3.3 (2) years. Clearly, based on our estimates, we cannot rule out that war has a permanent effect in Home. Turning to the top-right panel of Figure 5, we also observe a strong inflationary impact: Inflation increases for several years following the start of the war, exceeding its pre-war rate by up to 15 percentage points. It converges back to the pre-war norm only after six to seven years. Again, these patterns are consistent with the extent of excess inflation that we have documented for war periods in Section 2.3 above.

The top panels of the figure also show that, *on average*, there are virtually no spillovers to Foreign. The dashed black line is no different from zero, not for output (left) and barely for inflation (right). However, this average effect masks sizeable heterogeneity across countries. To see this, consider the bottom panels of Figure 5, which show results for Specification (3.2), allowing the spillovers of war to vary with the distance of Foreign from the war site. In the panels, the solid red line corresponds to regime N, showing the spillovers to foreign countries that are direct neighbors to the war, or Nearby. Technically, we define this nearby case as representing zero distance between a war site and a foreign country. The dashed blue line, in turn, corresponds to regime D, representing the spillovers to a distant country, meaning the maximum possible distance from the war site in our sample. The difference across these scenarios is stark, and it bears noting that actual effects fit somewhere in between these two limiting cases. Output declines on impact and persistently so in nearby economies. Five years after the onset of war, output is reduced by some 10 percent compared to the pre-war level. At the same time, inflation increases considerably, matching the shape of the impulse response in Home. Roughly speaking, we find that the output loss and the inflation increase in Nearby are about one-third of what we find for Home. For Distant, an altogether different pattern of spillovers emerges: output rises moderately and in a statistically significant manner, while inflation does not respond significantly.

Figure 5: The macroeconomic impact of war



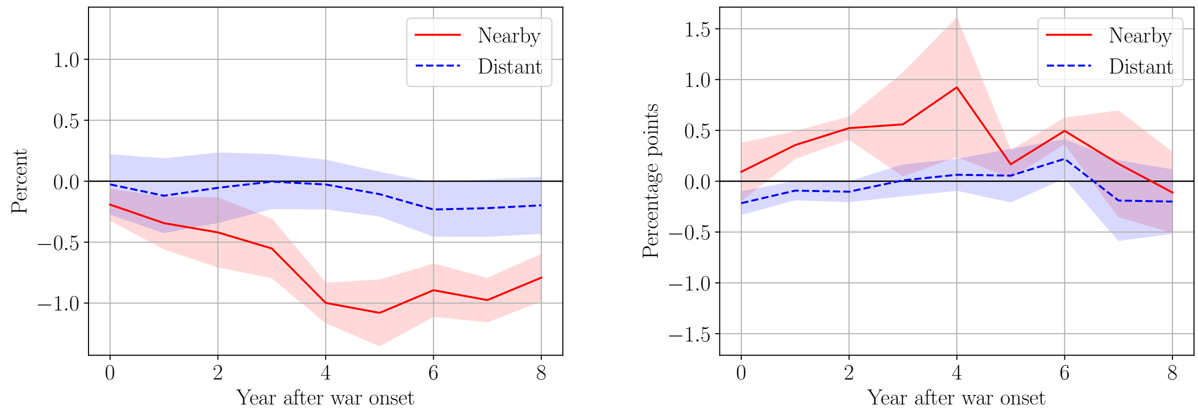
Notes: Left panels show percentage deviation of (detrended) output from pre-war level, right panels show deviation of inflation from pre-war rate in percentage points. Horizontal axis measures time in years since start of the war. Sample 1870–2022, large war sites (casualties > 10k). Top panel a) shows results for linear specification (3.1). Bottom panel b) shows response for smooth-transition specification (3.2). Shaded areas indicate 90% confidence bands.

Figure 6 shows the results for alternative specifications. Both panels are organized in the same way as the bottom panel of Figure 5 and show the spillovers of war to Foreign—distinguishing again the effects between Nearby and Distant. In the top panel a) we show results for the size specification. Specifically, in the estimation we now account for the economic size of the war site, using the measure given in equation (3.4). We then normalize the size of the war shock to be equal to one percent of world GDP. At the same time, we adjust the distance measure to reflect the GDP-weighted average distance from foreign war sites as specified in equation (3.5). While

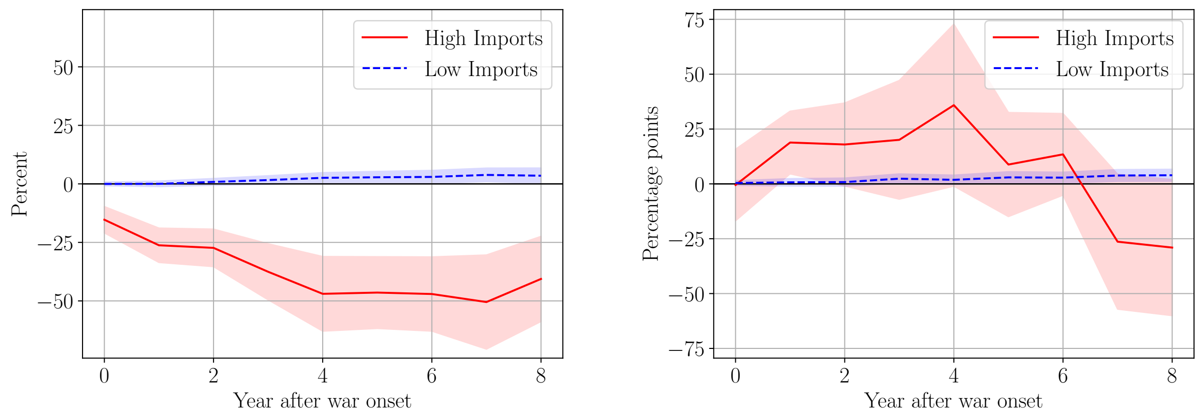
Figure 6: Alternative shock and distance measures

Output **Inflation**

a) Shock size: war-site accounts for 1% percent of world GDP



b) Accounting for trade exposure to war site



Notes: Left panels show percentage deviation of (detrended) output from its pre-war level, right panels show deviation of inflation from pre-war rate in percentage points. Horizontal axis measures time in years since start of the war. Top panels show results for size specification defined in equations (3.4) and (3.5). Bottom panels show response for trade-distance specification defined in equation (3.6). Shaded areas indicate 90% confidence bands. Sample 1870–2022, large war sites (casualties > 10k).

the effects shown in the figure are an order of magnitude smaller than those shown in Figure 5 above, the general pattern is the same, except that we no longer observe positive output spillovers to distant countries. Note also that the average size of war sites in our sample is about 6 percent of world GDP. If we amplify the responses in the top panel of Figure 6 with a factor of 6, we obtain results that are in the same ballpark as those for the baseline. Any remaining discrepancies are likely to reflect differences in the sample.[17]

[17]The size specification is more demanding in that it requires information on the economic size of the war site,

In the bottom panels of Figure 6 we show results that are based on trade distance as specified by equation (3.6), rather than geographic distance. Again, we obtain the familiar pattern. Spillovers are large in Nearby ("High imports"), as indicated by the solid red line. The difference relative to the earlier result is that Nearby is now defined in terms of the share of imports from the war site, that is, trade integration. Our nearby scenario is quite extreme: it assumes that a country imports only from the war site. Perhaps unsurprisingly, spillovers are massive in this case. In the opposite case where there are no imports from the war site at all—the hypothetical scenario indicated by the dashed blue line—the output spillovers are positive, as in our baseline specification above. Likewise, we observe very large inflation spillovers in the nearby scenario, and only small ones if the war is very distant in terms of trade relations.

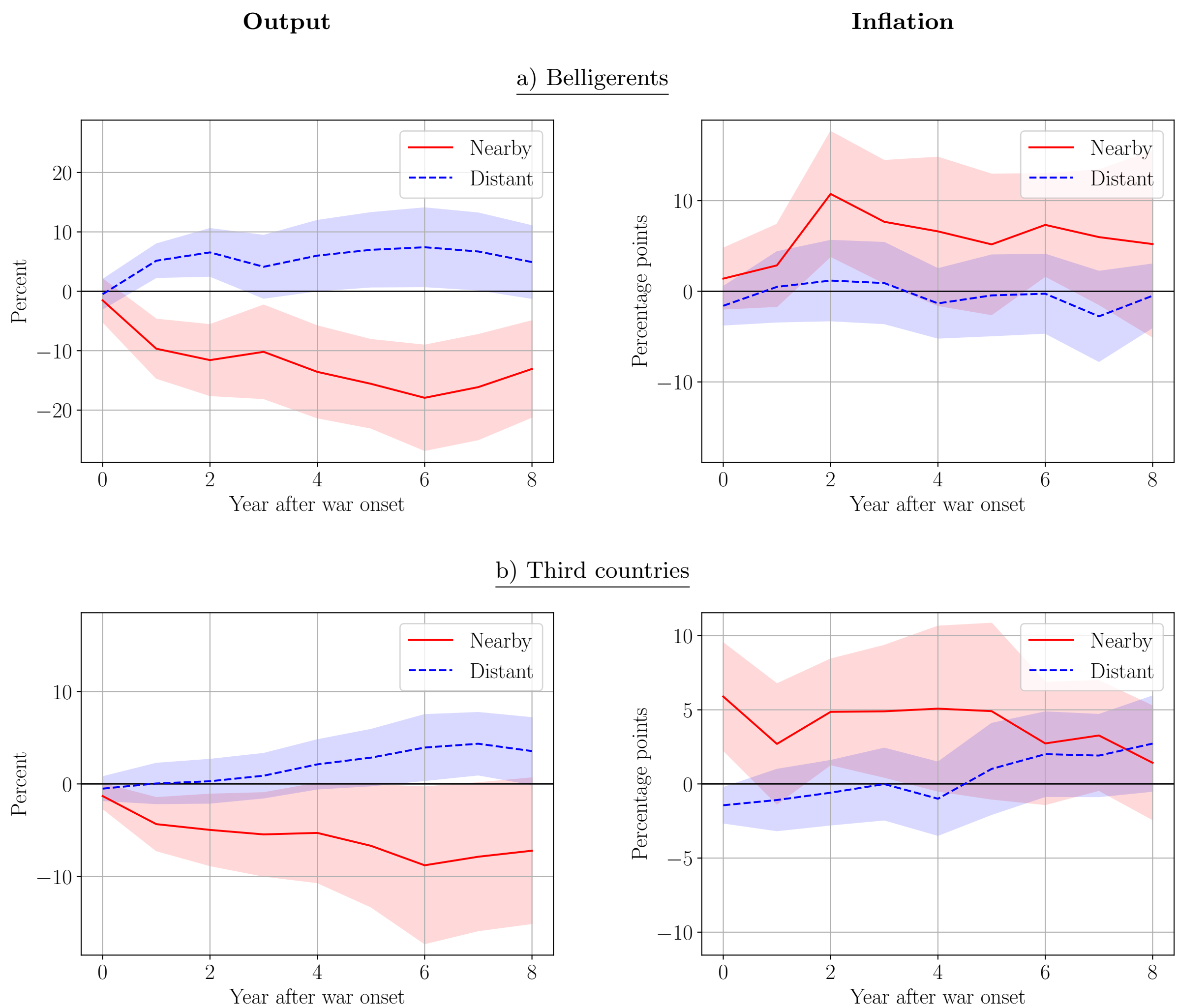
The estimates reported so far focus on geography and/or trade exposure as a key determinant of the spillovers from the war site. When it comes to Foreign, they do not distinguish between belligerent countries and third countries that are not parties to the war. We now assess whether this distinction matters for how spillovers play out and split the sample accordingly: Of the 1,798 country-year observations that capture foreign countries' exposure to war sites, 152 qualify as belligerent according to CoW. We revisit the unconditional projections and find that results are almost identical for belligerents and third countries, and thus in each case comparable to what we show for Foreign in panel a) of Figure 5 above: For the average foreign country—belligerent or not—there is not much of an effect on inflation and output, see Figure B1 in the appendix.[18]

We also estimate a version of our baseline specification (3.2) while allowing the effects of distance to differ for belligerents and third countries. Figure 7 shows the results for output and inflation for both country groups. The figure shows that—by and large—the effects are similar for belligerents (top) and third countries (bottom). For both country groups, we find strongly negative output spillovers in Nearby and mildly positive output spillovers in Distant (left column), matching the evidence for the whole sample, see again panel b) of Figure 5 above. And while the responses of belligerents are somewhat stronger (top panel), the first-order effect of geography dominates, with a change of sign in the spillovers as we move from Nearby to Distant. Similarly, the pattern of the inflation response, shown in the right column of the figure, is somewhat amplified as we zoom in on the belligerents, but does not change fundamentally. An implication of this finding is that participation in the war as such does not explain the spillovers from the war site.

which the baseline does not. As a result, our sample shrinks to 961 country-year observations for Foreign.

[18]In disentangling these effects we replace the Foreign dummy in equations (3.1) and (3.2) with two new dummies indicating whether the countries are belligerents or third parties in relation to a war which started in a given year, respectively.

Figure 7: Belligerents v third countries



Notes: Left panels show percentage deviation of (detrended) output from pre-war level, right panels show deviation of inflation from pre-war rate in percentage points. Horizontal axis measures time in years since start of the war. Top panels show how geography shapes response of belligerents. Bottom panels show how geography shapes response of third countries. Shaded areas indicate 90% confidence bands. Sample 1870–2022, large war sites (casualties > 10k).

3.3 Further evidence and robustness

In the first part of this section, we present evidence on the adjustment of additional outcome variables in an effort to shed some light on the transmission mechanism.[19] This evidence provides guidance for our modeling efforts in Section 4 below. Furthermore, we establish that our main results are robust across a number of alternative specifications.

[19]Since the outcome variables are gathered from different sources, their availability differs from that in our baseline sample. Thus, the samples used for the estimations vary from those in our baseline.

We begin by looking at government expenditures which have been shown to increase strongly during wars (Barro, 1987; Ramey, 2011). Given the context of our analysis, we simply estimate specifications (3.1) and (3.2) but consider military expenditures, measured in percentage points of pre-war GDP, as the outcome variable.[20] As above, these results are based on large wars (with casualties in excess of 10k). We find that during the average large war, military spending increases by about 10 percentage points, with a maximum effect four years from the start of the war. Importantly, military spending increases not only in the war site, but also in Nearby (by approximately 5 percentage points) and even in Distant, although in this case the effect is more delayed and less pronounced. In Distant, military spending increases on average by about 2.5 percentage points over the 8 years after the war onset, but the effect is back-loaded. To economize on space, we show these results in Figure B2 of the appendix. Note that both nearby and distant countries include belligerent countries. The results remain fairly similar across the two groups, although—quite plausibly—the effects for belligerents again look somewhat stronger and are also somewhat less delayed, see Figure B2.

Consistent with the increase in military spending during wars, we find that the fraction of the population employed in the military increases significantly. Again, the effect is strongest for the war sites, where the share of people employed in the military increases by 2 percentage points, measured in terms of the pre-war population. In nearby countries, it increases by about 1 percent. There is no significant response in distant countries, see Figure B3. We further find unemployment to briefly rise by close to 2 percentage points on impact in the war site, before decreasing by a cumulative 5 percentage points thereafter. Unemployment in Nearby and Distant is hardly affected, see Figure B4. The sample, however, only covers unemployment rates for 18 countries and therefore differs substantially from the baseline sample. In terms of total population, we find a moderate impact of wars, which also takes more time to materialize, see Figure B5. The population of the war site shrinks somewhat, with maximum effect of about 3 percent seven years after the start of the war. The effects in Foreign are not significant, neither in Nearby nor in Distant. In sum, while the apparent population dynamics may point to some migration flows in response to large wars, from a quantitative point of view these flows are unlikely to be a key driver of the economic spillovers we observe in the data. That said, a more systematic analysis of migration flows in the context of wars, based on more granular data than we have available, could be an important avenue for future research.

Another salient feature of war sites is physical destruction. Accordingly, we measure the response of the capital stock to the onset of large wars. This response is very strong and persistent for war sites, where the capital stock declines by some 20 percent within the eight years following the start of a war, see Figure B6. There is also evidence for spillovers along this dimension: in Nearby, the

[20] We obtain measures of military expenditures from the COW database, which relies on country codes referencing historical borders and states. These have been translated manually to ISO codes referring to countries in today's borders, which may result in minor inconsistencies within the data and in comparison to the main analysis above.

capital stock declines by more than 5 percent. This suggests that the decline of the capital stock not only reflects physical destruction but also an endogenous response to changes in the economy during war times, an issue we take up in our model analysis below. To inform this analysis further, we also estimate the response of total factor productivity. We find that TFP in Home responds strongly and quickly to the war. After two years, TFP is down by some 20 percent. This effect lasts for more than four years into the war. Only afterward do we observe some recovery. For nearby countries, there is also a decline, but the effect is only marginally significant, see Figure B7. This pattern is consistent with the notion that a shift of employment to the military sector lowers the productive capacity of the economy, as substantiated in the classic study of Ramey and Shapiro (1998). They put forward a neoclasscial two-sector model and study military buildups as well as estimates for specific episodes in the U.S. post-WW2 period. They find that labor productivity declines in response to the build-up (which, in their model analysis implies that capital in the civilian sector becomes idle) and provide supporting evidence based on data for the manufacturing sector.

In what follows, we explore the robustness of our results along a number of dimensions. First, we conduct several additional tests with regard to how the economic effects of war play out over time. For instance, we consider longer horizons and document that even 16 years after the onset, the adverse effects of war have not been completely reversed in Home, see Figure C2 in the appendix. We also verify that results are robust to expressing the dependent variables in levels (rather than in changes relative to the pre-war period). The resulting projections differ only marginally from our baseline results, see Figure C3 in the appendix. Lastly, we conduct a series of tests where we condition the sample of war sites on the duration of the wars. This involves producing two separate sets of projections: one for a sample of wars with a duration below or equal to the median duration of wars in the entire sample, corresponding to two years or less; and one for the sample of wars that last more than two years. Across both sets, we observe that our results do not change significantly. Even short wars with a duration of at most two years have a sizeable effect on output and inflation similar to what we find for the baseline, and the effect is still manifest some eight years after the beginning of the (short) war, see Figures C4 and C5 in the appendix.

Second, we explore to what extent our results are driven by the two largest wars in our sample, World Wars I and II. We do so by estimating our baseline specification on a sample from which we drop observations for the World Wars. Unsurprisingly, we find that the impact of war is somewhat weaker compared to the baseline, but the overall pattern is very much the same, see Figure C6 in the appendix. We conclude that the World Wars help to identify the economic impact of war, as one would have expected, but the apparent empirical pattern does not hinge on them. Likewise, we verify that the distinct effects in distant countries are not driven by the U.S. For this purpose, we exclude the U.S. from our panel and re-estimate our baseline projection for nearby and distant countries. We find that results are virtually unchanged, see Figure C7 in the appendix.

Third, we re-estimate our specification now including all wars and not only large wars, for which casualties exceed 10k. The estimated effects are smaller, which confirms that the size of military conflict matters, but they still mirror the findings from our baseline: wars are associated with a considerable shortfall in output and excess inflation in Home. Both effects spill over to nearby countries. By contrast, distant countries exhibit a mild increase in output, see Figure C8 in the appendix. In a similar vein, we re-estimate our baseline specification for the sample of major war sites with more than 100k casualties. The results are consistent with the notion of greater material destruction leading to more pronounced economic effects, see Figure C9 in the appendix.

In light of these results, we examine more systematically how a war's severity—as reflected in our casualties measure—shapes its economic spillovers. Thus, we estimate a variant of specification (3.2) which differs from the baseline in several respects. First, we expand our sample to include all wars, without any restrictions regarding the number of casualties. Second, we consider only spillover effects on countries located within 5,000 km of the war site and redefine variable $Foreign_{i,t}$ to take on the value of 1 in this case only. Third, we modify the transition function in the following way:

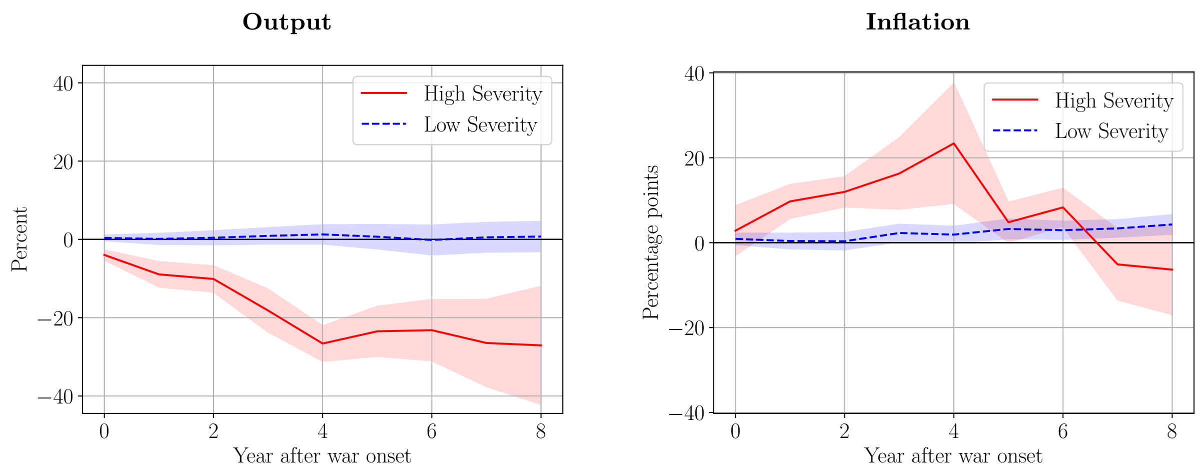
$$F(i,t) = \frac{casualties_{i,t}}{\max casualties_{i,t}}. \tag{3.7}$$

Here $casualties_{i,t}$ is the average number of casualties per war site for which country i is nearby (less than 5,000 km away) in year t and $\max casualties_{i,t}$ is the maximum exposure in terms of war severity in the sample. Thus, the transition function takes on the value of 0 if there is no war going on in the neighborhood of country i and the value of 1 for the country that was exposed to the most battle deaths in its neighborhood throughout the whole sample.

Figure 8 shows results for this modified specification. We find the severity of wars to be a significant determinant of spillovers to nearby countries. Notably, the effects for the "low severity" group are negligible for both output and inflation. At the other end of the spectrum, we find the spillovers of the most severe wars to be very large. Countries located in the neighborhood of such a severe war see their output declining by some 40 percent relative to trend, while inflation rises by about 20 percentage points for an extended period.

As an additional variation, we consider casualties as a measure to quantify the size of the war shock, rather than the economic size of the war site. Specifically, we depart from our size specification as specified in equations (3.4) and (3.5) and replace the GDP of foreign war countries with the casualties measure and scale it by world population. In this way, we seek to capture the size as well as the intensity of the war. It turns out that the results show the familiar pattern under this specification, as well; see Figure C10.

Figure 8: Spillovers from foreign nearby war by severity



Notes: Left panels show percentage deviation of (detrended) output from its pre-war level, right panels show deviation of inflation from pre-war rate in percentage points. Horizontal axis measures time in years since start of the war. Smooth-transition specification is weighted by severity of foreign war.

4 Structural interpretation

We now employ an international business cycle model to offer a structural interpretation of the evidence presented so far. The model features three countries—*Home*, *Nearby*, and *Distant*—as well as a *Rest of the World*. In this way we can simultaneously account for differences in the degree of trade integration among countries—their distance—as well as their size, both key aspects for the economic spillovers of wars according to our empirical analysis. In terms of features, our model synthesizes recent work by Gopinath et al. (2020) and Eichenbaum, Johannsen and Rebelo (2021) and accounts for the use of both intermediate goods and capital in production as well as nominal and real rigidities, familiar from empirically successful accounts of the business cycle (Smets and Wouters, 2007).[21]

We devise a war-shock scenario building on earlier work on rare disasters (Gourio, 2012). Specifically, we assume that there is a "war shock" in Home which destroys a fraction of the capital stock and lowers total factor productivity. Additionally, the war shock induces an increase in military expenditures not only in Home but also globally, albeit to a different degree. We show that, under these assumptions, the model is able to provide a quantitatively successful account of the

[21]Our model simulations are based on code that is easily adaptable in Dynare's macro-preprocessing language, allowing users to switch between different pricing regimes (DCP, PCP, LCP) and aggregation technologies, adjust the number of countries—including three- and two-country versions—and add or remove features as needed. It thus provides a robust and flexible tool for analyzing a wide range of international economic scenarios. The original models of Gopinath et al. (2020) and Eichenbaum, Johannsen and Rebelo (2021) are nested and can be accessed as special cases.

economic impact of the war—not only in Home but also in foreign countries. Trade integration proves to be key in this regard, similar in spirit with the evidence put forward in Martin, Mayer and Thoenig (2008). However, we pivot the focus toward the role that trade relationships have on the transmission of war shocks, rather than the impact of trade on the likelihood of war.

In what follows, we first outline the model structure and our calibration strategy, which relies on matching impulse response functions. We then use the model to inspect the mechanism through which a war shock affects the global economy.

4.1 Model outline

We keep the exposition of the model brief, using index $j \in \{H, N, D, R\}$ to denote countries, and relegate all derivations to the Online Appendix. The size of the world economy is normalized to unity, $\sum_j n_j = 1$, where $n_j = |\mathcal{N}_j|$ represents the proportion of the population and firms residing in each country j, distributed over distinct masses $\mathcal{N}_j$ on the unit interval. Countries are isomorphic and differ in three key aspects only: their size, their trade integration, and the way in which they are exposed to the war shock.

Within each country, a generic household $h \in \mathcal{N}_j$ chooses consumption, supplies labor, invests in physical capital and trades financial assets. At an international level, we restrict financial trade to a non-contingent bond issued in the Rest of the World's currency. Within countries, by contrast, financial markets are complete such that household heterogeneity due to sticky wages is largely immaterial and we may drop the household index h in what follows for most variables (Erceg, Henderson and Levin, 2000). The expected lifetime utility of a generic household is defined over consumption $C_{j,t}$ and labor $L_{j,t}$:

$$U_{j,t} = E_0 \sum_{t=0}^{\infty} \beta^t \left[\log\left(C_{j,t} - \hbar \bar{C}_{j,t-1}\right) - \frac{\chi^L}{1+\sigma^L} L_{j,t}^{1+\sigma^L} \right],$$

where β is the discount factor, σ^L the inverse Frisch elasticity of labor supply, and χ^L is a parameter that determines hours worked in steady state. $\bar{C}_{j,t}$ is per-capita aggregate consumption scaled by the degree of habit formation $\hbar$. The household owns an internationally immobile capital stock, $K_{j,t}$, which evolves according to:

$$K_{j,t} = \left\{ (1-\delta^K) K_{j,t-1} + \left[1 - \frac{\phi^K}{2} \left(\frac{I_{j,t}}{I_{j,t-1}} - 1 \right)^2 \right] I_{j,t} \right\} e^{-\Delta_j^K \omega_t}.$$

Here, δ^K denotes the rate of capital deprecation, $I_{j,t}$ represents investment, and ϕ^K is a scaling factor for quadratic investment-adjustment costs. As in Gourio (2012), the destruction of the capital stock is attributed to the war shock, denoted as ω_t, and assumed to follow an AR(2) process with persistence parameters ρ_1 and ρ_2:

$$\omega_t = \rho_1 \omega_{t-1} + \rho_2 \omega_{t-2} + \eta_t.$$

η_t triggers the war shock by assuming a value of 1 at the onset of war. $\Delta_H^K > 0$ parameterizes the size of the destruction of the capital stock. The household's flow budget constraint reads in nominal terms as:

$$\begin{aligned} P_{j,t}\left(C_{j,t} + I_{j,t}\right) + a\left[u_{j,t}\right] K_{j,t-1} + \mathcal{E}_{Rj,t} R_{R,t-1} B_{Rj,t-1} + \frac{\phi^B}{2}\left(\frac{\mathcal{E}_{Rj,t} B_{Rj,t-1}}{P_{j,t}}\right)^2 P_{j,t} + B_{j,t-1} \\ = R_{j,t}^K u_{j,t} K_{j,t-1} + W_{j,t}(h) L_{j,t}(h) + \mathcal{E}_{Rj,t} B_{Rj,t} + \sum_{s' \in \mathcal{S}} Q_{j,t}(s') B_{j,t}(s') + T_{j,t}, \end{aligned}$$

where $C_{j,t}$ and $I_{j,t}$ are final goods used for consumption and investment, respectively, and traded at $P_{j,t}$ which represents the consumer price index. The nominal exchange rate, $\mathcal{E}_{Rj,t}$, is the price of currency R expressed in the currency of country j. $B_{Rj,t}$ denote country-j holdings of the international bond, which yields a gross nominal interest rate of $R_{Rj,t}$ the subsequent period. Bond holdings are subject to a carrying cost, scaled by parameter ϕ^B, for all countries except for R. This reflects, albeit in a stylized manner, financial frictions as in García-Cicco, Pancrazi and Uribe (2010) and—more technically—ensures a stationary solution (Schmitt-Grohé and Uribe, 2003). Households also have access to a full set of domestic state-contingent securities, $B_{j,t}$, denoted in its own currency, that are traded domestically and are in zero net supply. Denoting by $\mathcal{S}$ the set of possible states of the world, $Q_{j,t}(s)$ is the period-t price of the security that pays one unit of domestic currency the next period in state $s \in \mathcal{S}$, and $B_{j,t}(s)$ are the corresponding holdings. The capital utilization rate $u_{j,t} \leq 1$ and the nominal rate $R_{j,t}^K$ determine the rental income from capital lent to firms subject to an adjustment cost function $a[u_{j,t}]$ that is parameterized by ϕ^u. Finally, $T_{j,t}$ encompasses lump-sum taxes and firm profits.

Household h provides differentiated labor services and, under the usual assumptions, faces the labor demand function: $L_{j,t}(h) = (W_{j,t}(h)/W_{j,t})^{-\epsilon^W} L_{j,t}$. Here $\epsilon^W > 1$ denotes the elasticity of substitution between distinct labor services at an individual nominal wage rate $W_{j,t}(h)$. The terms $W_{j,t}$ and $L_{j,t}$ are the corresponding aggregate indices. Wages are sticky à la Calvo: In each period, a randomly selected fraction of households $1 - \theta^W$ is permitted to renegotiate its wage.

Final goods $Y_{j,t}$ are assembled by combining wholesale goods from each country according to the aggregation technology:

$$Y_{j,t} = \left(\sum_{i \in \{H,N,D,R\}} \gamma_{ij}^{\frac{1}{\sigma}} \left[\varphi_{ij,t} Y_{ij,t}\right]^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}},$$

with $\gamma_{jj} = 1 - \sum_{i \neq j} \gamma_{ij}$. σ is the elasticity of substitution in the terms of trade and $Y_{ij,t}$ refers to the volume of wholesale goods produced by country i and utilized in country j for the production of final goods used, in turn, for consumption, investment, and as intermediate input in production. The term

$$\varphi_{ij,t} = \left[1 - \frac{\varphi_j}{2}\left(\frac{Y_{ij,t}/Y_{jj,t}}{Y_{ij,t-1}/Y_{jj,t-1}} - 1\right)^2\right]$$

captures adjustment costs due to altering the ratio of imports to domestically produced goods, effectively reducing the short-term price elasticity of imports. In our calibration below, we use parameter φ_j to capture the fact that countries find it difficult to adjust trade in the face of war. γ_{ij} is the weight of wholesale goods produced in country i that are used in the production of final goods in country j and controls the degree of trade integration in steady state. We set $\gamma_{ij} = \gamma_{ji}$ such that trade is balanced in steady state (for which we assume relative prices to be unity). We parameterize these weights according to:

$$\gamma_{ij} = \Omega_{ij}\ n_i,$$

where the "home bias" parameters $0 < \Omega_{ij} \leq 1$ control the degree of trade integration beyond size n_i. To see this, consider the limiting case where $\Omega_{ij} = 1$. In this case, imports from country i would simply reflect its size in the world economy. By varying home bias we may—in the spirit of gravity—account for other factors that determine trade integration, in particular geographic distance (Head and Mayer, 2014). Accordingly, values of Ω_{ij} close to zero imply almost no trade relationships.

The wholesale good $Y_{ji,t}$ is assembled in country j under perfect competition using a continuum of country-specific varieties. We index variety producers with m and let them operate under monopolistic competition. Under the usual assumptions, the demand for a specific variety $Y_{ji,t}(m)$ is given by: $Y_{ji,t}(m) = (P_{ji,t}(m)/P_{ji,t})^{-\epsilon^P} Y_{ji,t}$, where ϵ^P represents the constant elasticity of substitution between varieties. This demand function, combined with the zero-profit condition, determines the producer price index $P_{ji,t}$. Production of varieties adjusts to meet demand at posted prices and is Cobb-Douglas:

$$A_{j,t}(X_{j,t}(m))^{\alpha^X}\left(K_{j,t-1}(m)^{\alpha^K} L_{j,t}(m)^{1-\alpha^K}\right)^{1-\alpha^X} = \sum_{i\in\{H,N,D,R\}} Y_{ji,t}(m).$$

Here $X_{j,t}(m)$, $K_{j,t-1}(m)$ and $L_{j,t}(m)$ denote intermediate inputs, capital, and labor used in the production of variety m, respectively. Capital and labor are provided by the household and internationally immobile.[22] The parameters α^X and α^K determine the corresponding factor shares and $A_{j,t}$ denotes total factor productivity. We postulate that $A_{j,t}$ is adversely affected by the war: $\log(A_{j,t}/A_j) = \rho^A \log(A_{j,t}/A_j) - \Delta_j^A \omega_t$, with (additional) persistence parameter ρ^A. Importantly,

[22] Recall that we find no evidence for large demographic changes in the wake of the average war in our sample, see Figures B4 and B5.

we assume that the reallocation of resources toward military use affects only the Home country, $\Delta_H^A > 0$.[23] Prices are sticky à la Calvo: In each period a randomly selected fraction of firms $1-\theta^P$ is permitted to reset its price in their own currency. The prices charged abroad are invoiced in the currency of the destination market (local currency pricing) as in Eichenbaum, Johannsen and Rebelo (2021). Marginal costs, MC_t, are the same across firms, whether they are engaged in the production of domestic goods or export goods because they face identical input prices.

Bond market equilibrium requires that $\sum_j n_j B_{Rj,t} = 0$ for the internationally traded bond, whereas domestic bonds are in zero net supply. Exchange rates adjust freely to clear the foreign exchange market. Market clearing for final goods implies:

$$Y_{j,t} = C_{j,t} + I_{j,t} + X_{j,t} + G_{j,t} + a[u_{j,t}]K_{j,t-1} + \frac{\phi_b}{2}\left(\frac{B_{Rj,t}\mathcal{E}_{Rj,t}}{P_{j,t}}\right)^2$$

where $G_{j,t}$ denotes government spending, which is funded through lump-sum taxes and follows an autoregressive process which may respond to the war-shock innovation according to parameter Δ_j^G:

$$\log\left(\frac{G_{j,t}}{G}\right) = \rho_j^G \log\left(\frac{G_{j,t-1}}{G}\right) + \Delta_j^G\ \eta_t.$$

Monetary policy adjusts interest rates according to a simple feedback rule:

$$\frac{R_{j,t}}{R_j} = \left(\frac{R_{j,t-1}}{R_j}\right)^{\rho_j^R}\left(\left[\frac{\Pi_{j,t}}{\bar{\Pi}_j}\right]^{\psi_j^\Pi}\left[\frac{gdp_{j,t}}{gdp_j}\right]^{\psi_j^{gdp}}\right)^{1-\rho_j^R},$$

where ψ_j^Π and ψ_j^{gdp} are feedback parameters, ρ_j^R captures interest-rate smoothing and $\bar{\Pi}_j$ is the inflation target in terms of the consumer price index for CPI inflation $\Pi_{j,t} = P_{j,t}/P_{j,t-1}$. Real per-capita gross domestic product is defined as $gdp_{j,t} = Y_{j,t} - X_{j,t}$.

4.2 Model calibration and validation

We solve the model based on a first-order perturbation and compute the impulse response to the war shock. As calibration targets we use the empirical response functions of GDP and inflation in Home, Nearby, and Distant, as shown in the four panels of Figure 5 above. Specifically, we pin down key parameters by matching impulse response functions. The other parameters are fixed at conventional values prior to the matching exercise. We also validate the calibrated model by confronting its predictions for the responses of the capital stock, total factor productivity and military expenditures with their empirical counterparts.

[23] This assumption is conservative in light of the evidence presented in Figure B7. There is evidence of a sizeable, marginally significant reduction of TFP in Nearby. Yet, we aim to account for the endogenous spillovers of war, and TFP is exogenous in the model.

Fixed parameters. Parameter values are identical across countries, except when noted otherwise. A period in the model represents one year and we set the time-discount factor β to 1/1.04. The parameter reflecting bond holding costs is set to $\phi^B = 0.001$, capital depreciates at a rate of $\delta^K = 0.1$, the investment adjustment cost coefficient ϕ^K is set to 4, and the capital utilization parameter ϕ^u is 0.95. We set the elasticities of substitution across labor types (ϵ^W) and varieties (ϵ^P) both to 11. The habit parameter $\hbar$ is fixed at 0.75 and the inverse Frisch elasticity σ^L is set to 2. χ^L is determined endogenously for each country to normalize labor supply in steady state to 1. The same normalization applies to the levels of gross inflation and technology in the steady-state, $A_j = 1$ and $\Pi_j = 1$. θ^P and θ^W are calibrated to both equal 0.15, such that wages and prices are reset approximately after 1.2 years, on average. We set α^X to 0.40 and α^K to 0.35 (Bouakez, Rachedi and Santoro, 2023). We set the trade-price elasticity σ to 0.9 (Corsetti, Dedola and Leduc, 2008; Heathcote and Perri, 2002). We assume import adjustment costs for Home, $\varphi_H = 15$, to capture that the war site might find it particularly difficult to adjust imports. This value is at the upper bound estimate of Eichenbaum, Johannsen and Rebelo (2021) for normal times.

For the steady state we assume that trade is balanced and all relative prices as well as exchange rates are equal to unity. In terms of size, Home is calibrated to represent 6 percent of the world economy, which corresponds to the average size of war sites in our sample. We assume that Nearby and Distant each account likewise for 6 percent of the world economy, with the remaining 82 percent represented by the Rest of the World. In our sample, the degree of openness varies considerably across countries and over time. We set the share of imports to 30 percent of GDP in steady state: $1 - \gamma_{jj} = 0.3(1 - \alpha^X(\epsilon^P - 1)/\epsilon^P)$ for $j \neq R$. *Home* and *Nearby* are fully integrated with each other, $\Omega_{HN} = \Omega_{NH} = 1$, whereas trade with distant is almost irrelevant, $\Omega_{DH} = \Omega_{HD} = \Omega_{DN} = \Omega_{ND} = 0.01$. The assumptions of symmetry and balanced trade pin down the parameters in the Rest of the World.

IRF matching. We determine the key parameters by matching impulse response functions based on a Bayesian approach due to Christiano, Trabandt and Walentin (2010). In this way, we treat the empirical impulse responses as data and select parameters to ensure that the model's impulse responses closely mirror their empirical counterparts. Specifically, we target the responses of GDP and inflation in Home, Nearby, and Distant from years 0 to 6. In line with standard practices, we employ a diagonal weighting matrix, with the diagonal elements set to the inverse of the squared standard error of the respective empirical impulse response, see Meier and Müller (2006) for an early discussion.

Table 3 reports our priors and the parameters that are selected by the matching procedure. We start from the premise that the war shock affects all margins in a sizeable and persistent way. For parameters controlling the impact effects of the war shock on the capital stock, total factor productivity, and military expenditures, we assume an Inverse Gamma prior. Persistence parameters,

Table 3: War-shock scenario—priors and posteriors

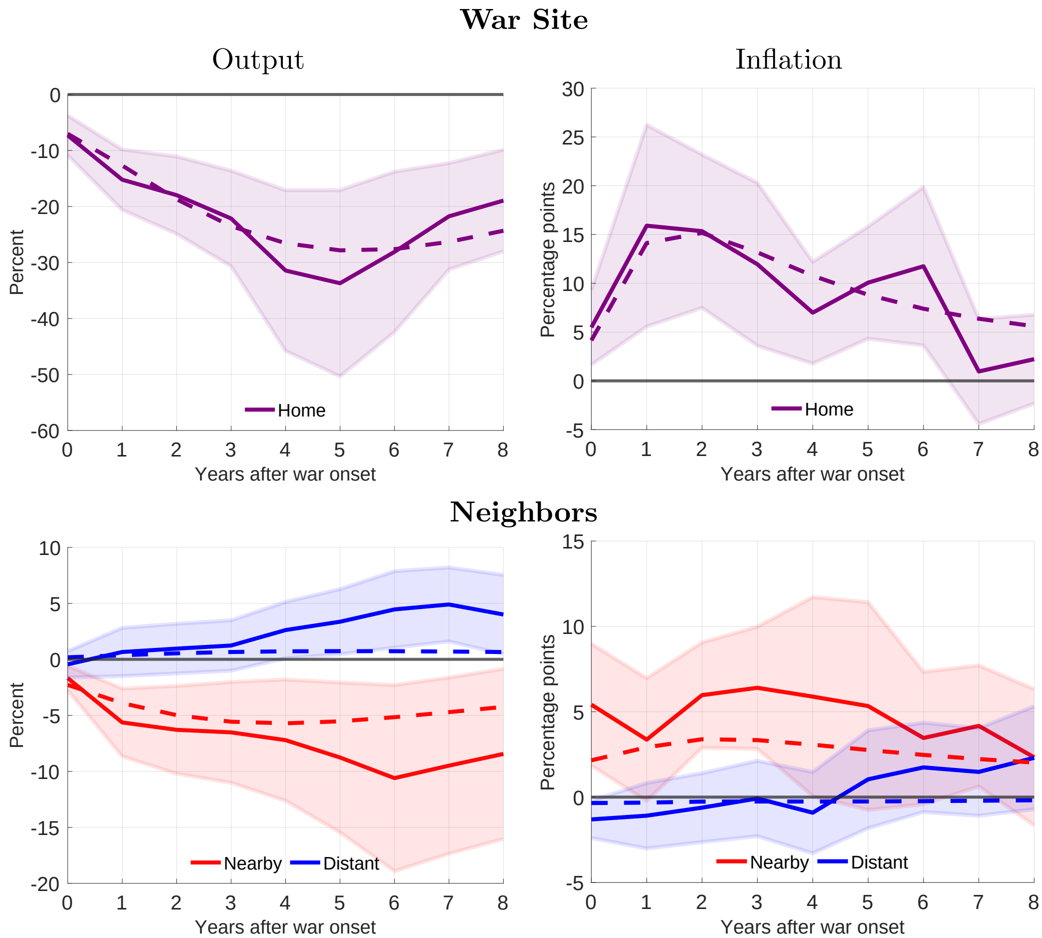
Parameter		Prior			Posterior			
		Distribution	Mean	Std. Dev.	Mode	Mean	5%	95%
War Roots	ρ_I	Beta	0.500	0.200	0.7024	0.6738	0.4799	0.7858
	ρ_{II}	Beta	0.500	0.200	0.7022	0.6334	0.4734	0.7829
Capital Destruction	Δ_H^K	InvGamma	0.020	0.200	0.0107	0.0463	0.0046	0.0586
Productivity Reallocation	Δ_H^A	InvGamma	0.030	0.200	0.0915	0.0896	0.0792	0.1000
	ρ_H^A	Beta	0.500	0.200	0.5949	0.5879	0.4188	0.7564
Military Expenditures	Δ_H^G	InvGamma	0.100	0.200	0.0683	0.0942	0.0463	0.1229
	Δ^G	InvGamma	0.010	0.200	0.0195	0.0135	0.0026	0.0260
	ρ_H^G	Beta	0.500	0.200	0.4728	0.4952	0.2135	0.9079
	ρ^G	Beta	0.900	0.200	0.9712	0.9538	0.8750	0.9900
Monetary Policy	ρ_H^R	Beta	0.500	0.200	0.7877	0.8021	0.6003	0.8633
	ρ^R	Beta	0.500	0.200	0.4565	0.5180	0.1507	0.7668
	ψ_H^{gdp}	Normal	0.500	0.200	0.3594	0.4162	0.2072	0.5060
	ψ^{gdp}	Normal	0.500	0.200	0.6341	0.6425	0.5069	0.7500
	ψ_H^{Π}	Normal	0.500	0.200	1.5291	1.4792	1.2244	1.8418
	ψ^{Π}	Normal	0.500	0.200	1.3279	1.3132	1.0165	1.5780

Notes: IRF matching based on RWMH algorithm with 24 million draws (24 chains, 50 percent of draws used for burn-in, draw acceptance rates about 25%.). We re-parameterize the driving process of the war shock based on its roots, given by $\rho_1 = \rho_I + \rho_{II}$ and $\rho_2 = -\rho_I \cdot \rho_{II}$.

in turn, follow a Beta prior distribution while the priors for the monetary policy parameters are normally distributed. Regarding the incidence of shocks, we posit that capital destruction and productivity disturbances happen in Home only, $\Delta_H^K > 0$ and $\Delta_H^A > 0$. We hypothesize that military spending increases not only in Home, $\Delta_H^G > 0$, but also globally, with increases outside the war site assumed to be symmetric and equal to $\Delta^G > 0$. Yet our prior for ρ_H^G and ρ^G implies that the effect is less persistent outside of the war site. Likewise, for monetary policy we assume response coefficients in Home to differ from those everywhere else, where we set identical coefficients. Instead of directly estimating the coefficients ρ_1 and ρ_2 of the second-order autoregressive process which governs the dynamics of the war shock, we estimate the roots ρ_I and ρ_{II} of the processes (Born, Peter and Pfeifer, 2013; Bayer, Born and Luetticke, 2023). These are related according to $\rho_1 = \rho_I + \rho_{II}$ and $\rho_2 = -\rho_I \cdot \rho_{II}$. By imposing the Beta prior distribution with a mean of 0.5, we ensure the stability of this process. All prior standard deviations are set equally to 0.2.

We initially employ a rotated slice sampler, generating 24,000 draws distributed across 24 parallel chains. The posterior mode from these samples serves as the initial guess for an optimization-based search to accurately find the posterior mode. The Hessian at the mode is computed numerically, and its inverse serves as the covariance matrix of the Student's t proposal distribution with 10 degrees of freedom in a Random Walk Metropolis-Hastings (RWMH) algorithm. We then generate 24 million

Figure 9: The macroeconomic impact of war: model v data (targeted)



Notes: dashed lines show adjustment of model economy to war-scenario in the war site. Solid line and shaded area corresponds to time-series estimate and confidence bounds shown in Figure 5 above. Horizontal axis measures time in years, vertical axis measures deviation from pre-war (steady-state) level in percent/percentage points.

draws, also distributed across 24 parallel chains, allocating half of these samples for burn-in.[24] We report posterior estimates in Columns 5 through 7 of Table 3. We observe updates to the prior distributions for all parameters and the highest posterior density (HPD) intervals contain economic plausible values. The estimated persistence of the war shock is adjusted upwards, with both roots being larger than 0.6. The initial exogenous destruction of the capital stock is approximately 4.6% on impact; yet because of the persistence of the war shock, combined with endogenous reductions in investment, this leads to a much larger reduction in the capital stock over time of up to 50% after

[24] Although we present results generated by the RWMH algorithm, it is noteworthy that the posterior distributions closely align with those obtained through the rotated slice sampler with 24,000 draws. The latter typically produces Markov chains with lower autocorrelation compared to the RWMH approach and, more important, does not require a (time-consuming) mode-finding step. For a comprehensive assessment, convergence diagnostics, trace plots, and relative inefficiency factors are provided in the supplementary Dynare replication codes. Note that we contributed our (user-friendly) IRF matching toolbox as a feature of Dynare from version 6.0 onwards.

8 years (as shown in Figure 10 below). The drop in productivity in Home is substantial, at almost 9% on impact. Military spending in *Home* is estimated to increase more strongly than in the other countries (9.4% vs. 1.4%), but with a lower persistence rate of 0.50 compared to 0.95 elsewhere, implying a slower military buildup in the other countries. The HPD intervals, however, are rather wide and the updating of the priors weak. We find similar weak identification for our estimates of the monetary policy parameters, even though the point estimates align with conventional estimates in the literature (reflecting our prior).

The dashed lines in Figure 9 show the impulse response functions predicted by the model at the posterior mean. We contrast them to their empirical counterparts (solid lines), reproduced from Figure 5 above. These responses have been used as calibration targets and hence—perhaps unsurprisingly—the model's predictions align well with the data, notably for the war site (Home). Still, we emphasize that the model is able to generate spillovers to Nearby which are quantitatively well in line with the evidence. The model also predicts positive output spillovers in Distant, but these are somewhat smaller than in the data and at the lower bound of the significance bands. We note, however, that the extent and even the sign of output spillovers to Distant varies across empirical specifications, see Figure 6 above. In terms of inflation spillovers, the model is both qualitatively and quantitatively in line with the evidence.

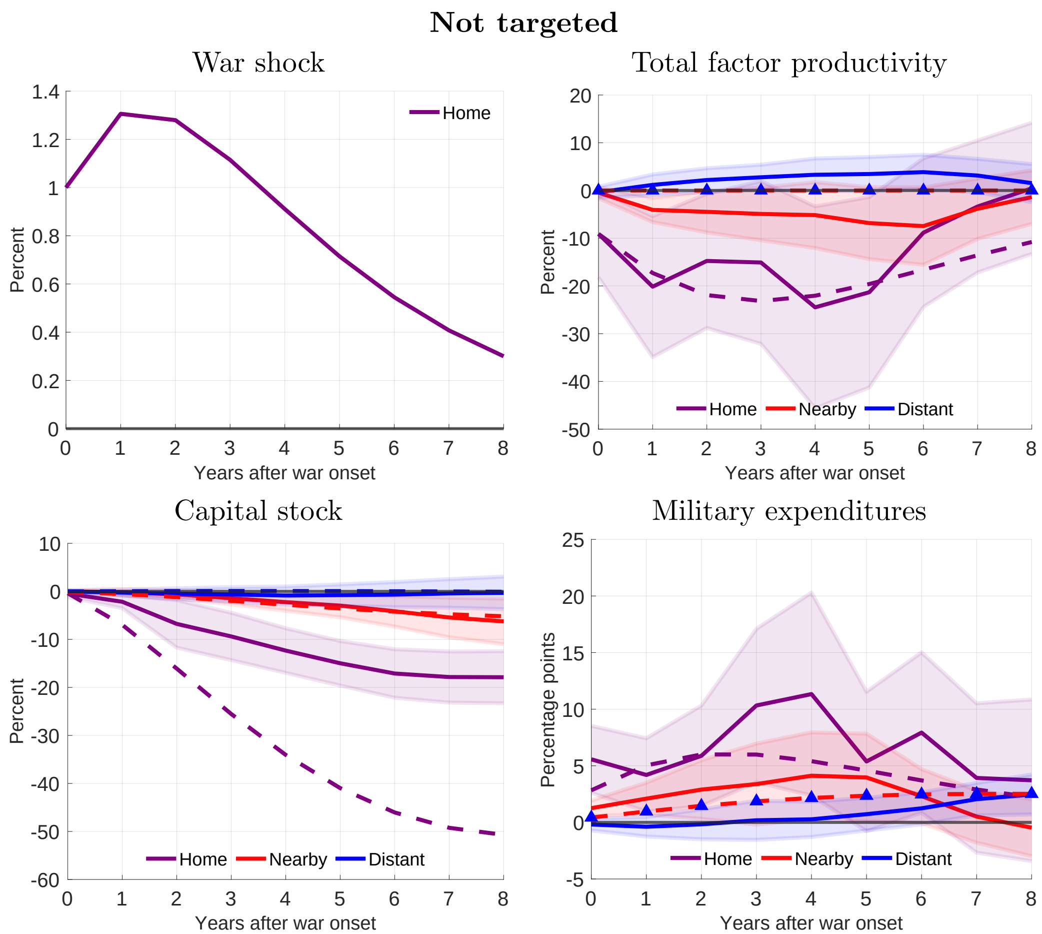
Model validation. We now assess the performance of the model based on evidence that has not been used in the calibration of the model. Here we focus on the key features of the war shock itself, which is shown in the upper-left panel of Figure 10. It exhibits a hump-shaped pattern and has no observable counterpart. Yet in the remaining panels of the same figure we show the dynamics of the capital stock, productivity, and military expenditures as predicted by the model (dashed line) alongside the empirical estimates (solid lines) reproduced from Figures B2, B6, and B7 in the appendix.[25]

In the upper-right panel we show the dynamics of total factor productivity. In the model we only allow TFP in Home to respond to the war shock, even though there is some evidence that TFP also drops in Nearby. This effect is only marginally significant, however, and we are particularly interested in the spillovers from the war site to the other countries that arise endogenously in the model. Remarkably, the TFP decline in Home, as implied by our model, aligns perfectly well with its empirical counterpart, even though it has not been targeted in the calibration. The model predicts a persistent TFP reduction of approximately 20 percent. Even eight years following the war's onset, TFP remains nearly 10 percent lower than its pre-war baseline.

In the lower-left panel we zoom in on the dynamics of the capital shock which can adjust endogenously in Home, Nearby, and Distant. Two observations are key. First, the reduction of the capital

[25]Note that the estimated responses used for validation are based on a more restricted sample of countries due to limitations in data availability.

Figure 10: The macroeconomic impact of war—model validation



Notes: dashed lines and triangles show adjustment of model economy to war-scenario in the war site. Solid line and shaded area corresponds to time-series estimate and confidence bounds shown in Figures B2, B6, and B7 in the appendix. Horizontal axis measures time in years, vertical axis measures deviation from pre-war (steady-state) level in percent/percentage points.

stock in the war-site economy is not only a consequence of direct, exogenous damage; instead it continues to decline over time, reflecting endogenous investment decisions which, in turn, are driven by the decline of total factor productivity. Remarkably, some 8 years after the start of the war, the capital stock is reduced by roughly 50 percent of its pre-war level. This overstates the decline apparent from the estimated impulse response somewhat, but we note that quantifying the actual change of the capital stock during wars is fraught with measurement problems. The capital stock starts to recover, both in the model and according to the estimated response after about 8 years. Second, the model also predicts a decline in the capital stock in Nearby, even though there is neither physical destruction nor a decline of productivity. Hence, in Nearby the decline of the capital stock reflects only the endogenous investment response and aligns remarkably well with the data (again not targeted). We do not observe a comparable effect in the distant economy, neither in the data nor in the model.

Finally, the lower-right panel shows the response of military expenditures. For Home we observe an increase of military expenditures which is in the ballpark of the empirical responses, if somewhat weaker: at the peak, military spending rises by some 10 percent in the data and by roughly 6 percent according to the model. In the other countries, the simulation constrains the response of military expenditures to be identical in order to limit the degrees of freedom as we match impulse responses. We find that the increase is considerably weaker than in Home, as observed in the data. Still, toward the end of the period under consideration, there is a non-trivial increase of military spending by approximately 3 percent of pre-war GDP, quite similar to what our empirical estimates imply for Nearby and Distant at that point. In the short run, the response of military expenditures in Nearby predicted by the model falls somewhat short of what we see in the data.

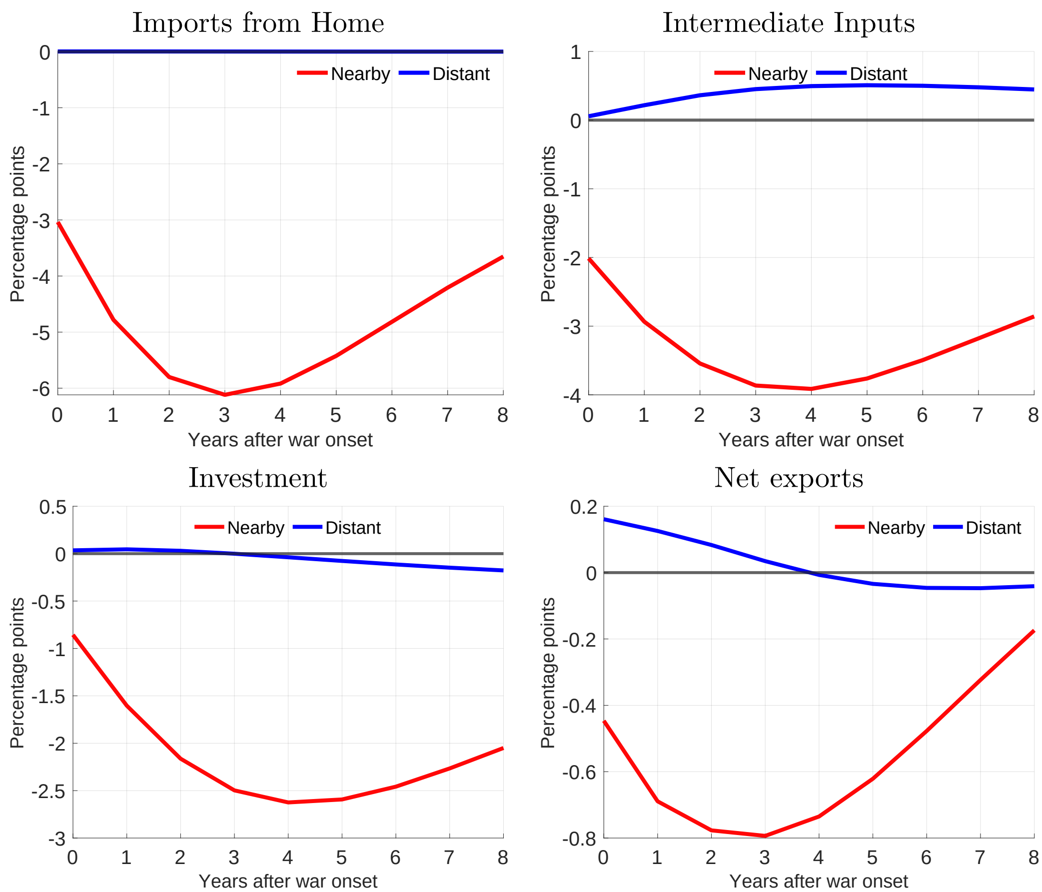
Overall, given that the model has been calibrated without taking the responses shown in Figure 10 into account, we consider the performance of the model along these dimensions as remarkably good and conclude that the model offers an empirically successful account of the macroeconomic impact of war on the global economy. Hence, we may rely on the model to gain further insights into the international transmission of the war shock.

4.3 Inspecting the mechanism

As a first step toward this end, we show the response of selected variables in Figure 11, contrasting the adjustment in Nearby (red lines) and Distant (blue lines). The import price of goods produced in Home increases sharply in Nearby, reflecting the supply-side contraction in the war site (not shown). The implication is that imports from the war site contract sharply in Nearby, an effect that is absent in Distant, as illustrated in the upper-left panel of the figure. Note that we measure the response of imports in percent of the pre-war GDP level. Here Nearby and Distant differ in their degree of trade integration with Home, meaning that Distant hardly imports from Home prior to the war. Given this low level of trade, the war has no perceptible impact on imports in Distant.

The upper-right panel of the same figure shows the response of intermediate inputs that are used in production. These are composed of domestically and imported goods; and as the imports from Home collapse, Nearby cuts down on the use of intermediate inputs in its production process. This, in turn, means that the pre-war level of production in Nearby can no longer be maintained. In this way, the supply shock in Home causes a supply-side contraction in Nearby, even though there is neither a destruction of physical capital nor a shock to productivity. The decline in production is absorbed by reduced consumption (not shown) as well as by investment, shown in the lower-left panel. This, in turn, accounts for the decline of the capital stock in Nearby (shown in Figure 10 above).

Figure 11: The transmission of the war shock

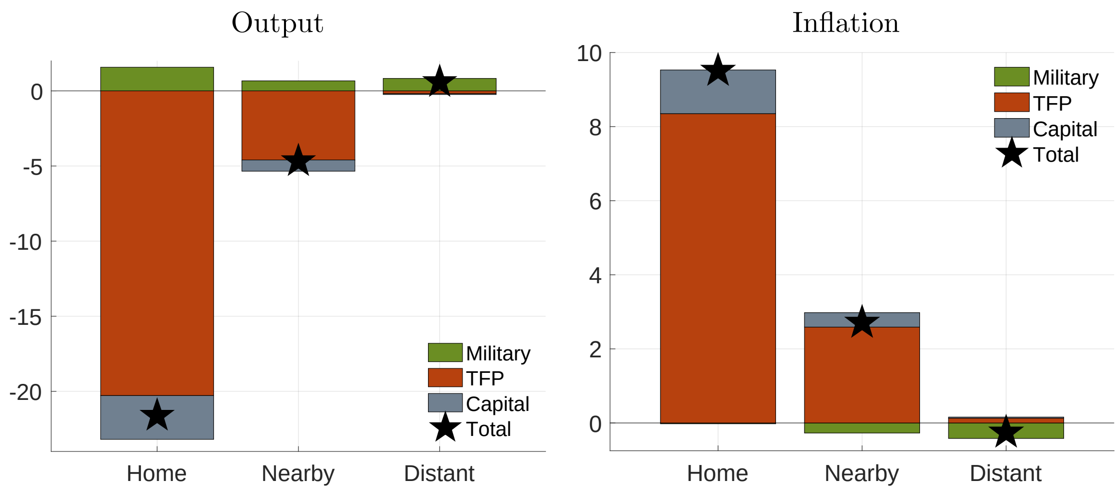


Notes: Adjustment to war shock according to estimated model. Horizontal axis measures time in years after start of the war. Vertical axis measures deviation from pre-war level in percent of pre-war GDP.

In Distant there is no comparable effect. Instead, we observe an increase of net exports, displayed in the bottom-right panel. This reflects a shift in trade patterns, with the Rest of the World moving away from trading with Home and Nearby and increasingly engaging with Distant. This, in addition to increased military expenditures, rationalizes some of the positive output spillovers that the model predicts for Distant. Quantitatively, the redirection of trade contributes only moderately to these spillovers. Finally, we note that according to the model, the trade balance in Nearby declines strongly because the price of imports from Home increases so strongly (upper-left panel). This effect dominates the substitution away from Home goods.

To synthesize the results of our model simulations, Figure 12 decomposes the overall effect of the war shock on output and inflation into the contributions from the different features of the war shock. Specifically, we compute the average change in output and inflation over the projection horizon in Home, Nearby, and Distant. In each panel, the grey area represents the contribution of the capital destruction, an event that occurs exclusively in Home but endogenously affects output

Figure 12: Decomposition of average effects



Notes: Average effect of individual war channels is computed by averaging the IRFs over the projection horizon.

and inflation not only in Home but also abroad. The decline in TFP, also unique to Home, is represented by the red area. Finally, the contribution of increased military expenditures is marked by the green area. The cumulative effect of these three factors is indicated by a star. Three aspects are worth noting. First, the TFP contraction in Home is key in driving the output effects, not only in Home but also in Nearby, reinforcing the view that war is first and foremost an adverse supply shock that spills over from Home to its trading partners. Second, while the capital destruction contributes significantly to output and inflation, its quantitative effect is more subdued in Nearby. Lastly, military expenditures contribute to positive output effects in all three countries, but these are relatively minor by comparison. Furthermore, the model suggests a mild deflationary effect of increased military spending. To understand this effect, note that the increase in spending is largely back-loaded. The adverse wealth effect of increased spending induces, all else equal, an increase in labor supply that leads to an immediate supply-side expansion. In contrast, the additional demand comes online only much later, enabling the deflationary effect.

5 Conclusion

Which countries pay the price of war? Our analysis addresses this question by focusing on the economic costs of war in terms of business cycle effects. We find that these economic costs are massive in the war-site economy itself but also spill over to a significant extent to countries that are geographically close to the war site. What matters less is whether countries are involved as parties to the war or not. In this sense, the price of war is largely paid by those countries that happen to be located in its proximity. They suffer lower output and higher inflation than would have been the case without the war.

We rationalize this result in a state-of-the-art model of the global economy. In the model, we do not distinguish between belligerent countries and third countries. Instead, we model the war shock in the war site and let countries differ in their degree of trade integration with the war site. In this way, we are able to account for the time series evidence. In a nutshell, as the war destroys the productive capacity in the war-site economy, exports to nearby economies falter. This, in turn, induces a scarcity of intermediate inputs and induces a decline of the capital stock in the nearby country—even in the absence of any physical destruction of capital. These dynamics accounts for the output and price effects that we observed in the data.

The main takeaway of our study is that the adverse impact of war is not limited to the war site. There are clear and significant spillovers from the war, notably for economies closer to the war site. These spillovers lower output while putting upward pressure on prices. As such, they represent an adverse supply shock and give rise to a difficult trade-off for stabilization policy. What's worse, in contrast to supply shocks of the garden-variety type, the supply contraction induced by war tends to be more persistent. This implies, among other things, that monetary policymakers will generally not be in a position to "look through" the supply shock.

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Online appendix

A Additional descriptives

Table A1: War site identified via GPT-4

War	Site	Total Casualties	Start Date
World War II	Estonia	489,459	1944
World War I	Turkey	392,856	1915
Russo-Polish	Poland	207,040	1920
World War II	Luxembourg	195,000	1940
World War I	Romania	184,560	1916
World War II	Slovakia	36,820	1944
World War I	Latvia	29,200	1917
World War I	Greece	10,745	1918
World War II	Austria	9,000	1945
Chaco	Bolivia	8,302	1932
World War II	Czechia	7,400	1942
Boxer Rebellion	China	4,508	1900
World War I	China	2,911	1914
World War I	Estonia	1,411	1917
World War II	Slovenia	130	1942
World War I	Lithuania	N/A	1914
Bangladesh	India	N/A	1971
Second Russo-Turkish	Romania	N/A	1877

Notes: Table shows war sites that have been identified after cross-checking with GPT-4 and additional sources. For some sites, we could not come up with credible sources for the casualties incurred (outlined as N/A). We assume that these poorly documented battles which are likely are smaller in terms of casualties.

Table A2: War Site Overview

War	Site	Total Casualties	Start Date
World War I	France	4,027,517	1914
Third Sino-Japanese	China	3,531,359	1937
World War II	Russia	2,288,675	1941
Vietnam War, Phase 2	Viet Nam	2,006,561	1957
World War I	Ukraine	1,891,000	1914
World War II	Poland	1,864,645	1939
World War I	Belgium	1,162,039	1914
World War II	Belarus	1,030,815	1941

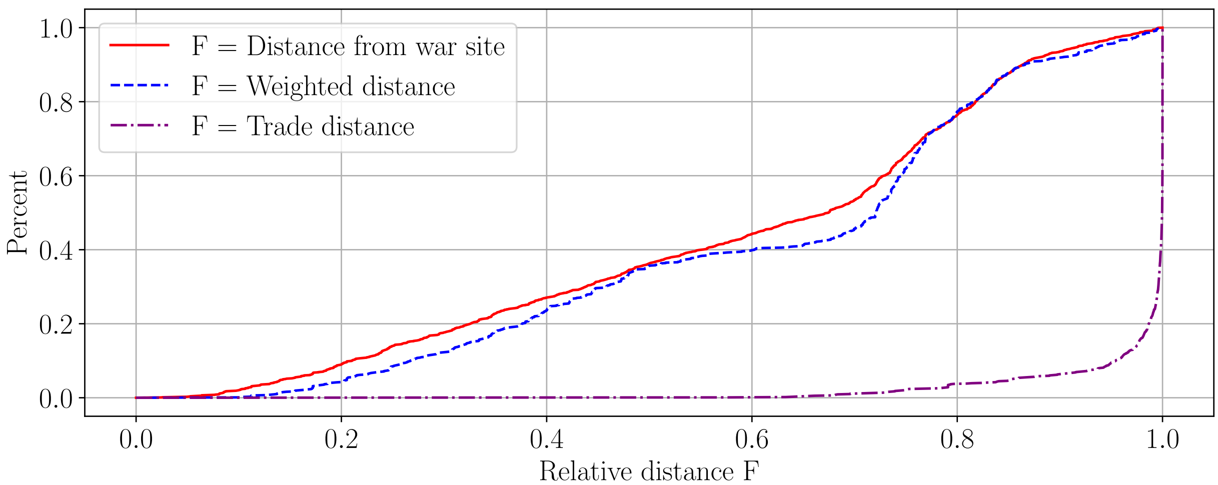
World War II	Germany	982,127	1941
World War I	Italy	951,812	1915
World War II	Japan	868,392	1944
World War I	Poland	640,500	1914
World War I	Slovenia	562,452	1915
World War II	Estonia	489,459	1939
World War II	Ukraine	440,807	1941
World War II	France	424,849	1940
Russo-Japanese	China	419,098	1904
World War II	Philippines	402,157	1941
World War I	Turkey	392,856	1914
World War II	Romania	369,188	1941
World War II	Hungary	369,082	1941
Conquest of Ethiopia	Ethiopia	349,601	1935
World War II	Indonesia	339,039	1941
World War I	Germany	303,000	1914
Vietnamese-Cambodian	Cambodia	280,300	1977
Franco-Prussian	France	266,224	1870
Korean	Korea, Republic of	262,037	1950
World War II	Italy	251,693	1943
Second Laotian, Phase 2	Lao People's Democratic Republic	250,000	1959
World War II	Greece	240,824	1940
Iran-Iraq	Iraq	224,526	1980
Russo-Polish	Poland	207,040	1919
Gulf War	Iraq	200,000	1990
World War II	Luxembourg	195,000	1939
Korean	North Korea	191,536	1950
World War I	Romania	184,560	1914
Invasion of Iraq	Iraq	177,113	2003
World War II	Belgium	173,010	1940
Second Greco-Turkish	Turkey	162,652	1920
Russo-Ukrainian	Ukraine	150,000	2022
Invasion of Afghanistan	Afghanistan	150,000	2001
World War II	United Kingdom	134,237	1940
World War I	Belarus	132,000	1916
World War II	Myanmar	125,843	1941
Second Russo-Turkish	Bulgaria	111,700	1877
First Balkan	Turkey	105,525	1912
World War II	China	94,857	1945
Chaco	Paraguay	94,581	1932
Chaco	Bolivia	94,581	1932
World War II	Libya	90,090	1940
Russo-Finnish	Finland	89,604	1939

Second Greco-Turkish	Greece	89,500	1920
Iran-Iraq	Iran, Islamic Republic of	77,293	1980
World War II	Egypt	70,924	1940
War over Lebanon	Lebanon	70,821	1982
Badme Border	Eritrea	70,500	1998
Badme Border	Ethiopia	69,500	1998
War over Angola	Angola	63,315	1975
Second Sino-Japanese	China	60,000	1931
World War I	Israel	45,324	1917
Second Balkan	Bulgaria	44,500	1913
World War I	Iraq	42,722	1915
Yom Kippur War	Egypt	40,223	1973
World War II	India	38,350	1941
World War II	Slovakia	36,820	1939
World War II	Malaysia	36,177	1941
Bosnian Independence	Bosnia and Herzegovina	34,617	1992
First Balkan	Bulgaria	30,273	1912
Hungarian Adversaries	Hungary	29,807	1918
Six Day War	Israel	29,594	1967
World War I	Latvia	29,200	1914
Soviet Invasion of Hungary	Hungary	25,013	1956
World War II	Papua New Guinea	24,311	1942
World War II	Palau	24,063	1944
World War II	Solomon Islands	21,723	1942
War of the Pacific	Peru	19,876	1879
War of Attrition	Egypt	18,548	1969
First Balkan	North Macedonia	16,594	1912
World War II	Netherlands	16,556	1944
Gulf War	Israel	16,532	1990
Gulf War	Kuwait	16,532	1990
Gulf War	Saudi Arabia	16,532	1990
World War II	Hong Kong	14,879	1941
World War I	Palestine, State of	14,869	1917
Sinai War	Egypt	14,656	1956
World War II	Norway	14,450	1940
Nomonhan	China	13,480	1939
Nomonhan	Mongolia	13,480	1939
Nomonhan	Russia	13,480	1939
World War II	Syrian Arab Republic	13,429	1941
Bangladesh	Pakistan	12,777	1971
Bangladesh	Bangladesh	12,777	1971
Latvian Liberation	Latvia	10,971	1918
World War I	Greece	10,745	1914

Second Ogaden War, Phase 2	Ethiopia	10,000	1977
Second Ogaden War, Phase 2	Somalia	10,000	1977

Notes: Table provides an overview over all large wars in our sample. Name corresponds to the war names given in the Correlates of War Project (Sarkees and Wayman, 2010).

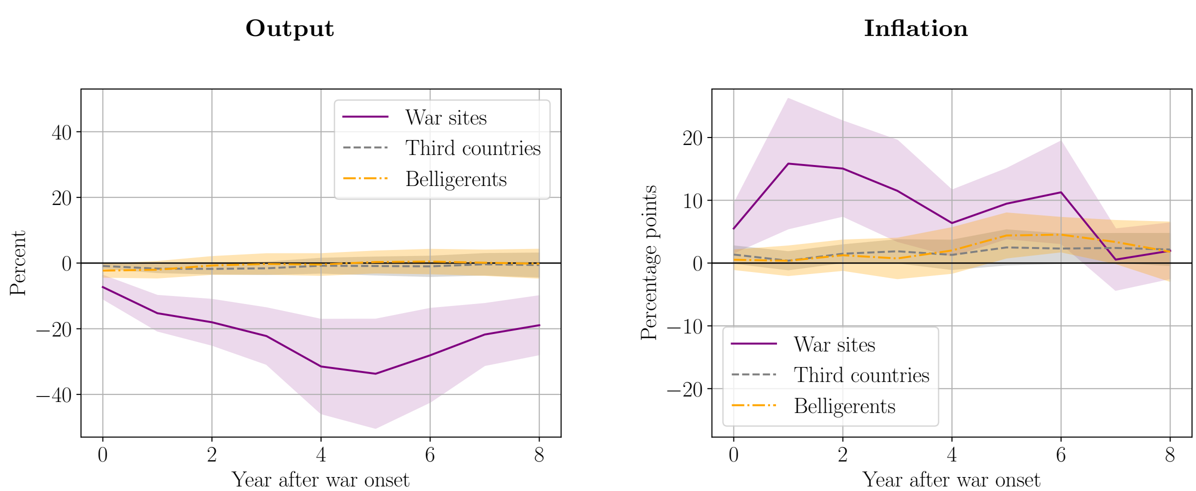
Figure A1: Cumulative distributions of transition functions



Notes: Figure shows cumulative distribution functions of the transition functions as defined by equations (3.3), (3.5), and (3.6).

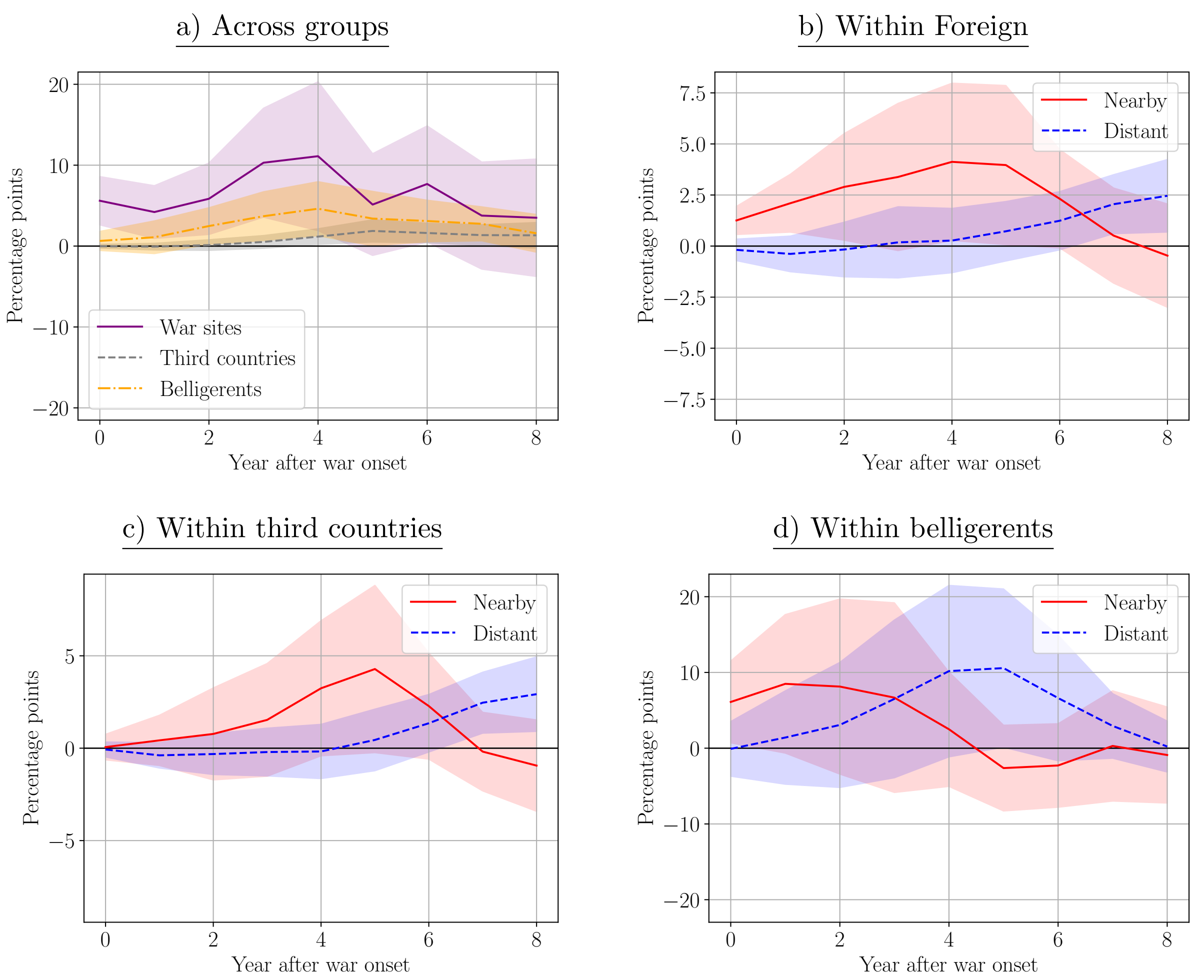
B Further evidence

Figure B1: Belligerents v third countries (unconditional)



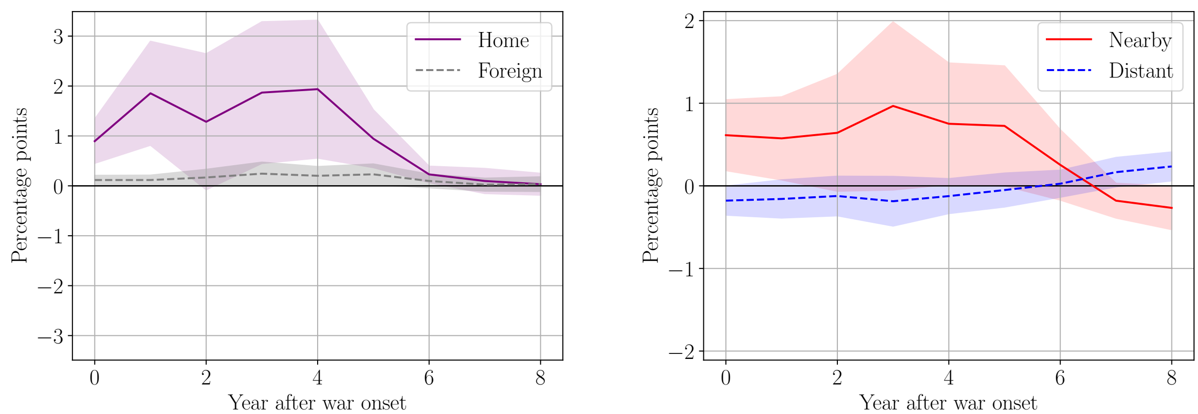
Notes: Left panels show percentage deviation of (detrended) output from its pre-war level, right panels show deviation of inflation from pre-war rate in percentage points. Horizontal axis measures time in years since start of the war. Foreign countries are split into belligerents and third countries. Shaded areas indicate 90% confidence bands. Sample 1870–2022, large war sites (casualties > 10k).

Figure B2: Military Expenditures



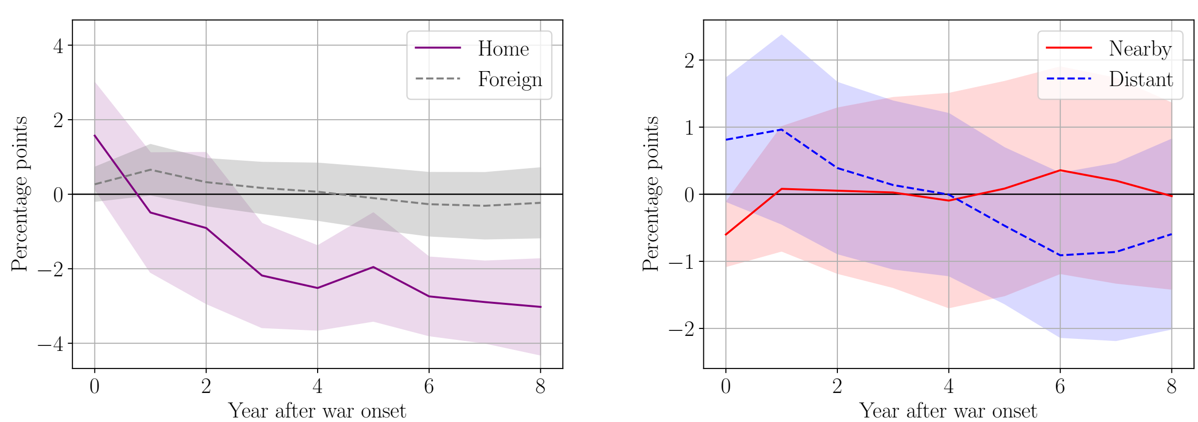
Notes: Panels show deviation of military expenditures relative to pre-war GDP in percentage points. Horizontal axis measures time in years since start of the war. Panel a) shows results for war sites, third countries, and belligerents. Panel b), c), and d) show how conditional projections for the Foreign countries, third countries, and belligerents, respectively. Shaded areas indicate 90% confidence bands. Sample 1870–2022, large war sites (casualties > 10k).

Figure B3: Employment in the military—response to war



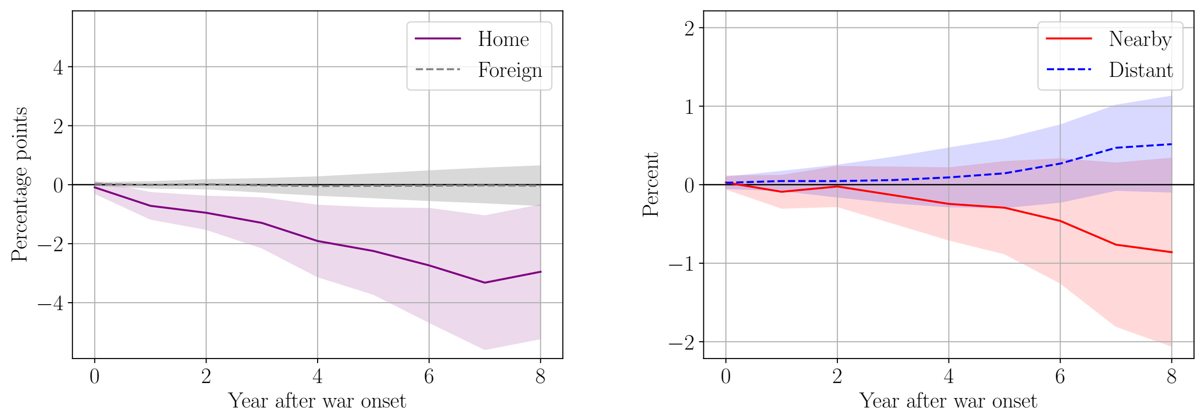
Notes: Panels show change in military personnel relative to pre-war population in percentage points. Horizontal axis measures time in years since start of the war. Sample 1870–2022, large war sites (casualties > 10k). Shaded areas indicate 90% confidence bands.

Figure B4: Unemployment–response to war



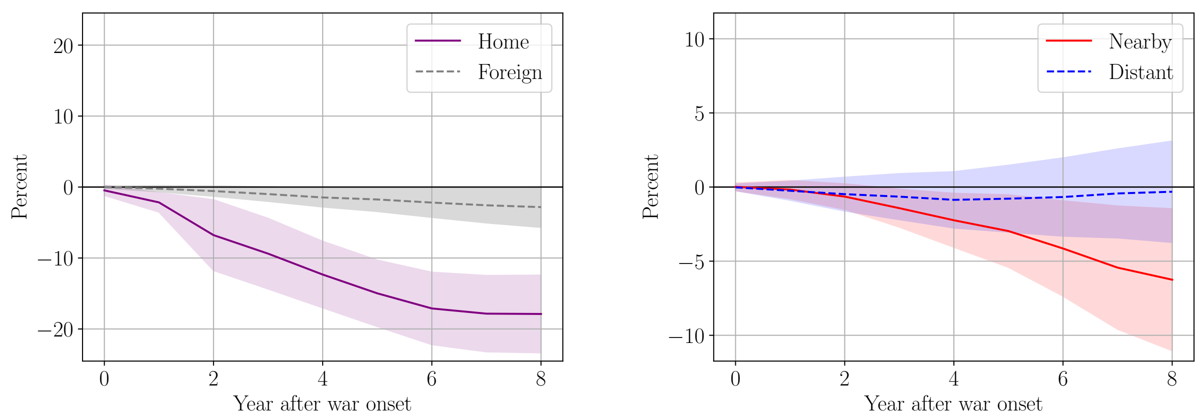
Notes: Panels show the change in unemployment in percentage points. Horizontal axis measures time in years since start of the war. Sample 1870–2022, large war sites (casualties > 10k). Shaded areas indicate 90% confidence bands.

Figure B5: Population response



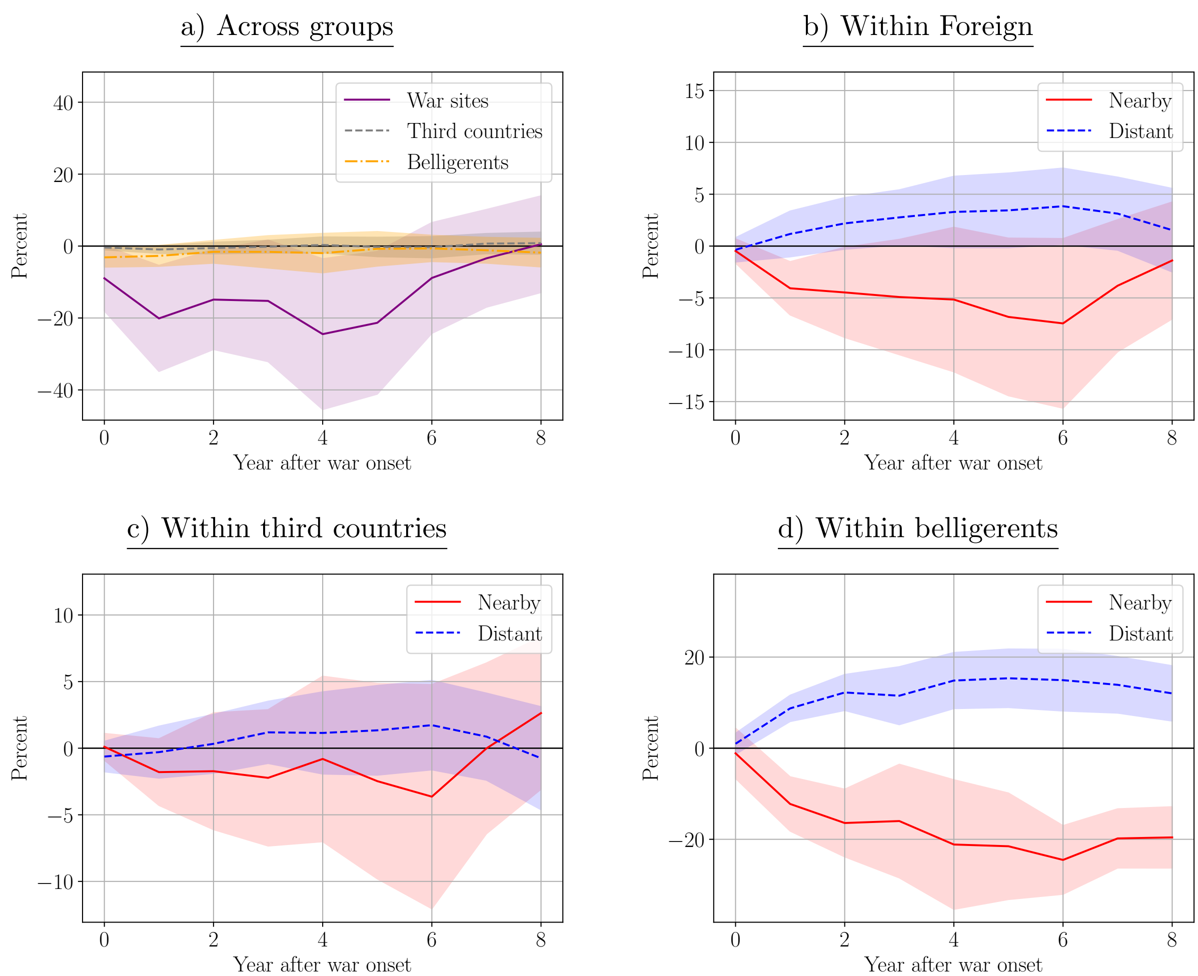
Notes: Panels show deviation of population relative to pre-war population in percent. Horizontal axis measures time in years since start of the war. Sample 1870–2022, large war sites (casualties > 10k). Shaded areas indicate 90% confidence bands.

Figure B6: Capital-stock response



Notes: Panels show deviation of capital stock from pre-war capital stock in percent. Horizontal axis measures time in years since start of the war. Sample 1870–2022, large war sites (casualties > 10k). Shaded areas indicate 90% confidence bands.

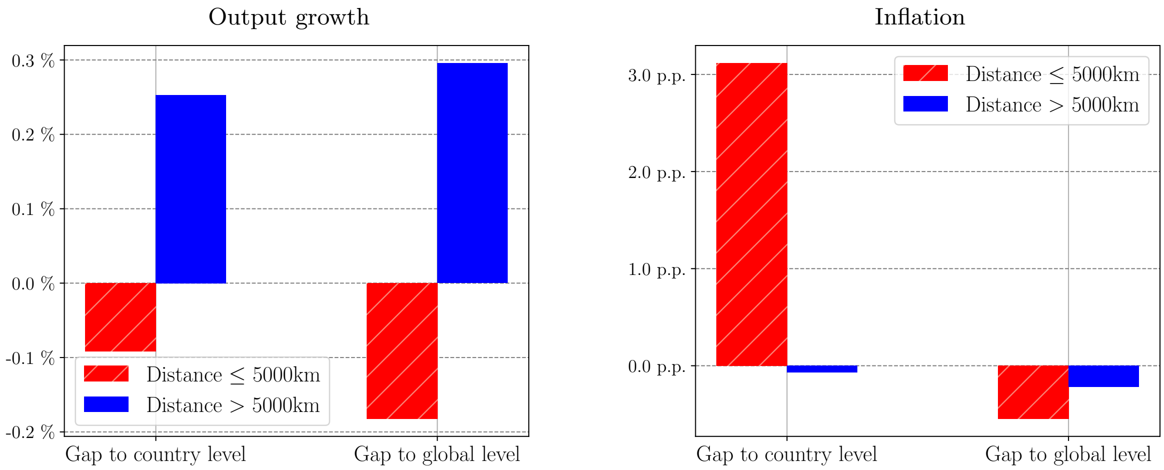
Figure B7: Total Factor Productivity



Notes: Panels show deviation of military expenditures relative to pre-war GDP in percent. Horizontal axis measures time in years since start of the war. Panel a) shows results for war sites, third countries, and belligerents. Panel b), c), and d) show how conditional projections for the Foreign countries, third countries, and belligerents, respectively. Shaded areas indicate 90% confidence bands. Sample 1870–2022, large war sites (casualties > 10k).

C Robustness

Figure C1: Economic performance of exposed countries during all wars

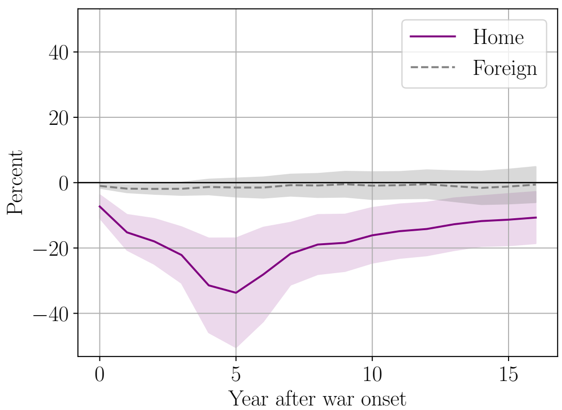


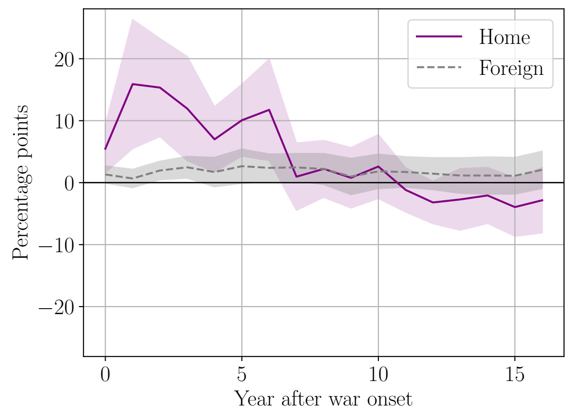
Notes: Output growth and inflation are annualized and measured relative to historical average (left) and the cross-sectional average (right). Sample: All war sites 1870–2022. "Nearby" are all Foreign wars located within about 5,000 kilometers of a country (corresponds to 25% quantile of in-sample distances), "distant" are wars farther away.

Figure C2: Longer horizons

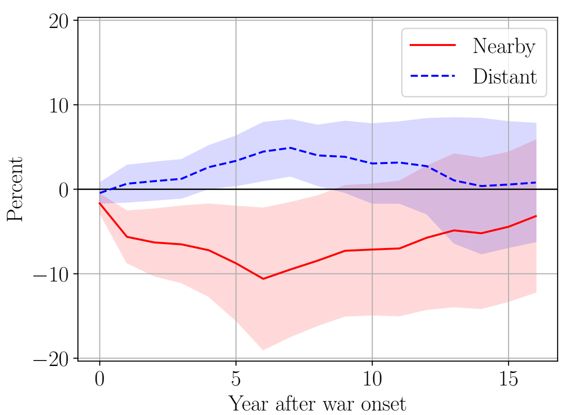
Output **Inflation**

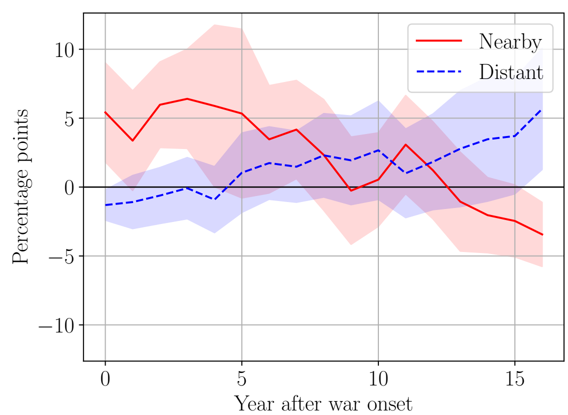
a) Home v Foreign (linear model)





b) Spillovers to Foreign: nearby v distant (smooth transition model)



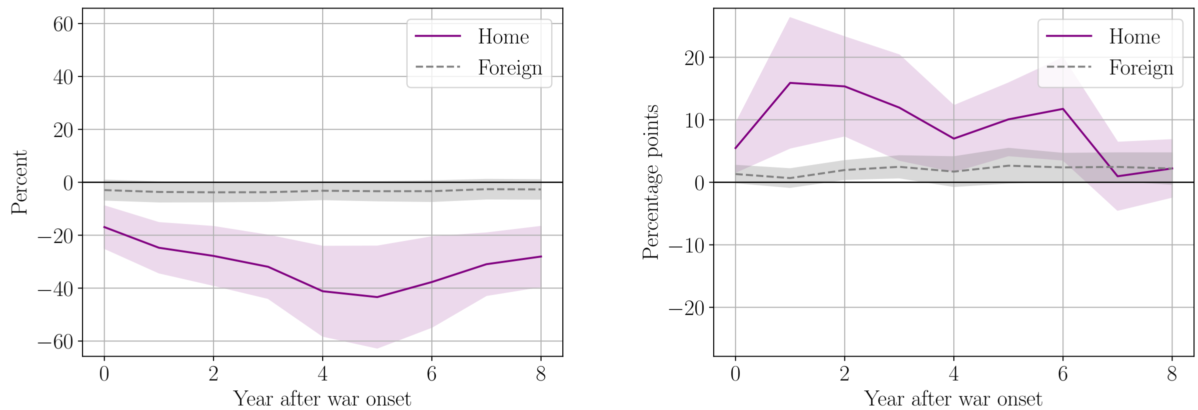


Notes: Left panel shows percentage deviation of (detrended) output from its pre-war level, right panel shows response of inflation. Vertical axis measures percentage deviation from the trend, horizontal axis measures time in years since start of the war. Top panels show results for linear specification (3.1). Bottom panel show response for smooth-transition specification (3.2). Shaded areas indicate 90% confidence bands. Sample 1870–2022, large war sites (casualties > 10k).

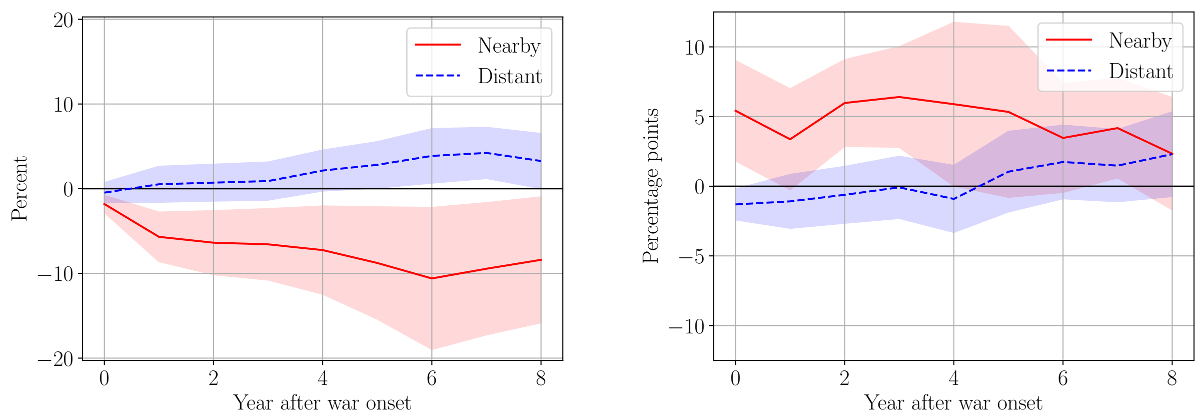
Figure C3: Dependent variables in levels

Output **Inflation**

a) Home v Foreign (linear model)

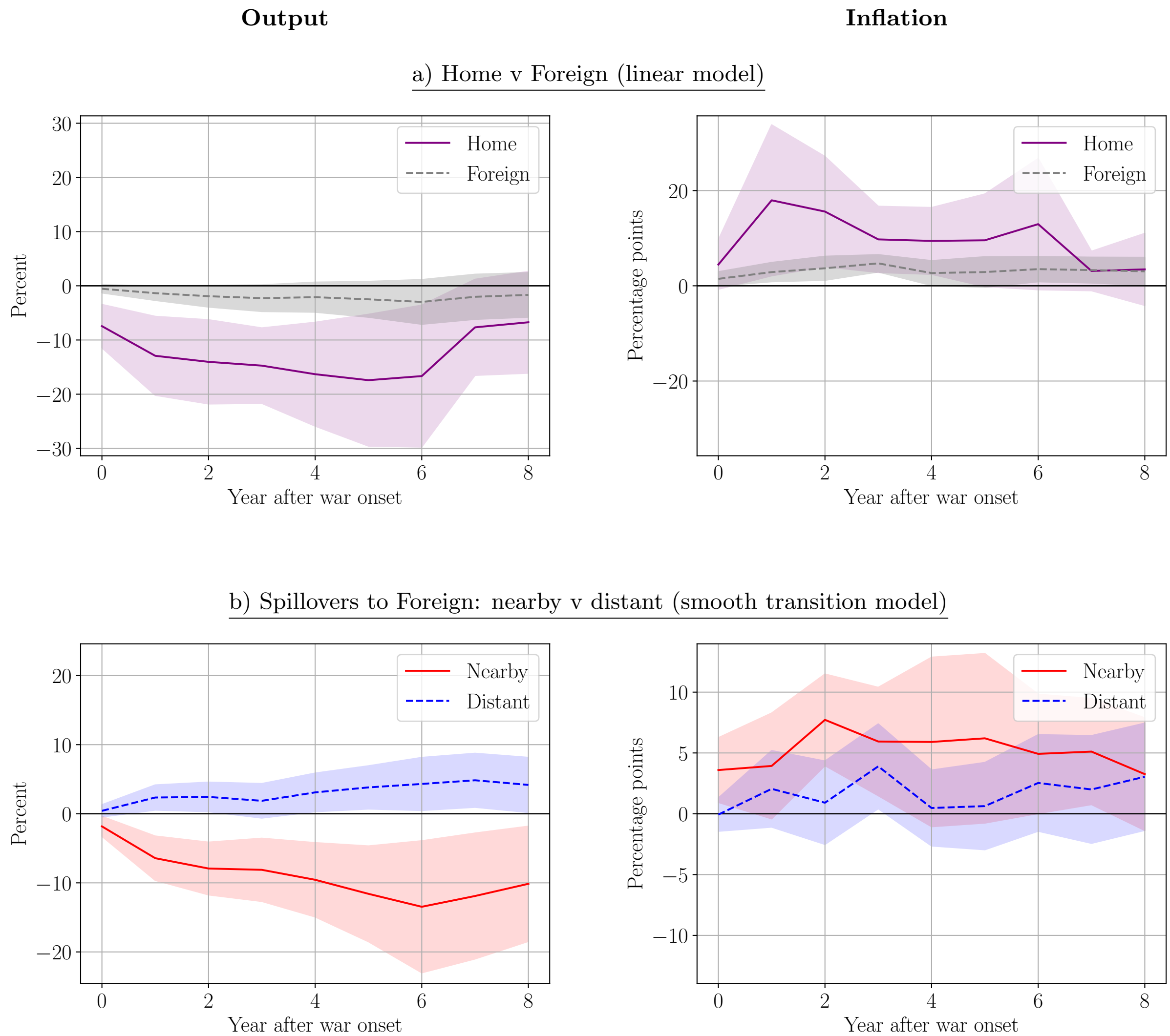


b) Spillovers to Foreign: nearby v distant (smooth transition model)



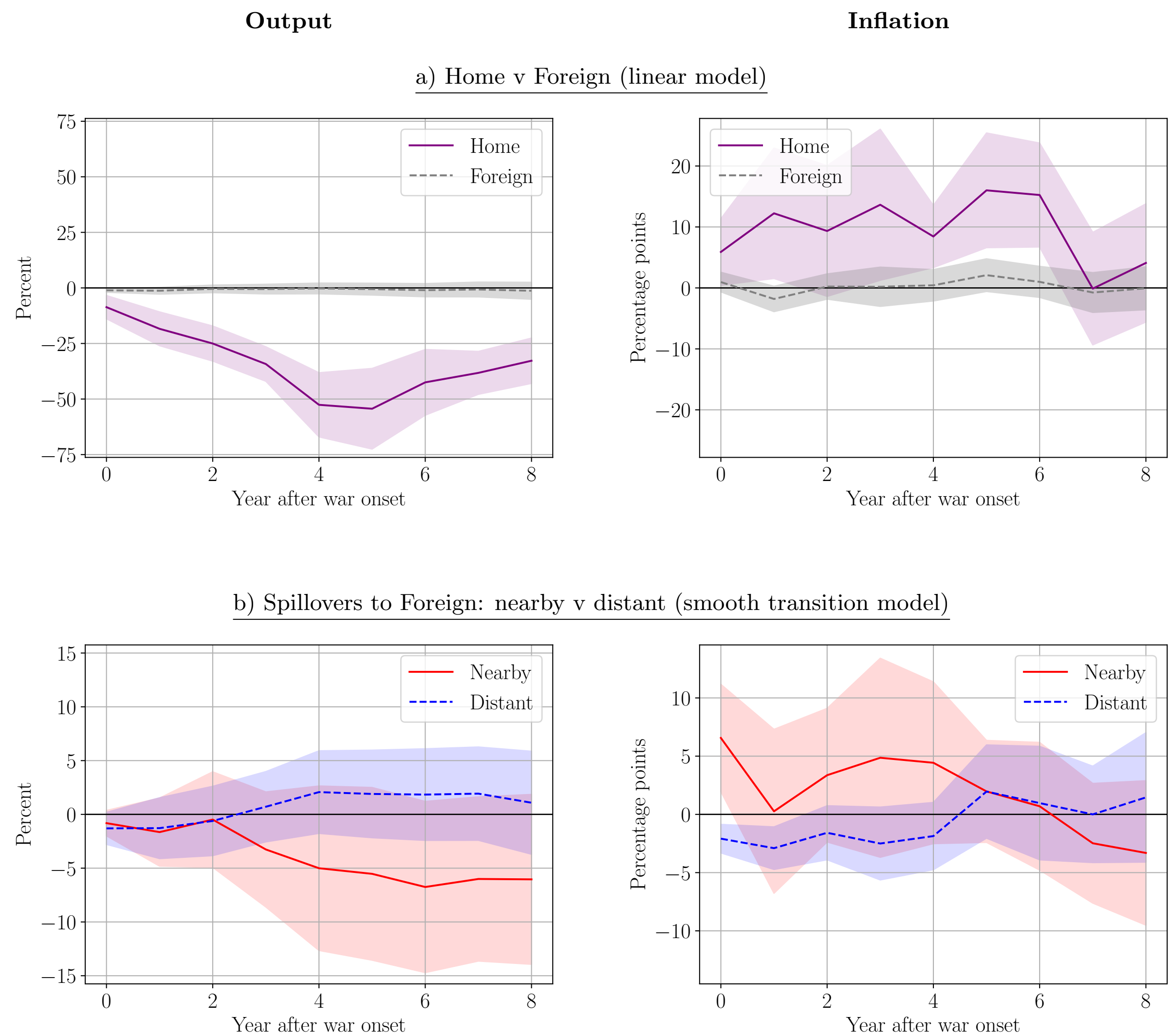
Notes: Left panels show percentage deviation of (detrended) output from its pre-war level, right panels show deviation of inflation from pre-war rate in percentage points. Horizontal axis measures time in years since start of the war. Sample 1870–2022, large war sites (casualties > 10k). Top panel a) shows results for linear specification (3.1). Bottom panel b) shows response for smooth-transition specification (3.2). In contrast to baseline specification, dependent variables are not specified in differences relative to pre-war period but in levels. Shaded areas indicate 90% confidence bands.

Figure C4: The macroeconomic impact of domestic and foreign wars (duration $\leq$ 2 years)



Notes: Left panels show percentage deviation of (detrended) output from its pre-war level, right panels show deviation of inflation from pre-war rate in percentage points. Horizontal axis measures time in years since start of the war. Sample 1870–2022, large war sites (casualties > 10k) with a duration of at most 2 years. Top panel a) shows results for linear specification (3.1). Bottom panel b) shows response for smooth-transition specification (3.2). Shaded areas indicate 90% confidence bands.

Figure C5: The macroeconomic impact of domestic and foreign wars (duration > 2 years)

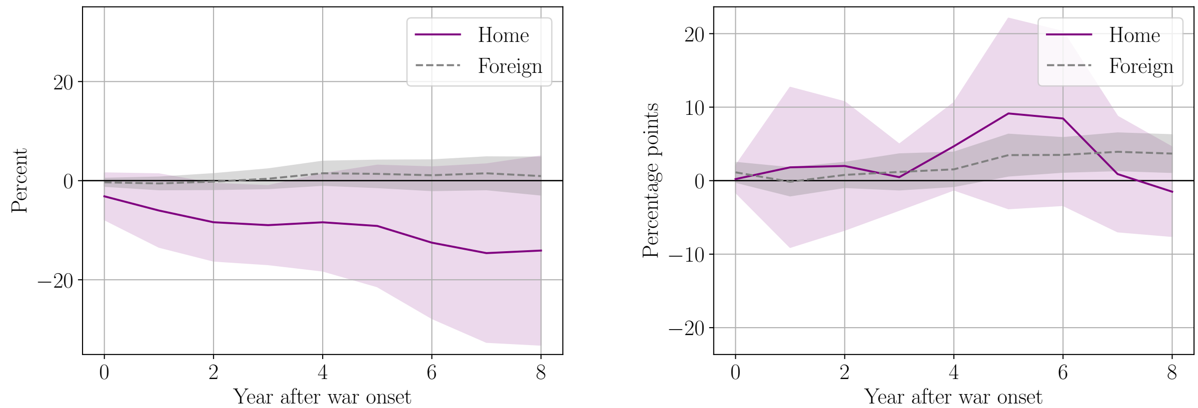


Notes: Left panels show percentage deviation of (detrended) output from its pre-war level, right panels show deviation of inflation from pre-war rate in percentage points. Horizontal axis measures time in years since start of the war. Sample 1870–2022, large war sites (casualties > 10k) with a duration of more than 2 years. Top panel a) shows results for linear specification (3.1). Bottom panel b) shows response for smooth-transition specification (3.2). Shaded areas indicate 90% confidence bands.

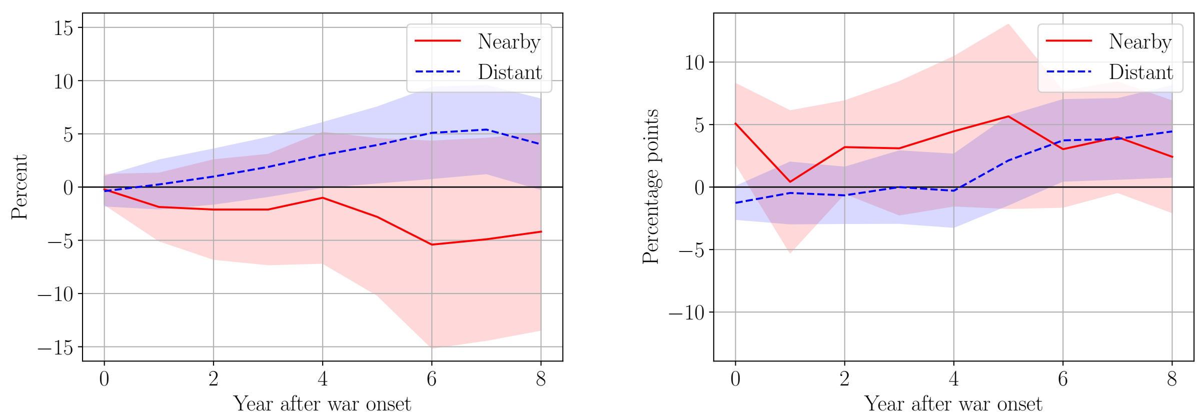
Figure C6: Large wars w/o world wars

Output **Inflation**

a) Home v Foreign (linear model)



b) Spillovers to Foreign: nearby v distant (smooth transition model)

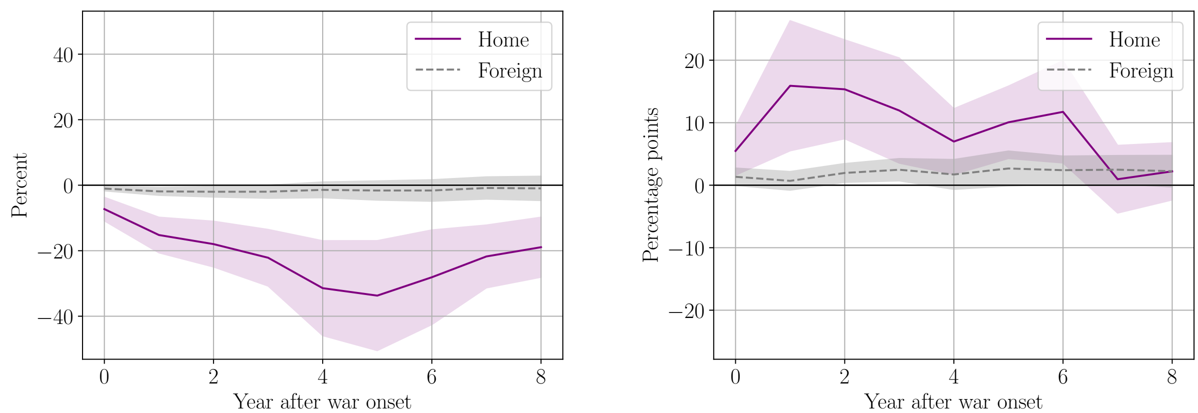


Notes: Left panel show percentage deviation of (detrended) output from its pre-war level, right panel shows response of inflation. Vertical axis measures percentage deviation from the trend, horizontal axis measures time in years since start of the war. Top panels show results for linear specification (3.1). Bottom panel show response for smooth-transition specification (3.2). Shaded areas indicate 90% confidence bands. Sample 1870–2022, large war sites (casualties > 10k) excluding those of World War I and World War II.

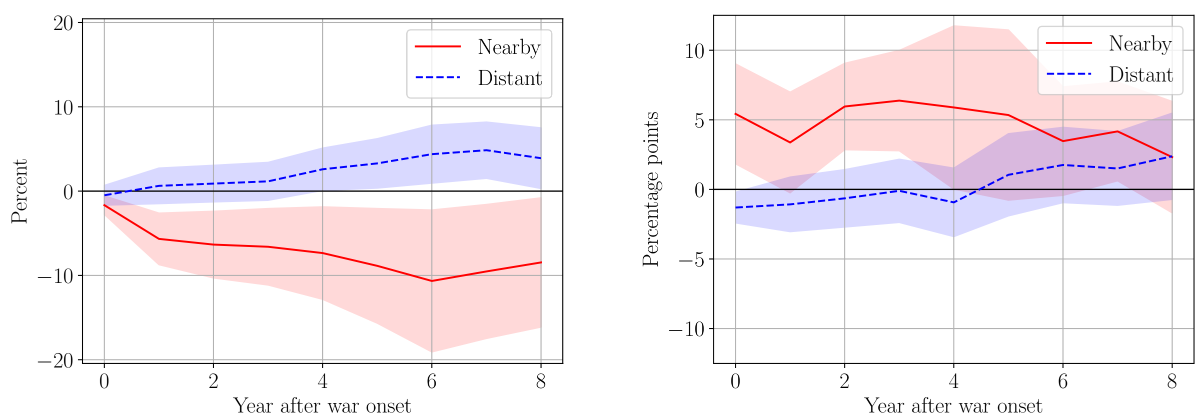
Figure C7: Excluding the U.S.

Output **Inflation**

a) Home v Foreign (linear model)

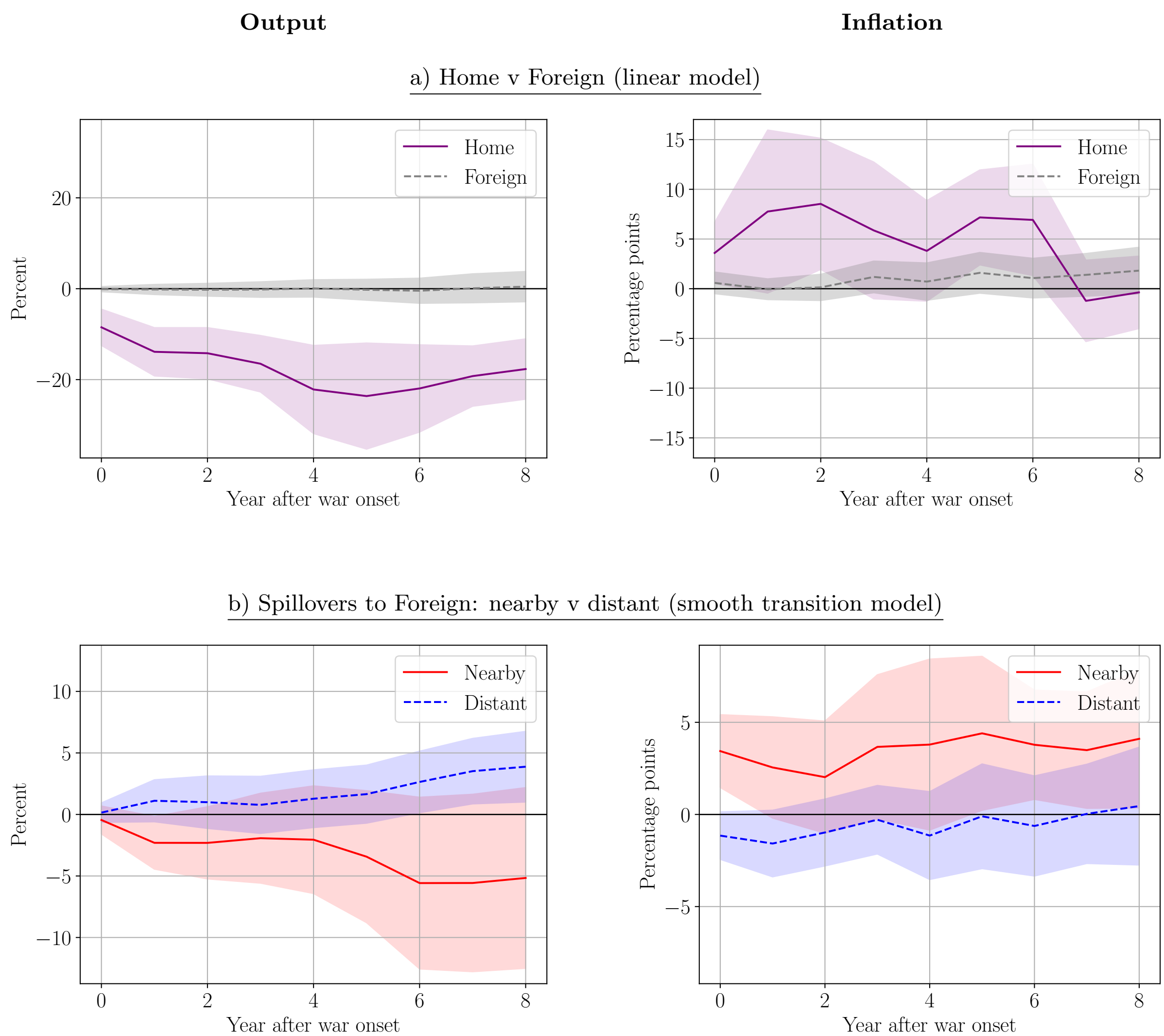


b) Spillovers to Foreign: nearby v distant (smooth transition model)



Notes: Left panels show percentage deviation of (detrended) output from its pre-war level, right panels show deviation of inflation from pre-war rate in percentage points. Horizontal axis measures time in years since start of the war. Sample 1870–2022, large war sites (casualties > 10k) excluding the U.S. Top panel a) shows results for linear specification (3.1). Bottom panel b) shows response for smooth-transition specification (3.2). Shaded areas indicate 90% confidence bands.

Figure C8: All sites

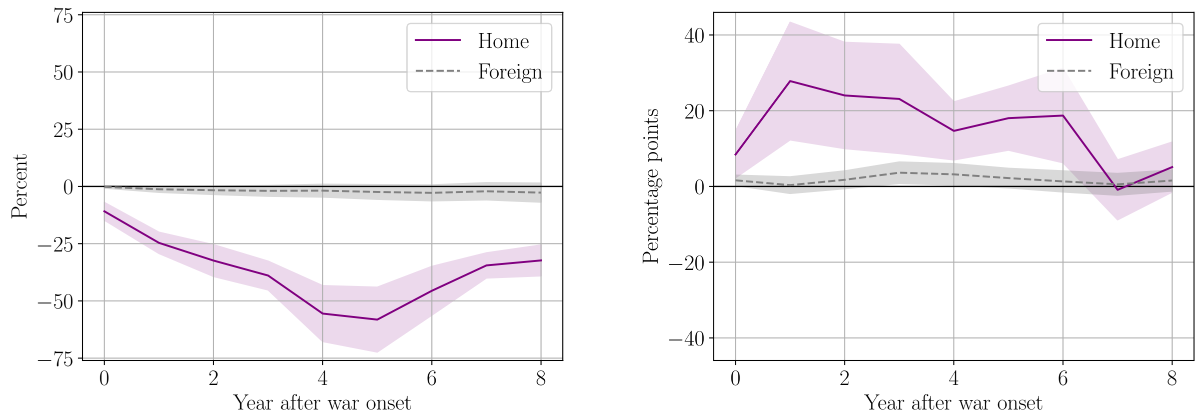


Notes: Left panel show percentage deviation of (detrended) output from its pre-war level, right panel shows response of inflation. Vertical axis measures percentage deviation from the trend, horizontal axis measures time in years since start of the war. Top panels show results for linear specification (3.1). Bottom panel show response for smooth-transition specification (3.2). Shaded areas indicate 90% confidence bands. Sample 1870–2022, all war sites.

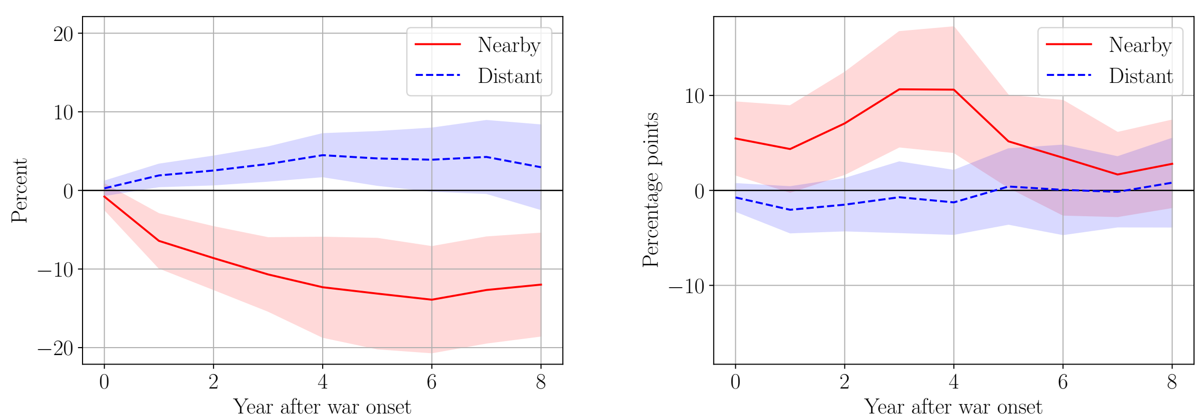
Figure C9: Major sites

Output **Inflation**

a) Home v Foreign (linear model)

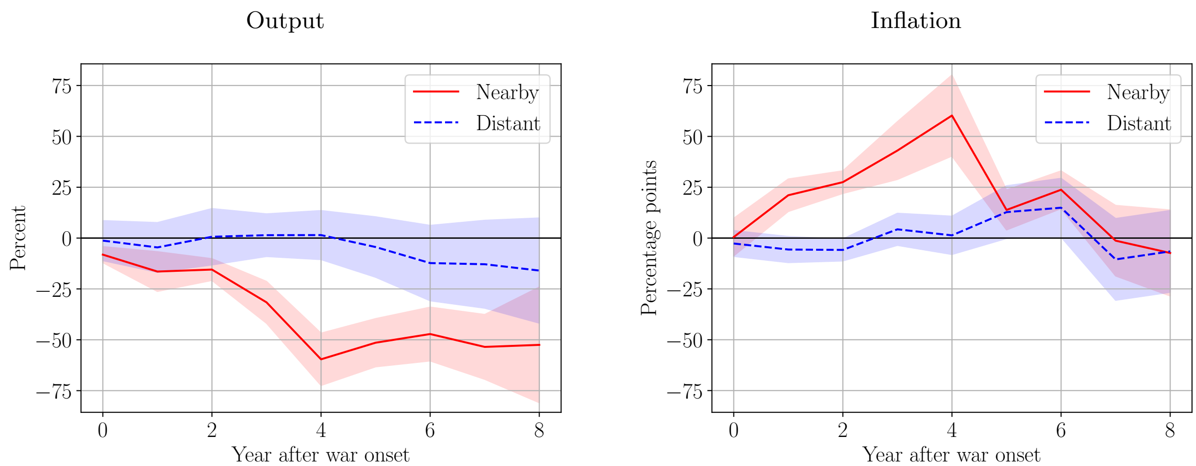


b) Spillovers to Foreign: nearby v distant (smooth transition model)



Notes: Left panel shows percentage deviation of (detrended) output from its pre-war level, right panel shows response of inflation. Vertical axis measures percentage deviation from the trend, horizontal axis measures time in years since start of the war. Top panels show results for linear specification (3.1). Bottom panel show response for smooth-transition specification (3.2). Shaded areas indicate 90% confidence bands. Sample 1870–2022, major war sites.

Figure C10: Casualties specification



Notes: Left panel shows percentage deviation of (detrended) output from its pre-war level, right panel shows response of inflation. Vertical axis measures percentage deviation from the trend, horizontal axis measures time in years since start of the war. Top panels show results for linear specification (3.1). Bottom panel show response for smooth-transition specification (3.2). Shaded areas indicate 90% confidence bands. Outlined regimes are specified as a 1 percent shock on world population. Sample 1870–2022, large war sites (casualties > 10k).

D Casus belli coding

Table D1: Wars and their casus belli

War	Onset	Nationalism	Religion or Ideology	Power Transition	Border Clashes	Economic, Long-Run	Domestic Politics	Revenge/Retribution	Economic, Short-Run	Secondary Sources
Franco-Prussian	1870		✓							Britannica. 2023. Franco-German War. Accessed August 19, 2023. https://www.britannica.com/event/Franco-German-War
First Central American	1876	✓								Bancroft, Hubert H. 1887. "History of Central America." p. 402.
Second Russo-Turkish	1877	✓	✓							Britannica. 2014. Russo-Turkish Wars. Accessed August 20, 2023. https://www.britannica.com/topic/Russo-Turkish-wars
War of the Pacific	1879					✓				Britannica. 2023. War of the Pacific. Accessed August 20, 2023. https://www.britannica.com/event/War-of-the-Pacific
Conquest of Egypt	1882					✓	✓			Hopkins, Antony. G. 1882. "The Victorians and Africa: A Reconsideration of the Occupation of Egypt, 1882." The Journal of African History.
Sino-French	1884	✓								Britannica. 2023. Sino-French War. Accessed August 20, 2023. https://www.britannica.com/event/Sino-French-War
Second Central American	1885	✓	✓	✓						Palmer, Steven. 1993. "Central American Union or Guatemalan Republic? The National Question in Liberal Guatemala, 1871-1885." The Americas.
First Sino-Japanese	1894		✓			✓				Britannica. 2023. First Sino-Japanese War. Accessed August 19, 2023. https://www.britannica.com/event/First-Sino-Japanese-War-1894-1895

War	Onset	Nation-alism	Religion or Ideology	Power Transition	Border Clashes	Economic, Long-Run	Domestic Politics	Revenge/ Retribution	Economic, Short-Run	Secondary Sources
Greco-Turkish	1897	✓		✓						Britannica. 2016. Greco-Turkish wars. Accessed August 19, 2023. `https://www.britannica.com/event/Greco-Turkish-wars`
Spanish-American	1898	✓								Britannica. 2023. Spanish-American War. Accessed August 20, 2023. `https://www.britannica.com/event/Spanish-American-War`
Boxer Rebellion	1900			✓					✓	Britannica. 2023. Boxer Rebellion. Accessed August 19, 2023. `https://www.britannica.com/event/Boxer-Rebellion`
Sino-Russian	1900	✓		✓						Glebov, Sergey. "11 Blagoveshchensk Massacre and Beyond: The Landscape of Violence in the Amur Province in the Spring and Summer of 1900." Russia's North Pacific: 211. Heidelberg University Publishing. ; Britannica. 2023. Boxer Rebellion. Accessed August 19, 2023. `https://www.britannica.com/event/Boxer-Rebellion`
Russo-Japanese	1904	✓								Britannica. 2023. Russo-Japanese War. Accessed August 20, 2023. `https://www.britannica.com/event/Russo-Japanese-War`
Third Central American	1906	✓								Slade, William F. 1917. "The Journal of Race Development." The Federation of Central America
Fourth Central American	1907		✓							Slade, William F. 1917. "The Journal of Race Development." The Federation of Central America; Martin, Percy F. 1911. "Salvador of the Twentieth Century". P. 72-74
Second Spanish-Moroccan	1909	✓	✓							Chandler, James A. 1975. "Spain and Her Moroccan Protectorate 1898 - 1927." Journal of Contemporary History.

War	Onset	Nation-alism	Religion or Ideology	Power Transition	Border Clashes	Economic, Long-Run	Domestic Politics	Revenge/ Retribution	Economic, Short-Run	Secondary Sources
Italian-Turkish	1911	✓					✓		✓	Clark, Christopher M. 2012. “The Sleepwalkers: How Europe Went to War in 1914.” Allen Lane. p. 177.; See “Libyen, verheißenes Land,” Die Zeit, May 15, 2003.
First Balkan	1912	✓								Britannica. 2023. Balkan Wars. Accessed August 19, 2023. `https://www.britannica.com/topic/Balkan-Wars`
Second Balkan	1913	✓								Britannica. 2023. Balkan Wars. Accessed August 19, 2023. `https://www.britannica.com/topic/Balkan-Wars`
World War I	1914	✓	✓							Norwich University Only. 2017. “Six Causes of World War I.” Accessed August 20, 2023. `https://online.norwich.edu/academic-programs/resources/six-causes-of-world-war-i`
Estonian Liberation	1918	✓		✓				✓		Minnik, Taavi. 2015. “The Cycle of Terror in Estonia, 1917–1919”.; Republic of Estonia, Ministry of Foreign Affairs. “Estonian War of Independence 1918-1920 Estonia’s Allies”
Latvian Liberation	1918	✓		✓						Britannica. 2023. Baltic War of Liberation. Accessed August 20, 2023. `https://www.britannica.com/event/Baltic-War-of-Liberation`
Russo-Polish	1919	✓								Britannica. 2023. Russo-Polish War. Accessed August 20, 2023. `https://www.britannica.com/event/Russo-Polish-War-1919-1920`
Hungarian Adversaries	1919		✓							University of Central Arkansas. `https://uca.edu/politicalscience/home/research-projects/dadm-project/europerussiacentral-asia-region/hungary-1918-present/`

War	Onset	Nation-alism	Religion or Ideology	Power Transition	Border Clashes	Economic, Long-Run	Domestic Politics	Revenge/ Retribution	Economic, Short-Run	Secondary Sources
Second Greco-Turkish	1919				✓					Britannica. 2016. Greco-Turkish wars. Accessed August 19, 2023. `https://www.britannica.com/event/Greco-Turkish-wars`
Franco-Turkish	1919	✓	✓							Britannica. 2023. The nationalist movement and the war for independence. Accessed August 19, 2023. `https://www.britannica.com/biography/Kemal-Ataturk/The-nationalist-movement-and-the-war-for-independence`
Lithuanian-Polish	1920	✓	✓	✓	✓					Balkelis, Thomas. 2018. “War, Revolution, and Nation-Making in Lithuania, 1914–1923” via Tauber, Joachim. 2019. “Tomas Balkelis, War, Revolution, and Nation-Making in Lithuania, 1914–1923.” European History Quarterly.; Britannica. 2023. Vilnius Dispute. Accessed August 20, 2023. `https://www.britannica.com/event/Vilnius-dispute`
Manchurian	1929	✓					✓			Siegelbaum, Lewis. “Chinese Railway Incident”. Michigan State University. Accessed August 20, 2023. `https://soviethistory.msu.edu/1929-2/chinese-railway-incident/`
Second Sino-Japanese	1931	✓			✓					Britannica. 2022. Mukden Incident. Accessed August 20, 2023. `https://www.britannica.com/event/Mukden-Incident`
Chaco	1932		✓			✓				Britannica. 2023. Chaco War. Accessed August 19, 2023. `https://www.britannica.com/event/Chaco-War`
Saudi-Yemeni	1934		✓		✓					Britannica. 2023. The Kingdom of Saudi Arabia. Accessed August 20, 2023. `https://www.britannica.com/place/Saudi-Arabia/The-Kingdom-of-Saudi-Arabia`

War	Onset	Nation-alism	Religion or Ideology	Power Transition	Border Clashes	Economic, Long-Run	Domestic Politics	Revenge/ Retribution	Economic, Short-Run	Secondary Sources
Conquest of Ethiopia	1935	✓								Britannica. 2023. Italo-Ethiopian War. Accessed August 19, 2023. https://www.britannica.com/event/Italo-Ethiopian-War-1935-1936
Third Sino-Japanese	1937	✓								Britannica. 2023. Second Sino-Japanese War. Accessed August 20, 2023. https://www.britannica.com/event/Second-Sino-Japanese-War
Changkufeng	1938		✓							Blumenson, Martin. 1960. “The Soviet Power Play at Changkufeng”. World Politics.
World War II	1939	✓	✓			✓	✓			Vasquez, John A. 1996. “The Causes of the Second World War in Europe: A New Scientific Explanation.”
Nomonhan	1939	✓	✓							Otterstedt Charles. 2000. “The Kwantun Army and the Nomonhan Incident: Its Impact on National Security”. USAWC Strategy Research Project.; Britannica. 2023. Mongolia - Counterrevolution and Japan. Accessed August 20, 2023. https://www.britannica.com/place/Mongolia/Reform-and-the-birth-of-democracy
Russo-Finnish	1939		✓							Britannica. 2023. Russo-Finnish War. Accessed August 20, 2023. https://www.britannica.com/event/Russo-Finnish-War
Franco-Thai	1940				✓					Flood Thadeus. 1969. “The 1940 Franco-Thai Border Dispute and Phibuun Sonkhraam’s Commitment to Japan.” Journal of Southeast Asian History
First Kashmir	1947	✓								Britannica. 2023. Kashmir. Accessed August 19, 2023. https://www.britannica.com/place/Kashmir-region-Indian-subcontinent

War	Onset	Nation-alism	Religion or Ideology	Power Transition	Border Clashes	Economic, Long-Run	Domestic Politics	Revenge/ Retribution	Economic, Short-Run	Secondary Sources
Arab-Israeli	1948	✓					✓			Cashman, G., and Leonard C. Robinson. 2007. “An Introduction to the Causes of War: Patterns of Interstate Conflict from World War I to Iraq.” Rowman & Littlefield Publishers, Inc.
Korean	1950	✓	✓	✓						Britannica. 2023. Korean War. Accessed August 20, 2023. `https://www.britannica.com/event/Korean-War`
Off-shore Islands	1954	✓	✓							Office of the Historian, Foreign Service Institute United States Department of State. “The Taiwan Straits Crises: 1954–55 and 1958.”
Sinai War	1956			✓		✓				Wright, William M., Michael C. Shupe, Niall M. Fraser, and Keith W. Hipel. 1980. “A Conflict Analysis of the Suez Canal Invasion of 1956.” Conflict Management and Peace Science
Soviet Invasion of Hungary	1956	✓								Britannica. 2023. Hungarian Revolution. Accessed August 20, 2023. `https://www.britannica.com/event/Hungarian-Revolution-1956`
IfniWar	1957	✓	✓							Studies Institute, US Army War College. 2013. “War and Insurgency in the Western Sahara”; Britannica. 2023. Ifni. Accessed August 19, 2023. `https://www.britannica.com/place/Ifni`
Taiwan Straits	1958	✓	✓							Office of the Historian, Foreign Service Institute United States Department of State. “The Taiwan Straits Crises: 1954–55 and 1958.”
Assam	1962				✓					Britannica. 2023. Sino-Indian War. Accessed August 19, 2023. `https://www.britannica.com/topic/Sino-Indian-War`

War	Onset	Nation-alism	Religion or Ideology	Power Transition	Border Clashes	Economic, Long-Run	Domestic Politics	Revenge/ Retribution	Economic, Short-Run	Secondary Sources
Vietnam War, Phase 2	1965	✓		✓						Britannica. 2023. Vietnam War. Accessed August 20, 2023. `https://www.britannica.com/event/Vietnam-War`
Second Kashmir	1965			✓						Britannica. 2023. Kashmir. Accessed August 20, 2023. `https://www.britannica.com/place/Kashmir-region-Indian-subcontinent`
Six Day War	1967		✓	✓	✓					Britannica. 2023. Six-Day War Accessed August 20, 2023. `https://www.britannica.com/event/Six-Day-War`
Second Laotian, Phase 2	1968			✓						Britannica. 2023. History of Laos. Accessed August 20, 2023. `https://www.britannica.com/topic/history-of-Laos`
War of Attrition	1969		✓	✓	✓					Britannica. 2020. War of Attrition. Accessed August 20, 2023. `https://www.britannica.com/event/War-of-Attrition-1969-1970`; Britannica. 2023. Six-Day War Accessed August 20, 2023. `https://www.britannica.com/event/Six-Day-War`
Football War	1969	✓								Britannica. 2023. El Salvador - Military Dictatorships. Accessed August 19, 2023. `https://www.britannica.com/place/El-Salvador/Military-dictatorships`#ref468021
Communist Coalition	1970	✓	✓	✓						Pradhan, P. C. “Cambodian Crisis of 1970.” Proceedings of the Indian History Congress.
Bangladesh	1971	✓								The National Archive. “The Independence of Bangladesh in 1971 .” Accessed 2023-08-19. `https://www.nationalarchives.gov.uk/education/resources/the-independence-of-bangladesh-in-1971`

War	Onset	Nation-alism	Religion or Ideology	Power Transition	Border Clashes	Economic, Long-Run	Domestic Politics	Revenge/ Retribution	Economic, Short-Run	Secondary Sources
Yom Kippur War	1973		✓	✓	✓					Britannica. 2023. Yom Kippur War. Accessed August 20, 2023. `https://www.britannica.com/event/Yom-Kippur-War`; Britannica. 2023. Six-Day War Accessed August 20, 2023. `https://www.britannica.com/event/Six-Day-War`
Turco-Cypriot	1974			✓						Bishku, Michael B. 1991.“Turkey, Greece and the Cyprus Conflict.” Journal of Third World Studies
War over Angola	1975	✓	✓							Britannica. 2023. Angola - Independence and Civil War. Accessed August 20, 2023. `https://www.britannica.com/place/Angola/Independence-and-civil-war`
Second Ogaden War, Phase 2	1977	✓								Lewis, Ioan M. 1989. “The Ogaden and the Fragility of Somali Segmentary Nationalism.” African Affairs.
Vietnamese-Cambodian	1977	✓	✓				✓			Abuza, Zachary. 1995.“The Khmer Rouge and the Crisis of Vietnamese Settlers in Cambodia.” Contemporary Southeast Asia
Ugandian-Tanzanian	1978	✓			✓					Thomas, C. 2022. Uganda–Tanzania War. Oxford Research Encyclopedia of African History. Accessed August 20, 2023. `https://oxfordre.com/africanhistory/display/10.1093/acrefore/9780190277734.001.0001/acrefore-9780190277734-e-1040`
Sino-Vietnamese Punitive	1979		✓					✓		Britannica. 2023. 20th Century International Relations - American Uncertainty. Accessed August 20, 2023. `https://www.britannica.com/topic/20th-century-international-relations-2085155/American-uncertainty`#ref305042

War	Onset	Nation-alism	Religion or Ideology	Power Transition	Border Clashes	Economic, Long-Run	Domestic Politics	Revenge/ Retribution	Economic, Short-Run	Secondary Sources
Iran-Iraq	1980			✓	✓	✓				Britannica. 2023. Iran-Iraq War. Accessed August 19, 2023. `https://www.britannica.com/event/Iran-Iraq-War`
War over Lebanon	1982	✓		✓	✓					Britannica. 2023. Lebanese Civil War. Accessed August 20, 2023. `https://www.britannica.com/event/Lebanese-Civil-War`
Falkland Islands	1982	✓					✓			Britannica. 2023. Falkland Islands War. Accessed August 19, 2023. `https://www.britannica.com/event/Falkland-Islands-War`
War over the Aouzou Strip	1986	✓				✓				Naldi, Gino J. 2009. "The Aouzou Strip Dispute — A Legal Analysis." Journal of African Law; Britannica. 2011. Aozou Strip. Accessed August 20, 2023. `https://www.britannica.com/place/Aozou-Strip`
Sino-Vietnamese Border War	1987		✓				✓			Yu, Miles M. 2022. "The 1979 Sino-Vietnamese War and Its Consequences ." Hoover Institution.; Britannica. 2023. 20th Century International Relations - American Uncertainty. Accessed August 20, 2023. `https://www.britannica.com/topic/20th-century-international-relations-2085155/American-uncertainty`#ref305042
Gulf War	1990		✓			✓				Britannica. 2023. Persian Gulf War. Accessed August 19, 2023. `https://www.britannica.com/event/Persian-Gulf-War`
Bosnian Independence	1992	✓								Britannica. 2023. Bosnian War. Accessed August 19, 2023. `https://www.britannica.com/event/Bosnian-War`
Azeri-Armenian	1993			✓						Melander, Erik. 2001. "The Nagorno-Karabakh Conflict Revisited." Journal of Cold War Studies.

War	Onset	Nation-alism	Religion or Ideology	Power Transition	Border Clashes	Economic, Long-Run	Domestic Politics	Revenge/ Retribution	Economic, Short-Run	Secondary Sources
Cenepa Valley	1995				✓	✓				The Economist. 1998. Peace in the Andes.
Badme Border	1998				✓			✓		Pratt, Martin. 2006. “A Terminal Crisis? Examining the Breakdown of the Eritrea-Ethiopia Boundary Dispute Resolution Process.” Conflict Management and Peace Science; Britannica. 2023. Independent Eritrea. Accessed August 19, 2023. `https://www.britannica.com/place/Eritrea/Independent-Eritrea`
War for Kosovo	1999	✓		✓						Larson, Eric V. and Bogdan Savych. 1999. “Operation Allied Force (Kosovo, 1999).” in Misfortunes of War. RAND Corporation.
Kargil War	1999		✓		✓					Tellis, Ashley J., C. Christine Fair, and Jamison Jo Medby. 2001. “Limited Conflicts Under the Nuclear Umbrella: Indian and Pakistani Lessons from the Kargil Crisis.” 1st ed. RAND Corporation.; Britannica. 2023. Kargil War. Accessed August 20, 2023. `https://www.britannica.com/event/Kargil-War`
Invasion of Afghanistan	2001		✓	✓						Britannica. 2023. Afghanistan War. Accessed August 19, 2023. `https://www.britannica.com/event/Afghanistan-War`
Invasion of Iraq	2003		✓	✓						Britannica. 2023. Iraq War. Accessed August 19, 2023. `https://www.britannica.com/event/Iraq-War`
Invasion of Ukraine	2022	✓	✓							The Economist. 2022. “John Mearsheimer on why the West is principally responsible for the Ukrainian crisis.”.

Notes: Table provides an overview of reasons for which wars were fought. Except for the 2022 invasion of Ukraine, primary sources always are Sarkees and Wayman (2010) and Clodfelter (2017). Secondary sources as outlined in table were used to cross-check and complement casus belli coding, where applicable.