

Economic Warfare: Lessons from Two World Wars

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Abstract

Economic warfare was a product of the total wars of the twentieth century. Four lessons are discussed: (1) Modern economies are resilient under attack. (2) The action of economic warfare is slow. (3) Economic warfare is powerful—eventually. (4) The threat of economic warfare is also powerful—although not always as hoped. To conclude, economic warfare belongs to wars of attrition. In such wars, economic and military measures are complements, not substitutes.

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Economic Warfare: Lessons from Two World Wars

The idea of “economic warfare” arose in the era of total wars. It did not exist before the twentieth century.¹ Economic warfare is usefully defined by Charles Vickers (1943: 14), at the time deputy director-general of Britain’s Ministry of Economic Warfare: “The attack on the enemy’s economic fighting power: on his power to keep his forces armed, equipped, munitioned, fed, mobile, which is . . . the greatest single element in his power to resist, and therefore the greatest single objective of total war.”

Being sharply focused, these few words leave many things unsaid. One is that economic warfare was not the same as “trade wars”—conflicts over market access or competitive advantage. In economic warfare, the sole criterion of success was the extent to which the adversary’s fighting power was weakened as a result. Because of economic warfare, a country’s market access or competitive advantage might well be weakened, but that was incidental to the main purpose, which was to weaken its fighting power. In economic warfare, we will see, a country’s access to supplies was more fought over than access to markets.

Another issue is the difference between economic warfare and economic sanctions. At first sight it might seem that the two are similar if not the same, and that what we call “sanctions” in peacetime turns into “economic warfare” when war breaks out. But this is too simple. Not all sanctions fit the bill of economic warfare. According to Francesco Giumelli (2011: 34), the purposes of sanctions comprise “coercing, constraining, and signalling.” As it happens, the domain of economic warfare is limited to constraining sanctions. In two world wars, the purpose of economic warfare was to constrain the adversary’s choices by limiting their access to supplies.² It is true that the other modern uses of economic sanctions (to signal rule-breaking behaviour and to coerce “rogue” states into

¹ See the Google Books Ngram Viewer at <https://books.google.com/ngrams/>, searching for “economic warfare” (case-insensitive, unsmoothed) in the Google Books English language corpus (2019).

² Giumelli (2012: 77-101) associates constraining sanctions with conflicts involving high threat, salience, and complexity—a good enough description of coalition warfare.

changing their behaviour) grew out of the experience of wartime blockade (Dehne 2018, Mulder 2022). Nonetheless, the coercive and signalling types of sanctions do not belong to economic warfare. Thus, economic warfare (or “constraining” sanctions) turns out to be a subfield within the wider subject of economic sanctions.

After more than a century of experience, what do we know about economic warfare? Here, the reader should note a bias in the literature. At least 80 percent of what we think we know about economic warfare in history is based on the experience of a single country, Germany, between 1914 and 1945. In two world wars, German leaders anticipated economic warfare, were subjected to it, responded to it, and practiced it on others.³ The literature has studied this experience intensively, seasoned it with snippets from other countries and periods, added fibre from a large political science literature on economic sanctions in a wide variety of settings and mostly in peacetime, and garnished it with a wide array of plausible inferences.

Subject to the qualifications and the biases, four lessons emerge from the historical experience of economic warfare as we know it. The first two are negative: (1) Modern economies are resilient under attack. (2) The action of economic warfare is slow. Then, a positive lesson: (3) Economic warfare is powerful—eventually. Finally, a warning: (4) The threat of economic warfare is also powerful—but not always as hoped. In conclusion, history shows that in war economic and military actions should be seen as working together. They are strategic complements—not substitutes.

At the time of writing, these issues have ceased to be purely historical. Economic warfare is being waged in Europe today on three fronts. Russia, having failed to overwhelm Ukraine in a surprise attack in February 2022, is now seeking to undermine its fighting power by repeated attacks on Ukraine’s civilian infrastructure. Most NATO countries are united in imposing sanctions on Russia, some of which are clearly intended to constrain Russia’s fighting power and so to qualify as economic warfare. And Russia is engaged in an undeclared war to destabilize Western Europe, using the denial of energy exports as its weapon. While each of these campaigns has novel aspects, it will be seen that all the lessons that are available from history continue to apply today.

³ *Economic Warfare in Modern History* is the working title of a volume of original papers to be collected, edited, and introduced by Stephen Broadberry and myself and (subject to the usual contingencies) published by Cambridge University Press in 2025. One aim of this project is to overcome the literature’s undue focus on Germany in the two World Wars by exploiting a wider sample of cases drawn from the last three centuries.

1. Modern economies: resilient under attack

The two world wars were wars of attrition. Victory cost years of effort, tens of millions of lives, and many billions in the currencies of the time. They were fought, if not literally to the last man standing, then to the last unit of resource. In World War I, both sides looked for ways to avoid attrition. They hoped to find it in surprise (Germany's Schlieffen Plan), in novel weapons (poison gas, submarines), and in aiming for the adversary's weakest ally (Turkey on one side, Russia on the other). With every new venture, however, the expenditures of blood lives and treasure increased.

Some placed their hopes in blockade. At the end of the nineteenth century, noting the growing dependence of the European powers on long-distance trade, the Russian banker Ivan Bloch pointed to implications for contemporary conflict. Modern war, he thought, would begin and end with the interruption of trade. In the first year of war, France would miss a month of food supplies, Germany two months' worth, and England would run out of food after only three months. Famine among the people would destroy their capacity for resistance (Bloch 1899: xlix-l, 296). As a result, he concluded, modern war had become impossible to contemplate. A book on the same theme by the journalist Norman Angell (1910) sold two million copies.

If Angell thought he had shown the impossibility of war, however, his readers could infer otherwise: it was mass armies that had lost their *raison d'être*, while naval blockade could be a war-winning weapon. The war could be won quickly by bringing about the economic collapse of the adversary or by forcing the adversary into a decisive sea battle, or the threat of blockade could even win a war before it began. These messages were not without influence, particularly in the British Admiralty (Offer 1989: 263, 285-299).

Less popular, but also influential, were the ideas of the economist Robert Giffen, who emphasized the dependence of global trade on intertemporal contracts and credit. The outbreak of a major war, he warned, could lead to financial panic and a meltdown of global finance.⁴

British war plans did not expect the Royal Navy to win the next war either quickly or unaided. The effects of French and Russian resistance on the battlefield would be combined with those of a British blockade of German ports and shipping to wear Germany down by a gradual process. The plan was not settled: it continued to evolve, while leaving important issues unresolved concerning the treatment of neutral shipping and trade

⁴ As described by Lambert (2012: 109-126), Giffen became an early advocate of credit sanctions. This interpretation rests on a "lost" paper.

in nonwar goods (Marder 1961: 367-383; Offer 1989: 270-299). Anyway, the plan did not quite work out for several reasons. Neither the French nor Russian armies were fully up to the task presented by Germany and required reinforcement, immediately from Britain, and later from the United States. In wartime the blockade proved to be a work in progress. In principle the Allies resolved their issues in the spring of 1915 by extending the embargo to all goods potentially bound for Germany on all ships, including those of neutral countries (Hardach 1987: 11-34).⁵ At the same time the British blockade was resisted by the neutral powers and also by the considerable threat of a German counter-blockade. Total war took time, and this one dragged on for more than four years.

What did Bloch and Angell miss? To their way of thinking, an interruption of normal commerce would first of all strangle Britain, with its most industrialized, most import-dependent economy, while food-exporting Russia could survive the longest. In fact, when blockaded, these economies did not collapse; they adapted. The complex relationships of the supply side proved to be self-repairing networks, not brittle chains. When one commodity was denied, or its supply was impaired, other commodities flowed in to take its place or action was taken to mitigate the loss. In the adjustment, openness and interdependence gave strength, not weakness. When confidence in credit was shaken, it was repaired by government guarantees. Despite the thorough disruption of global trade, the war saw economic fighting power on all sides grow steadily up to 1917/18. Civilian wellbeing declined, but the decline was slow. Contrary to Bloch's expectation, it was in the less modernized, more agrarian continental economies that the undermining went on most rapidly.

2. Economic action: slow

Because modern economies are resilient, economic warfare is slow. World War I lasted four years and World War II lasted six. In both wars, economic warfare was a powerful factor in the outcome, but the measures taken had to overcome powerful frictions before their effects became apparent. The frictions arose in two phases, the phase of preparations and the phase of implementation.

⁵ This understanding is opposite to that of Lambert (2012), who argued that the last years before the war saw the British adopt an even more radical plan for a speedy victory by sealing the German economy off from world trade and pulling the plug on the global financial system to that end; when war broke out, the plan was watered down. For representative critiques see Gough (2013) and Coogan (2015). I thank Avner Offer for comments.

Preparations were the first source of delay. Economic warfare involved attacking civilian property and lives, against which there stood powerful moral and legal barriers, and these took time to overcome. Time was also required to scale up the armament and administration of economic warfare.

The blockades of World War I, which had been expected to bring economic life to an immediate standstill, proved slow to put in place. Germany's overland trade with France and Russia was naturally interrupted by the state of war. As for trade by sea, the Allied blockade was limited at first to "war goods" narrowly defined. This allowed Germany still to import the much wider range of commodities used indirectly by its war effort, so in March 1915 the Allied blockade was widened to all goods bound for German ports. Meanwhile, Germany's trade was redirected through the ports of neutral neighbours, carried on neutral and even British ships. To retain its effectiveness the Allied blockade placed severe limits on neutral trade and shipping. A comprehensive blockade was not achieved until the largest neutral trading economy had joined the Allies—the United States in April 1917. If we compare 1917 to 1913, German imports were halved: their volume fell to 40 percent of the prewar level, and their share in GDP to 9 percent from 19 before the war (Ritschl 2005: 50).

Germany entered the war without a plan for blockade of the British Isles, and with a small submarine fleet primarily intended to attack the British warships closely blockading German ports. For that reason, among others, the British did not offer such a battle, pursuing a policy of "distant" blockade. The submarines were repurposed to attack Allied merchant shipping in the Atlantic, but it took time to expand their number.

Meanwhile, like the British, the German leaders had to push at the existing norms protecting nonwar goods and neutral shipping. A submarine blockade based on warning and inspection proved ineffective, prompting a turn towards "sink without warning." This led to crises of both conscience and diplomacy. Attacks on neutral shipping eventually caused the United States to abandon neutrality and enter the war. There is a sense here in which Britain got away with the attack on neutral trade, while Germany suffered more serious consequences.

Table 1 provides a simple measure of the rate at which the German submarine campaign developed. It measures intermediate products (in this case, ships sunk)—not the final output (damage to the adversary's fighting power). The pace was leisurely: it took nearly a year to chalk up the first 10 percent of the eventual wartime total of Allied and neutral shipping losses. After almost three years of a four-year war, half of wartime sinkings still lay in the future; the campaign was still building.

Table 1 near here

In World War II, German submarine warfare reprised its role. Submarines were no longer a novel weapon. Given the greater scope for preparation and the reduced concern for legality, the German campaign unfolded at a smarter pace. Table 1 shows that Allied and neutral shipping had suffered the first 10 percent of losses in less than a year of a longer war. The 50 percent mark was attained in fewer than three years, before the war's half-way mark. Nonetheless the deployment of the technology of blockade was far from instantaneous.

Air power was the innovation of World War II on the economic front. As the war began, there were fears that clouds of bombers would quickly bring widespread devastation. The British authorities forecast that, in two months of war, German bombing of the UK would kill 600,000 and injure 1.2 million (Titmuss 1950: 13). In reality, neither side was equipped or ready for such measures. In the last months of 1939, both sides hesitated to move first. In 1940 and 1941, the two sides traded blows of roughly equal weight—but the blows were puny. The bombs were carried by handfuls of light aircraft, a pale shadow of what was to come.

At this moment, the sides drew divergent lessons: Hitler decided the bombing war on British factories was a failure, while the Allies determined to try much harder (Overly 1977: 55-57). As a result, the bomb tonnage that the Allies dropped on Germany eventually exceeded the German tonnage on Britain by 25 or more times. In the last nine months of the war the Allied air war on Germany unfolded on a terrifying scale. But, as Table 1 shows, the climax of the bomber offensive arrived with far more delay than in the submarine campaigns. In short, air war might sound faster than naval war, but the Allied air war against the German economy took much longer to build than Germany's naval wars against Allied trade.

The next phase of postponement of the impact of economic warfare arose when the adversary undertook countermeasures. These could be both economic and military. Military countermeasures could be defensive (considered shortly) and offensive (considered in a later section). While defences aimed to stop economic warfare in its tracks, economic countermeasures came into play afterwards, by inventory disinvestment and economizing, by trade diversion and import substitution, and by substitution of alternative commodities for those denied by the enemy.

Defences were costly, even prohibitively so. In two world wars, the Central Powers could do little to drive away the Allied naval supremacy. In 1916 the German battle fleet ventured out, fought the Battle of Jutland, and returned to port. Being inconclusive, the battle amounted to a German defeat. In contrast, the Allies defended against submarine attacks

on shipping by convoy protection and anti-submarine technologies, which became increasingly effective. Air defence was another matter. In World War II both sides invested heavily in fighter protection, anti-air artillery, and air raid precautions. The difference was that the Allies bore these costs and at the same time made still greater investments in the bomber offensive. For Germany air defence came at the expense of its own air offensive and deprived the Eastern front of adequate air cover.

Turning to economic adaptation, much of the story is already represented in the German experience of World War I. Trade diversion came first: in 1914/15, while German ports on the North Sea were already closed by the “distant” blockade, German trade surged overland through neutral Netherlands and across the Baltic with Sweden—as did Allied exports and re-exports to those countries (Hardach 1987: 17-27). These practices, which were perfectly legitimate under prewar treaties and international norms, led the Allies to seek to impose agreements on the neutral powers to limit their imports to the quantities required for the domestic market alone, leaving no surplus for re-export to Germany. The agreements were backed up by Allied certification of neutral ships and cargoes and aggressive blacklisting of potential violators.

Then, as the blockade cut into German supplies, there was fierce economizing of the civilian uses of fuels, chemicals, metal goods, and textiles. Synthetic nitrates took the place of the naturally occurring commodities that were previously imported. Raw cotton was replaced by flax, hemp, and wooden fibres. Meat and butter were replaced by vegetables and vegetable fats, wheat flour by barley, oats, and corn meal, and coffee by ground acorns. In these ways, German producers and consumers made extraordinary efforts to make do with less. Blockaded supplies that were often previously thought to be essential turned out to have many inessential uses that could be cut back. As Olson (1963) later wrote, no commodity was truly essential at the margin. As a result, the repercussions of any loss of supplies were always less than was expected, because the economy under attack always found some sort of scope for adaptation.

Adaptation was not free, but the civilian costs of adaptation were lower in Britain than in Germany. Starting from higher prewar nutritional standards, British consumers had more scope to adapt to a more vegetarian diet. For British farmers, a larger extensive margin allowed cheaper expansion of field crops. Moreover, Britain retained access to Atlantic trade. Rationing was introduced later in Britain, across fewer food products, and was more effective. The relative disadvantage of low-income households in UK food markets was reduced, whereas in Germany it increased (Blum 2013; Gazeley and Newall (2013). By 1917/18, Germany was reaching the limits of adaptation, suggested by widespread

hunger illnesses and deaths, but the UK saw no hunger deaths and nutritional standards were largely maintained.

The advent of the bomber in World War II did not much change this story. A canonical episode was the raids carried out by the Eighth USAAF on Germany's ball-bearing industry in Schweinfurt in 1943. Ball bearings were essential to every kind of military vehicle and machine. Any loss of production capacity was expected to disable German war production.

The attacks destroyed up to half Germany's existing capacity. But there was "no evidence that the attacks on the ball-bearing industry had any measurable effect on essential war production" (USSBS 1945a: 6). To explain this, Olson (1962) found that the attack was answered by a ripple of economizing and substitution. Germany's ball-bearing supplies were previously more than adequate for the needs of war production. The user industries adapted by running down inventories and economizing on the many inessential uses of ball-bearings for which other kinds of bearings could be substituted.

The bombing of Germany's synthetic oil plants later in the war provides another case. The industry was created before the war to insure against a blockade that would deny Germany access to imported oil. By 1944 nearly all German aviation fuel was obtained from specialized chemical plants that turned plentiful domestic coal into hydrocarbons.

Requiring the precision of daylight bombing, the oil campaign began only in May 1944. It took on a large scale – more than 10 per cent of the Allied bombing effort by the end of the war (Table 3). According to the data, it was highly effective in stopping fuel production in the short term. The impact on fighting power was put off by two factors. One, the German economy held large stocks, so the loss of output did not translate into immediate shortages. Two, oil plants could be rebuilt more quickly than thought. Repeated bombing might have prevented this but was not undertaken.

The American and British survey groups drew different conclusions. The USSBS (1945b: 82-83) concluded that the oil industry should have been bombed sooner and at higher frequency. The BBSU (1998: 153-154) maintained that the decisive factor in the eventual collapse of fuel supplies was not so much the bombing of the oil plants as of the railways (discussed below), which cut off inter-industry supplies and prevented the distribution of stocks.

As can be seen in the case of oil, other factors could also add to the long delay before economic warfare could have its effect fighting power. One was the time required for those in charge of economic warfare to monitor results, learn from mistakes, and adapt techniques—for example, to increase the frequency of attacks. Economic warfare did not only take time: it also required persistence and alertness. But responses could be

deadened by competing career concerns and infighting among those responsible. Too often “the probabilities of war were overshadowed by the imperatives of departmental conflict” (Offer 1989: 286). Much of the effectiveness of economic warfare could be understood only years after the war was over. Even then national honour and bureaucratic interests risked biasing the analysis (Biddle 2015: 752-754).

In two world wars, politicians and military leaders repeatedly dreamed of quick results. In fact, a decision to launch a campaign of economic warfare marked the beginning of a lengthy and complicated process of repetition and mutual adjustment on both sides, measured in years, during which little impact on the adversary’s fighting power might be registered. For present purposes, the important thing is not the complexity but the duration: economic warfare took time, lots of it.

3. Economic action: powerful, eventually

Economizing and workarounds helped to make economic warfare slow, but they were not the end of the story. Adaptations and countermeasures were costly. While the countermeasures protected the war effort in the short term, the price was displaced onto civilian producers and consumers whose conditions of work and life were gradually degraded. In the long term, the war effort relied on those same civilian producers and consumers to supply war goods and services. As long as the civilian sector would cushion the blows, the war could be carried on as before. While this went on, economic warfare would seem to have little effect. But civilian resources could not be depleted for ever. Eventually, the war effort too would suffer. Suddenly, the cumulative impact of economic warfare on fighting power would become apparent.

The validity of this mental model requires demonstration of two effects: one, the depletion of civilian resources by economic warfare, and two, the consequent loss of fighting power as the civilian sector reaches the limit of adaptability. It is easier to show the first than the second.

In Germany in two world wars, civilian resources were gradually depleted. During World War I the German population became increasingly sick and hungry, with serious dietary deterioration and hundreds of thousands of hunger deaths by 1918 (Davis and Engerman 2006: 210). We will see below that there was more than one cause, but the blockade played a significant part. In World War II, Germans did not suffer hunger deaths but, despite their privilege relative to the occupied populations, their food rations deteriorated sharply to the level of physiological subsistence in 1941/42 and below in 1944/45 (Abelshauser 1998: 155).

Table 2 near here

The decline of civilian wellbeing was the result not of economic warfare alone, but of its interaction with other wartime processes, especially war mobilization. The case of Germany in World War I allows the two factors to be compared. Table 2 measures human calories consumed in Germany and their sources. As previously noted, in 1913, Germany produced four-fifths of human calories and imported the rest. War mobilization stripped German farms of men, horses, machinery, and chemicals. As a result, farm output fell by roughly 40 percent. Home-produced calories, 72 trillion in 1913, were only 43 trillion in 1917. At the same time, the Allied blockade cut import volumes by roughly 60 percent up to 1917, that is, from 18 to 7 trillion. This allows us to see that, of the total harm to German nutrition, the mobilization shock accounted for more than three-quarters (a loss of 29 trillion calories), while the trade shock accounted for the rest. The calculation also illustrates that the effects of economic warfare and of military mobilization on the civilian population, were additive: neither would have been as powerful without the other.

This is the easy part: to show how economic warfare contributed to the gradual depletion of the civilian resources on which fighting power is based. The more difficult part is to identify the eventual impact on fighting power. The one case where investigators have tried to go the full distance is that of Germany in World War II. They allow us to ask when Germany's war effort became unsustainable and what made it so.

As a starting point, the aggregate data of Germany's war effort are relatively unhelpful. Month by month through most of the war, Germany's war production rose nearly in step with the intensity of Allied bombing (Figure 1). Over three years of war, from 1942 to 1944, while the volume of bombing increased by two orders of magnitude, German war production tripled in volume, pausing only from mid-1943 to early 1944. The broad co-variation of the measures of German war production with the intensity of Allied bombing underpinned decades of scepticism about the effectiveness of the latter. On the most optimistic reading, up to the summer of 1944, the bombing could only have prevented German war production from increasing by more than it did.

Figure 1 near here

Searching for a more granular approach to causation, scholars have added a range of plausible narratives to the mix of evidence. These include contemporary German accounts (Milward 1977, Overy 1984, Tooze 2005, Biddle 2015) and retrospective Allied sources (USSBS 1946, BBSU 1998)—all, however, potentially tainted by self-interest.

A data-driven approach, surely the gold standard for this project was rarely undertaken. One relevant finding was that town raids did somewhat depress the German economy's total output. In 1945 the US bombing survey team estimated the overall effects of town raids on the Germany economy from a sample of ten cities. Comparing the destruction of these towns with their contributions to industrial production, the US survey estimated losses of total production year by year. The lost production was thought to have peaked at 17 per cent in 1944 (BBSU 1998: 93).

This was the loss of total output, but the point of economic warfare was to damage the enemy's fighting power; damage to the economy as a whole was incidental to that goal. The British survey unit worked to close the gap. They compared 21 towns that were heavily bombed to 14 that were largely unscathed – an early use of differences-in-differences. Monthly data by town and by industrial branch from April 1943 to June 1944 showed that, while total output rose everywhere over the period, in the bombed towns it fell short of the untreated group by 13.7 percent. But the loss of war production was much less – only 6 per cent. Moreover, the loss diminished over time. By implication, “with increasing experience of air attack, the Germans became more skilled at diverting the effects of air attack onto the civilian sector of industry” (BBSU 1998: 95-96). Generalized to Germany as a whole, these findings suggested modest losses of overall war production.

Another exercise indicated that that the pause of 1943 marked the moment when Allied bombing began to have its impact on German war production. As Figure 1 showed, the Wagenführ index of finished German armaments, 100 in the first months of 1942, and a little over 230 in mid-1943, stopped there and remained at the level through early 1944. The British survey unit estimated potential output (or capacity) of every plant in every specialized branch of German war industry month by month through the war and aggregated each sector up on the same basis as the Wagenführ index. In the outcome (Figure 2), German war production first fell short of potential in the third quarter of 1943 and paused its growth at that level until 1944. This was evidence of an external disturbance—Allied bombing.⁶

Figure 2 near here

In September 1944, Allied bombing turned to German transportation, which eventually accounted for more than one-third of the overall Allied bombing effort (Table 3). The campaign received special attention in the

⁶ Precise interpretations of the 1943 pause vary. Compare Tooze (2007: 596-598) and Biddle (2015; 501-503) to O'Brien 2015: 297-298).

British bombing survey report. It began just as Allied forces on both sides began to encroach on Reich territories, so a first step was to control for the direct effects of territorial losses on German war production. These were found to be insubstantial before the beginning of 1945. German war production had peaked and begun to turn down in the summer of 1944, so it followed that the decline was not triggered by territorial losses.

Could the onset of the collapse of the German war industries be linked causally to the attack on the railways? This required two more steps. One was to identify the direct effects of bombing on German railway shipments. Starting from time-plots for 31 railway districts and monthly data through 1944, the British survey unit again used differences-in-differences to identify the relationship. Railway shipments declined precipitately from August 1944. The decline was found exclusively in the 23 districts (three quarters of the total) that were attacked from the air. Districts that were not attacked showed no loss of performance (BBSU 1998: Figure 47, facing page 129).

The final step was to link the disruption of the railways to the decline of war production. Over the ten months up to the end of the war, the decline of German war production appeared to respond to the decay of railway shipments with a lag of one or two months. This was taken in evidence that bombing the railways was the thing that finally collapsed the German war economy (BBSU 1998: Figure 42, facing page 134). Ten data points from a period when everything was collapsing at once might be less than ideal for explanatory power, but that was the data to hand.

Why would the attack on German transportation have its effect when everything else seemed to fail? An answer takes us back to the Schweinfurt raids of 1943, which were inspired by the idea that the modern economy's weakness was its reliance on vertical (supply-chain) integration. As Olson showed, the analogy of the supply chain was misleading. Modern economies are integrated by robust networks, not fragile chains. The transportation campaign attacked the German economy from a different angle, its horizontal (spatial) integration. Intense bombing knocked out all the connections that linked production to supplies of stocks and materials and the front line to production. As a result, everything stopped moving. After five years of war, the German economy had run out of inventories and out of scope to economize and substitute. Now, sustained attack led to precipitate collapse. As Germany reached the limit of adaptation, economic warfare became suddenly powerful.

4. The threat of economic action: also powerful

Economic warfare works by constraining the adversary. Because economic warfare is powerful eventually, the threat of economic warfare

can also be powerful. But threats do not constrain; they attempt to coerce by promising penalties. The adversary's responses to the threat of economic warfare need not be confined to mitigation of the economic consequences. Adaptation can be pre-emptive, and it can also be displaced to the military sphere. Here we gain a fuller understanding of what it means to claim that economic action is slow. What is it that is faster than economic action? The answer is military action. If economic action is powerful, but slow, then military action can pre-empt its anticipated effects.

German leaders feared an Allied blockade before 1914, but the fear did not deter them from launching World War I. How do we know this? For twenty years before the war, the Germany Navy built battleships to neutralize the Royal Navy in the North Sea (Berghahn 1973). Once the technology was developed, they also built submarines to attack a close blockade (Karau 2017). In the years before the war, Prussian civil servants developed plans to feed the population through two years of blockade (Lee 1975). Finally, the German war plan envisaged a short victorious war against France and then Russia, but the road to France lay partly through neutral Netherlands. In 1911, just in case, the plan was modified to avoid infringing Dutch neutrality, leaving a way open for Germany to retain access to North Sea trade (Herwig 2002: 689). Thus, wartime blockade was turned from a deterrent into a managed risk.

The preparations for World War II further illustrate the power of economic warfare in prospect. In World War I, the Central Powers staggered under Allied naval blockade. In the 1920s, Hitler developed the aim of a German colonial empire in Eastern Europe, ethnically cleansed, economically self-sufficient, and invulnerable to blockade. In the 1930s, in power, Hitler prepared the German economy for war through self-sufficiency in steel and synthetic oil and rubber (Overy 1994). The problem of German dependence on food imports remained. In 1939, Hitler declared, "I need the Ukraine, so that no one is able to starve us again, like in the last war" (Collingwood 2011: 37). In 1940, the war spilled over into Western Europe. On the territory now under Germany control, 25 million lived on imported food. This territory was once again subject to Allied blockade. An immediate attack on the Soviet Union became the solution. Seizure of the resources on Soviet territory, combined with the Hunger Plan (to starve out 30 million Slavs would release Ukraine's food for Germany and nullify the Allied blockade. (Kay 2006).

In the Far East, World War II developed on parallel lines. Dependent on imported food and fuel, Japanese leaders developed the aim of colonizing China, occupying its northern provinces in 1931 and proceeding to full scale war in 1937. In 1940 the Roosevelt administration

placed oil sanctions on Japan to stop its aggression. Japan appeared to be faced with a Hobson's choice: give up its ambitions or be ground down and defeated slowly. Rejecting both options, Japan's war cabinet chose a gamble on resurrection, widening the war to the United States and seeking to swallow the British, French, and Dutch colonies in southeast Asia (Huff 2020: 1-21).

In the history of inter-state conflict, economic warfare is often treated as a peripheral issue. But, if strategy decides which battles will be fought, then economic warfare is not a side issue: it is central. In two world wars, economic warfare decided which battles would be fought and who would win them. Between the wars, the anticipation of economic warfare framed the plans of the Axis leaders as they decided which countries to colonize, and which battles to fight.

What went wrong? Wars broke out because deterrence failed. The leaders of the League of Nations believed they held in their hands the power to coerce a "rogue" nation by threatening blockade. They expected this threat to be a sufficient deterrent. Rather than having to spill blood for the sake of punishing an aggressor, they could preserve the peace by imposing economic sanctions. This worked when the rule-breaker was a small power, lacking the capacity for a military confrontation, say Yugoslavia in 1921 or Greece in 1925 (Mulder 2020: 122-125, 151-155). But when the rule-breaker was a great power with the option to go to war, the imposition of sanctions gave a perverse signal. The sender wrote the signal in the language of deterrence: "Economically we are strong and you are weak: comply or we will strangle you." But when received, the same words were read as an incitement: "Economically they are strong, but militarily they are weak. Don't wait while they strangle us. Strike now—there will never be a better time." Thus, deterrence by economic sanctions failed.

Was there a better way? Only if the economic threat was bundled with military deterrence. The threat of sanctions might have deterred them all—Japan, Italy, and Germany—only if matched by military preparations. Perhaps it was inevitable that the democracies would be reluctant to prepare for war on a scale sufficient to prevent the dictatorships from upending the international order. Instead, they turned to the more "peaceful" instrument of sanctions. But, as it turned out, sanctions were not the alternative to military force that liberals were looking for. Sanctions could have worked only in combination with strong military defences. Thus, economic and military measures turned out to be complements, not substitutes.

5. Conclusion

When does economic warfare make sense? According to Milevski (2019: 47), we should expect to see the combined action of military and non-military means in war, only when military means alone cannot secure a quick victory. In short, economic warfare belongs to wars of attrition.

In two world wars attrition took place on land, at sea, and in the air. There was attrition of the soldiery in millions and attrition of their equipment, from bullets to battleships, in thousands and millions. On land, the ground forces fought for territory while air and naval forces helped to deploy and support the ground forces, kept supply lines open, and attacked the adversary's economy. Every operation involved attrition, but not in equal proportions. Reviewing the role of air and naval power in World War II, O'Brien (2015: 67-87) points out, the great land campaigns accounted for most of the human losses on each side, but most equipment by value was written off in the continuous, three-dimensional air-sea war. The attrition of equipment, he argues, took places in successive phases. Combat losses were just the final phase, and the final phase was not the most important from a quantitative perspective. Before combat came losses in deployment, in production (when facilities were closed or disrupted by dispersal), and before production (because of the loss of workers, equipment, or materials or their diversion to other uses). The production and pre-production losses are the domain of economic warfare. From this perspective, economic warfare is simply the first phases of the war of attrition.

Economic warfare was a stage of attrition. Nothing could explain more simply why economic action could not provide an alternative to attrition or an escape route from it. It also explains why economic action and military action were complements. By different means they led to the same objective, and their success could be measured in the same units.

Economic and military action were complements, not substitutes. They were complements in the strict sense that an increase in the quantity of one raised the return on the other at the margin. This is no more than what should be inferred when observers concluded that the blockade or the air offensive shortened the war (e.g. Davis and Engerman 2006: 211-214; BBSU 1998: 161-162; Overy 1973: 136), or that the air offensive played its part alongside the other campaigns (Webster and Frankland 1961, vol. 3: 289). It is also what military leaders had in mind when they demanded an air offensive that would enable the Allies to invade Europe and occupy Germany (Webster and Frankland 1961: vol. 4, 273-283).

The complementarity of economic and military action has a further implication. If the two were mutually reinforcing, then the absence of one

weakened the other. Either on its own was like one hand clapping. It was inefficient to engage in frontal combat without also aiming at the enemy's supply chain. It was reckless to threaten blockade (or sanctions) without the readiness to engage in combat, for this invited escalation and a wider war. In modern times, nothing proves the point more painfully than the West's failure to deter a Russian attack on Ukraine in 2022 by economic threats.

Tables

Table 1. Economic warfare took time: months to 10% and 50% of cumulative war total in three campaigns

	Time to 10%, months	Time to 50%, months	War duration, months
Allied and neutral shipping losses to Germany			
—World War I	14	33	52
—World War II	10	31	68
Allied bombs dropped on the Germany economy			
—World War II	47	60	68

Sources: Allied and neutral shipping losses in gross tons in two world wars are from Davis and Engerman (2006: 171, 268-270). Allied bombs dropped on Germany in World War II are from USSBS (1945b: 2-5). RAF Bomber Command and the U.S. 8th and 15th Air Forces dropped approximately two megatons of high explosives on Axis Europe during the war. Three-quarters of this tonnage was applied to towns, factories, and transportation, and these are the figures used in the table. The omitted data concern the bombing of airfields, submarine pens, and miscellaneous other targets that fall outside the sphere of economic warfare.

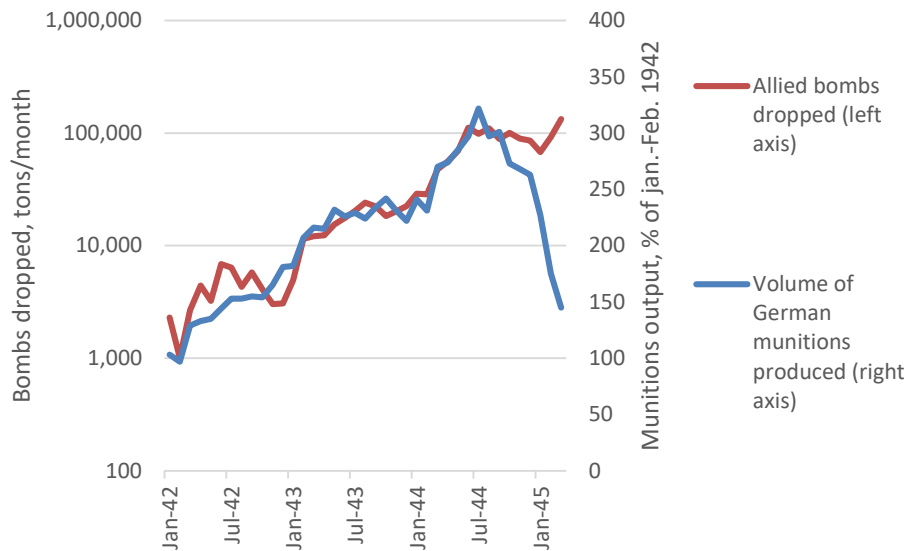
Table 2. Energy content of food for human consumption in Germany, 1913 and 1917 (trillion calories)

	1913	1917	Change
Home produced	72.3	43.4	-28.9
Imported	18.1	7.2	-10.8
Total	90.4	50.6	-39.8

Sources. Imported and total calories for human consumption, based on 1912/13 averages, from Woodbury (1916: 94, 96). Home produced calories are calculated as the residual. The declines in home produced and imported calories up to 1917 are estimated from the 40 percent decline of agricultural production and the 60 percent decline of imports reported by Ritschl (2005: 41, 50). The changes in 1917 over 1913 and the 1917 total are then calculated from the results.

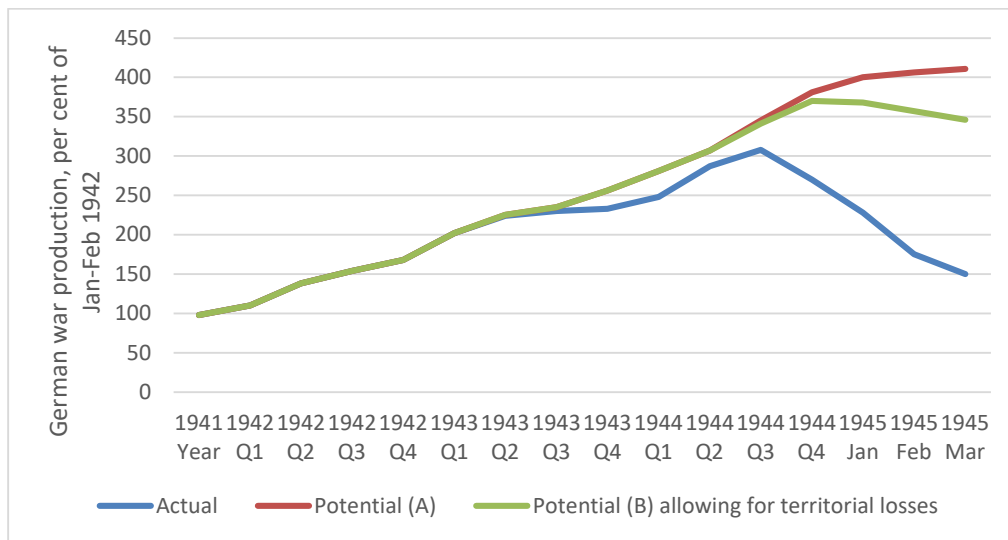
Figures

Figure 1. German munitions output and Allied bombs dropped, monthly data, January 1942 to April 1945



Sources: Webster and Frankland (1962, vol. 4: 455-457, 466-467). The bombing data, of monthly frequency, not disaggregated by target, including tactical missions, but excluding tonnage dropped by the US Fifteenth Air Force (operating out of southern Italy). The volume index of German munitions output is expressed as per cent of an average of January and February 1942. The worsening quality of German manufacture as the war progressed likely overstates the upward slope of the series, but the sign of the slope is unmistakable. The depiction of the two series, one scaled arithmetically, the other in logarithms, is a rhetorical device, designed to underline their covariation.

Figure 2. German armaments production, 1941-1945, quarterly data: actual versus potential, showing the role of territorial losses (per cent of Jan.-Feb. 1942)



Source: BBSU (1998: Figure 20, facing page 90). Potential (A) is estimated within constant frontiers; potential (B) takes into account the loss of territorial control in the war's closing stages. The same qualification regarding the worsening quality of German manufacture as the war progressed as in Figure 1 applies here, but it does not affect the timing or size of the gaps between the series.

References

- Abelshauser, Werner. 1998. Germany: Guns, Butter, and Economic Miracles. In *The Economics of World War II: Six Great Powers in International Comparison*, pp. 122-176. Edited by Mark Harrison. Cambridge: Cambridge University Press.
- Angell, Norman. 1910. *The Great Illusion: A Study of the Relation of Military Power to National Advantage*. London: Heinemann.
- BBSU (British Bombing Survey Unit). 1998. *The Strategic Air War Against Germany, 1939-1945*. Report of the British Bombing Survey Unit [declassified in 1956]. Introd. by Sebastian Cox. London, Frank Cass.
- Biddle, Tami Davis. 2015. Anglo-American Strategic Bombing, 1940-1945, and an appended bibliographic essay. In *The Cambridge History of the Second World War*, vol. 1, 485-526 and 752-759. Edited by John Ferris and Evan Mawdsley. Cambridge: Cambridge University Press.
- Bloch, Ivan. 1899. *Is War Now Impossible?* London: Grant Richards.
- Collingham, Lizzie. 2011. *The Taste of War: World War Two and the Battle for Food*. London: Allen Lane.
- Davis, Lance E., and Stanley L. Engerman. 2006. *Naval Blockades in Peace and War. An Economic History since 1750*. Cambridge: Cambridge University Press.
- Dehne, Phillip A. 2019. *After the Great War: Economic Warfare and the Promise of Peace in Paris 1919*. London: Bloomsbury.
- Giumelli, Francesco. 2011. *Coercing, Constraining and Signalling: Explaining UN and EU Sanctions after the Cold War*. Colchester: ECPR Press.
- Hardach, Gerd. 1987. *The First World War, 1914-1918*. Harmondsworth: Penguin.
- Herwig, Holger H. 2002. Germany and the "Short War" Illusion: Towards a New Interpretation? *Journal of Military History* 66(3): 681-693.
- Huff, Greg. 2020. *World War II and Southeast Asia: Economy and Society under Japanese Occupation*. Cambridge: Cambridge University Press.
- Karau, Mark D. 2017. Submarines and Submarine Warfare. In *1914-1918-Online: The International Encyclopedia of the First World War*. Edited by Ute Daniel, Peter Gatrell, Oliver Janz, Heather Jones, Jennifer Keene, Alan Kramer, and Bill Nasson. Berlin: Freie Universität Berlin. DOI: 10.15463/ie1418.11131.
- Kay, Alex J. 2006. *Exploitation, Resettlement, Mass Murder: Political and Economic Planning for German Occupation Policy in the Soviet Union, 1940-1941*. New York: Berghahn Books.
- Lambert, Nicholas A. 2010. *Planning Armageddon: British Economic Warfare and the First World War*. Cambridge, MA., Harvard University Press

- Lee, Joe. 1975. Administrators and Agriculture: Aspects of German Agricultural Policy in the First World War. In Jay M. Winter (ed) *War and Economic Development: Essays in Memory of David Joslin*, pp 229–238. Cambridge University Press, Cambridge
- Milevski, Lukas. 2019. Grand Strategy is Attrition: The Logic of Integrating Various Forms of Power in Conflict (p. 47). Strategic Studies Institute. Kindle Edition.
- Mulder, Nicholas. 2022. *The Economic Weapon: The Rise of Sanctions as a Tool of Modern War*. Yale University Press: New Haven and London.
- O'Brien, Phillips P. 2015. *How the War was Won: Air-Sea Power and Allied Victory in World War II*, Cambridge: Cambridge University Press.
- Offer, Avner. 1989. *The First World War: An Agrarian Interpretation*. Oxford: Clarendon Press.
- Olson, Mançur. 1962. The Economics of Target Selection for the Combined Bomber Offensive. *Royal United Services Institution Journal* 107(628): 308–14.
- Olson, Mançur. 1963. *The Economics of the Wartime Shortage: A History of British Food Supplies in the Napoleonic War and in World Wars I and II*, Durham, NC: Duke University Press.
- Overy, Richard. 2003. *The Air War, 1939-1945*. Kindle Edition.
- Ritschl, Albrecht. 2005. The Pity of Peace: Germany's Economy at War, 1914-1918 and Beyond. In *The Economics of World War I*, pp. 41-76. Edited by Stephen Broadberry and Mark Harrison. Cambridge: Cambridge University Press.
- Titmuss, R. M. 1950. *Problems of Social Policy*, London HMSO, History of the Second World War: United Kingdom Civil Series.
- Tooze, Adam. 2006. *The Wages of Destruction: The Making and the Breaking of the Nazi Economy*. London: Allen Lane.
- USSBS (US Strategic Bombing Survey). 1945a. Summary Report (European War). Washington DC.
- USSBS (US Strategic Bombing Survey). 1945b. The Effects of Strategic Bombing on the German War Economy. Overall Economic Effects Division. Washington DC.
- Vickers, C. G. 1943. Economic Warfare. *Royal United Services Institution Journal* 88(549), pp. 14-22.
- Webster, Charles, and Noble Frankland. 1961. *The Strategic Air Offensive Against Germany, 1939-1945*, vols 1-4. History of the Second World War: Military Series. London: HMSO.
- Woodbury, Robert Morse. 1916. Statistics of the Food Supply in Germany. *Publications of the American Statistical Association* 15(113): 93-109.