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Blockading Britain and Germany during World War 1: Preparations, conduct and consequences of Economic Warfare

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BLOCKADING BRITAIN AND GERMANY DURING WORLD WAR 1: PREPARATIONS, CONDUCT AND CONSEQUENCES OF ECONOMIC WARFARE

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Abstract: A pre-war policy of free trade in Britain and protection in Germany meant that Britain entered the war producing 35 per cent of its food needs while Germany produced 80 per cent. And yet Britain managed to feed itself adequately while Germany faced food shortages. Britain successfully adopted a range of counter-measures, exhibiting a capacity for substitution, allowing the economy to be flexible enough to survive the German blockade. The blockade accounted for at most around a quarter of the decline in German food consumption, which was largely the result of a collapse in domestic production caused by excessive mobilisation. German counter-measures were sometimes successful, but at other times indicate a less flexible economy with a limited capacity for substitution. The British government quickly reversed wartime policies to boost agricultural production and entered World War 2 equally vulnerable to submarine blockade, while Germany pursued autarkic policies to avoid dependence on seaborne imports.

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1. INTRODUCTION

Economic warfare was employed as a complement to military action during World War 1 by both the Allies and the Central Powers, as Britain tried to starve Germany through surface blockade while Germany tried to starve Britain through submarine blockade. The outcome of the blockades was very different from what many commentators had predicted before 1914 (Olson, 1963: 38-42). Germany protected its agriculture and produced 80 per cent of its calorific requirements in the run up to World War 1, with the remaining calories supplied by imports that could largely be delivered overland. Britain, by contrast, allowed free trade in agricultural goods, and produced just 35 per cent of its requirements, leaving itself highly dependent on seaborne imports of food (Olson, 1963: 74-75). In theory, then Germany should not have suffered greatly from blockade, while Britain should have succumbed quickly to famine. And yet in practice, Britain managed to feed its population adequately throughout the war, while Germans suffered grievously. In this chapter, we adopt a framework of preparations, conduct and consequences to understand these outcomes.

2. PREPARATIONS: AGRICULTURAL AND FOOD POLICIES BEFORE 1914

Policies towards agriculture and food differed sharply between Britain and Germany from the late-nineteenth century to the start of World War 1. Britain pursued a free trade policy from the 1840s, repealing the Corn Laws, Navigation Acts and phasing out restrictions on imported livestock (Afton and Turner, 2000: 2106). Although Prussia and other Zollverein states had also pursued a low tariff policy at this time, the situation changed following German unification in 1871. During the 1850s and 1860s, German grain producers had initially opposed tariffs for industry, which they feared would lead to retaliatory tariffs against German grain exports, but by the late 1870s they were being undercut by American farmers as transport improvements drastically reduced price differentials between the United States and Europe (Gerschenkron,

1943). In a “marriage of rye and iron”, Bismarck’s tariff of 1879 imposed tariffs on both grain and manufactures, and in addition to further increases of these tariffs, livestock products were added in what Webb (1980: 309) called an “empire of iron, pork and rye”. Although there was a vocal campaign for Tariff Reform in Britain during the early twentieth century, advocates of free trade successfully argued that British workers gained from the cheap price of food imports, and Britain remained committed to free trade until World War 1 (Marrison, 1996).

As a result of the different tariff policies pursued in Britain and Germany, the “grain invasion” from the New World affected them very differently. In Britain, cereal producers were offered zero protection across the board, while in Germany tariffs had reached around 40 per cent by 1909-1913. Table 1 shows that the grain price spreads between Britain and the United Sates narrowed dramatically between 1870 and 1913, disappearing altogether for wheat, while the spreads between Bavaria and the United States narrowed marginally at best, and for barley and oats even widened. Accordingly, cereal production trends charted in Table 2 were also very different in the two countries. Whereas the output of all major crops increased substantially between 1885 and 1913 in Germany, in Britain their cultivation declined significantly or stayed constant. Whereas Britain became increasingly dependent on food imports, Germany continued to produce most of its food supply.

3. CONDUCT: BLOCKADING BRITAIN

3.1 Off to a slow start: restricted submarine blockade, 1914-1916

The German submarine blockade got off to a slow start for two main reasons. First, when war broke out on 4 August, Germany had only a limited supply of 33 submarines, compared with Britain’s 74 (Churchill, 1923: 278). Second, submarine warfare was restricted by international law. Since the Hague Convention of 1899, the so-called prize rules compelled warships,

including submarines, to warn merchant vessels of an impending attack, search the vessels and move their crews into a place of safety.

For a brief period in 1915, the Germans did ignore the prize rules to counter the use of British ships with concealed deck guns and armed merchantmen. On 3 November 1914, London declared the entire North Sea, along with the waters around Iceland and Southern Norway, a war zone to control maritime trade. In retaliation, on 4 February 1915, Germany declared the seas around the British Isles a war zone and from 18 February, Allied ships in the area would be sunk without warning. However, neutral countries, particularly the United States, protested against the unrestricted attacks, which inevitably sank neutral as well as Allied ships. As a result, after the Lusitania was torpedoed on 7 May 1915, with many American passengers onboard, Germany agreed to refrain from unrestricted submarine warfare until February 2017 (Chickering, 1998: 90; Hardach, 1987: 37-41). British shipping losses during this first phase of the German blockade of Britain averaged 83,000 gross tons per month, with the world total averaging 144,000 tons, significant but not yet sufficient to pose a serious threat to Britain's food supply (Beveridge, 1928: 5-18, 26-27).

3.2 Unrestricted submarine blockade, 1917-1918

Throughout 1916, Chancellor Bethmann-Hollweg resisted calls from the German navy to return to unrestricted warfare on the grounds that it would bring the United States into the war (Olson, 1963: 810). In addition, at the start of 1916, Germany clearly had insufficient U-boats to bring about a swift surrender of Britain (Churchill, 1927: 220-221). By the end of the year, however, the German navy was confident that it could sink up to 600,000 tons of cargo per month, regarded as sufficient to starve Britain out of the war within six months. Unrestricted submarine warfare was declared in January 2017 and the campaign began on 1 February.

Initially, German sinkings of Allied and neutral shipping increased dramatically, as can be seen clearly in Figure 1A, peaking at over 850,000 tons in April 1917. Figure 1A also shows the number of U-boats in the German fleet, which doubled between mid-1916 and mid-1917. Although this expansion of capacity led initially to a sharp increase in the Allied and neutral shipping losses per U-boat, as can be seen in Figure 1B, the German advantage was short-lived.

How were the British able to remain in the war and go on to achieve victory despite the initial success of the German unrestricted submarine campaign? Olson (1963: 86-113) points to a series of effective counter-measures. These can be divided into measures to maintain shipping capacity, economise on the use of shipping, reduce demand for importable goods and boost home production to substitute for imports.

3.3. Counter-measures to maintain shipping capacity

The first important counter-measure was the development of the convoy system, which helped to reduce sinkings, since it was just as difficult for a U-boat to spot a convoy as a single ship in the vast expanse of the Atlantic and convoys could be escorted by destroyers and other patrol vessels capable of taking defensive counter-measures. The effectiveness of the convoy system is demonstrated by the statistics on convoy sailings and losses in Table 3. Of 16,693 ships sailing in convoys on both homewards and outwards voyages between 10 May 1917 and 23 November 1918, 99.08 per cent were escorted safely, with just 0.61 per cent torpedoed in convoy. The other 0.31 per cent of losses resulted either from marine perils or after leaving the convoy. This was more helpful than had been expected by British naval opinion, with a sceptical Admiralty being cajoled into experimenting with it by Prime Minister Lloyd George (Churchill, 1927: 363-368). After reaching a peak of 881,000 tons in April 1917, world total

sinkings fell back under 300,000 tons by September and fluctuated around this level for the rest of the war (Figure 1).

Another way of offsetting the losses from sinkings was through building new ships. The United States made an enormous contribution to the maintenance of Allied shipping capacity through the devotion of resources to building cargo ships. By May 1918, the monthly gains through shipbuilding more than offset the losses through sinkings, and the Allies continued to record a net gain until the end of the war, as can be seen in Table 4.

3.4 Counter-measures to economise on the use of shipping

In addition to reducing sinkings and rebuilding capacity, however, it was important for the British to devise a series of counter-measures that allowed them to get along without the merchant tonnage sunk by the German U-boats. The policy of Atlantic concentration was of critical importance. It meant that a much larger share of Britain's total imports was obtained from the United States and Canada, while shares from further afield declined. This shortened the average length of voyages, thus allowing more food to be carried to Britain with the same tonnage of ships. Table 5 shows a rising share of North America during the first two years of the war, which can be seen as offsetting the sharp decline in imports from the Central Powers and Belgium. From 1916, however, the further increase in the share of imports from North America largely reflects the policy of North Atlantic concentration, since there were no further gains to be had through the replacement of imports from the Central Powers. As a result, we see declining shares in British imports from Australasia, South America, the Far East, West Africa, South and East Africa, and the Middle East during the last two years of the war.

A further way of economising on scarce shipping was to reduce the amount of time spent by ships in port. This was aided by the formation of Transport Workers' Battalions to ensure the availability of more labour for the loading and unloading of ships (Olson, 1963: 93-95; Fayle, 1927: 171-172)). They were widely used to speed up turnaround times at ports during the period of unrestricted submarine warfare, with the average number of men from the Battalions employed in daily work at the ports increasing from 2,131 in January 1917 to 5,760 in July of the same year (Fayle, 1924: 166).

3.5 Counter-measures to reduce consumption of importable goods

Another important British counter-measure to alleviate the shortage of shipping space caused by sinkings was a sharp reduction in investment, which can be seen clearly in Figure 2. Between 1900 and 1913, net fixed capital formation (NFCF) averaged £77 million per annum at 1900 prices but became negative during the war, reaching a trough of -£28 million in 1916. As Olson (1963: 93-94) notes, it is always possible during wartime to cut back on normal peacetime investment by continuing to use old capital stock. Since the largest element of the capital stock at the time of World War I was buildings in the form of dwellings, factories and offices, cutting back on investment meant saving on bulky imports of materials such as wood and timber and iron and steel, thus freeing up valuable shipping space.

The demand for scarce shipping space was also reduced by limiting exports. Although not directly competing with imports since they were shipped on outgoing vessels, exports were produced using raw materials that had to be imported from abroad. Without the exports, raw material imports could be reduced, so vital space on incoming ships was saved.

During the first two years of the war, the importation of non-essential items and the excessive consumption of essential food and war material was limited to a large extent through the normal operation of the price mechanism. As shipping became scarcer, this raised the price of imported goods and deterred consumption. It was not quite “business as usual”, but the spread of government controls was generally slow (Broadberry and Howlett, 2005: 222-224). The pace of change accelerated following the replacement of Asquith’s government by Lloyd George’s government in December 1916. With the start of unrestricted submarine warfare, it was clear that the volume of imports in 1917 would be significantly lower than in the previous year, so that direct government action would be needed to safeguard imports of essential food and war material. In February 1917, the War Cabinet therefore approved a programme to both prevent the importation of non-essential items and to discourage the excessive consumption of essential imports (Fayle, 1924: 57; Olson, 1963: 94). The target of reducing imports by 500,000 tons per month was exceeded, with Board of Trade data showing that total imports declined from 44.3 million tons in 1916 to 37.3 million tons in 1917, a fall of 7 million tons between the two years, or a monthly saving of 583,333 tons (Fayle, 1924: 477).

In another important move designed to reduce imports, whilst at the same time ensuring that the available food supply was distributed in a way that maximised its contribution to the health and energy of the nation, direct controls were extended over food supply to such an extent that the government bought and sold 85 per cent of the food consumed (Beveridge, 1928: 56-57). A Wheat Commission was established at the end of 1916 with responsibility for the importation of cereals and control of home crops, making the most economic use of grains through policies such as increasing extraction rates and restrictions on brewing, and the introduction of a bread subsidy to keep down the price of bread to consumers (Beveridge, 1928: 88-112). Other foods were the responsibility of the Ministry of Food under the direction of the

Food Controller. Beginning in February 1917, the Food Controller appealed to the nation to place itself on voluntary rations with a prescribed maximum weekly allowance of bread, meat and sugar (Beveridge, 1928: 34-35). A formal rationing scheme was first approved in June 1917 for sugar but as queues built up for other foods, local rationing schemes were introduced, and in July 1918 formal national rationing was introduced, administered by autonomous local committees (Beveridge, 1928: 188-217).

3.6 Counter-measures to boost agricultural production

One final important counter-measure against the German submarine blockade was the introduction of incentives for farmers to increase agricultural production and thus reduce dependence on food imports. Rowland Prothero, later Lord Ernle, became the President of the Board of Agriculture and Fisheries in Lloyd George's new coalition government in December 1916 and set up a new Food Production Department (Middleton, 1923: 162-163). The new department moved quickly to develop a policy of ploughing up pasture land and converting it from grazing livestock to growing arable crops (Beveridge, 1928: 105). This had the effect of increasing the supply of calories from a given acreage, as growing grain or potatoes on a given plot of land provided more calories than could be derived from meat and dairy produce derived from livestock raised on the same piece of land. This went against the trend of structural change away from arable towards livestock farming during the pre-1914 period, when British farmers found it increasingly difficult to compete against imports of cheap grain from the New World, and was therefore underpinned by the Corn Production Act of 1917, which guaranteed minimum prices for a five-year period (Whetham, 1978: 94-95). Although there was a great deal of controversy surrounding the Corn Production Act, it provided the incentives for farmers to make the changes (Middleton, 1923: 271-275) The effects can be seen in Table 6 in the bumper harvests of grains and potatoes in 1918, combined with a drop in home production of

meat and dairy produce. The bumper harvests owed much to the high yields on the stored-up fertility of long-fallowed grassland, as well as to the increase in the acreage under crop (Middleton, 1923: 247-256).

3.7 Assessing the effects of the German submarine blockade

The success of the British counter-measures can be seen in Table 7, which shows the calorie value of weekly quantities of food consumed per 'man' in Britain prior to and during the war. Because food requirements of individuals vary by age, gender, size, amount of physical work performed and other circumstances, they are all reduced to 'man equivalents' of an agreed average size and activity, requiring 3,300 calories a day. As Table 7 demonstrates, average food consumption barely declined during even the worst years of the war and always remained above the daily requirement of 3,300 calories per day.

Olson's (1963: 113) conclusion on Britain's ability to survive the submarine blockage is that "(i)t is the capacity for substitution that the German naval authorities must have failed to take into account when they advocated an unrestricted submarine campaign. It was the principle of substitution that accounted for the unexpected flexibility of the British economic system, and that deserves much of the credit for the campaign's failure."

4. CONDUCT: BLOCKADING GERMANY

4.1 Restricted blockade, 1914-1915

Just as the German submarine blockade of Britain began in a restricted manner out of concerns over international law and the attitude of neutral countries, so too did the British blockade of Germany between August 1914 and March 1915 (Hardach, 1987: 11-19). The London Declaration concerning the Laws of Naval War was signed in 1909 by the major powers of the

day, including Britain and Germany, but was never ratified by any state. It nevertheless formed the basis of the initially restricted Allied blockade. The London Declaration permitted the maintenance of a patrol line off an enemy's ports and coasts but prohibited the blockading of neutral ports and littorals. It also stipulated that ships should not be sunk without warning and that the safety of the crews of sunk ships should be guaranteed (Chickering, 1998: 90; Hardach, 1987: 12-13). In addition, it also divided goods into three categories: absolute contraband, conditional contraband and free list goods. Absolute contraband such as arms, munitions and military equipment could be interdicted, even if *en route* to neutral countries if there was good reason to believe that the ultimate destination was enemy territory. Conditional contraband consisted of non-military goods that could be used for warlike purposes, including foodstuffs, fuel, lubricants, and clothing. Free list goods included raw materials for industry and agriculture, such as ores, cotton, and fertiliser, and could not be declared as contraband (Hardach, 1987: 13).

Initially, imports of contraband were stopped from reaching Germany, but free list imports were allowed and German exports in neutral ships were not indicted. However, as suspicions grew that contraband goods useful for the war effort were being re-exported to Germany via neutral northern countries, the contraband list was soon extended and more rigorous controls were imposed on the trade of neutral countries (Hardach, 1987: 14-15). Davis and Engerman (2012: 207-208) provide data on the share of Scandinavian and Dutch exports and re-exports going to Germany consistent with these suspicions, shown here in Table 8. The share of Scandinavian exports going to Germany increased substantially at the start of the war, and it was some time before the blockade brought the shares back down close to prewar levels, although the blockade appears to have been more effective in clamping down on Dutch exports to Germany from the start of the war. It was particularly concerning that Britain appeared to be

becoming an entrepôt for overseas products reaching Germany via the northern neutrals, as the share of northern neutrals in British exports doubled in the first six months of the war, while their share of British re-exports trebled (Hardach, 1987: 18-19).

4.2 Unrestricted blockade, 1915-1917

Following the announcement by the German government in February 1915 that they would treat the waters around Britain and northern France as a war zone and sink enemy merchant ships without warning, the Allies moved to unrestricted blockade from March 1915, announcing a more intensive policy of stopping all shipping movements to and from ports of the Central Powers and all goods entering or leaving those ports via neutral countries (Hardach, 1987: 20). However, the British still had to be careful to avoid alienating neutral countries, particularly the United States, Scandinavia and the Netherlands This required the establishment of a trust system, whereby a neutral country's government and shipping companies undertook to restrict the import of all goods to the quantity required for internal consumption, based on prewar levels, in return for a relaxation of controls. Ultimately, this led to the navicert system, whereby an exporter could be given a certificate by a British consular officer after an inspection prior to dispatch. This ensured that the cargo would not be detained by a blockading ship (Hardach, 1987: 20-26).

The unrestricted blockade was extended to the other Central Powers, Austria-Hungary, Bulgaria, and Turkey (Bell, 1961). This involved the British navy controlling entry to the Mediterranean at Gibraltar and Suez and the French and Italian navies blockading the Mediterranean ports of the Central Powers (Hardach, 1987: 26-27).

4.3 Blockade after the entry of the United States into the war, 1917-1918

Germany's adoption of unrestricted submarine warfare in February 1917 inevitably led to a swift reduction in neutral shipping, thus to a decline of imports into the neutral countries and in turn to a fall in exports from the neutrals into Germany. The intensified U-boat offensive also brought the United States into the war on the Allied side in April (Hardach, 1987: 27-28). The neutral countries now lost their most powerful advocate, as the US poacher turned gamekeeper and further strengthened the blockade. The Americans introduced a system of blacklists for companies that were caught violating the blockade rules, tight control of bunker coal and navicerts, and participated in schemes for rationing neutral imports, which were largely sourced from the United States. The effect of these measures on American exports to the neutral neighbours of the Central Powers can be seen in Table 9. The decline in American exports between the year June 1915 to June 1916 and the year June 1917 to June 1918 was 53 per cent for Norway and more than 90 per cent for Denmark, the Netherlands and Norway. Switzerland, which saw an increase of 265 per cent, received favourable treatment on the advice of the French, who thought it wise to respect the economic importance of Switzerland to the Allies.

4.4 Assessing the effects of the Allied blockade

Many contemporary and historical assessments have attributed the eventual German economic and military collapse to the effects of the British blockade (Parmelee, 1924; Skalweit, 1927; Goebel, 1930, Cox, 2019). The legend of the starving out (*Aushungerung*) of Germany was born in the early days of the war. Even though the British blockade had barely made any impact on domestic food supplies by then, in their memorandum published in December 1914, the Erzbacher commission already spoke of a dangerous British plan to starve the German nation out of the war. Wartime propaganda built on this hyperbole. In a widely circulated pamphlet, von Bühlow (1917) placed the blockades in a historical context of British imperialism and

accused British economic warfare of genocidal intent. A common approach to prove the legend was to highlight the decline in per capita food consumption and the increase in mortality.

Per capita wartime rations are compared with peacetime consumption in Table 10, taking the agricultural year as running from July to June. Although the consumption of sugar and potatoes held up reasonably well, the situation was far worse for most other items. Rations per head fell to just 1344 calories by autumn 1916 and as low as 1100 calories by summer 1917, which forced people to resort to the black market to survive (Davis and Engerman, 2006: 204). However, the nutritional deprivation was not shared equally across all regions and classes (Roerkohl 1991). Using anthropometric data from World War II conscription records, Blum (2011) was able to confirm that while all social strata were affected by malnutrition and starvation, in the cohorts born during the Great War, farmers, the urban poor, Catholics, and especially residents of the highly integrated food importing regions along the northern coastline and the Rhine suffered disproportionately. Cox (2019) has also used anthropometric data to provide evidence of nutritional deprivation, including weight, height, and body mass index of individuals from surveys carried out in Germany at the time.

As Offer (1989: 34) notes, to isolate the effects of living conditions on mortality, it is necessary to remove the effects of military casualties, and the easiest way to do this is to examine only female mortality. This is done in Table 11, which compares levels and trends of deaths per 1000 females in Germany and in England and Wales. There was a moderate increase in German female mortality during the first two years of the war, but a severe crisis in 1917, rising further to peak mortality in 1918, when female mortality was more than 50 per cent higher than in 1913. Note how much worse German female mortality became relative to female mortality in England, which continued its prewar downward trend.

However, simply documenting changes in per capita food consumption and mortality inevitably overstates the significance of the blockade, since it ignores the development of domestic food production. Olson (1963: 80-81) suggests that the major reason for the collapse of food consumption was Germany's inability to expand its farm output during the war, as Britain had done. Similarly, Hardach (1987: 34) conjectures that "the tremendous economic decline of the Central Powers between 1914 and 1918 was caused less by the blockade than by the excessive demands made on their economies by the war". Hardach's Conjecture hinges on (1) the scale of the change in agricultural production, (2) the scale of the change in imports and (3), the prewar share of imports in food consumption.

Dealing first with the fall in imports, Hardach (1987: 33) constructs a table that compares Kleine-Natrop's (1922) series for imports and exports during 1914-1918 with Hoffmann's (1965) data for 1913, shown here in Table 12. We are interested in the scale of the fall in German imports at constant prices in the final column. Making a comparison with 1913, the last complete year before the outbreak of war, then imports had fallen by 61 per cent from their prewar level by 1917. Note that annualising the monthly average for imports during the first seven months of 1914 rather than using 1913 as the prewar benchmark level of imports does not significantly alter the scale of the decline. The monthly average for January to July was 0.91 billion Marks, which would imply a total for 1914 of 10.9 billion Marks in the absence of war, almost identical to the 1913 total, rather than the 8.5 billion Marks actually achieved. For exports the decline was substantially greater than for imports, with a peak fall in 1917 of 80 per cent measured against the 1913 level.

The second element in assessing Hardach's conjecture is the performance of German agriculture. In fact, the situation was worse than Olson had thought, since output did not merely fail to expand during the war, but decreased substantially (Ritschl, 2005: 46; Starling, 1920). Table 13 sets out trends in the major crops and total agricultural output, including pastoral as well as arable production. Output of most crops declined throughout the war due to a serious loss of manpower and horses to the armed forces and a lack of fertiliser caused by the diversion of nitrates to the production of munitions. This shows up in a decline of harvest per hectare in metric tons. The situation was exacerbated by the priority given to war production, which limited the availability of manufactures that farmers might want to purchase. As food prices increased and the government introduced price controls, farmers began to retreat from the market into autarky rather than increase output, and to the extent that they did continue to produce more output than needed for their own consumption, farmers tried to sell as much as possible through the black market (Broadberry and Harrison, 2005: 18-19).

The third element is the prewar share of imports in food consumption, which is generally agreed to have met about 20 per cent of calorific needs. With these figures, Table 14 quantifies the relative contributions of the blockade and the excessive demands of the war economy to the reduction of food consumption in Germany. Column (1) shows the shares of domestic production and imports in food consumption before the outbreak of war, while column (2) shows the decline in production and imports between 1913 and 1918. Column (3) multiplies columns (1) and (2) together to obtain the weighted reduction of domestic production and imports, while column (4) reports the relative shares of domestic production and imports in the reduction of consumption. Imports accounted for 27.6 per cent of the decline in consumption, while domestic production accounted for the other 72.4 per cent. It is clear that the decline in agricultural production played a far more important role than the blockade-

induced reduction of imports in the nutritional deprivation of the German people. Harrison (2023) reaches the same conclusion using data on trends in the energy content of home-produced and imported food between 1913 and 1917.

The excessive demands made by the war on the German economy weighed heavily on agriculture, right from the start of the war, as farms were drained of manpower, horses and fertiliser. These demands increased heavily after the launch of the Hindenburg Programme that planned a dramatic increase in munitions production from 1916 together with greater manpower mobilisation for the frontlines (Goebel, 1930: 82-96). The first six months of the programme pushed the German economy to the brink of disaster. Increased mobilization and the enhanced capacity needed to transport material to munitions factories stretched the railways to their limits. In the winter of 1916-17, the crisis in the transport sector resulted in an acute coal shortage in the economy. The rising costs of war financing and the resulting acceleration of resort to the monetary printing press led to a devaluation of the Reichsmark in international financial transactions. Germany could thus no longer attract imports from neutral partners by offering to pay high prices (Boldorf, 2022: 503). It also became increasingly difficult for European neutrals to re-export to Germany after the American Export Prohibition Act of 16 June 1917 (Bell, 1961: 622). Contemporary statistics highlight the drastic reduction in German food imports between 1916 and 1917. However, this cannot explain the deterioration of food supplies in Germany, which had more to do with the collapse of domestic food production. Whereas monthly imports of rye and wheat declined from 20,000 tons in 1916 to little more than 3,000 in 1917, much more consequential was the drop in domestic output from 985,000 tons to 703,000 tons per month between the two years (Skalweit, 1927, 235-9).

It is worth emphasising that it took three years to reduce German imports by 61 per cent and that this had only a minor effect on overall food supply in Germany compared with the decline in domestic agricultural output. It is perhaps surprising, therefore, to find Lambert (2012) claiming that the British could have brought the war to a quick end if only they had implemented economic warfare according to aggressive plans drawn up by Admiral Sir John "Jacky" Fisher and approved in 1912 by the Committee for Imperial Defence to collapse the international trading system. In contrast to the gradual implementation of the blockade that actually occurred at the start of the war, Fisher's plan envisaged the immediate and ruthless exploitation of Britain's control of the seas through the Royal Navy and the massive British merchant marine, combined with Britain's control of communications through the telegraph and telephone infrastructure of the Empire and the City of London's leadership of the international financial system.

There are a number of serious problems with Lambert's interpretation. First, it seems likely that this more aggressive approach to economic warfare would have severely damaged the British economy and would also have alienated the most important neutral countries, particularly the United States, which would have been counter-productive. Second, however, as the war proceeded, economic warfare was indeed pursued more aggressively but without delivering the decisive blow that had been anticipated. The problem here is that Lambert has under-estimated the adaptability of the German economy and did not take into account the counter-measures that would be adopted. These measures included naval attempts to break the blockade, policies to reduce consumption of importable goods and policies to boost availability of importable goods. Since Germany lost the war, it is tempting to dismiss these counter-measures as having failed miserably. However, we have seen that Germany was only dependent on imports for a small share of its food requirements before the war, so that the fall in

agricultural production was what really mattered. A more nuanced approach to the evaluation of counter-measures is therefore needed. Things could have been a lot worse for the German people if at least some of these measures had not met with some success.

4.5 Naval counter-measures to break the blockade

Within a week of the outbreak of war, the German merchant fleet had been effectively banished from the oceans, following a strategic retreat by the German High Seas Fleet in the face of the Royal Navy's substantial numerical superiority. Of the roughly 1500 German merchant ships of at least 100 gross registered tons, 245 had been captured, 1059 were locked up in neutral ports and 221 were confined to operating in the Baltic (Lambert, 2012: 212; Boldorf, 2020, 485). This dramatic reduction in Germany's capacity for overseas transport was further aggravated by the British policy to limit Germany's access to transcontinental telegraph cables, which made it more difficult for German companies to arrange trade with international partners and neutral shipping companies (Kramer, 2014, 465).

Prewar German naval policy had been based on systematically challenging British surface naval superiority. However, at the start of the war, the High Seas Fleet was trapped in port by the British blockade, where it remained for the duration of the war apart from an indecisive skirmish with part of the British Grand Fleet at the Battle of Jutland in May 1916, after which the German ships returned to port while the British ships went back to blockade duty, so that effectively the "prisoners had attacked their jailer……but in the end they were safely back in jail" (Chickering, 1998: 91-92).

German naval counter-measures can thus reasonably be judged to have failed. By failing to break out from the blockade, the High Seas Fleet abandoned the German merchant

fleet, which was effectively banished from the oceans. Despite the fact that submarine warfare had only held a subordinate place in German strategic planning before the war, Jutland left the German navy with intensifying the submarine blockade as its only realistic option, a risky move that brought the United States into the war on the Allied side.

4.6 Counter-measures to reduce consumption of importable goods

Counter-measures to reduce consumption of importable goods included regulation and rationing, which played an important role in reducing demand from the early stages of the war. However, the system did not work well. Offer (1989: 65-66) suggests that the German tradition of political economy predisposed the authorities to a regulatory approach favouring organisation and compulsion rather than price incentives. As the supply of food fell and prices increased in the summer and autumn of 1914, state regulation initially tended to exacerbate the situation. Capping the prices of individual products led farmers to switch to producing more unregulated products, so that the regulated products became ever scarcer (Chickering, 1998: 42). In early 1915, an Imperial Grain Corporation was introduced to implement grain rationing and was used as a model for rationing other products. By 1916, there was even a War Corporation for Sauerkraut (Chickering, 1998: 43-44). However, the situation continued to worsen until the end of the war. A popular joke in Berlin later in the war after a heavy fall of snow was that the best way to clear snow from the streets would be to establish an Imperial Snow Corporation (Chickering, 1998: 44).

One of the low points of the German administrative response to food shortages was the implementation of a *Schweinemord* (pig massacre) on the grounds that pigs were competing with humans for scarce grain (Kramer, 2014: 475). This followed the recommendations of the Eltzbacher commission of academic experts and officials that reported in December 1914 and

resulted in the killing of 9 million pigs by mid-April 1915 (Offer, 1989: 25-26). However, it soon became clear that pigs were producers of fertiliser as well as consumers of fodder, so that the measure had a negative rather than positive effect on long run food supply (Chickering, 1998: 42). So, regulation and rationing may have reduced consumption of importable goods, but it also contributed significantly to the decline in agricultural output.

4.7 Counter-measures to boost availability of importable goods

One way in which Germany could boost the availability of importable goods during the blockade was through the exploitation of occupied Europe. In the west, occupied France offered rich reserves of iron ore while in Belgium the principal resource was coal (Scherner, 2020: 79-81). In addition, a programme of forced deportations to Germany was introduced to boost the German labour force (Chickering, 1998: 84). In the east, Germany was able to extract relatively few resources from Poland, although 600,000 Polish workers had been enticed or forced to work on German farms by the summer of 1917 (Lenhstaedt, 2020: 586-588; Chickering, 1998: 85). Romania remained neutral until August 1916, then joined the war on the Allied side before being occupied by the Central Powers between December 1917 and May 1918, which gave Germany an opportunity to gain control of Romania's substantial oil wells. However, this was largely frustrated by the actions of a group of British engineers in late 1917 who delayed German access to this important resource through sabotage (Kramer, 2014: 477). Thus, even though the creation of a safe reservoir of raw materials for the German economy, and "extended economic space" in Central and Southeast Europe became an obsession of German leaders and policymakers in the 1930s in preparation for World War 2, the German experience in World War 1 offered little justification for this strategy.

The development of *ersatz* (substitute) goods was another way to boost the availability of importable goods. The policy of using artificial substitutes to replace scarce imported natural products is particularly associated with Germany during World War 2, but also played a role in World War 1. The prime example is the development of the Haber-Bosch process just before the start of the war, which was crucial for the production of both fertiliser and explosives in Germany during World War 1 (Kramer, 2014: 479). The Germans had more limited success in substituting for mineral-oil imports with by-products of coke, especially benzene. Fuel shortages therefore remained critical, particularly since although prewar Germany had been a major exporter of coal, growing demand, transportation bottlenecks and declining domestic mining due to shortages of labour and materials led to coal shortages during the war (Roelevink and Ziegler, 2020: 126-134).

Germany devoted much attention to boosting the availability of metals through increased domestic mining with state financial support for exploration and the development of new mines. These measures led to an increased production of key metals such as nickel, tin, and tungsten, while recycling campaigns for the collection of everyday objects, known as *Metallmobilmachung* (Metal Mobilisation), were more important for other metals such as copper, brass and bronze (Scherner, 2020: 72-78).

Germany succeeded in boosting the availability of importable goods with the exploitation of industrial raw materials from western Europe, but was less successful in the extraction of resources from eastern Europe. There were also notable successes in the production of *ersatz* goods, particularly those arising from the synthesis of ammonia using the Haber-Bosch process, while metal shortages were alleviated through state support for new mines and recycling campaigns.

5. CONSEQUENCES: AGRICULTURAL AND FOOD POLICIES AFTER 1918

5.1 British policy after World War 1

It might have been expected that the British would maintain the incentives used to boost grain production during the war, to avoid dependence on vulnerable agricultural imports in any future war. The Corn Production Act of 1917 guaranteed minimum prices for the next six years until 1922 and envisaged the payment of deficiency payments to farmers based on average yields per acre if market prices fell below the guaranteed minimum. During the war, however, market prices remained substantially above the guaranteed minimum price, so that the support given to farmers was purely hypothetical (Whetham, 1978: 95). As the government began to wrestle with how to adjust the guaranteed prices to changing costs and the long run position of agriculture, the problem was referred to a Royal Commission, which produced an interim report in 1919, recommending new minimum prices for wheat, barley and oats, although barley was excluded from the resulting legislation to satisfy the temperance lobby (Whetham, 1978: 120-121). The resulting Agriculture Act of December 1920 envisaged the new price guarantees coming into force from August 1921. Within a few months, however, prices stopped rising and began a precipitous fall, as shown in Figure 3. Once it became clear that the guaranteed prices would probably mean deficiency payments of £30 million a year at a time when government spending was being cut back drastically in most areas, the government repealed the guarantees. The Corn Production Acts (Repeal) Act of August 1921 affected what became known by farmers as the “Great Betrayal” (Whetham, 1978: 141).

Subsequent support for agriculture was kept low between the wars and generally took the form of subsidies and marketing schemes rather than tariffs, because of imperial preference (Pollard, 1969: 134-145). If Britain was to obtain access to Empire markets for industrial

exports, Empire farmers had to have access to the British market for agricultural produce. Thus, short run pressures on government continued to hinder long term plans for food security during the 1930s, just as they had in the 1920s. Figure 3 shows how the real price of wheat continued to fall faster than the GDP deflator, so that by the 1930s, the real price of grain was barely half of its 1913 level. The share of agriculture in economic activity and agricultural employment continued to decline in Britain during the interwar period and Britain would again enter World War 2 highly dependent on imported grain and vulnerable to German submarine blockade (Olson, 1963: 117-119). Again, however, Britain used its flexibility to survive (see Chapter 6). Agricultural support was strengthened during World War 2, again with promises of continued postwar incentives. This time, unlike after World War 1, the incentives were retained in the 1947 Agriculture Act and Britain's reliance on imported food was greatly reduced (Bowers, 1985).

5.2 German policy after World War 1

Mulder (2022) suggests that the German pursuit of autarky policies during the interwar period may have been driven by an exaggerated belief in the power of blockade and fear of sanctions. We have already seen in section 4.7 that the reduction of food consumption in Germany owed far less to the contribution of the blockade-induced decline in imports than to the decline in agricultural production caused by the disruptive effects of mobilisation. However, while the link between the blockade and a reduction in food imports was easy for people to grasp, the link between the spill-overs from mobilisation and shortages of food was more indirect and harder to perceive. Furthermore, the effects of the blockade were still visible for a further eight months after the end of the war, as the Allies retained it in place until Germany submitted to the terms of the Treaty of Versailles (Cox, 2019: 53). Blaming the blockade was also encouraged by the way that Ludendorff acted during the final stages of the war to shape public

opinion. After the failure of the Ludendorff Offensive of spring 1918 and as the Allied counter-offensive gathered momentum over the summer, military leadership realised that the war was lost and on 29 September handed over responsibility for negotiating an armistice to the civilian government (Chickering, 1998: 178-189). As a result, during the run up to the armistice on 11 November, civilians rather than soldiers shouldered the responsibility of suing for peace, while the military leadership spread the myth of the *Dolchstoss*, or "stab in the back", blaming the home front for the failure of the Ludendorff Offensive through the withholding of adequate supplies and reserves. The soldiers in the field could then be portrayed as remaining valiant and in good order until the autumn of 1918, when subversive agitation by "pacifists, socialists, slackers and Jews" could be blamed for bringing about the final collapse of morale on the home front after years of struggle against the blockade-induced shortages (Chickering, 1998: 190).

As Germans formed an exaggerated belief in the power of blockade during and after the war, it was natural that this should spill over into a fear of sanctions, the peacetime application of the economic weapon. Thus, the blockade myth had a profound effect on German strategic thinking during the interwar period, leading to an interest in the idea of Mitteleuropa, a German-led central European economic zone (Mulder, 2022: 59-60). This led to sharp changes in the direction of Germany's trade during the 1930s as autarkic policies were actively pursued via bilateral trade and exchange clearing agreements. The share of southern and eastern Europe in German imports increased from 9.8 to 18.7 percent between 1929 and 1938, while for exports the share increased from 11.2 to 20.8 per cent over the same period (Feinstein et al., 1997: 164). It highlights the strategic motive behind this shift that Germany was willing to pay between 20 and 40 per cent above world-market prices for essential raw materials, including farm staples, from its 'extended economic sphere' (Abelshauser 1999, 519-20).

6. CONCLUSIONS

This chapter has compared the German blockade of Britain and the British blockade of Germany during World War 1, using a framework of preparations, conduct and consequences. We began by examining how domestic agriculture came to produce just 35 per cent of Britain's calorific requirements before the war, leaving the country highly dependent on seaborne imports of food, while Germany produced 80 per cent of its food requirements domestically. Trade policy is the answer to these divergent paths, with Britain pursuing a policy of free trade in food after the repeal of the Corn Laws while Germany continued to protect its farmers, with tariffs reaching about 40 per cent by the outbreak of the war.

We then explained how Germany came to face food shortages while Britain managed to feed itself adequately throughout the war despite the prewar preparations apparently favouring Germany. How did the country that produced most of its food at home suffer greatly from the blockade while the country that imported most of its food manage to survive the blockade without any significant deterioration in the calorific value of the diet? The answer here is that Britain successfully adopted a range of counter-measures to maintain shipping capacity (the convoy system and shipbuilding), to economise on the use of shipping (Atlantic concentration, speeding up turnaround times at ports), to reduce consumption of importable goods (cutting back investment, limiting exports, controlling the importation of non-essential imports while discouraging excessive consumption of essential imports, and eventually introducing rationing) and also to boost agricultural production (introducing incentives for farmers to increase agricultural production). In essence, the British exhibited a capacity for substitution, allowing the economy to be flexible enough to survive the German submarine blockade.

By contrast, Germany suffered a substantial deterioration in the calorific value of its food supply. The main cause of this was the excessive demands made on the economy by mobilisation. Robbed of labour, horses, and fertiliser, and facing weak incentives to produce for the market as consumer goods disappeared, German farmers reduced output. We must be careful, therefore, not to follow much of the literature and overstate the role of the blockade in the relatively poor performance of the German economy during the war. Some simple calculations suggest that the blockade accounted for between 17.5 and 27.6 per cent of the decline in food consumption between 1913 and 1918, with the vast bulk of the decline in food consumption due to a 40 per cent collapse in domestic production.

Given the much greater importance of the fall in domestic production of food than the decline in imports, it is important to take a nuanced approach to the evaluation of German counter-measures to the blockade, rather than jumping to the conclusion that they all must have failed badly. Naval counter-measures were clearly unsuccessful as the German High Seas Fleet remained locked in port throughout the war apart from a couple of indecisive skirmishes, thus accepting the banishment of the German merchant fleet from the oceans. Counter-measures to reduce consumption of importable goods included regulation and rationing, but these were implemented in a less flexible way than in Britain, with the authorities favouring organisation and compulsion rather than price incentives. Counter-measures to boost availability of importable goods included the exploitation of occupied Europe. These met with some success in the west, but were limited in the east by the economic backwardness of the territories occupied. The most successful countermeasures to boost availability were the development of *ersatz* goods and policies to boost the availability of metals through subsidised development of new mines and recycling campaigns.

Finally, we consider the consequences of the war for agricultural and food policies after 1918. Perhaps surprisingly, the British government quickly reneged on the price guarantees offered into the future, resulting in a rapid reversal of the wartime increase in the production of grain, so that Britain entered World War 2 once again highly dependent on imported grain and vulnerable to German submarine blockade. Germany, by contrast, with an exaggerated belief in the power of blockade and a fear of sanctions, drew the conclusion that it needed to pursue autarkic policies and used bilateral trade and exchange clearing agreements to increase its trade with southern and eastern Europe.

TABLE 1: International grain price spreads, 1870-1913 (percentages)

	Britain-United States		Bavaria-United States	
	1870	1913	1870	1913
Wheat	54.1	-0.8	44.0	37.1
Barley	45.9	10.9	5.4	43.6
Oats	138.1	28.1	82.6	106.3
Rye	n.a.	n.a.	66.5	48.5

Source: O'Rourke (1997: 782).

TABLE 2: Growth of cereal production, 1885-1913 (percentage change)

	Britain	Germany
Wheat	-28.2	+59.6
Barley	-25.9	+36.0
Oats	+3.2	+84.5
Rye	n.a.	+77.3

Sources and notes: Derived from Ministry of Agriculture, Fisheries and Food and Department of Agriculture and Fisheries for Scotland (1968: 108-112); Hoffmann (1965: 292-293).

TABLE 3: Convoy sailings and losses

		Gross	Percentage of total	
	Ships	tonnage	Ships	Tonnage
Escorted safely	16,539	86,373,725	99.08	99.04
Torpedoed in convoy	102	585,283	0.61	0.67
Lost in marine perils	16	82,359	0.09	0.09
Lost while not in convoy	36	172,052	0.22	0.20
Total sailings	16,693	87,213,419	100.00	100.00

Source: Fayle (1924: 473).

TABLE 4: Net loss or gain in Allied and neutral shipping during 1918 (000 deadweight tons)

	Italy	France	UK	USA	Other Allies	Neutrals	Total
January	-21	-46	-212	88	8	-33	-216
February	-35	-10	-225	116	25	-45	-174
March	-56	-23	-56	158	5	-59	-31
April	6	-30	-186	164	-5	14	-37
May	-15	-24	-31	229	84	-20	223
June	12	-25	-47	252	72	5	269
July	-26	-20	-18	226	30	-18	174
August		-32	-17	275	62	-30	258
September	-3	-2	6	340	48	-3	386
October	-11	-13	106	385	46	-3	510
Total	-149	-225	-680	2,233	375	-192	1,362

Source: Salter (1921: 366-367).

TABLE 5: British import value shares by region of origin (%)

	1914	1916	1918
Principal European trades cut-off by war	10.8	0.2	0.0
Principal European Allies	10.7	5.9	4.6
North European neutrals	10.3	8.7	4.5
Rest of Europe and Mediterranean	6.0	9.3	9.3
North America	24.6	37.2	48.7
Central America and West Indies	1.9	2.4	2.8
South America	9.0	9.3	8.8
West Africa	1.6	1.8	1.7
South and East Africa	2.5	1.9	1.8
Middle East	7.7	8.9	7.6
Far East	6.1	7.2	4.9
Australasia	8.8	7.2	5.3
Grand total	100.0	100.0	100.0

Sources and notes: Fayle (1924: 480-483). Principal European trades cut-off by war: Central Powers plus Belgium. Principal European Allies: France, Italy, Russia. North European neutrals: Norway, Sweden, Denmark plus Iceland and Greenland, Netherlands. North America: United States, Canada, Newfoundland and Bermuda.

TABLE 6: British agricultural output (000 tons)

	1913	1914	1915	1916	1917	1918
Wheat	1,541	1,706	1,961	1,559	1,634	2,428
Barley	1,408	1,367	986	1,110	1,189	1,299
Oats	1,986	2,033	2,168	2,100	2,730	2,965
Potatoes	3,865	4,031	3,830	3,036	4,451	5,360
Beef & veal	753	789	789	773	831	557
Mutton & lamb	322	283	282	304	318	218
Pork	224	194	227	228	134	65
Bacon & ham	125	120	130	136	108	71
Fresh milk & cream	4,510	4,630	4,565	4,190	3,825	3,325
Butter	126	126	126	125	114	103

Source: Beveridge (1928: 261).

TABLE 7: Per ‘man’ calorie value of weekly quantities of food consumed in Britain

	1909-13	1914	1915	1916	1917	1918
Flour	8,464	8,365	8,266	8,613	9,355	9,570
Butchers’ meat	3,086	2,988	2,891	2,692	2,332	1,710
Bacon & ham	1,036	1,054	1,263	1,336	1,181	1,426
Butter	1,346	1,285	1,177	1,011	845	732
Margarine	458	574	854	1,036	1,022	945
Lard	520	512	608	540	412	708
Potatoes	1,408	1,638	1,715	1,574	1,488	2,029
Sugar	3,236	3,311	3,534	2,716	2,232	2,065
Fresh milk	1,642	1,654	1,654	1,530	1,402	1,219
Other foods	2,895	2,797	2,892	2,879	2,971	3,102
Total weekly calories	24,091	24,178	24,854	23,927	23,240	23,506
Calories per day	3,442	3,454	3,551	3,418	3,320	3,358

Sources and notes: Beveridge (1928: 313). Figures are quoted per ‘man’, based on a man of 15 to 16 stone weight doing average work during eight hours a day, requiring 3,300 calories a day.

TABLE 8: Share of Scandinavian and Dutch exports going to Germany (%)

	Denmark	Sweden	Norway	Netherlands
1911	29.8	20.2	17.1	49.7
1912	30.5	22.5	16.4	50.0
1913	28.1	21.9	17.0	47.9
Avg. 1911-13	29.5	21.5	17.0	49.2
1914	38.6	22.7	18.5	44.9
1915	49.7	36.9	28.5	40.8
1916	58.7	28.1	29.6	38.6
1917	50.5	26.1	19.0	38.6
1918	43.4	21.7	11.3	39.9
Avg. 1914-18	49.3	27.5	22.0	41.6

Source: Davis and Engerman (2012: 208).

TABLE 9: American exports to the Central Powers' neutral neighbours ($m)

	June 1915 to June 1916	June 1917 to June 1918
Denmark	55.9	5.0
Netherlands	97.5	6.4
Norway	53.6	25.2
Sweden	52.0	4.1
Switzerland	8.0	21.2

Source: Hardach (1987: 30).

TABLE 10: German wartime rations compared with peacetime consumption (peacetime consumption = 100)

Commodity	July 1916 to July 1917	July 1917 to July 1918	July 1918 to December 1918
Meat	31	20	12
Fish	51	–	5
Eggs	18	13	13
Land	14	11	7
Butter	22	21	28
Cheese	3	4	15
Rice	4	–	–
Pulses	14	1	7
Sugar	49	56-67	80
Vegetable Fats	39	41	17
Potatoes	71	94	94
Flour	53	47	48

Source: Hardach (1987: 119).

TABLE 11: Female mortality in Germany and in England and Wales, 1913-1923 (Deaths per 1000 females)

Year	Germany	England	Germany as a percent of England
1913	14.3	12.2	117.2
1914	15.2	12.4	122.6
1915	15.3	13.2	115.9
1916	15.2	11.7	129.9
1917	17.6	11.4	154.4
1918	21.6	14.6	147.9
1919	16.7	11.9	140.3
1920	15.3	10.9	140.4
1921	13.6	10.2	133.3
1922	13.9	10.5	132.4
1923	13.6	9.3	146.2

Source: Offer (1989: 36); Davis and Engerman (2011: 205).

TABLE 12: German foreign trade in current and constant prices (billions of Marks)

	At current prices		At constant 1913 prices	
	Exports	Imports	Exports	Imports
1913	10.1	10.8	10.1	10.8
1914				
Jan-July	6.0	6.4	6.0	6.4
Aug-Dec	1.4	2.1	1.5	2.1
Jan-Dec	7.4	8.5	7.5	8.5
1915	3.1	7.1	2.5	5.9
1916	3.8	8.4	2.9	6.4
1917	3.5	7.1	2.0	4.2
1918	4.7	7.1	2.8	4.2

Source: Hardach (1987: 33). Data for 1913 from Hoffmann (1965: 817), data for 1914-1918 from Kleine-Natrop (1922: 11).

TABLE 13: German agricultural output 1913-1918 (% of 1913)

	Rye	Wheat	Summer barley	Potatoes	Oats	Meadow hay	Total agriculture
1913	100.0	100	100	100	100	100	100
1914	85	86	86	85	93	100	89
1915	75	84	68	100	62	83	85
1916	73	68	77	47	73	99	65
1917	58	50	51	65	38	77	60
1918	66	56	58	56	49	76	60

Source: Crops: Parmelee (1924: 212); Total agriculture: Ritschl (2005: 46).

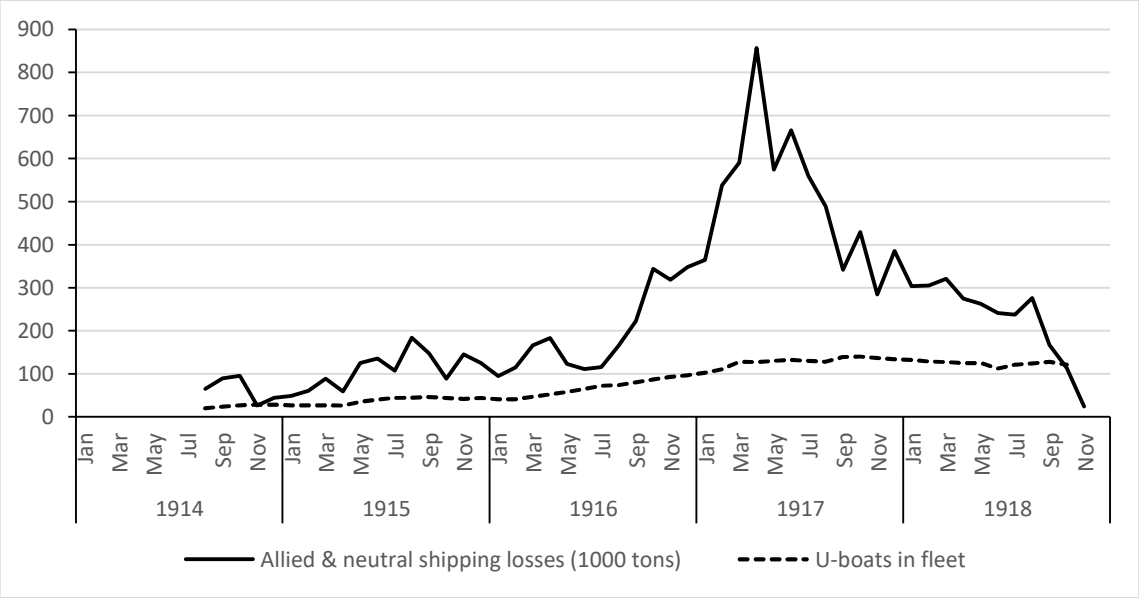
TABLE 14: Contribution of the decline in imports to the reduction of food consumption in Germany between 1913 and 1918

	(1) 1913 shares of production and imports in food consumption (%)	(2) Reduction of production and imports, 1913-1918 (%)	(3) Weighted reduction of production and imports, 1913-1918 (%)	(4) Relative shares of production and imports in reduction of consumption (%)
Production	80	40	32.0	72.4
Imports	20	61	12.2	27.6
Consumption	100		44.2	100.0

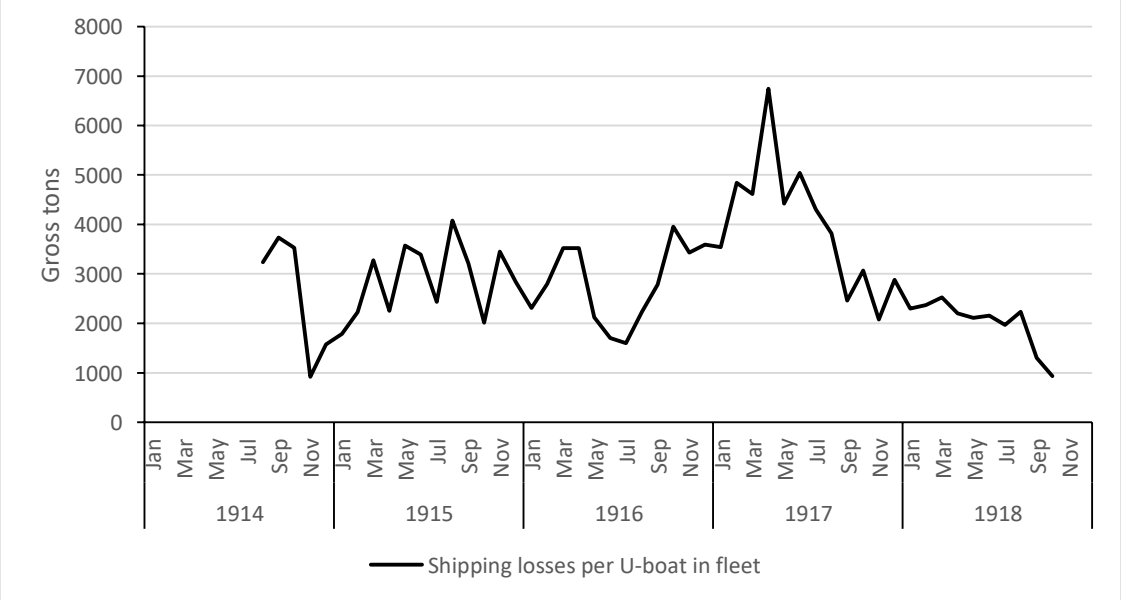
Sources and notes: Food production and import shares of consumption in 1913: Olson, (1963: 74). Reduction of agricultural production 1913-1918: Ritschl (2005: 46). Reduction of imports 1913-1918: Hardach (1987: 33). Column (3) = (1)x(2). Column (4) expresses the weighted reduction of production and imports from column (3) as shares of the reduction in consumption.

FIGURE 1: The Battle of the Atlantic

A. Allied and neutral shipping losses (000 gross tons) and the number of U-boats in the German fleet

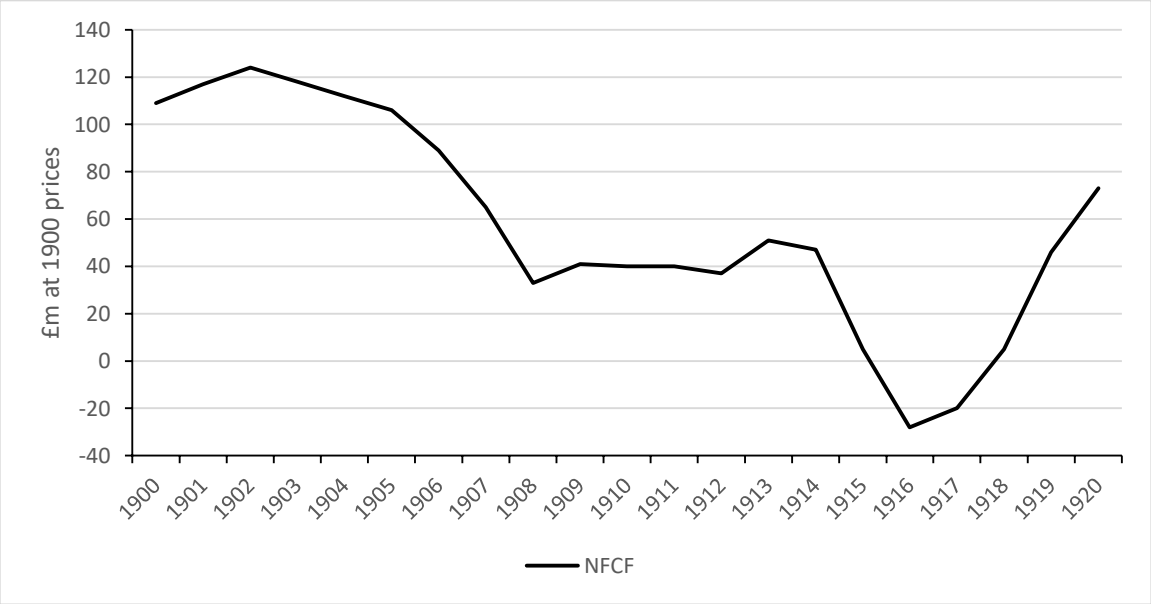


B. Shipping losses per U-boat in the German fleet



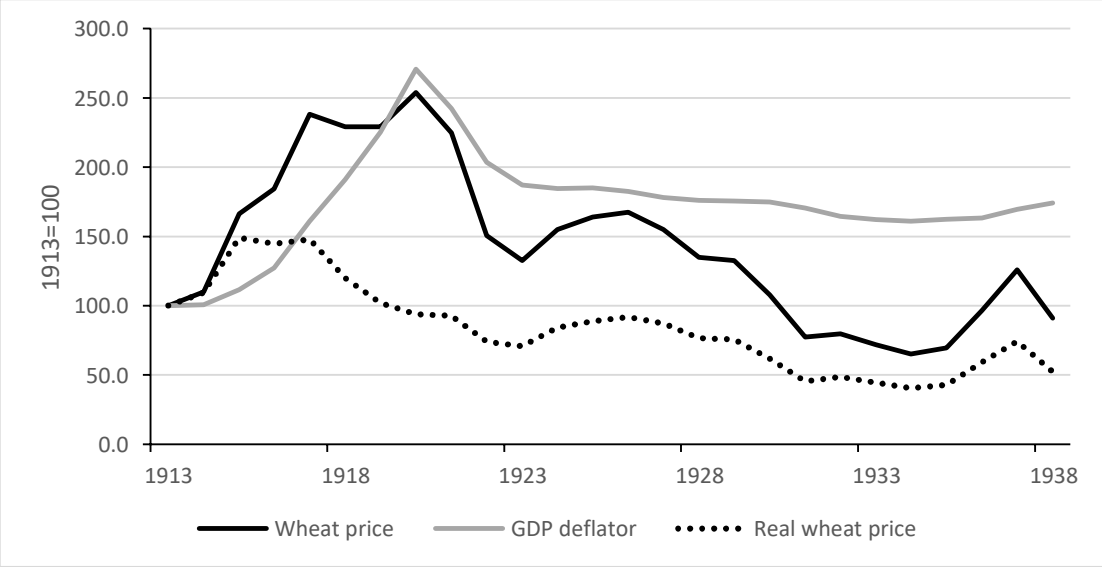
Sources and notes: Davis and Engerman (2006: 182-183).

FIGURE 2: UK net fixed capital formation (£m at 1900 prices)



Source: Feinstein (1988: 442-443).

FIGURE 3: UK nominal and real wheat prices, 1913-1938 (1913=100)



Sources: Ministry of Agriculture, Fisheries and Food and Department of Agriculture and Fisheries for Scotland (1968: 82); Feinstein (1972: T132-T133).

REFERENCES

Abeslhauser, W. (1999), "Kriegswirtschaft und Wirtschaftswunder: Deutschlands wirtschaftliche Mobilisierung für den Zweiten Weltkrieg und die Folgen für die Nachkriegszeit", Vierteljahrshefte für Zeitgeschichte, 47, 503-538.

Afton, B and Turner, M. (2000), "The Statistical Base of Agricultural Performance in England and Wales, 1850-1914", in Collins, E.J.T. (ed.), *The Agrarian History of England and Wales, 1850-1914, Part II*, Cambridge: Cambridge University Press, 1757-2140.

Bell, A. C. (1961), *A History of the Blockade of Germany and the Countries associated with her in the Great War, Austria-Hungary, Bulgaria, and Turkey, 1914-1918*, London: Her Majesty's Stationery Office.

Beveridge, W.H. (1928), *British Food Control*, Oxford: Oxford University Press.

Blum, M. (2011). 'Government Decisions Before and During the First World War and the Living Standards in Germany During a Drastic Natural Experiment', *Exploration in Economic History*, 48 (4): 556-567.

Boldorf, M. (2020), "Außenhandel und Blockade", in M. Boldorf (Ed.), *Deutsche Wirtschaft im Ersten Weltkrieg*, Berlin, Boston: De Gruyter Oldenbourg, 479-520.

Bowers, J.K. (1985), British Agricultural Policy since the Second World War", *Agricultural History Review*, 33, 66-76.

Breemer, J. S. (2010), *Defeating the U-boat: Inventing Antisubmarine Warfare*, Newport Papers No. 36, Newpor, RI: Naval War College Press.

Broadberry, S. and Harrison, M. (2005), "The Economics of World War I: An Overview", in Broadberry, S. and Harrison, M. (eds.), *The Economics of World War I*, Cambridge: Cambridge University Press, 3-40.

Broadberry, S. and Howlett, P. (2005), "The United Kingdom During World War I: Business as Usual", in Broadberry, S. and Harrison, M. (eds.), *The Economics of World War I*, Cambridge: Cambridge University Press, 206-234.

von Bühlow, H. (1917), *Deutschlands Aushungerung?* Dresden, Leipzig: Globus.

Chickering, R. (1998), *Imperial Germany and the Great War, 1914-1918*, Cambridge: Cambridge University Press.

Churchill, W.S. (1923), *The World Crisis: 1915*, London: Thornton Butterworth.

Churchill, W.S. (1927), *The World Crisis: 1916-1918, Part II*, London: Thornton Butterworth.

Cox, M. (2019), *Hunger in War and Peace: Women and Children in Germany, 1914-1924*, Oxford: Oxford University Press.

Davis, L. E., and Engerman, S. L. (2012), *Naval Blockades in Peace and War. An Economic History Since 1750*, Cambridge: Cambridge University Press.

Fayle, C.E. (1924), *Seaborne Trade, Volume III: The Period of Unrestricted Submarine Warfare, with a Map and Statistical Diagrams*, London: Murray.

Fayle, C.E. (1927), *The War and the Shipping Industry*, Oxford: Oxford University Press.

Feinstein, C.H. (1972), *National Income, Expenditure and Output of the United Kingdom, 1855-1965*, Cambridge: Cambridge university Press.

Feinstein, C.H. (1988), "National Statistics, 1760-1920: Sources and Methods of Estimation for Domestic Reproducible Fixed Assets, Stocks and Works in Progress, Overseas Assets, and Land", in Feinstein, C.H. and Pollard, S. (eds.), *Studies in Capital Formation in the United Kingdom, 1750-1920*, Oxford: Oxford University Press, 257-471.

Feinstein, C.H., Temin, P. and Toniolo, G. (1997), *The European Economy Between the Wars*, Oxford: Oxford University Press.

Gerschenkron, A. (1943), *Bread and Democracy in Germany*, Berkeley CA: University of California Press.

Goebel, O. (1930), *Deutsche Rohstoffwirtschaft im Weltkrieg: einschliesslich des Hindenburg-Programms*. Stuttgart, Berlin, Leipzig: Deutsche Velags-Anstalt.
Hardach, G. (1987), *The First World War, 1914-1918*, Harmondsworth: Penguin.
Harrison, M. (2023), "Economic Warfare: Lessons from History", in Eloranta, J., Fishback, P., Kuorelahti, E. and Land, J. (eds.), *The Routledge Economic History of War*, Abingdon: Routledge, (forthcoming).
Hoffmann, W.G. (1965), *Das Wachstum der deutschen Wirtschaft seit der Mitte des 19. Jahrhunderts*, Berlin: Springer.
Kleine-Natrop, H. (1922), *Devisenpolitik (Valutapolitik) in Deutschland vor dem Kriege und in der Kriegs- und Nachkriegszeit*, Berlin: Preiss.
Kramer, A. (2014), "Blockade and Economic Warfare", in Winter, J. (ed.), *The Cambridge history of the First World War, Vol. 2: The State*, New York: Cambridge University Press, 460-489.
Lambert, N. (2012), *Planning Armageddon: British Economic Warfare and the First World War*, Cambridge MA: Harvard University Press.
Lehnstaedt, S. (2020), "Bezatzungswirtschaft in Generalgouvernement Warschau und in Osteuropa", in M. Boldorf (Ed.), *Deutsche Wirtschaft im Ersten Weltkrieg*, Berlin, Boston: De Gruyter Oldenbourg, 575-600.
Marrison, A. (1996), *British Business and Protection1903-1932*, Oxford: Clarendon.
Middleton, T.H. (1923), *Food Production in War*, Oxford: Oxford University Press.
Ministry of Agriculture, Fisheries and Food and Department of Agriculture and Fisheries for Scotland (1968), *A Century of Agricultural Statistics: Great Britain 1866-1966*, London: HMSO.
Mulder, N. (2022), *The Economic Weapon: The Rise of Sanctions as a Tool of Modern War*. New Haven: Yale University Press.
O'Rourke, K.H. (1997), "The European Grain Invasion, 1870-1913", *Journal of Economic History*, 57, 775-801.
Offer, A. (1989), *The First World War: An Agrarian Interpretation*, Oxford: Oxford University Press.
Olson, M. (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.
Parmelee, M. (1924), *Blockade and Sea Power*, New York: Thomas Y. Crowell Company Publishers.
Pollard, S. (1969), *The Development of the British Economy, 1914-1967*, (Second Edition), London: Arnold
Ritschl, A. (2005), "The Pity of Peace", in Broadberry, S. and Harrison, M. (eds.), *The Economics of World War I*, Cambridge: Cambridge University Press, 41-76.
Roelevink, E-M. and D. Ziegler (2020), "Rohstoffwirtschaft: die bergbaulichen Rohstoffe", in M. Boldorf (Ed.), *Deutsche Wirtschaft im Ersten Weltkrieg*, Berlin, Boston: De Gruyter Oldenbourg, 125-156.
Roerkohl, A. (1991), *Hungerblockade und Heimatfront: Die kommunale Lebensmittelversorgung in Westfalen während des Ersten Weltkrieges*. Stuttgart: Steiner.
Salter, J.A. (1921), *Allied Shipping Control*, Oxford: Oxford University Press.
Scherner, J. (2020), "Metallbewirtschaftung", in M. Boldorf (Ed.), *Deutsche Wirtschaft im Ersten Weltkrieg*, Berlin, Boston: De Gruyter Oldenbourg, 67-88.
Skalweit, A. (1927), *Die deutsche Kriegsernährungswirtschaft*. Stuttgart, Berlin, Leipzig: Deutsche Velags-Anstalt.

Starling, E.H. (1920), The Food Supply of Germany During the War", *Journal of the Royal Society*, 83, 225-254.
Webb, S.B. (1982), "Agricultural Protection in Wilhelminian Germany: Forging an Empire with Pork and Rye", *Journal of Economic History*, 42, 309-326.
Whetham, E. (1978), *The Agrarian History of England and Wales, 1914-39,* Cambridge: Cambridge University Press.