

THE ECONOMICS OF WORLD WAR I: A COMPARATIVE QUANTITATIVE ANALYSIS

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Abstract: We draw on the experience of the major combatant countries in World War I to analyse the role of economic factors in determining the outcome of the war and the effects of the war on subsequent economic performance. We demonstrate that the degree of mobilisation for war can be explained largely by differences in the level of development of each country, leaving little room for other factors that feature prominently in narrative accounts, such as national differences in war preparations, war leadership, military organisation and morale. We analyse the effects of the war on subsequent economic performance in terms of the scale of destruction of physical and human capital. Although the growth rate between 1918 and 1929 was highest in the economies which experienced the worst destruction, over the period 1913-1929 as a whole, per capita income growth in Europe was reduced. Thus there was some rebound, but not enough to undo the negative effects of the capital destruction and the damage to the international institutional framework caused by the war.

I. INTRODUCTION

There has been little quantitative economic analysis of World War I, and even less that uses a systematic comparative framework. Although some quantitative work was conducted at the end of the war under the auspices of the Carnegie Endowment for International Peace, most of this was organised around individual economies, with only the study by Bogart (1920) taking a systematic comparative approach.

Subsequent comparative work was either narrowly focused on specific themes such as public finance (Fisk, 1924; Mendershausen, 1941) or has tended to be rather less systematically quantitative or economic (Hardach, 1977; Chickering and Förster, 2000). To some extent, previous generations of scholars could point to data problems as an excuse for not adopting a comparative quantitative approach to the economics of World War I; the increasing availability of historical national accounts for the major combatant countries, however, makes this argument no longer sustainable.

In this paper, we draw on the experience of the major combatant countries to examine the economics of World War I. There was a circle of causation linking total war and economics, which we decompose into its two halves.

First, we examine the role of economic factors in determining the outcome of the war. As with our analysis of World War II (Harrison, 1998), we argue that the size of national resources mattered greatly, but that size was not everything: the quality of the economy, or its level of development, was also important. The resources of rich countries were more available for mobilization than the resources of poor countries. If poor countries tended to get four when they added two and two, rich countries usually got more. We demonstrate that the degree of mobilisation for war can be explained largely by differences in the level of development of each country; in other words, the level of development acted as a multiplier of size. This also leaves little room for other factors that feature prominently in most narrative accounts, such as national differences in war preparations, war leadership, military organisation and morale.

Second, we examine the effects of World War I on subsequent economic performance. Here, we quantify the scale of destruction of physical and human capital and examine the implications for national balance sheets. Although the growth rate between 1918 and 1929 was highest in the economies which experience the worst destruction, over the period 1913-1929 as a whole, per capita income growth in Europe as a whole was reduced. Thus there was some rebound, but not enough to

undo the negative effects of the capital destruction and damage to the international institutional framework caused by the war.

II. WHY THE ALLIES WON

What did economic factors contribute to victory and defeat in World War I? Before the event, so to speak, the answer should have been nothing; after the event, it turned out to be nearly everything. From the standpoint of the German war plan for 1914, economic factors were not expected to count. The German general staff hoped for victory in the west within six weeks. The war was intended to be won by military, not economic means, and was to be finished off long before economic factors could be brought into play. It was only after this plan had failed, as the leaders on each side contemplated the ensuing stalemate, that belts began to be tightened and sleeves rolled up for the mobilisation of entire economies (Chickering and Förster, 2000).

Once plans were redrawn for a longer haul, a war of attrition developed in the west where the opposing forces of Germany, France, and Britain, each backed by large, rich, and successful economies, ground each other down with rising force levels and rising losses. In battles that were intended to be won by the last man left standing, resources counted for almost everything. Once the German military advantage had failed to win an immediate victory in the west, it seems inevitable that the greater Allied capacity for taking risks, absorbing the cost of mistakes, replacing losses, and accumulating overwhelming quantitative superiority should eventually have turned the balance against Germany.

The realization of this advantage took time, which seems to have misled Ferguson (1998: 248-81) into writing about an “advantage squandered”. However, there is simply no need to conclude that “the Germans were significantly better at mobilizing their economy for war than the Western powers” just because the war had not ended by the winter of 1916-17 (Ferguson, 1998: 256-257). Total war is, by definition, a drawn out affair. Eastern Europe, the Balkans, and the Near East formed the theatre of combat for the economically weaker powers: Russia, Italy, and the Austro-Hungarian and Ottoman empires. The British and Germans wished to be more involved there, but neither could withdraw significant forces from the western front. In the east, therefore, the immediate outcomes of battles were less determined by economic factors, at least in the short run. Over a period of years, however, the battles drained the weakest economy first, and this led to Russia’s exit from the war in 1917. Then,

the Central Powers' chance for victory in the east was destroyed by Germany's defeat in the west.

The economic advantage of the Allies over the Central Powers was substantial at the outbreak of war and rose steadily as the composition of the belligerents changed on each side. The most striking change was that during 1917 Russia was defeated and abandoned the Allies, but was replaced by the United States. Thus the richest great power stepped into the gap left by the poorest, and this led to a further increase in the Allied advantage.¹ In some ultimate sense economic advantage did determine the outcome, but only after much time had passed and purely military advantage had failed to win the day.

1. Size and Development

What were the resources that were deployed on either side in the war? These are best measured by adding up the populations, territories, and gross domestic products of the territories at war. Populations limited the numbers of men and women available in each country for military service or war work. Territories limited the breadth and variety of natural resources available for agriculture and mining; the wider the territory, the more varied were the soil types and the minerals beneath the soil. GDPs limited the volume of weapons, machinery, fuel, and rations that could be made available to arm and feed the soldiers and sailors on the fighting front. The larger the population, territory, and GDP of a country, the easier it would be for that country to overwhelm the armed forces of an adversary.

In adding up the resources available to each country we also compute the territories and income available per head of the population. Most important was average GDP per head, which reflected the country's development level. A poor country might have a large population, but if most of the adults were engaged in low-productivity subsistence farming then there would be little real possibility of transferring many of them out of agriculture to the armed forces or war industry since the remaining farmers would be unable to produce enough food to keep everyone alive. Equally, a poor country might have a large territory but, without a high level of development of roads and railways, would be unable to exploit it economically or defend it militarily. Finally, a poor country typically lacked efficient government and financial services of the kind necessary to account for resources and direct them into

national priorities. Thus, a relatively high level of economic development was essential if territory and population were to count in war.

Table 1 adds up the resources on the Allied side at the outbreak of war and shows how the volume of resources on each side changed or, more accurately, would have changed if the populations of 1913 had remained in the same place and continued to produce at the same rate in subsequent years as in 1913. Thus, the figures for population and output that are reported for each territory listed in the table are those for 1913. In reality, the populations and productivities of each territory changed year by year as the war progressed. But we have such wartime figures only for a handful of countries. To extend coverage to all the powers and their colonies and dependencies as well, while maintaining comparability, it is necessary to confine ourselves to what we know for most of the countries, that is, the situation as it was in 1913 and as it would have been in subsequent years, had 1913 populations and productivities been maintained.

In this table and the next, countries are listed as far as possible in order of their entry into the war. In the first phase of the war Russia, France, and the United Kingdom were joined together as the power of the Triple Entente. They brought with them their dependencies and colonies. Other countries joined in too: Serbia and the other Yugoslav states, the British Dominions, Liberia, and Japan with her colonies. During 1915/16 a second wave of countries joined the Allies: Italy, Portugal, and Roumania. In the third wave of 1917/18 Russia dropped out but the United States joined in, bringing its own possessions, most of Central America and Brazil. Greece, Siam, and China also joined. By the end of this process governments representing 70 per cent of the world's prewar population and 64 per cent of its prewar output had declared war on the Allied side.

The bare totals on the Allied side do not give any idea of their heterogeneity. The British empire will do for illustration since it comprised some of the richest and poorest regions in the world. Britain itself had a prewar population of 46 million with an average income per head of nearly \$5,000 (at 1990 prices). Its colonies, excluding the Dominions, had a prewar population of 380 millions, mostly Indians, with an average income of less than \$700. Thus a colonial population eight times that of Britain produced a similar volume of output. Moreover this output was far less available than Britain's for fighting Germany for three reasons: it was hundreds or thousands of miles away from the theatre of war, the level of development of colonial

government administration and financial services rendered it hard to track and control, and most of it was already committed to the subsistence needs of the colonial populations. In short, the mere possession of low income territories was of little value to a great power in the war. If India helped Britain in the war it was to enable British trade and commerce rather than because Britain could mobilise Indian resources in any meaningful sense. And the trade that really mattered to the British economy in the war was with rich America and Canada, not with poor India.

Table 2 adds up the resources of the Central Powers, using the same conventions as Table 1. This is a much shorter story with a smaller bottom line. Austria-Hungary began the war, joined immediately by Germany and soon by the Ottoman Empire. In 1915 the Central Powers were joined by Bulgaria, although not by Italy which went back on its prewar treaty obligations. At its maximum extent the alliance of the Central Powers comprised little more than 150 million people, but their relative lack of success in accumulating low-income colonies made them relatively well off with an average income per head of less than \$2,500, roughly comparable to that of Italy on the Allied side.

2. Allied Superiority

Table 3 allows us to compare the resources on each side at three benchmark dates: November in each of 1914, 1916, and 1918. This table offers comparisons for each alliance as a whole, and also counting great powers only. The rationale for the latter is very simple: if low-income colonies did not count much, how do the figures look if we do not count them at all? There is some imprecision here, of course. For example Russia is included as a great power, but much of its territory was little more developed than that of India which is excluded as a colony; also excluded are the British Dominions, which were much richer than Russia. Still, singling out the great powers has the merit of simplicity.

The table shows something very striking: in terms of the resources on either side the Central Powers do not seem to have had much hope. If Germany could not win the war for the Central Powers in the first six weeks, using surprise in the west and an army with superior military qualities, then the chances of victory could only diminish over a longer span of time in which economies would be mobilised on each side and the balance of resources would count for more and more.

Even in the first stage of the war the Allies had access to five times the population, eleven times the territory, and three times the output of the Central powers.² This access was limited by relatively low average incomes across the colonial empires of Britain and France, and low incomes in Russia; we see that the average level of GDP per head on the Allied side in 1914 was not much more than half that of the Central Powers. If we consider great powers only then the Allied advantages in population and output shrink to twice; the Allied advantage in territory actually increases, reflecting the German and Turkish propensities to colonise sandy deserts in Africa and the Middle East.

As the war continued, the Allied powers' advantage in output grew. The decisive year was 1917. When America displaced Russia the Allied population and territory declined but its output multiplied; the average development level of the Allied powers rose above that of the Central Powers for the first time. Although it would take time for America's presence to be felt on the battlefield, it sealed the Central Powers' fate.

The force of these changes is felt even more strongly when it is remembered that the figures in Table 3 are based on the assumption that in wartime the real output of a given territory did not change. While we cannot track the changes for more than a few countries, the figures available suggest further substantial swings which worked primarily to favour the richer powers, Britain and America. Table 4 shows that in wartime the British and American economies expanded by over 10 per cent. The trend in Italy's output is not really known but the Italian economy certainly kept going and did not collapse. Russia, however, began to collapse in 1916 and France in 1917; this emphasises the importance of the American entry into the war on the Allied side. On the side of the Central Powers the dismal failure of wartime mobilisation was evident from the outset: for much of the war period the German and Austrian economies flatlined at 20 to 25 per cent below their prewar benchmarks for real output. Pamuk (2005) estimates that by 1918 the GDP of the Ottoman Empire had declined by 30 to 40 percent.

3. The Human Factor

Where, in all this, is there room for factors other than the economic ones? Reviewing our previous work on World War II (Harrison, 1998) the historian Richard Overly (1998) objected that we left no role to "a whole series of contingent factors – moral, political, technical, and organisational – [that] worked to a greater or lesser degree on

national war efforts.” Such factors were clearly significant in World War I, and economists have considered why they must matter in principle (Brennan and Tullock, 1982) but we do not apologise for still giving most weight to the quantities of resources.

At first the two sides were unequal in military and civilian organisation, motivation, and morale. Germany entered the war with first-rate military advantages associated with “the most formidable army in the world” (Kennedy, 1988: 341), past victories, and the exploitation of initial shock and rapid movement, and maintained this relative military edge throughout the war (Ferguson, 1998, 298-300). But the effects of looming defeat electrified Britain and France, transformed public opinion, and forced their armies and governments through intensive courses in the new rules of warfare and mobilisation. This proved to be the pattern through the war: each temporary setback was followed by strenuous efforts to refine strategy and strengthen morale, organisation, and supplies, and these efforts generally succeeded within the limits permitted by the resources available to support them. In short, the “moral, political, technical, and organisational” issues of the war on each side were not independently variable factors but proved to be endogenous to the progress of the war. Other things being held equal, a deficit of organisation or morale on one side tended to be overcome through a self-balancing process. The one thing that could not be overcome was a deficit of resources.

This approach is well illustrated by comparing the two offensives that appeared to give Germany its best chances of winning the war: August 1914 and March 1918. In the first of these Germany planned to exploit mass, movement, and surprise to destroy the French Army before the British could intervene in the West and before the Russians could mobilise in the East. In practice the German army succeeded in many of its planned objectives but failed in the ones that were vital. The stalemate of the trenches resulted. Had the German plan succeeded the economic factors on each side would never have had time to be felt. Given that it did not, the richer Allies won time to put right their military and organisational failings, but they could not have done so without resources on their side.

Its spring offensive in 1918 again seemed to offer Germany the prospect of winning the war on a purely military advantage. For the first time since 1914 its soldiers opened up great gaps in the Allied lines and advanced dozens of kilometres towards the Channel ports. The offensive badly shocked the Allies and forced them

into reorganisation; the Americans had to accept a unified command. Resources defeated the advancing Germans: their own lack of supply, for they were badly clothed and undernourished even before they began their advance; the abundance of supplies they found in the Allied trenches that caused many to turn away from the attack to eat and drink their advantages away (Herwig, 1988: 102); and the superabundance of war materials that enabled the Allies to regroup and go on to inflict a far greater defeat on the exhausted enemy.

III. MOBILISATION AND THE LEVEL OF DEVELOPMENT

1. Four Aspects of Mobilisation

In this section we examine production mobilisation (the wartime increase in real GDP), fiscal mobilisation (the wartime transfer of resources into the hands of government), military mobilisation (the wartime transfer of persons into the armed forces), and the capital-intensity of warfare (the flow ratio of weapons produced to years of combat service). We find that the comparative success of the various economies in mobilising their resources depended largely on their level of economic development. In some aspects this relationship is found only after controlling for the confounding influences of combat duration and proximity. Britain and the United States were both rich and highly developed, for example, but the briefer involvement of the United States in the war and its greater distance from the continental theatre of warfare inevitably weakened some of the mobilising impulses felt there. A warning about selection bias may also be in order: poorer countries had less good government and national accounts, so the data reported by richer countries tends to be overrepresented; we also have less confidence in the data of the poorer countries when it is reported.³

In Figure 1 production mobilisation is measured by the wartime change in GDP up to 1917. Production mobilisation was strongly and positively correlated with prewar GDP per head. The relationship would look still stronger if we included Pamuk's (2005) figures for Turkey, with a prewar GDP per head of less than \$800 and a wartime output decline of 30 to 40 per cent.⁴

The available measures of fiscal mobilisation do not give such a clearcut result. Figure 2, based on Table 5, shows the change in the government share of GDP in the first year of the war for five countries close to the fighting and three distant ones. It shows a positive relationship between mobilisation and prewar development level but

it is necessary to control for distance for the relationship to become apparent. The measure that we use tends to underestimate the richer countries' ability to transfer resources rapidly from peacetime to wartime uses since they also tended to spend a lower proportion of their national income on defence in peacetime (Eloranta, 2003). It is not clear whether the association suggested by Figure 2 would be strengthened by inclusion of the Ottoman Empire where the proportion of GDP under the control of the state was no more than 16-20 per cent at the peak (Pamuk, 2005). With regard to fiscal mobilisation Figure 2 is our best shot: after the first year of warfare, any relationship between fiscal mobilisation and development level ceases to be apparent.

Men and weapons may provide more unambiguous measures of mobilisation than money. In the mobilisation of young men we find a pattern that again rises with development and falls with distance. Figure 3 plots the wartime mobilisation rates of various countries against their prewar incomes per head in three distance bands. The first band comprises the front-line Eurasian states on whose territory or borders the war was fought. The second band is for the European countries separated from the war by land or sea, with only two members: Britain and Portugal. The third band includes countries that joined the war from continents beyond Europe and the Near East. Cumulative numbers mobilised are shown as a proportion of young men in the age group from 15 to 49 years of age. In each distance band, i.e. controlling for distance, the figures show a consistent positive dependence of the proportion mobilised in each country on its prewar income level. However, dropping a band lowered the proportion substantially.⁵

The richer countries were not only able to mobilise more men. Regardless of distance, they also supplied them better. Capital-abundant economies were able to support capital-intensive warfare. Figure 4 plots cumulative war production of rifles, machine guns, field guns, tanks, and aircraft in units per thousand men mobilised through the war and per year of the war. In each case we see that supply rose strongly with the development level of the country.

To summarise, size mattered for the ability of a country to supply the means of military power, but the level of economic development was a multiplier of size. Richer countries were able to mobilise production, public finance, soldiers, and weapons per soldier, out of proportion to their general economic capacities.

2. Mobilisation and Agriculture

Countries like Russia and Austria-Hungary were large; why did it make such a difference that they were also poor? We could imagine the relationship between mobilisation and economic development operating through several possible channels. A pure income effect is one candidate. Another candidate is the effect of economic development on the general quality of legal and financial institutions, that might support more efficient wartime administration and a wider capital market to support wartime deficit finance. A third effect, on which we concentrate here, is the effect of economic development on the economic structure: in World War I, poor countries ran short of food long before they ran out of guns and shells (Offer, 1989), and we associate this with a negative influence of peasant agriculture on mobilisation.

One of the most striking attributes of relative poverty was the role of subsistence farming. Contemporary observers were aware of these differences and interpreted them as follows: when war broke out, a country such as Russia would have an immediate advantage in the fact that most of its population could feed itself; moreover, the ability to divert food supplies from export to the home market would actually increase Russia's advantage. In contrast Britain would quickly starve (Gatrell and Harrison, 1993). This diagnosis could not have been more wrong. In practice the presence of a large peasantry proved to be a great disadvantage when it came to the mobilisation of resources for war. Peasant agriculture behaved very much like a neutral trading partner. Why should Netherlands trade with Germany given the latter's reduced ability to pay, except under threat of invasion and confiscation? Peasant farmers made the same calculation. Thus the Russian economy looked large, but if the observers of the time had first subtracted its peasant population and farming resources they would have seen how small and weak Russia really was. Meyendorff (cited by Gatrell, 2005) described what happened in Russia as "the Russian peasant's secession from the economic fabric of the nation". And not only from Russia, for Italy, Austria-Hungary, the Ottoman Empire, and Germany all had large peasant populations that proved extremely difficult to mobilise for much the same reason.

The common process of the peasant's secession is clearly visible from a comparison of the richer and poorer countries' experience. When war broke out British and American farmers boosted production because they were offered higher prices and responded normally to incentives. The fact that British farming had already contracted to a small part of the economy made its expansion easier: there were

plentiful reserves of land unused or little exploited, and the high productivity of farm labour meant that substantial increases in farm output could be achieved with relatively little extra in the way of resources.

In the poorer countries, in contrast, wartime mobilisation began by taking resources away from farming, particularly young men and horses for the army. Once in the army these young men and horses still needed to be fed, of course, which implied a diversion of food supplies from rural households to government purchasers. But at the same time the motivation for farmers in the countryside to sell food was greatly reduced. These were subsistence farmers who grew food partly for their own consumption; what they sold, they took to the market primarily to buy the manufactured commodities, mainly textiles and metal goods, that they needed for their families. But war dried up the supply of manufactures to the countryside. The small industrial sectors of the poorer countries were soon wholly concentrated on supplying the army with weapons and equipment, uniforms and rations. There was no capacity left to supply the countryside, which faced a steep decline in supplies. Consequently, peasant farmers retreated into subsistence activities. As the market supply of food dried up, in the towns food prices soared.

The economy began literally to disintegrate: there might still be plenty of food, but it was in the wrong place. The farmers preferred to eat it themselves than sell it for a low return. The government had to feed the army at all costs for a simple reason: hungry soldiers will not fight. Between the army and the peasantry the urban workers were now caught in a double squeeze. There was still enough food for everyone to have enough to eat; the localised shortages that began to spread were famines that arose from the urban society's loss of entitlement (Sen, 1983; Offer, 1989), not from the decline in aggregate availability.

Aware of the unequal distribution of food, public opinion might blame unpatriotic speculators or incompetent officials, but the truth was that a poor country had few real choices. The scope for policy to improve the situation was usually more apparent than real, and government action typically made things worse: for example the Russian, Austrian, and German governments all began to ration food to the urban population, while attempting to buy up food from the countryside at purchasing prices that were fixed low for budgetary reasons. To repeat: in richer countries the government paid *more* to the food producers, and this worked, but in poorer countries we will see that

the government wanted to pay *less* and this had entirely predictable results. The willingness of farmers to participate in the market was still further undermined.

This process may be illustrated in a couple of diagrams. Figure 5 represents the urban-rural markets of two countries, one that we will style “Russia” and the other “Germany”; the difference between the two is that before 1914 Russia was a substantial net exporter of food, Germany a net importer. The figures use the offer curves that are conventionally used in international economics, but the market here is partly domestic in peacetime, and wholly domestic after the war virtually halted international trade. In both countries the farmers offer food along a curve FF and buy manufactures along the matching curve MM but in peacetime foreign buyers and sellers also intervene at the world terms of trade, T. Thus, in Panel A Russian farmers sell their food surplus partly at home, partly abroad; manufactured goods are offered partly by domestic industry along the MM curve and, when domestic marginal costs rise above the world price, by foreigners. A corresponding role is played in Panel B by German industry, which sells partly at home and partly abroad, importing food when marginal costs along the domestic FF offer curve rise above the world price. The upshot is that in both panels the rural offer is A at the world price T, while the urban offer is B, the difference being made up by exports and imports.

By implication, when the war cuts off foreign markets, the domestic equilibrium goes to C. The main adjustment is a fall in the availability of manufactures in Russia, where the terms of trade shift against the peasant. In Germany it is mainly food that becomes less available and the terms of trade facing the peasant improve. This is not the end of the story, however.

Figure 6 shows further effects of war on the market equilibrium. The military mobilisation of young men, horses, and nitrates raised farm costs. Nitrates proved to be a classic “dual use” commodity of modern warfare. They were an essential ingredient in both farm fertilisers and high explosives. Their chemical instability made them very hard to synthesise. Before World War I the bulk supply of nitrates to Europe came from natural deposits overseas. The trade disruption associated with the war forced the development of a German industry to manufacture nitrates artificially, but these were costly and war needs took up the supply that was created (Lee, 1975). As a result the availability of nitrates for farming fell sharply in Germany, but the impact was less in Russia where the initial reliance on nitrates was less widespread. The losses of human, animal, and chemical power combined to push the rural offer

curve leftward to FF' in both countries. This shift was limited, however, by the fact that young men and horses are consumers of food as well as producers. At the same time a decline in the availability of manufactures for rural consumption displaced the urban offer curve sharply downwards to MM' . In Panel A we suppose for illustration that the MM downshift exceeded the leftward shift of FF because limited industrial capacity was greatly pre-empted by wartime mobilisation. A great market contraction followed, equilibrium adjustment leading both countries to D . In Germany the notional improvement in the peasants' terms of trade from economic isolation was counter-balanced by further movement to T' . In Russia the peasants' terms of trade became doubly disadvantageous.

Finally, the government stepped in and tried to hold food prices down by enforcing a state price at T'' , creating excess demand and scope for a black market in each country. This is shown in Figure 6, Panel B. To the extent that such controls were effective, the rural offer fell back to E although urban agents were willing to trade at G at the state enforced terms of trade. The EG gap reflected a matching unsatisfied demand for food and an excess supply of manufactures: the least privileged townspeople would be found in the markets trying to sell off their fabricated possessions for money that farmers would refuse to accept for their produce. To the extent that intervention failed, however, there was scope for black marketeers to step in and capture rents; as long as the rents were competed away production and consumption could both tend back to D but popular respect for law and government would inevitably suffer in the process.

Here we see why the outcome was potentially as bad for German consumers as for Russians, or worse. The Russians did indeed have their prewar export surplus to fall back on. Although a much richer nation than Russia, urban famine was as acute in Germany in the closing stages of the war.

Some readers may be surprised to find Germany numbered among the countries that suffered a decline in agricultural output during the war. Although pre-1914 Germany has entered the economic history textbooks as a developed economic power, it should be noted that its modernisation was highly unbalanced. High levels of productivity in heavy industry co-existed with much lower productivity in light industry, and much of the service sector was also characterised by low productivity, despite Gerschenkron's (1962) focus on the modernised railways and the universal banks (Broadberry, 1998). But perhaps the most obvious sign of Germany's relative

backwardness was the high share of the labour force engaged in low productivity agriculture. Germany paid a high price during the two world wars for protecting its agriculture in peacetime (Olson, 1963).

In summary, to be poor when war broke out was to suffer the consequences of a peasant agriculture, which was essentially a dead weight on the mobilisation efforts of the country concerned. For this purpose we include Germany. The process that resulted had its inexorable conclusion in urban famine, revolutionary insurrection, and the downfall of emperors.

IV. EFFECTS OF THE WAR ON THE ECONOMY

We begin our analysis of the effects of the war on the economy by considering the scale of the destruction of physical and human capital. This forces us to reconsider the literature produced during the immediate aftermath of the war on the direct and indirect costs of war, which we reinterpret in the context of a national balance sheet approach. We then consider the effects on economic growth of this capital destruction. Comparing 1929 with 1918, it is clear that the economies which suffered the worst destruction during the war experienced the fastest growth during the 1920s, as would be predicted in a neoclassical growth model with a declining marginal product of capital. However, comparing 1929 with 1913, it is equally clear that the war lowered the growth rate of per capita income for Europe as a whole, and particularly for combatant countries relative to neutral countries. Europe remained on this slow growth path until after World War II, with the higher growth rate between 1950 and 1973 merely returning the European economy to its pre-1914 trend projected forward in time.

1. Bogart's Study of Direct and Indirect Costs

Table 6 provides estimates of what Bogart (1920) labels "direct costs" of the war. These costs are calculated as the flow of spending by governments on the prosecution of the war, i.e. spending over and above normal prewar levels. Inter-allied transfers are subtracted from gross expenditures to arrive at net costs, which show the heaviest burden to have been borne by Britain and Germany, with France, Russia and the United States also bearing a substantial net cost on the Allied side and Austria-Hungary amongst the Central Powers. On a per capita basis, Britain, France and Germany stand out as bearing a much higher net cost than the other countries. Nevertheless there are a number of disadvantages to the way that Bogart presents the

data. First, it is inappropriate simply to add up nominal sums spent at different times, given the wartime inflation. Second, this problem, as well as the related problem of the conversion to dollars of all values expressed in national currencies can be avoided if the war expenditures are expressed as a proportion of national income in each year, as in Table 5 above.

Table 7 introduces a number of what Bogart labels “indirect costs”, consisting largely of losses to human and physical capital. The capitalised value of war deaths shows the biggest losses to have been sustained by Russia and Germany, with other substantial losses borne by Britain, France and Austria-Hungary. Property losses on land were heaviest in France and Belgium, which is included here in Other Allies. The heaviest shipping losses were sustained by Britain, the dominant nation in world shipping before 1914.

A number of accounting procedures here give cause for concern. Although the accounting for losses to physical capital is unremarkable (remembering that cargoes can be seen as inventories), the treatment of human capital requires some attention. The capitalised value of human life, based simply on lifetime earnings, would overstate the social loss since people consume as well as produce. One way of arriving at the social loss is therefore to subtract consumption from lifetime earnings, as in the work of Clark (1931). Obviously this is not an attempt to capture the loss of utility arising from war deaths, but merely treats people as human capital to be replaced like physical capital so as to maintain production. As Edelstein (2000: 349) points out “It is absurd to think the methods and perspectives of economic history can come anywhere near to comprehending the meaning of human losses from war. We are far better served by the speeches and letters of Lincoln or the poetry of Sassoon, Brooke, Owen, Graves and Seager.” However, for symmetry with the treatment of physical capital on a replacement cost basis, the simplest procedure is to add up the cost of rearing and training a worker, since this is the net loss to society by premature death.

In Table 8, Bogart simply adds the direct and indirect costs to arrive at a grand total. The justification for this is unclear, since it combines flows of current spending with changes in the stock of assets needed to generate those flows. To add to the confusion, lost production (a flow concept) is included as an indirect cost (a stock concept). Note also that some of the government spending on the war effort, which is included negatively as a direct cost by Bogart, should actually enter positively in the

national balance sheet, contributing to intangible physical and human capital. To the extent that the war induced additional spending on health and welfare, this contributed to the accumulation of intangible human capital, while research expenditure on the development of weapons may have had spin-off effects on the accumulation of intangible physical capital. Finally, note that Bogart (1920: 299) makes no attempt to relate his estimates of the direct and indirect costs of World War I to levels of income or wealth, but simply concludes that “the figures presented in this summary are both incomprehensible and appalling”. This is an issue which can be addressed in the national balance sheet approach.

2. Effects on National Balance Sheets

Broadberry and Howlett (1998) provide an accounting framework for evaluating the long run impact of war on wealth, which is based on national balance sheets. The first important distinction is between stocks and flows in the system of national accounts. Issues concerned with the scale of mobilisation are best tackled by looking at flows of income, expenditure and output, and calculating the proportion of these flows that is devoted to the war effort, as in Table 5. However, the long run impact of the war can best be assessed by looking at the effects on national wealth, defined here to include human as well as physical capital, intangible as well as tangible capital and net overseas assets (Goldsmith et al., 1963; Revell, 1967; Kendrick, 1976).

Tangible physical capital is the conventional form of capital, consisting of buildings, equipment and inventories. Intangible physical capital is cumulated expenditure on research and development, which is seen as improving the quality of the tangible physical capital. Tangible human capital is the spending required to produce an uneducated, untrained worker, i.e. basic rearing costs. Intangible human capital is mainly spending on education and training to improve the quality of the human capital, although it also includes other items such as spending on health and safety and mobility costs. In an open economy, the impact of the war on net overseas assets must also be taken into account.

We believe that this accounting framework deals with the main objections raised by writers such as Hardach (1977: 286) and Milward (1984: 9-27) to previous attempts to quantify the impact of war on the economy. In particular, note that: (1) a clear distinction between stock and flow concepts is maintained throughout (2) all nominal values are converted to a constant price basis so that values for different

years can be added together (3) human capital calculations take account of the fact that people consume as well as produce (4) the fact that postwar birth rates rise does not alter the fact that the human capital embodied in those killed by warfare is lost; this has a negative impact on national wealth as much as any destruction of physical capital, which is usually followed by increased investment to make good war losses (5) technological change stimulated by wartime research and development can be seen as having a positive impact on intangible physical capital (6) social spending stimulated by the war can be seen as having a positive impact on intangible human capital.

3. War Casualties and Human Capital Losses

One obvious cost of the war was the huge number of deaths resulting from the “industrialisation” of warfare, which led to the growing use of the term “total war” (Chickering and Förster, 2000). There are conceptual difficulties with the types of death to be included in any definition of war deaths, which could be restricted to battle deaths of military personnel or broadened to include non-battle deaths of civilians as well as military personnel. We have opted for battle and non-battle deaths of military personnel, following Urlanis (1971) since this offers a high degree of uniformity in data across countries while going beyond those killed in battle or who died from wounds or poison gas. Non-battle deaths includes those who died from disease, died in captivity or died from accidents and other causes. We exclude most deaths in the influenza pandemic of 1918, however.

The data in Table 9 show how military deaths were spread across the combatant countries. Germany suffered the most casualties in absolute numbers, although a number of countries sustained heavier losses as a percentage of the population, including France, Serbia-Montenegro and Rumania amongst the Allies and Turkey amongst the Central Powers. Although Russia sustained the second highest losses in absolute numbers, this was a lower proportion of the population than the losses in Britain and Italy amongst the Allies and Austria-Hungary amongst the Central Powers. Taking the Central Powers and the Allies together, the battle and non-battle deaths of military personnel represented about 1% of the population of the combatant nations.

Turning these casualties into estimates of human capital losses in the national balance sheet framework requires knowledge of the prewar costs of rearing and

educating a child, together with cohort-specific estimates of the education of the labour force. In the absence of sufficient data for many countries, the human capital losses in Table 10 are calculated as the ratio of war deaths to the prewar population of prime working age, taken from Urlanis (1971). This differs from the proportion of human capital destroyed by the war to the extent that younger cohorts had more human capital investment, particularly through education. Also, since the human capital losses are not calculated in monetary units, they cannot be added to physical capital losses to provide an estimate of the proportion of physical and human capital destroyed by the war.

4. Physical Capital Losses and Changing National Wealth

Turning to physical capital losses in Table 10, we have largely relied for the losses of domestic assets on Bogart's (1920) estimates of property losses on land and shipping and cargo losses from Table 7. However, whereas Bogart (1920) expressed the losses in terms of US dollars, we have expressed them as percentages of prewar capital. France's losses were extremely heavy when expressed as a percentage of prewar capital in Table 10, as well as in dollar terms in Table 7.⁶ Russia's losses appear rather heavier in proportionate terms than in absolute dollar values, due to the low level of Russia's prewar capital stock. Also in Table 10, for some countries it has been possible to obtain estimates of the change in overseas assets and national wealth. In the case of Britain, nearly a quarter of overseas investments were liquidated during the war, so that the reduction of national wealth was proportionally much greater than the loss of physical capital. For France, although the loss of overseas assets was proportionally higher due to heavy exposure to Russian loans, the share of physical capital losses was also much higher than in Britain (Hardach, 1977: 289-290). Hence the share of national wealth lost in the war was about the same as the share of physical capital lost.

In principle, some of the government spending on the war effort, which is included negatively as a direct cost by Bogart (1920) should actually enter positively in the national balance sheet, contributing to intangible physical capital in the form of cumulated research and development spending and to intangible human capital in the form of spending on health and mobility. However, in practice, Broadberry and Howlett (1998) found that these effects were very small even during World War II. During World War I, these positive effects were difficult to discern at all in the British

case. Such effects were unlikely to have been of much more significance for other countries.

5. Reparations and National Wealth

Finally in Table 10, we have added in Germany's reparations bill as a proportion of prewar capital, since they represented an increase in overseas liabilities and hence a reduction in national wealth just as much as the liquidation of Britain's overseas assets meant a reduction in national wealth. Of course there is a huge debate over the extent to which Germany actually had to pay these reparations, but that does not alter the effect on the national balance sheet as it stood immediately after the Treaty of Versailles (Ritschl, 2003). These figures include the A+B+C Bonds, which added up to a total of 132 billion Gold Marks.

V. THE IMPACT ON GROWTH AND DEVELOPMENT

Milward (1984: 15-16) is critical of studies that focus on the costs of the war, which he sees as neglecting the wider impact of the war on growth and development. This reflects a substantial literature arguing that the two world wars stimulated economic and social changes which had positive as well as negative effects (Andrzejewski, 1954; Titmuss, 1950). However, there are good grounds to be sceptical here. Milward (1984: 17-18) cites Bowley (1930) as a pioneer of this view, but Bowley (1930: 21-23) himself pointed out how difficult it is to show that any of these wider changes were actually the result of the war and would not have occurred anyway in its absence. Classifying developments as (a) mainly unconnected with the war, (b) accelerated or retarded by it or (c) apparently arising out of it, Bowley was himself reluctant to put anything other than the key elements of the "cost of war" calculations such as loss of life and destruction of capital into category (c). He did mention the new economic relation between Europe and the United States in this category, but with hindsight we can see that the process of US overtaking was already underway well before World War I (Abramovitz, 1986; Broadberry 1998).

1. Wartime destruction and postwar recovery

The neoclassical growth model assumes a diminishing marginal product of capital. Hence capital destruction should lead to an increase in the marginal product of capital and faster growth during a transitional phase. This suggestion of a negative relationship between the scale of wartime destruction and the subsequent growth rate

has previously been quantified in the literature on the post-World War II period, particularly by Janossy (1971), who used it to predict the end of the postwar economic miracles in Germany and Japan, subsequently borne out by events (Dumke, 1990). The relationship has been little discussed in the context of World War I, with the notable exception of a study by Eichengreen (1990), who pointed to a negative relationship between the growth of industrial production 1921-1927 and the level of industrial production in 1921 relative to its 1913 level in a sample of thirteen industrial countries.

Figure 7 shows the relationship between GDP growth during the recovery period 1918-1929 and the scale of wartime destruction as measured by the level of GDP in 1918 relative to 1913, for a sample of 17 rich nations from Maddison (1995). The negative relationship can be confirmed using regression analysis.⁷

2. Effects on growth over the longer run

Over the longer run, however, there is little doubt that World War I had a negative impact on the growth rate in Europe as a whole. One way of understanding that is through the effects on accumulation. As already noted, the war had a significant negative impact on physical and human capital in the combatant countries. Although there was some rebound, it was not sufficient to undo the damage of the war. Furthermore, these negative effects on accumulation had a high degree of persistence because of the effects of the war on the institutional framework. Although World War I may be seen as the culmination of a period of existing national rivalry, there can be little doubt that it served to strengthen the forces of nationalism. This can be seen as having serious economic consequences, giving a boost to protectionism and autarkic policies during the 1920s and 1930s.

The consequences of the capital destruction of the war combined with the economic dislocation of its aftermath for the growth of per capita income in Europe and other parts of the world over the longer run can be seen in Table 11. The first point to note is that growth of per capita GDP for a weighted average of fifteen European countries was 1.8 per cent per annum between 1890 and 1994. However, whilst Europe grew at roughly this secular rate before 1914 and after 1973, there was a period of slower growth between 1913 and 1950, followed by a period of more rapid growth between 1950 and 1973. This slower growth during 1913-1950 is interpreted by Feinstein et al. (1997:8-9) as the destructive impact of World War I, followed by

the economic disintegration of the interwar period and the further destruction of World War II. The argument is given added weight by the fact that the impact was much greater in Europe than in the United States, since the war was fought largely on European soil with unprecedented severity, and Europe's economies were more dependent on international economic transactions before 1914. On this interpretation, the period 1950-1973 is best seen as catching-up in a more integrated world economy.

Turning in Table 12 to variation between European countries in the growth rate of GDP during the shorter period 1913-1929, we see that the most important difference is between neutral and combatant countries. The lowest growth rate amongst the neutrals (Sweden) was equal to the highest growth rate amongst the combatants (France). This again supports the emphasis on the costs of war in the traditional literature. Important themes stressed in this literature include the protectionist environment and the general lack of international co-operation over the international monetary system as well as the international trading system (Eichengreen, 1992). One factor which needs to be mentioned here is the proliferation of independent nation states following the break-up of the Austro-Hungarian and Ottoman Empires. This was based on one of the founding principles of the League of Nations, the self-determination of nations. In eastern and central Europe, this led to a proliferation of states with separate currencies and customs jurisdictions. In a less protectionist environment, this may not have been of great significance, but in the context of protectionist interwar Europe, it clearly had serious trade-diverting effects. Nevertheless, although there was clearly a net effect of economic disintegration in central and eastern Europe, we should not forget that there were also areas of increased integration. Probably of most significance here was the increased integration of the reunited parts of Poland that had previously been partitioned between Prussia, Austria and Russia (Wolf, 2003).

V. CONCLUSIONS

We have used the experience of the major combatant countries in World War I to analyse the role of economic factors in determining the outcome of the war and the effects of the war on subsequent economic performance. We have shown, first, that the degree of mobilisation for war can be explained largely by differences in the level of development of each country, leaving little room for other factors that feature prominently in narrative accounts, such as national differences in war preparations,

war leadership, military organisation and morale. This matches the conclusions of Harrison (1998) that the outcome of World War II was also determined largely by economic factors. For total warfare during the twentieth century, at least, it seems that the outcome of wars can be explained quite simply: in the words of James Carville, managing Bill Clinton's US presidential election campaign in 1992, "It's the economy. Stupid".

We have examined the effects of the war on subsequent economic performance in terms of the scale of destruction of physical and human capital. Here, we defend the basic approach of liberal economists who calculated the costs of the war, but we reinterpret the results within a national balance sheet framework. Although the growth rate between 1918 and 1929 was highest in the economies which experienced the worst destruction, over the period 1913-1929 as a whole, per capita income growth in Europe was reduced. Thus there was some rebound, but not enough to undo the negative effects of the capital destruction and the damage to the international institutional framework caused by the war.

TABLE 1: The World at War: Allied Populations, Territories, and GDPs of 1913

	Popul- ation, million	Territory,		Gross Domestic Product,	
		million sq. km	ha. per head	\$ billion	per head, \$
<i>First Wave: Great Powers, 1914</i>					
Russian Empire, exc. Finland	173.2	21.7	12.6	257.7	1488
France	39.8	0.5	1.3	138.7	3485
United Kingdom	46.0	0.3	0.7	226.4	4921
<i>Dependencies and Colonies</i>					
Finland (Russian Empire)	3.2	0.4	11.7	6.6	2050
French Colonies	<i>a</i> 48.3	10.7	22.1	31.5	652
British Colonies	<i>b</i> 380.2	13.5	3.6	257.0	676
<i>Other Powers</i>					
Yugoslav States	<i>c</i> 7.0	0.2	2.2	7.2	1029
British Dominions	<i>d</i> 19.9	19.5	97.8	77.8	3909
Liberia	1.5	0.1	6.7	0.9	585
Japan	55.1	0.4	0.7	76.5	1387
Japanese Colonies	<i>e</i> 19.1	0.3	1.6	16.3	857
<i>Second Wave: 1915/16</i>					
Italy	35.6	0.3	0.8	91.3	2564
Italian Colonies	<i>f</i> 2.0	2.0	101.0	1.3	634
Portugal	6.0	0.1	1.5	7.4	1244
Portuguese Colonies	<i>g</i> 8.7	2.4	27.9	5.2	603
Roumania	7.7	0.1	1.8	11.7	1527
<i>Third Wave: 1917/18</i>					
United States	96.5	7.8	8.1	511.6	5301
US Dependencies and Colonies	<i>h</i> 9.8	1.8	18.9	10.6	1088
Central American States	<i>i</i> 9.0	0.6	6.4	10.6	1184
Brazil	25.0	8.5	34.0	20.3	811
Greece	4.8	0.1	2.5	7.7	1592
Siam	8.4	0.5	6.2	7.0	835
China	441.5	11.1	2.5	243.7	552
<i>November 1914</i>					
Allies, total	793.3	67.5	8.5	1096.5	1382
UK, France, and Russia only	259.0	22.6	8.7	622.8	2405
<i>November 1916</i>					
Allies, total	853.3	72.5	8.5	1213.4	1422
UK, France, and Russia only	259.0	22.6	8.7	622.8	2405
<i>November 1918</i>					
Allies, total	1271.7	80.8	6.4	1760.5	1384
Per cent of world	70%	61%	...	64%	...
UK, France, and USA only	182.3	8.7	4.8	876.6	4809
Per cent of world	10%	7%	...	32%	...
<i>World, 1913</i>	1810.3	133.5	7.4	2733.9	1510

Sources: Populations and territories are from League of Nations (1927: 10-16). GDPs per head are from Maddison (2001); where the country or territory is not listed, the appropriate regional average is used.

Notes: Figures show populations, territories, and incomes for the year 1913. Currency units are international dollars at 1990 prices. Countries and territories are listed in approximate order of their entry into the war.

- a) Many countries in Africa, Asia, and Oceania. Algeria, French West Africa, and Indo-China together accounted for more than 70% of the population and GDP but less than half of the territory of the French Empire.
- b) Many countries in Africa, Asia, and Oceania, including Anglo-French and Anglo-Egyptian territories. India accounted for more than four fifths of the population and GDP but only one third of the territory of the British Empire not counting the Dominions.
- c) Serbia, Bosnia-Herzegovina, and Montenegro.
- d) Australia, Canada (including Labrador and Newfoundland), New Zealand, and Union of South Africa.
- e) Korea, Formosa, Kwantung, and Sakhalin.
- f) Eritrea, Libya, Somalia, the Aegean Islands, and Tientsin.
- g) Angola, Cape Verde Islands, Portuguese Guinea, Mozambique, St Thome and Principe Islands, Portuguese India, Macao, and Timor and Cambing.
- h) Alaska, American Samoa, Guam, Hawaii, the Panama Canal Zone, and Phillipines.
- i) Costa Rica, Cuba, Guatemala, Haiti, Honduras, Nicaragua, and Panama.

TABLE 2: The Central Powers' Populations, Territories, and GDPs of 1913

	Popul- ation, million	Territory		Gross Domestic Product	
		million sq. km	ha. per head	\$ billion	per head, \$
<i>First Wave: Great Powers, 1914</i>					
Austria-Hungary	50.6	0.6	1.2	100.5	1986
Germany	67.0	0.5	0.8	244.3	3648
German Colonies, etc.	<i>a</i> 10.7	3.0	27.5	6.4	601
<i>Other Powers</i>					
Ottoman Empire	<i>b</i> 23.0	1.8	7.7	25.3	1100
<i>Second Wave: 1915</i>					
Bulgaria	4.8	0.1	2.3	7.4	1527
<i>November 1914</i>					
Central Powers, total	151.3	5.9	3.9	376.6	2489
Germany and Austria- Hungary only	117.6	1.2	1.0	344.8	2933
<i>November 1915</i>					
Central Powers, total	156.1	6.0	3.8	383.9	2459

Sources: Populations and territories are from League of Nations (1927: 10-16), except Austria-Hungary taken from Schulze (2005) and the Ottoman Empire from Pamuk (2005). GDPs per head, except the Austro-Hungarian and Ottoman Empires, are from Maddison (2001); where the country or territory is not listed, the appropriate regional average is used.

Notes:

Figures show populations, territories, and incomes for the year 1913. Currency units are international dollars at 1990 prices. Countries and territories are listed in approximate order of their entry into the war.

- a) Cameroon, Caroline Islands, German East Africa, German South West Africa, Klau-Chau, New Guinea Samoa, and Togoland.
- b) Turkey within its present-day boundaries plus Syria and Palestine, Iraq, and parts of the Arabian peninsula.

TABLE 3: Allies Versus Central Powers: Resource and Development Ratios

	Population	Territory	Territory per head	Gross Domestic Product	GDP per head
November 1914					
Total	5.2	11.5	2.2	2.9	0.6
Great Powers only	2.2	19.4	8.8	1.8	0.8
November 1916					
Total	5.5	12.1	2.2	3.2	0.6
Great Powers only	2.2	19.4	8.8	1.8	0.8
November 1918					
Total	8.1	13.5	1.7	4.6	0.6
Great Powers only	1.6	7.5	4.8	2.5	1.6

Source: Calculated from Tables 1 and 2. Figures show ratios of Allies (Table 1) to Central Powers (Table 2) in populations, territories, and incomes for the year 1913. Currency units are international dollars at 1990 prices.

TABLE 4: The Wartime Change in Real GDP: 1914-1918, by Country

	UK	USA	Germany	Austria	Russia	France
1913	100	100	100	100	100	100
1914	92.3	101.0	85.2	83.5	94.5	92.9
1915	94.9	109.1	80.9	77.4	95.5	91.0
1916	108.0	111.5	81.7	76.5	79.8	95.6
1917	105.3	112.5	81.8	74.8	67.7	81.0
1918	114.8	113.2	81.8	73.3	...	63.9

Sources: Maddison (1995: 148-51), except Russia from Gatrell (2005). Italy is omitted for reasons given in Broadberry (2005).

TABLE 5: The Share of Government Spending in National Income: 1913-1918, by Country (per cent of GDP at current prices)

	Australia	Canada	France	Germany	UK	USA
1913	5.5	7.0	10.0	9.8	8.1	1.8
1914	5.7	10.0	22.3	23.9	12.7	1.9
1915	9.6	13.1	46.4	43.8	33.3	1.9
1916	14.0	16.5	47.2	50.3	37.1	1.5
1917	17.2	15.7	49.9	59.0	37.1	3.2
1918	17.2	16.9	53.5	50.1	35.1	16.6

Sources: Obstfeld and Taylor (2003); Mitchell (2003a, 2003b); France from Hautcoeur (2005); Germany from Sommariva and Tullio (1987); and UK from Feinstein (1972: tables 2 and 3). Thanks to Jari Eloranta for help with these figures.

TABLE 6: Bogart's "Direct Costs" of World War I

	Gross cost (\$m)	Advances to allies (\$m)	Net cost (\$m)	Net cost per capita (\$)
Great Britain	44,029	8,695	35,334	766
Rest of British Empire	4,494		4,494	13
France	25,813	1,547	24,266	613
Russia	22,594		22,594	135
Italy	12,314		12,314	343
United States	32,080	9,455	22,625	229
Other Allies	3,964		3,964	127
<i>Total Allies</i>	145,288	19,697	125,591	
Germany	40,150	2,375	37,775	557
Austria-Hungary	20,623		20,623	352
Turkey and Bulgaria	2,245		2,245	85
<i>Total Central Powers</i>	63,018	2,375	60,643	
<i>Total</i>	208,306	22,072	186,234	

Sources: Cost data from Bogart (1920: 267); Population data from Ulanis (1971: 209).

TABLE 7: Bogart's "Indirect Costs" of World War I (\$m)

	Capitalised value of war deaths	Property losses on land	Shipping and cargo losses
British Empire	3,477	1,750	3,930
France	4,818	10,000	453
Russia	8,104	1,250	933
Italy	2,385	2,710	431
United States	518		365
Other Allies	3,215	11,500	525
<i>Total Allies</i>	22,517	27,210	6,637
Germany	6,751	1,750	121
Austria-Hungary	3,080	1,000	15
Turkey and Bulgaria	1,203		27
<i>Total Central Powers</i>	11,034	2,750	163
<i>Total</i>	33,551	29,960	6,800

Source: Bogart (1920: 269-299).

Notes: For shipping losses, Other Entente Allies includes neutrals.

TABLE 8: Bogart's "Direct and Indirect Costs" of World War I (\$m)

	All countries
Capitalised value of human life:	
soldiers	33,551
civilians	33,551
Property losses:	
on land	29,960
shipping and cargo	6,800
Loss of production	45,000
War relief	1,000
Loss to neutrals	1,750
<i>Total indirect costs</i>	151,612
Total direct costs, net	186,234
Grand total	337,846

Source: Bogart (1920: 269-299).

TABLE 9: Battle and Non-Battle Deaths of Military Personnel in World War I

	Deaths (1000s)	Population (millions)	Deaths as % of population
Great Britain	715	46.1	1.6
British Empire	198	342.2	0.1
France	1,327	39.6	3.4
French colonies	71	52.7	0.1
Russia	1,811	167.0	1.1
Italy	578	35.9	1.6
USA	114	98.8	0.1
Belgium	38	7.6	0.5
Serbia-Montenegro	278	4.9	5.7
Rumania	250	7.6	3.3
Greece	26	4.9	0.5
Portugal	7	6.1	0.1
<i>Total Allies</i>	5,413	813.4	0.7
Germany	2,037	67.8	3.0
Austria-Hungary	1,100	58.6	1.9
Turkey	804	21.7	3.7
Bulgaria	88	4.7	1.9
<i>Total Central Powers</i>	4,029	152.8	2.6
<i>Total</i>	9,442	966.2	1.0

Source: Uralanis (1971: 209).

Notes: Battle deaths includes killed in battle, died from wounds and died from poison gas. Non-battle deaths includes died from disease, died in captivity and died from accidents and other causes.

TABLE 10: Destruction of Human and Physical Capital (% of prewar assets)

	Human capital	Physical capital			National wealth
		Domestic assets	Overseas assets	Reparations bill	
<i>Allies</i>					
Britain	3.6	9.9	23.9	...	14.9
France	7.2	59.6	49.0	...	54.7
Russia	2.3	14.3	...	...	...
Italy	3.8	15.9	...	...	...
United States	0.3	...	...	...	...
<i>Central Powers</i>					
Germany	6.3	3.1	...	51.6	54.7
Austria-Hungary	4.5	6.5	...	...	...
Turkey and Bulgaria	6.8	...	...	...	...

Sources: Human capital: war deaths as a percentage of population aged 15-49 from Uralnis (1971: 209). Physical capital: Britain: Broadberry and Howlett (2005); France: Hautcoeur (2005) and Hardach (1977: 289-290); Russia: Gatrell (2005); Italy: Property and shipping losses from Bogart (1920), capital from Ercolani (1969); Germany: Property and shipping losses from Bogart (1920), capital from Hoffmann (1965), with reparations bill from Hardach (1977: 248); Austria-Hungary: Property losses from Bogart (1920), capital from Fellner (1915).

Notes: Reparations bill expressed as % of prewar physical capital.

TABLE 11: Growth of Real GDP, 1890-1994: Europe and the United States (per cent per year, average)

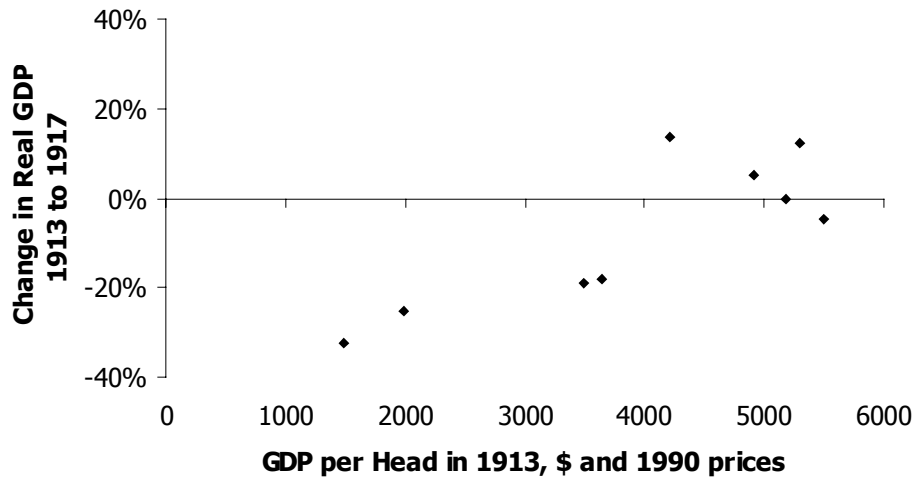
	Europe			USA,
	GDP	population	GDP per head	GDP per head
1890-1994	2.4	0.6	1.8	1.8
1890-1913	2.2	0.7	1.4	2.0
1913-1950	1.4	0.5	0.9	1.4
1950-1973	4.8	0.8	4.0	2.9
1973-1994	2.1	0.4	1.7	1.4

Source: Feinstein et al. (1997: 7, 9).

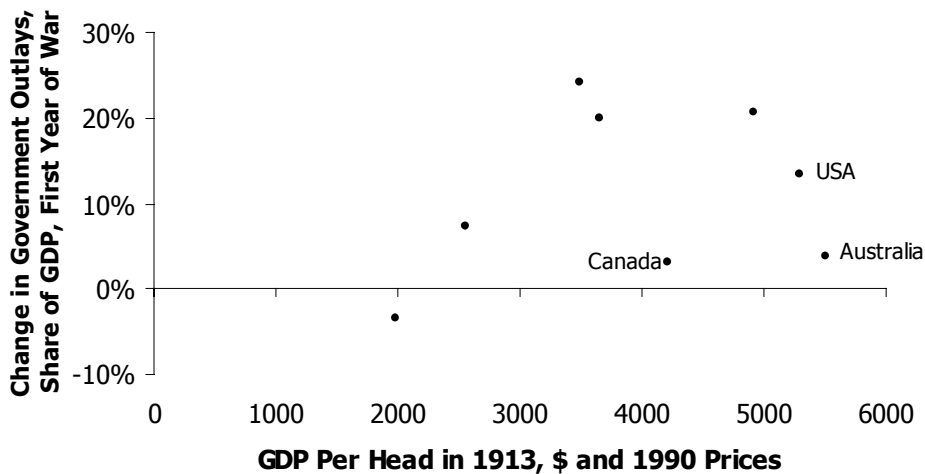
TABLE 12: Growth of Real GDP, 1913-1929: Selected European countries

World War I neutrals	% p.a.	World War I combatants	% p.a.
Sweden	1.9	United Kingdom	0.7
Finland	2.4	France	1.9
Denmark	2.7	Italy	1.7
Switzerland	2.8	Belgium	1.4
Norway	2.9	Germany	1.2
Netherlands	3.6	Austria	0.3

Source: Feinstein et al. (1997: 13).

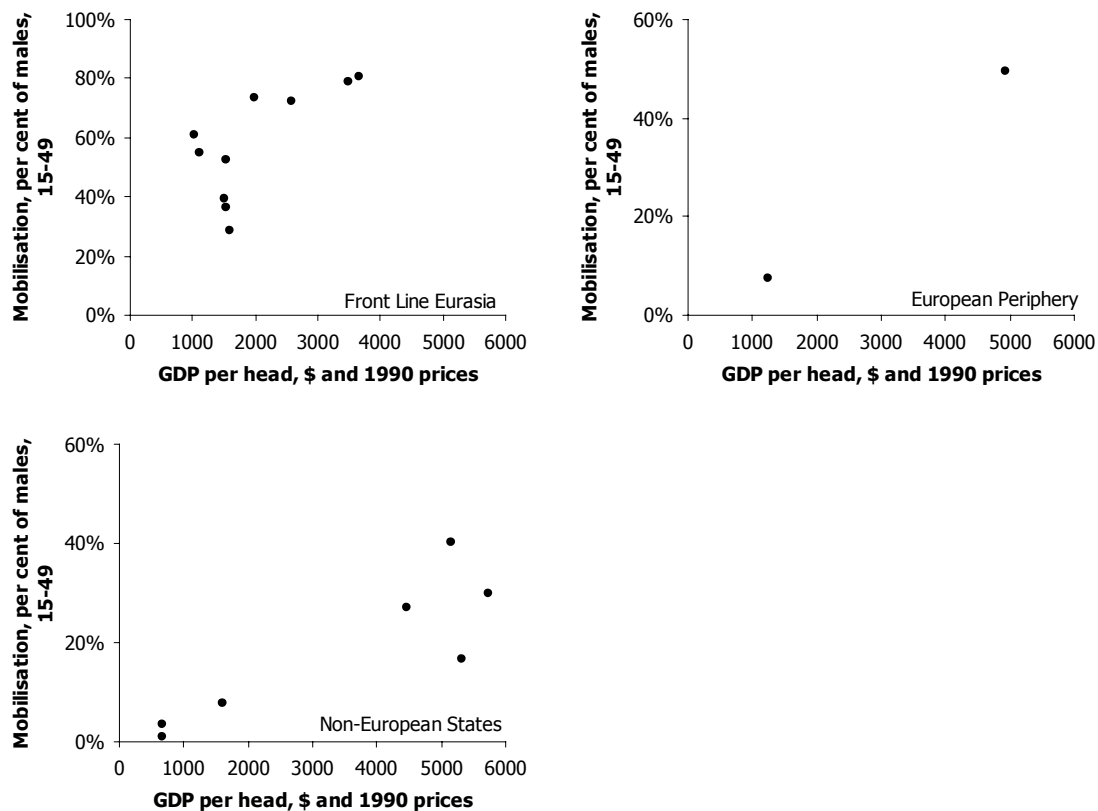
FIGURE 1: Production Mobilisation, 1913 to 1917: Ten Countries

Source: Table 4 and Maddison (2001). Observations from left to right are Russia, Austria-Hungary, France, Germany, Canada, UK, New Zealand, USA, and Australia. Territories are measured within contemporary frontiers. Currency units are international dollars at 1990 prices.

FIGURE 2: Fiscal Mobilisation in the First Year of War: Eight Countries

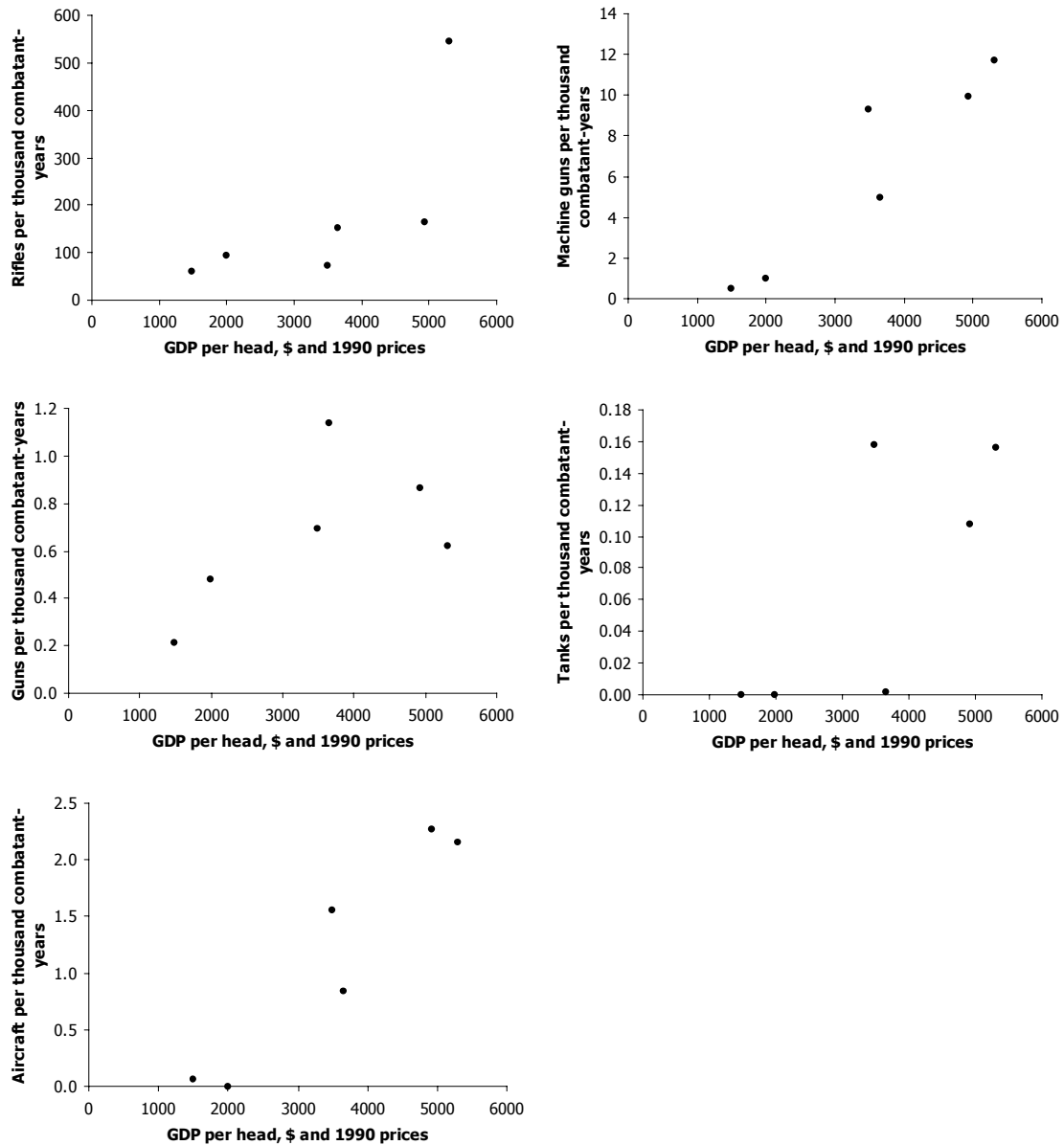
Source: Table 5, except Austria-Hungary (military expenditure only) from Schulze (2005). Observations not labelled within the figure are, from left to right, Austria-Hungary, Italy, France, Germany, and UK.

FIGURE 3: Military Mobilisation, 1914-1918: Eighteen Countries and the French Colonies



Sources: GDPs per head in 1913 from Tables 1 and 2 or, if not listed there, from Maddison (2001: 185); cumulative mobilisation rates, 1914-1918, from Uralnis (1971: 209).

Note: Observations, reading from left to right in order of increasing GDP per head are as follows. Front line Eurasia: Serbia, Turkey, Russia, Bulgaria, Roumania, Greece, Austria-Hungary, Italy, France, and Germany. European periphery: Portugal and UK. Non-European States: French colonies, India, South Africa, Canada, New Zealand, USA, Australia.

FIGURE 4: The Capital-Intensity of Warfare, 1914-1918: Six Countries

Sources: GDPs per head in 1913 from Tables 1 and 2; cumulative war production, 1914-1918, from Adelman (1988: 45), except UK from Broadberry and Howlett (2005) and Austria-Hungary from Schulze (2005); cumulative mobilisation as Figure 3. For each country “combatant years” are numbers mobilised multiplied by years of engagement in the war rounded to 1.5 years for the USA, 3.5 years for Russia, and 4.25 years for the others.

Note: Observations, reading from left to right in order of increasing GDP per head are Russia, Austria-Hungary, France, Germany, the United Kingdom, and the United States.

FIGURE 5: The Prewar Food Market: Russia and Germany

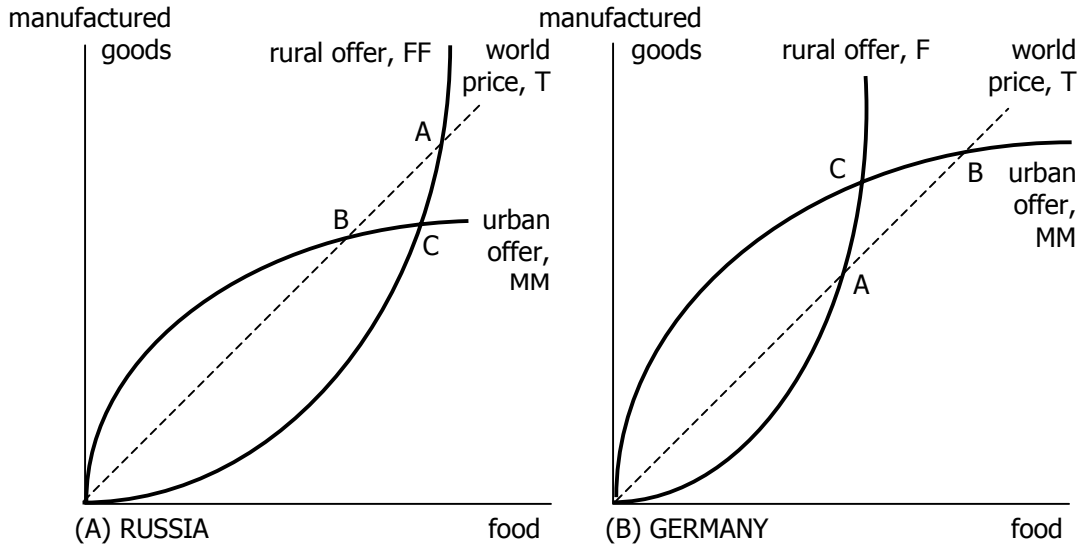


FIGURE 6: The Wartime Food Market

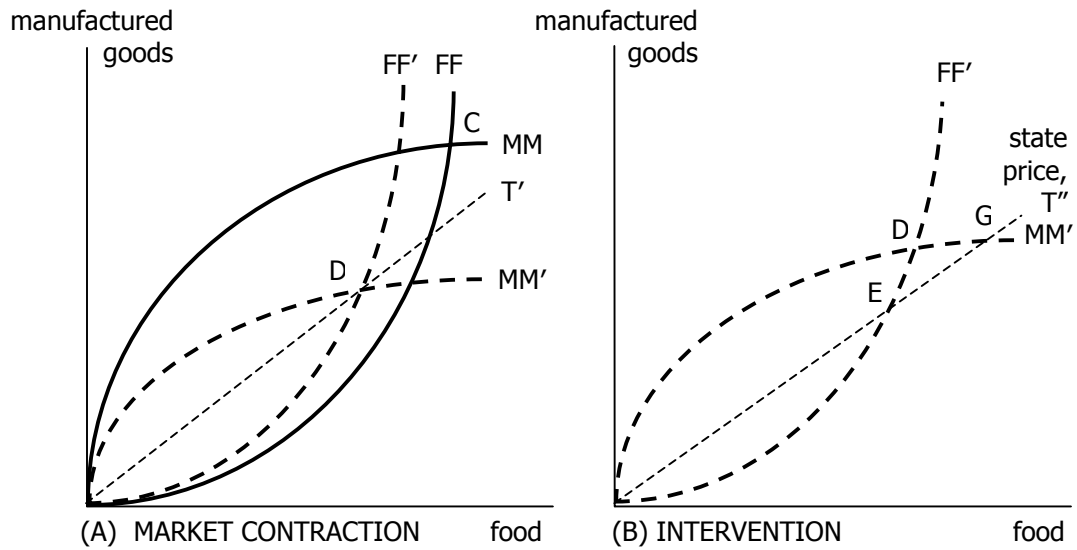
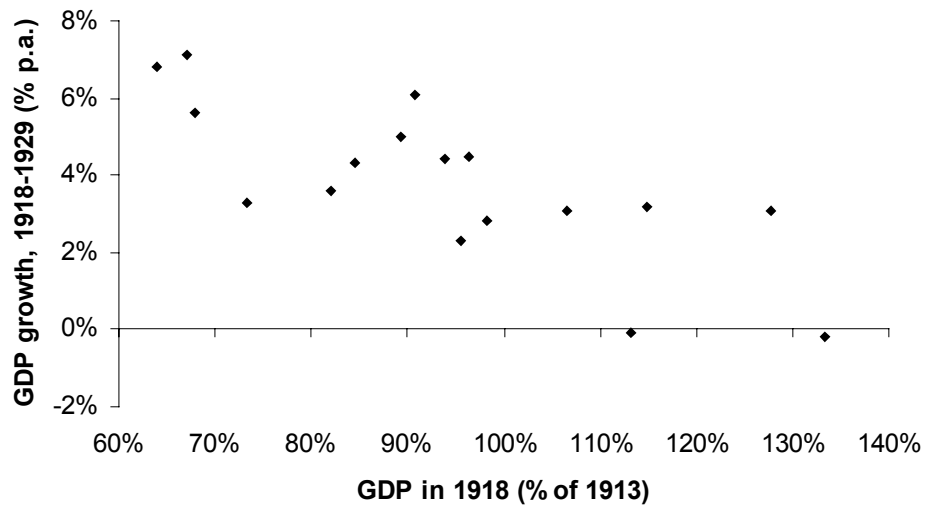


FIGURE 7: Postwar GDP Growth and Wartime Destruction

Source: Maddison (1995: Table B-10a).

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Endnotes

¹ Technically speaking, the United States of America never joined Britain and France in a formal Alliance; therefore, the United States was not strictly an “Ally”. This had minor consequences for the co-ordination of military strategy in the west, and major consequences for postwar diplomacy and the negotiation of a peace treaty with defeated Germany. For the present paper it is not an important distinction.

² Those ratios in Table 3 that are comparable with those computed by Ferguson (1998: 248-9) slightly exceed his estimates, the differences being accounted for in part by the quality of his sources which are adequate but less than authoritative. Ferguson gives the ratio of Entente GDPs to GDPs of the Central Powers in 1913 as 1.6:1; our figure is 1.8:1. Ferguson gives the ratio of populations of the two sides, including their colonial possessions, as 4.5:1; our figure is 5.2:1. Whether or not “squandered,” therefore, the Allied “advantage” appears undeniable.

³ In the charts that follow we simply point to bi- or trivariate relationships. Harrison hopes to widen the sample and pool data from World War II in future work with Jari Eloranta.

⁴ But the relationship would be destroyed by inclusion of Italy, with a prewar GDP per head of just over \$2,500, and a reported wartime economic miracle: an output expansion of 30 percent or more. Broadberry (2005) considers this doubtful phenomenon in more detail.

⁵ The power of this relationship may be confirmed by multiple regression. We code the three distance bands 0 for front-line Eurasian states, 1 for the European periphery, and 2 for non-European states. We measure the duration of each state’s engagement in the war in years rounded to the nearest quarter. Then we regress the mobilisation rate on GDP/head in dollars, distance, and duration. With 19 observations and *t*-statistics in parentheses we find:

$$Mobilisation = 0.0685 + \underset{(6.04)}{0.0773 \times 10^{-3}} \times GDP/head + \underset{(4.58)}{0.0999} \times Duration - \underset{(-11.62)}{0.2733} \times Distance$$

In words, each additional thousand dollars of GDP per head raised the mobilisation rate by more than 7 points; each additional year of engagement raised the mobilisation rate by 10 points; dropping one distance band lowered the mobilisation rate by 27 points. All the slope coefficients are significant at the 0.1% level and the R-squared has a value of 0.91. In words, the relationships are very significant; by far the greater part of the variation in mobilisation is explained by them; hardly any room is left for traditional historical accounts based on the peculiarities of national public and private institutions and government policies.

⁶ It should be noted that Bogart (1920) provides no source for his estimate of French capital losses. We have retained this estimate in the absence of any alternative, but suspect that it exaggerates French losses, perhaps in line with inflated reparations claims.

⁷ The relationship is as follows, with t-statistics in parentheses and an R-squared of 0.59:

$$GDPGrowth = 11.04 - 7.68 \times GDP1918$$

(6.93) (14.63)